Elk Valley Water Quality Plan

2022 Implementation Plan Adjustment

Annex B - Methods Used to Develop the 2022 Implementation Plan Adjustment

Rev0

July 2022

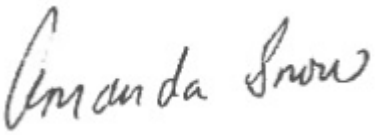
Teck

This report has been prepared by:

GOLDER ASSOCIATES LTD.

Deneyn White, BSc
Water Quality Modeller

This report has been reviewed by:



Amanda Snow, MASc
Senior Water Quality Modeller

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1 Introduction

The methods used to develop the 2022 Implementation Plan Adjustment (IPA) are described in this document. The 2022 IPA is an adjustment to the *Elk Valley Water Quality Plan 2019 Implementation Plan Adjustment* (2019 IPA; Teck 2019a). The 2022 IPA is Teck's updated mitigation plan to meet the long-term water quality-based compliance limits and Site Performance Objectives (SPOs) for nitrate, selenium, and sulphate defined in *Environmental Management Act* Permit 107517.

The 2022 IPA was developed using the 2020 Regional Water Quality Model (RWQM) described in Teck (2021), and updated as outlined in Annex A. The 2022 IPA was developed considering existing waste rock placed through 2019 and all permitted development. Future planned developments that have not been approved are not considered in the 2022 IPA. The model period encompasses the full duration of permitted development, plus additional time to account for the full effects of loading from the permitted waste rock and from pit decanting. The purpose is to demonstrate how the mitigation outlined in the 2022 IPA is expected to manage the full effects of nitrate, selenium, and sulphate from permitted development and to form the base case for future mining and mitigation permit applications.

The 2022 IPA is based on the application of Saturated Rock Fills (SRFs), active water treatment facilities (AWTFs), and clean water diversions where practical to support efficient treatment, to address increasing nitrate, selenium, and sulphate water concentrations in the Elk Valley.

The expected performance of SRFs and AWTFs, in terms of effluent concentrations, as well as the clean water diversions incorporated into the 2022 IPA are outlined in the main report.

The purpose of this document (Annex B) is to describe the methods used to develop the 2022 IPA in reference to the overall approach outlined in the main report, which consisted of:

- Reviewing and, where appropriate, updating source prioritization for water treatment.
- Determining mitigation to meet long-term compliance limits and SPOs.
- Sequencing and phasing mitigation to meet, to the extent possible, short and medium-term compliance limits and SPOs.

Source prioritization for water treatment is discussed below in Section 2. A description of the methods used to identify the hydraulic capacity and phasing of mitigation to meet short, medium, and long-term SPOs and compliance limits is outlined in Section 3.

2 Treatment Source Prioritization

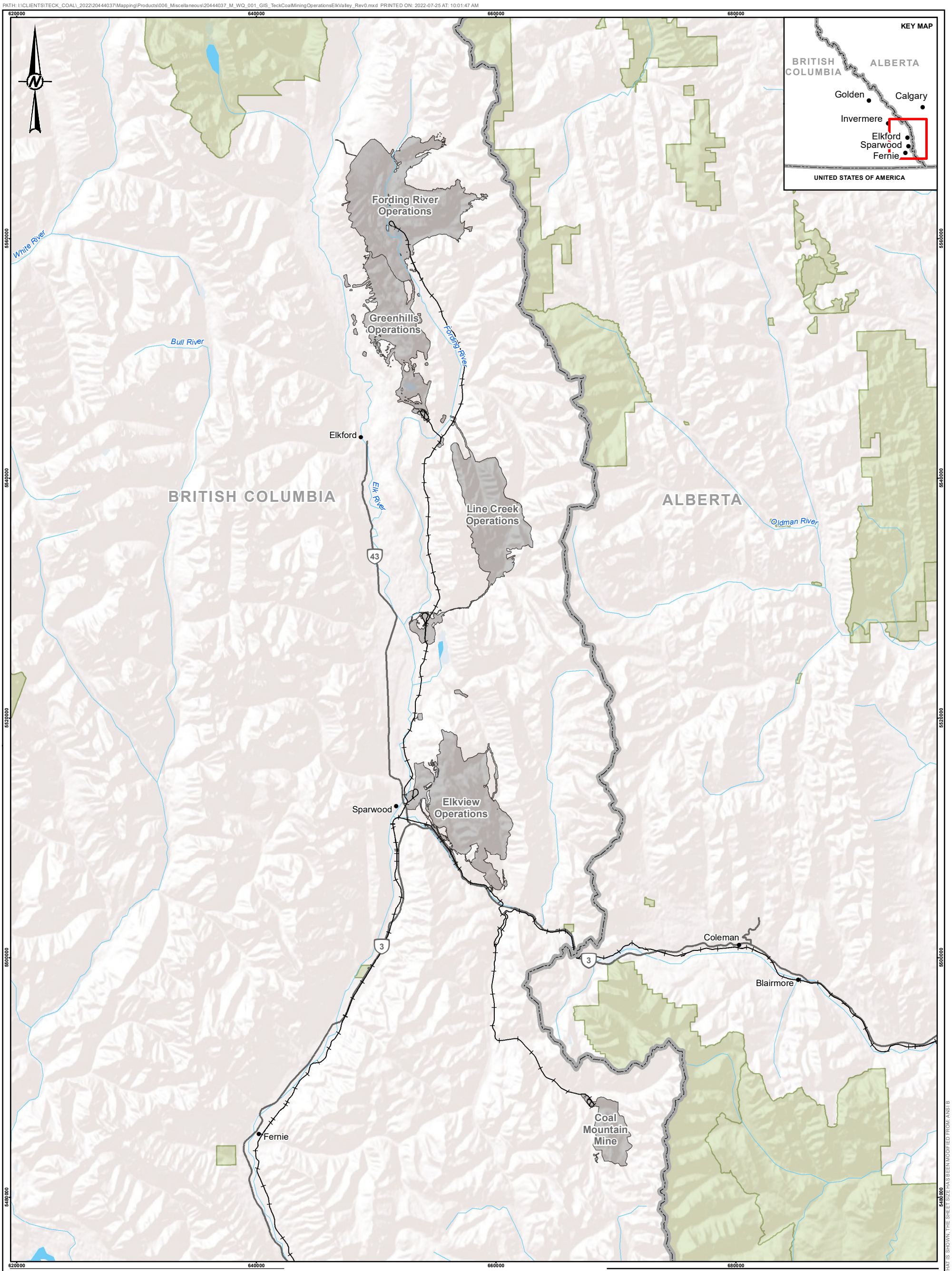
The need for water quality mitigation has been identified at four of Teck's five mining operations in the Elk Valley (Figure 2-1): Fording River Operations (FRO), Greenhills Operations (GHO), Line Creek Operations (LCO), and Elkview Operations (EVO). Coal Mountain mine (CMm) has not been identified for mitigation in the 2022 IPA, because projected concentrations of nitrate, selenium, and sulphate are below compliance limits at the CMm Michel Creek Compliance Point (CM_MC2; E258937) and it does not contribute appreciably to nitrate, selenium, or sulphate loading in the Elk Valley. Water quality mitigation focused on other constituents will continue to advance at CMm, if and as appropriate, to address local water quality.

Each SRF or AWTF in the 2022 IPA was modelled as collecting and treating mine-influenced water from one or more mine-affected drainage areas in its vicinity. Grouping multiple treatment sources is necessary for efficient treatment given the significant seasonal fluctuation in flows available for treatment. The objective is to maximize the use of each facility, by managing flows as close as possible to the maximum hydraulic capacity. Seven treatment areas were the focus for mitigation for the 2022 IPA:

- FRO North (FRO-N)
- FRO South (FRO-S)
- GHO
- LCO Line Creek
- LCO Dry Creek
- EVO Michel Creek
- EVO Elk River

With multiple intake sources in each treatment area, sources were prioritized for treatment based on consideration of current and future cumulative waste rock volumes, current and future selenium concentrations, and current and future flow volumes. Receiving environment concentrations are driven by load and flow. Load removal is required to meet downstream compliance limits and SPOs; however, concentration and flow inform treatability. As a result, consideration was given to both the load carried by potential treatment sources and constituent concentrations contained therein, with a view to maximizing the load removal across a treatment facility while minimizing the volume of treated water. Load removal across a treatment facility is maximized by targeting sources with high selenium concentrations and reasonable flow volumes. Sources with selenium concentrations that are lower than or in a similar range to selenium effluent concentrations were not selected for treatment. This approach was adopted, so that selenium-rich sources were targeted first, thereby providing the best opportunity to influence constituent concentrations on a regional scale.

Potential mine-affected drainage areas in each treatment area were characterized with reference to current and future cumulative waste rock volumes, current and future selenium concentrations, and current and future selenium loads from 2019 to 2053 based on Teck's 2019 long-range mine plans as outlined in more detail below.



LEGEND

- CITY / TOWN / COMMUNITY
- PRIMARY HIGHWAY
- RAILWAY
- WATERCOURSE
- BRITISH COLUMBIA - ALBERTA BOUNDARY
- COAL MINING OPERATION
- PROVINCIAL PARK / PROTECTED AREA
- WATERBODY

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

TECK COAL LIMITED

PROJECT
2022 IMPLEMENTATION PLAN ADJUSTMENT

TITLE
TECK COAL MINING OPERATIONS IN THE ELK VALLEY

YYYY-MM-DD	2022-07-25
DESIGNED	AS
PREPARED	DR
REVIEWED	CG
APPROVED	JPB

PROJECT NO.	PHASE	REV.	FIGURE
20444037	M_WQ_001	0	2-1

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2.1 Fording River Operations

Mine-affected drainage areas at FRO are divided into two areas for mitigation: FRO-N and FRO-S (Figure 2-2). Details for each treatment area are provided below.

2.1.1 Fording River Operations North

The FRO-N treatment area includes the following drainages, listed from upstream to downstream, that have been affected by historical mining activities at FRO or will be affected by future permitted mining activities (Figure 2-2):

- Henretta Creek
- Turnbull Bridge Spoil
- Post Ponds
- Clode Creek (i.e., Clode Creek, Eagle 4 Pit, and Eagle 6 Pit drainage areas)
- Lake Mountain Pond
- Fording LF2 Upper
- Eagle Pond
- Liverpool Ponds/Swift Pit
- Fording LF2 Lower

An evaluation of the mine-affected drainage areas in the FRO-N treatment area in 2019 and 2053 is presented in Table 2-1. Year 2019 corresponds to the end of the calibration period for the 2020 RWQM and Year 2053 corresponds to a time at which all of the waste rock associated with permitted development at all operations has been deposited and the hydraulic lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load). The data summarized in the table include cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean 50th percentile (P_{50}) monthly average selenium loads and concentrations in 2053. Table 2-1 includes the drainage areas listed above, as well as other drainages areas. The other drainage areas contain a small volume of waste rock (i.e., 2.5% of the total waste rock volume in the FRO-N treatment area in 2053) and contribute a negligible amount of load to the receiving environment (i.e., less than 5% of the selenium load in the FRO-N treatment area in 2053). As such, the other drainage areas are not considered for treatment and are not discussed further.

In 2019, most of the waste rock in the FRO-N treatment area is located in the Clode Creek drainage area, which has been disturbed by historical and on-going mining activities at Turnbull and Eagle pits (514 million bank cubic metres [BCM], or 40% of the 2019 total waste rock volume in the FRO-N treatment area; Table 2-1). Clode Creek also has the highest selenium load and the fourth highest selenium concentration.

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Elk River
Upper Fording
Henretta Creek
Henretta Creek
Swift North West
Post Ponds Rock Drain
Turnbull Bridge Spoil
FR_HC1
Additional FR_FRNTP
North and East Tributary Rock Drain
Turnbull Bridge Spoil
McMillan Creek
McSlide Creek
Moore Creek
Turnbull South Tailings Storage Facility
McDonald Creek
Turn Creek
Tower Diversion Extension
John Creek
FR_PP1
Turnbull South Pit
FR_CC1
Clode Creek Lower
Clode Creek Upper
Brownie Creek
Lake Pit
Lake Mountain Pit
Eagle 6 West Pit
Eagle 6 Pit to Clode
Fording EC1 Eagle Ponds
FR_LMP1
FR_EC1
Tower Diversion
Fording LF2 Upper
Eagle 4 Pit
FR_LP1
Eagle 6 Pit to Kilmarnock
Fording LF2 Upper
North Tailings Pond
Wash Plant_NLP
Swift Pit
Unnamed Elk Tributaries 4
Fording STP
Kilmarnock Lower
Kilmarnock Creek
Kilmarnock Upper
Fording LF2 Lower
South Tailings Pond
Unnamed Elk Tributaries 3
Swift Creek Upper Diversion
Swift Bens Pit
Fording LF2 Lower
FR_KC1
Unnamed Elk Tributaries 2
Castle FR_FRCP1_A
Swift Spoil
GH_SC1
Castle FR_FRCP1_B
Castle GH_PC2_A
Chauncey Creek North Trib
Chauncey Creek Upper
Unnamed Elk Tributaries 1
Branch F Creek
Phase 7 North
GH_CC1
Wolf Creek
Fording River
FORDING MINE ROAD
Willow Creek North
Phase 7 South
Cataract Creek
Castle GH_PC2_B
Additional GH_PC2
Willow Creek South & Wilde Creek
Castle FR_FRABCH_A
Wade Creek
West Spoil Ph3_C
Cougar Creek
Phase 6 Pit
Porter Creek
Chauncey Creek
Elk River
West Spoil Ph3_A
Mickelson Creek
Castle FR_FRABCH_B
Chauncey Creek Lower
Leask Creek Upper
Phase 4/5 Pits
Additional FR_FRABCH
West Spoil Ph3_B
Wolfram Creek North Upper
Leask Creek Lower
Phase 3 Pit
Wolfram Creek North Lower
Wolfram Creek South Lower
Wolfram Creek South Upper
FR_FRDSCH1
Greenhills Creek North
Wolfram Creek West
Thompson Creek Upper
Thompson Creek Lower
Greenhills Creek South

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LEGEND

- MONITORING STATION / MODELLING NODE
- RAILWAY
- ROAD - PAVED
- ROAD - UNPAVED
- SURFACE FLOW WATERCOURSE
- SUBSURFACE FLOW WATERCOURSE
- BRITISH COLUMBIA - ALBERTA BOUNDARY
- FRO C-3 PERMIT BOUNDARY
- GHO C-137 PERMIT BOUNDARY
- FRO CATCHMENTS
- GHO CATCHMENTS
- TAILINGS POND
- WASTE WATER/SEDIMENT POND
- WATERBODY

0 1 2
1:65,000 KILOMETRES

REFERENCE(S)

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

TECK COAL LIMITED

PROJECT
2022 IMPLEMENTATION PLAN ADJUSTMENT

TITLE
MINE-AFFECTED WATERSHEDS CONSIDERED FOR TREATMENT AT FORDING RIVER OPERATIONS

YYYY-MM-DD	2022-07-25
DESIGNED	AS
PREPARED	DR
REVIEWED	CG
APPROVED	JPB

PROJECT NO.	PHASE	REV.	FIGURE
20444037	M_WQ_002	0	2-2

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Table 2-1: Selection and Prioritization of Mine-affected Drainage Areas for the Fording River Operations North Treatment Area

Mine-affected Drainage Areas	Current (2019)[a]			Future (2053)			Priority[b]
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Selenium Load (kg/d)	Mean Monthly Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Selenium Average Concentration (µg/L)	
Clode Creek	514	1.04	166	701	2.21	265	1
Liverpool Ponds/Swift Pit[c, d]	155	0.03	55	1,025	2.96	382	2
Lake Mountain Pond[e]	65	0.41	59	-	-	-	-[e]
Post Ponds	69	0.07	32	282	3.31	528	3
Eagle Pond	136	*0.32*	279	137	0.68	357	4
Turnbull Bridge Spoil	65	*0.45*	*294*	125	1.31	1007	n/a
Henretta Creek	178	*1.16*	*45*	212	1.53	51	n/a
Fording LF2 Lower	27	*0.24*	*259*	89	0.88	857	n/a
Other drainage areas[f]	66	*0.97*	n/a	66	0.67	n/a	n/a
Total (FRO-N)	**1,275**	**4.71**	n/a	**2,637**	**13.56**	n/a	n/a

BCM = bank cubic metres; kg/d = kilograms per day; n/a = not applicable; µg/L = micrograms per litre.

(a) Values in italics are modelled data. Modelled data are presented because measured data were not available. Modelled data are the mean P_{50} monthly average loads or concentrations.

(b) The mine-affected drainage areas selected for treatment in order of priority are: Clode Creek, Liverpool Ponds/Swift Pit, Post Ponds, and Eagle Pond until December 31, 2034. The mine-affected drainage areas selected for treatment in order of priority are: Post Ponds, Liverpool Ponds/Swift Pit, Clode Creek, and Eagle Pond from 2035 onwards.

(c) Swift Pit is modelled to be sent to Liverpool Ponds until December 31, 2040. Mining in Swift Pit is modelled to be completed by the end of 2040 after which the pit is allowed to fill. While Swift Pit is filling, water is pumped from the pit to the FRO-N 1 SRF to maintain flows in the Fording River.

(d) Fording LF2 Upper is modelled to be sent to Liverpool Ponds from January 1, 2019 to December 31, 2026 and to Swift Pit from January 1, 2027 onwards.

(e) Lake Mountain Pond is modelled to be sent to the Fording River until December 31, 2022 and to Liverpool Ponds from January 1, 2023 to December 31, 2026. Lake Mountain Pond is modelled to be decommissioned by the end of 2026 due to mining in Swift Pit.

(f) Other drainage areas are Turnbull South Pit, Fording South Tailings Pond, and Wash Plant NLP.

Future mining activities in the FRO-N treatment area include completion of the Turnbull, Eagle, Lake Mountain and Swift pits and placement of associated waste rock. Waste rock from the Turnbull and Eagle pits will be placed in the Clode Creek and Henretta Creek drainage areas. Waste rock from the Swift and Lake Mountain pits will be placed in the Liverpool Ponds/Swift Pit, Post Ponds, Turnbull Bridge Spoil, and Fording LF2 Lower drainage areas, as well as in the combined Swift/Cataract drainage area (addressed in the FRO-S treatment area).

The Liverpool Ponds/Swift Pit drainage area will contain the largest volume of waste rock (i.e., 1,025 million BCM, or 39% of the 2053 total waste rock volume in the FRO-N treatment area) by the end of 2053, followed by the Clode Creek drainage area (701 million BCM, 27%) and the Post Ponds drainage area (282 million BCM, 11%). The Post Ponds, Liverpool Ponds/Swift Pit, and Clode Creek drainage areas also have the highest projected selenium loads and high selenium concentrations in 2053, as shown in Table 2-1.

Other potential sources in the FRO-N treatment area (i.e., Turnbull Bridge Spoil, Henretta Creek, and Fording LF2 Lower drainage areas) are not selected for treatment because these mine-affected drainage areas have among the lowest waste rock volumes and projected selenium loads in 2053, as shown in Table 2-1. While the Turnbull Bridge Spoil and Fording LF2 Lower drainage areas are projected to have the highest selenium concentrations in 2053, they have relatively low selenium loads compared to the selected mine-affected drainage areas. The drainage area associated with the Turnbull Bridge Spoil is approximately 3.2 km^2, of which 1.2 km^2 are disturbed (2018 snapshot) and the drainage area associated with the Fording LF2 Lower drainage area is 1.4 km^2, of which 1.4 km^2 are disturbed. There is no single point of discharge from the Turnbull Bridge Spoil or the Fording LF2 Lower drainage area to the Fording River; seepage from these spoils discharges directly to the Fording River alluvial sediments (i.e., as shallow groundwater flow).

The mine-affected drainage areas selected for treatment in the FRO-N treatment area, in order of priority until December 31, 2035 are:

- Clode Creek (i.e., Clode Creek, Eagle 4 Pit, and Eagle 6 Pit drainage areas)
- Liverpool Ponds/Swift Pit
- Post Ponds
- Eagle Pond

The mine-affected drainage areas selected for treatment in the FRO-N treatment area, in order of priority from 2036 onwards are:

- Post Ponds
- Liverpool Ponds/Swift Pit
- Clode Creek (i.e., Clode Creek, Eagle 4 Pit, and Eagle 6 Pit drainage areas)
- Eagle Pond

The order of priority of Clode Creek and Post Ponds is switched because the selenium loads and concentrations from the Post Ponds are projected to be higher than those from Clode Creek by December 31, 2035.

These mine-affected drainage areas account for 74% of the total waste rock volume in the FRO-N treatment area in 2019 and are expected to account for 81% of the total waste rock volume and 68% of the selenium load in the FRO-N treatment area in 2053.

2.1.2 Fording River Operations South

The FRO-S treatment area includes the following mine-affected drainage areas (Figure 2-2):

- Swift Creek
- Cataract Creek
- Kilmarnock Creek

Porter Creek is addressed in the GHO treatment area in the 2022 IPA. However, it may be considered in the FRO-S treatment area at a future date.

Explicit representation of the division of flow between surface water and groundwater pathways (i.e., surface water - groundwater partitioning) in Kilmarnock Creek is included in the 2020 RWQM (Teck 2021). Kilmarnock Creek surface water and groundwater flow pathways are considered when prioritizing sources for treatment.

An evaluation of the mine-affected drainage areas in the FRO-S treatment area in 2019 and 2053 is presented in Table 2-2. Year 2019 corresponds to the end of the calibration period for the 2020 RWQM and Year 2053 corresponds to a time at which all of the waste rock associated with permitted development at all operations has been deposited and the hydraulic lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load). The data summarized in the table include cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean P_{50} monthly average selenium loads and concentrations in 2053. Table 2-2 includes the drainage areas listed above, as well as other drainages areas. The other drainage areas contain a small volume of waste rock (i.e., less than 1% of the total waste rock volume in the FRO-S treatment area in 2053) and contribute a negligible amount of load to the receiving environment (i.e., less than 1% of the selenium load in the FRO-S treatment area in 2053). As such, the other drainage areas are not considered for treatment and are not discussed further.

Swift Creek, Cataract Creek, and Kilmarnock Creek have been disturbed by historical mining and waste rock placement at FRO. Swift Creek and Cataract Creek also have historical disturbance associated with GHO. Currently, waste rock is located primarily in Kilmarnock Creek (1,249 million BCM, or 67% of the 2019 total waste rock volume in the FRO-S treatment area; Table 2-2), Cataract Creek (394 million BCM, 21%), and Swift Creek (230 million BCM, 12%). Consequently, these three drainage areas have the highest selenium loads and concentrations in the FRO-S treatment area, as shown in Table 2-2.

Table 2-2: Selection and Prioritization of Mine-affected Drainage Areas for the Fording River Operations South Treatment Area

Mine-affected Drainage Areas	Current (2019)[a]			Future (2053)			Priority
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Selenium Load (kg/d)	Mean Monthly Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Average Selenium Concentration (µg/L)	
Swift Creek[b]	230	1.1	522	829	7.6	1,069	1
Cataract Creek[b]	394	1.6	642				
Kilmarnock Creek surface water	1,249	5.4	192	1,319	11	320	2
Kilmarnock Creek groundwater		*2.3*	*209*		3.5	320	3
Other drainage areas[c]	2	*0.02*	n/a	2	*0.02*	n/a	n/a
Total	**1,875**	**10.4**	n/a	**2,150**	**22.2**	n/a	n/a

BCM = bank cubic metres; kg/d = kilograms per day; n/a = not applicable; µg/L = micrograms per litre.

(a) Values in italics are modelled data. Modelled data are presented because measured data were not available. Modelled data are the mean P_{50} monthly average loads or concentrations.

(b) Flow from Cataract Creek is diverted to Swift Creek from August 2019 onward.

(c) The other drainage area is additional to GH_PC2.

Future mining activities in the FRO-S treatment area include completion of Eagle and Swift pits and placement of associated waste rock. Future waste rock placement is planned for the Kilmarnock Creek drainage area from mining in Eagle Pit and for Swift Creek and Cataract Creek drainage areas from mining in Swift Pit. The Kilmarnock Creek drainage area will continue to have the largest volume of waste rock (1,319 million BCM, or 61% of the 2053 total waste rock volume in the FRO-S treatment area), followed by the combined Swift/Cataract drainage area (829 million BCM, 39%). Although Kilmarnock Creek will continue to have the highest projected selenium load, the combined Swift/Cataract drainage area will have higher projected selenium concentrations.

The mine-affected drainage areas selected for water treatment in the FRO-S treatment area, in order of priority are summarized below and shown in Table 2-2:

- Combined Swift Creek and Cataract Creek
- Kilmarnock Creek

These mine-affected drainage areas account for 100% of the total waste rock volume in the FRO-S treatment area in 2019 and are expected to account for 100% of the total waste rock volume and 100% of the selenium load in the FRO-S treatment area in 2053.

The mine-affected drainage areas account for 89% of the total waste rock volume in the FRO-N and FRO-S treatment areas in 2019 and are expected to account for 90% of the total waste rock volume in 2053.

2.2 Greenhills Operations

The GHO treatment area includes the following drainage areas that have been affected by historical mining activities at GHO or will be affected by future permitted mining activities (Figure 2-3):

- Porter Creek
- Greenhills Creek
- Thompson Creek
- Wolfram Creek
- Leask Creek
- Cougar South Pit (i.e., Phases 3 to 6)
- Mickelson Creek
- Cougar Creek
- Wade Creek
- Willow Creek
- Wolf Creek

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Tower Diversion
Swift Pit
North Tailings Pond
Wash Plant_NLP
Fording EC1 Eagle Ponds
Eagle 4 Pit
Eagle 6 Pit to Kilmarnock
Kilmarnock Creek
Kilmarnock Upper
Kilmarnock Lower
Fording STP
South Tailings Pond
Unnamed Elk Tributaries 4
Unnamed Elk Tributaries 3
Unnamed Elk Tributaries 2
Unnamed Elk Tributaries 1
Swift Bens Pit
Swift Creek Upper Diversion
Fording LF2 Lower
Swift Spoil
Branch F Creek
Phase 7 North
Wolf Creek
Willow Creek North
Phase 7 South
Cataract Creek
Willow Creek South & Wilde Creek
Wade Creek
West Spoil Ph3_C
Cougar Creek
Phase 6 Pit
Cougar South Pit
West Spoil Ph3_A
Mickelson Creek
Elk River
Porter Creek
Phase 4/5 Pits
Leask Creek Upper
West Spoil Ph3_B
Leask Creek Lower
Wolfram Creek North Upper
Wolfram Creek North Lower
Wolfram Creek South Upper
Wolfram Creek South Lower
Phase 3 Pit
Wolfram Creek West
Thompson Creek Upper
Thompson Creek Lower
Greenhills Creek North
Greenhills Creek South
Fowler Creek
Tailings Pond
Rush Creek
Additional Area to LC_LC5_GHO
Additional to GH_FR1
Castle FR_FRCP1_A
Castle FR_FRCP1_B
Castle GH_PC2_A
Additional GH_PC2
Castle GH_PC2_B
Castle FR_FRABCH_A
Additional FR_FRABCH
Castle FR_FRABCH_B
FR FRDSCH1
Chauncey Creek North Trib
Chauncey Creek Upper
Chauncey Creek Lower
Chauncey Creek
Fording River
FORDING MINE ROAD
GH_WOLF
GH_WILLOW
GH_WADE
GH_COUGAR
GH_PC1
GH_MC1
GH_LC1
GH_WC1
GH_TC1
GH_GH1

LEGEND

- MONITORING STATION / MODELLING NODE
- RAILWAY
- ROAD - PAVED
- ROAD - UNPAVED
- SURFACE FLOW WATERCOURSE
- SUBSURFACE FLOW WATERCOURSE
- BRITISH COLUMBIA - ALBERTA BOUNDARY
- FRO C-3 PERMIT BOUNDARY
- GHO C-137 PERMIT BOUNDARY
- FRO CATCHMENTS
- GHO CATCHMENTS
- TAILINGS POND
- WASTE WATER/SEDIMENT POND
- WATERBODY

0 1 2
1:55,000 KILOMETRES

REFERENCE(S)

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TECK COAL LIMITED

PROJECT
2022 IMPLEMENTATION PLAN ADJUSTMENT

TITLE
MINE-AFFECTED WATERSHEDS CONSIDERED FOR TREATMENT AT GREENHILLS OPERATIONS

YYYY-MM-DD	2022-07-25
DESIGNED	AS
PREPARED	DR
REVIEWED	CG
APPROVED	JPB

PROJECT NO.	PHASE	REV.	FIGURE
20444037	M_WQ_003	0	2-3

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Table 2-3: Selection and Prioritization of Mine-affected Drainage Areas for Greenhills Operations Treatment Area

Mine-affected Drainage Areas	Current (2019)[a]			Future (2053)			Priority
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Selenium Load (kg/d)	Mean Monthly Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Average Selenium Concentration (µg/L)	
Cougar Pit Phase 3[b]	70	*0.24*	*74*	520	1.8	248	1
Cougar Pit Phase 6[c]	195	*0.23*	*69*				
Leask Creek	72	*0.24*	*228*	88	0.40	310	2
Wolfram Creek North	132	*0.27*	*257*	164	0.38	286	
Wolfram Creek South	92	*0.20*	*209*	99	0.21	181	
Thompson Creek	110	*0.76*	*232*	111	1.02	265	
Greenhills Creek	130	*0.74*	*231*	130	0.89	244	3
Porter Creek	44	0.16	75	44	0.18	73	4
Mickelson Creek[d]	0	<0.01	3.2	13	0.11	245	n/a
Cougar Creek[d]	0	*<0.01*	0.7	2	0.017	67	n/a
Wade Creek[e]	0	*<0.01*	3.2	0	<0.01	11	n/a
Willow Creek[e]	0	*<0.01*	1.1	0	0.01	15	n/a
Wolf Creek[e]	0	*<0.01*	0.6	0	<0.01	7	n/a
Other drainage areas[f]	11	*<0.01*	n/a	14	0.10	n/a	n/a
Total	**856**	**2.85**	n/a	**1,185**	**5.08**	n/a	n/a

BCM = bank cubic metres; kg/d = kilograms per day; n/a = not applicable; µg/L = micrograms per litre.

(a) Values in italics are modelled data. Modelled data are presented because measured data were not available. Modelled data are the mean P_{50} monthly average loads or concentrations.

(b) Lower Wolfram Creek is modelled to receive operational dewatering flows from Cougar South Pit Phase 3 in 2019. Cougar South Pit Phase 3 is modelled to merge with Cougar South Pit Phase 6 by the end of 2025.

(c) Lower Leask Creek and Lower Wolfram Creek are modelled to receive operational dewatering flows from Cougar South Pit Phase 6 in 2019. Mining in Cougar South Pit (i.e., Phases 3 to 6) is modelled to be completed by the end of 2027 after which the pit is allowed to fill.

(d) Waste rock volumes in Mickelson Creek and Cougar Creek are cast over from the Cougar South Pit (i.e., Phases 3 to 6) and may be over-estimated. Mickelson Creek and Cougar Creek have small areas (i.e., Mickelson Creek has an area of approximately 1.05 km^2 of which 0.28 km^2 is mine-affected and Cougar Creek has an area of approximately 0.82 km^2 of which 0.13 km^2 is mine-affected), which is why small waste rock volumes yield elevated concentrations, but small loads.

(e) Selenium concentrations are projected to increase in Wade Creek, Willow Creek, and Wolf Creek due to seepage from the Cougar South Pit (i.e., Phases 3 to 6) and the Cougar North Pit (i.e., Phase 7-1). Selenium concentrations are also projected to increase in Willow Creek due to operational dewatering from the Cougar North Pit (i.e., Phase 7-1).

(f) The other drainage areas are West Spoil Phase 3B, Lower Leask Creek, Lower Wolfram Creek North, Lower Wolfram Creek South, and Lower Thompson Creek.

An evaluation of the mine-affected drainage areas in the GHO treatment area in 2019 and 2053 is presented in Table 2-3. Year 2019 corresponds to the end of the calibration period for the 2020 RWQM and Year 2053 corresponds to a time at which all of the waste rock associated with permitted development at all operations has been deposited and the hydraulic lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load). The data summarized in the table include cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean P_{50} monthly average selenium loads and concentrations in 2053. Table 2-3 includes the drainage areas listed above, as well as other drainages areas. The other drainage areas contain a small volume of waste rock (i.e., 1.2% of the total waste rock volume in the GHO treatment area in 2053) and contribute a negligible amount of load to the receiving environment (i.e., 2% of the selenium load in the GHO treatment area in 2053). As such, the other drainage areas are not considered for treatment and are not discussed further.

Most of the historical waste rock from GHO mining activities has been placed in the West Spoil, which is located in the Leask Creek, Wolfram Creek, and Thompson Creek drainage areas (406 million BCM, or 47% of the 2019 total waste rock volume in the GHO treatment area; see Table 2-3); the East Spoil in the Greenhills Creek drainage area (130 million BCM; 15%); Porter Creek (44 million BCM; 5%), and spoils in the Swift Creek and Cataract Creek drainage areas (addressed as part of the FRO-S treatment area). Waste rock from GHO mining activities has also been placed as backfill in the Cougar South Pit (i.e., Phases 3 to 6), which is modelled to be dewatered to Leask Creek and Wolfram Creek. No historical mining or waste rock placement has occurred in Michelson Creek, Cougar Creek, Wade Creek, Willow Creek, or Wolf Creek. Wolfram Creek, Leask Creek, Thompson Creek, and Greenhills Creek have the highest selenium loads and concentrations in the GHO treatment area, as shown in Table 2-3.

Future mining activities in the GHO treatment area include on-going mining of the Cougar South Pit (i.e., Phases 3 to 6), mining of the Cougar North Pit (i.e., Phase 7-1) and placement of associated waste rock. Future waste rock is placed in the West Spoil and as backfill in the Cougar South Pit. Since 2016, the West Spoil has been expanding at a slower rate than planned, because of mine plan optimization and the realization of more opportunities to place permitted waste rock as backfill in Cougar South Pit rather than in the external West Spoil. Consistent with this past practice, future waste rock will be placed preferentially as backfill in the Cougar South Pit, with some waste rock placed in the West Spoil. Cougar South Pit will have the largest volume of waste rock in the GHO treatment area (520 million BCM, or 44% of the 2053 total waste rock volume in the GHO treatment area; see Table 2-3) followed by the West Spoil (463 million BCM; 39%). No additional waste rock placement is planned for the East Spoil or Porter Creek.

Flows from Leask Creek, Wolfram Creek, and Thompson Creek (i.e., the West Spoil) are assumed to be mixed and collected as a single source for treatment for planning purposes. The sources selected for water treatment at GHO, in order of priority, are summarized below and shown in Table 2-3.

- Cougar South Pit (i.e., Phases 3 to 6)
- Combined flow from Leask Creek, Wolfram Creek, and Thompson Creek
- Greenhills Creek
- Porter Creek

Cougar South Pit (i.e., Phases 3 to 6), the combined flow from Leask Creek, Wolfram Creek, and Thompson Creek, and Greenhills Creek have been selected for treatment, because these mine-affected drainage areas are projected to have high selenium loads and concentrations in 2053. Together with Porter Creek, these mine-affected drainage areas account for 99% of the total waste rock volume in the GHO treatment area in 2019 and are projected to account for 98% of the total waste rock volume and 88% of the selenium load in the GHO treatment area in 2053. Other potential sources in the GHO treatment area (i.e., Mickelson Creek, Cougar Creek, Wade Creek, Willow Creek, or Wolf Creek) are not selected for treatment, because these mine-affected drainage areas have relatively small waste rock volumes and projected selenium loads. While Mickelson Creek is projected to have among the highest selenium concentrations in 2053, it has relatively low selenium loads compared to the selected mine-affected drainage areas.

2.3 Line Creek Operations

Mine-affected drainage areas at LCO are divided into two areas for mitigation: LCO Line Creek and LCO Dry Creek (Figure 2-4). Details for each treatment area are provided below.

2.3.1 Line Creek Operations Line Creek

The LCO Line Creek treatment area includes the following mine-affected drainage areas (Figure 2-4):

- West Line Creek
- North Line Creek (a sub-drainage (backfilled pit) of Line Creek upstream of West Line Creek)
- Mine Services Area West (a sub-drainage (backfilled pit) of Line Creek upstream of West Line Creek)
- Line Creek upstream of West Line Creek

Explicit representation of the division of flow between surface water and groundwater pathways (i.e., surface water - groundwater partitioning) in West Line Creek is included in the 2020 RWQM (Teck 2021). West Line Creek surface water and groundwater flow pathways are considered when prioritizing sources for treatment.

An evaluation of the mine-affected drainage areas in the LCO Line Creek treatment area in 2019 and 2053 is presented in Table 2-4. Year 2019 corresponds to the end of the calibration period for the 2020 RWQM and Year 2053 corresponds to a time at which all of the waste rock associated with permitted development at all operations has been deposited and the hydraulic lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load). The data summarized in the table include cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean P_{50} monthly average selenium loads and concentrations in 2053.

Historically, waste rock from mining activities in Line Creek has been placed in Line Creek upstream of West Line Creek (547 million BCM, or 72% of the total waste rock in the LCO Line Creek treatment area in 2019) and in West Line Creek (214 million BCM, 28%). Approximately 224 million BCM of waste rock (or 29%) has been placed in the North Line Creek drainage area and 137 million BCM of waste rock (or 18%) has been placed in the Mine Services Area West drainage area, both of which are sub-drainage areas of Line Creek upstream of West Line Creek. Currently, West Line Creek surface water has the highest selenium concentration in the LCO Line Creek treatment area, followed by West Line Creek groundwater, North Line Creek, Mine Services Area West, and Line Creek upstream of West Line Creek, as shown in Table 2-4.

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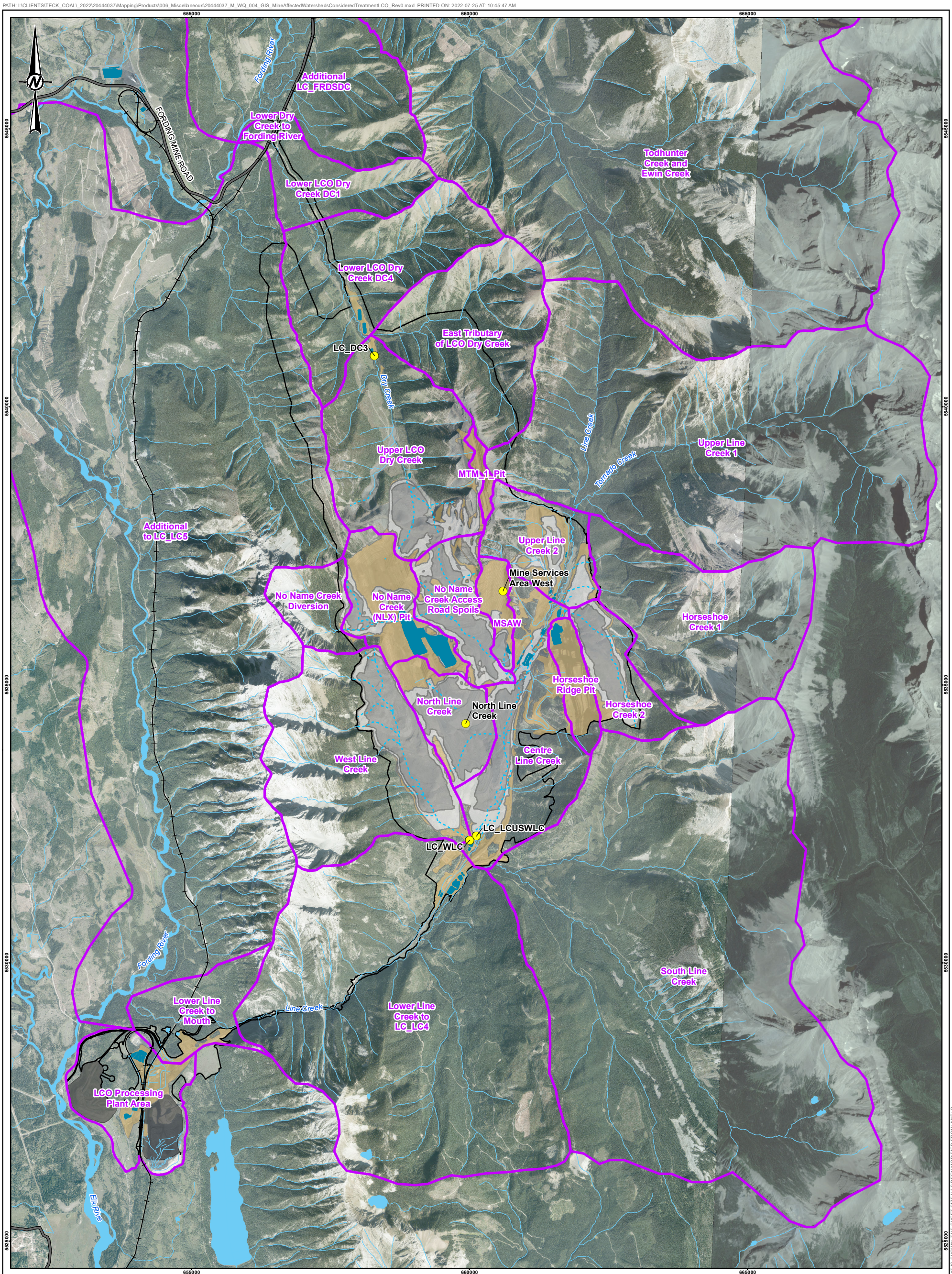

LEGEND

- MONITORING STATION / MODELLING NODE
- RAILWAY
- ROAD - PAVED
- SURFACE FLOW WATERCOURSE
- SUBSURFACE FLOW WATERCOURSE
- LCO C-129 PERMIT BOUNDARY
- LCO CATCHMENT
- COARSE COAL REJECTS (CCR)
- HARD MINE AREA
- WASTE ROCK AREA (> 10 M TO 50 M THICK)
- WASTE ROCK AREA (> 50 M THICK)
- WASTE WATER/SEDIMENT POND
- WATERBODY

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REFERENCE(S)

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

TECK COAL LIMITED

PROJECT
2022 IMPLEMENTATION PLAN ADJUSTMENT

TITLE
MINE-AFFECTED WATERSHEDS CONSIDERED FOR TREATMENT AT LINE CREEK OPERATIONS

YYYY-MM-DD	2022-07-25
DESIGNED	AS
PREPARED	DR
REVIEWED	CG
APPROVED	JPB

PROJECT NO.	PHASE	REV.	FIGURE
20444037	M_WQ_004	0	2-4

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Table 2-4: Selection and Prioritization of Mine-affected Drainage Areas for Line Creek Operations Line Creek Treatment Area

Mine-affected Drainage Areas	Current (2019)[a]			Future (2053)			Priority
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Selenium Load (kg/d)	Mean Monthly Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Average Concentration (µg/L)	
West Line Creek surface water	214	1.46	409	214	1.72	463	1
Mine Services Area West[b]	137	*0.30*	*93*	210	0.89	208	2
North Line Creek[b]	224	*0.59*	*129*	263	1.55	164	3
West Line Creek groundwater	-[c]	*0.71*	*155*	-[c]	0.82	158	4
Line Creek u/s of West Line Creek	547	0.95	39	661	3.55	62	5
Total	**761**	**3.13**	n/a	**875**	**6.08**	n/a	n/a

BCM = bank cubic metres; kg/d = kilograms per day; n/a = not applicable; µg/L = micrograms per litre; u/s = upstream.

(a) Values in italics are modelled data. Modelled data are presented because measured data were not available. Modelled data are the mean P_{50} monthly average loads or concentrations.

(b) The Mine Services Area West and North Line Creek drainage areas are sub-drainage areas of Line Creek upstream of West Line Creek.

(c) Surface water - groundwater partitioning of flow and load is explicitly built into the 2020 RWQM in West Line Creek (Teck 2021).

Future mining activities in the LCO Line Creek treatment area include completion of the Mine Service Area Extension (MSX), North Line Creek Extension (NLX) and Burnt Ridge Extension (BRX) pits, and placement of associated waste rock in existing disturbed areas in Line Creek upstream of West Line Creek. No additional waste rock is permitted to be placed in the West Line Creek drainage area. By the end of 2053, the Line Creek upstream of West Line Creek drainage area will contain the largest volume of waste rock (661 million BCM, or 76%), with approximately 263 million BCM or 30% located in the North Line Creek sub-drainage area and 210 million BCM or 24% located in the Mine Services Area West sub-drainage area. West Line Creek surface water is projected to have the highest selenium concentration in 2053, followed by Mine Services Area West, North Line Creek, West Line Creek groundwater, and Line Creek upstream of West Line Creek (Table 2-4).

All mine-affected drainage areas in the LCO Line Creek treatment area are selected for treatment at either the existing West Line Creek (WLC) AWTF or the proposed North Line Creek (NLC) SRF. The mine-affected drainage areas selected for treatment at the WLC AWTF in order of priority are:

- West Line Creek surface water - West Line Creek surface water is currently treated at the WLC AWTF.
- Mine Services Area West - Treatment of Mine Services Area West is proposed to begin in 2023.
- West Line Creek groundwater - Treatment of West Line Creek groundwater is proposed to begin in 2029.
- Line Creek upstream of West Line Creek - Line Creek upstream of West Line Creek is currently treated at the WLC AWTF.

The mine-affected drainage areas selected for treatment at the proposed NLC SRF are:

- North Line Creek
- Mine Services Area West - Flows from Mine Services Area West that are not treated at the WLC AWTF due to hydraulic capacity constraints.
- West Line Creek surface water - Flows from West Line Creek surface water that are not treated at the WLC AWTF due to hydraulic capacity constraints.
- West Line Creek groundwater - Flows from West Line Creek groundwater that are not treated at the WLC AWTF due to hydraulic capacity constraints.
- Line Creek upstream of West Line Creek - Flows from Line Creek upstream of West Line Creek that are not treated at the WLC AWTF due to hydraulic capacity constraints.

2.3.2 Line Creek Operations Dry Creek

The LCO Dry Creek treatment area is north of LCO Line Creek (Figure 2-4). Mining activities in LCO Dry Creek include completion of the Burnt Ridge North and Mount Michael pits and placement of associated waste rock in upper LCO Dry Creek and as backfill in the Burnt Ridge North and Mount Michael pits.

Dry Creek upstream of the East Tributary is the only drainage area affected by historical and on-going mining activities; therefore, prioritization of mine-affected drainage areas is not required. The cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean P_{50} monthly average selenium loads and concentrations in 2053 are presented in Table 2-5.

Table 2-5: Mine-affected Drainage Areas at Line Creek Operations Dry Creek

Mine-affected Drainage Area	Current (2019)			Future (2053)			Priority
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Selenium Load (kg/d)	Mean Monthly Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Average Selenium Concentration (µg/L)	
Dry Creek u/s of the East Tributary	74	0.47	31	570	6.1	591	1

BCM = bank cubic metres; kg/d = kilograms per day; µg/L = micrograms per litre; u/s = upstream.

2.4 Elkview Operations

Mine-affected drainage areas at EVO are divided into two areas for mitigation: EVO Michel Creek and EVO Elk River (Figure 2-5). Details for each treatment area are provided below.

2.4.1 Elkview Operations Michel Creek

The EVO Michel Creek treatment area includes the following mine-affected drainage areas (Figure 2-5):

- F2 Pit
- Natal Pit
- Baldy Ridge Pits
- Cedar Pit
- Adit Pit
- Erickson Creek
- South Pit Creek
- Milligan Creek
- Thresher Creek
- Gate Creek
- Bodie Creek
- Aqueduct Creek

An evaluation of the mine-affected drainage areas in the EVO Michel Creek treatment area in 2019 and 2053 is presented in Table 2-6. Year 2019 corresponds to the end of the calibration period for the 2020 RWQM and Year 2053 corresponds to a time at which all of the waste rock associated with permitted development at all operations has been deposited and the hydraulic lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load). The data summarized in the table include cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean P_{50} monthly average selenium loads and concentrations in 2053.

Most of the historical waste rock in the EVO Michel Creek treatment area is in the Erickson Creek drainage area (877 million BCM, or 56% of the 2019 total waste rock in the EVO Michel Creek treatment area) and as backfill in Natal Pit (278 million BCM, or 18%). These drainage areas have the highest selenium loads and concentrations in the EVO Michel Creek treatment area, as summarized in Table 2-6.

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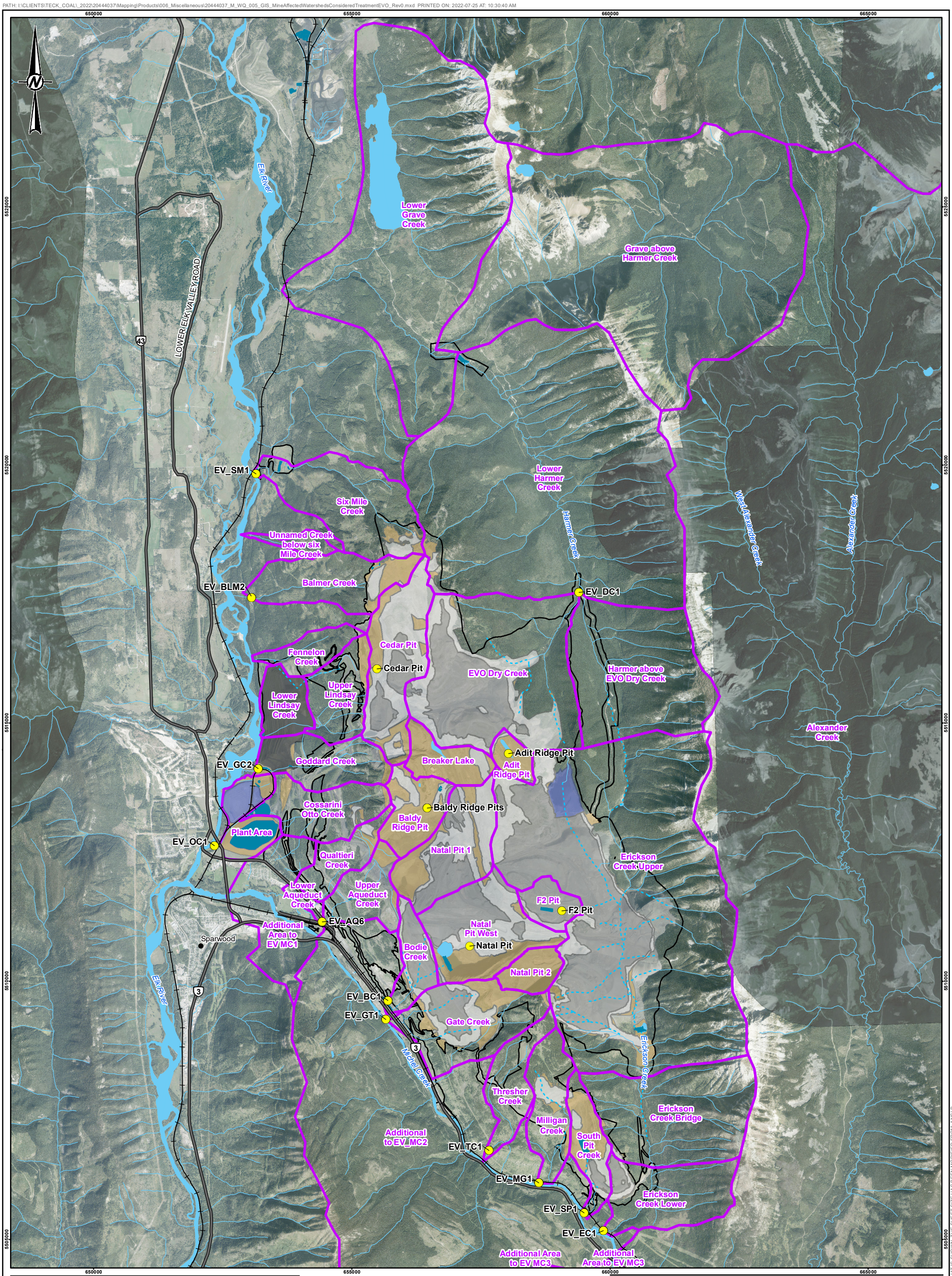

LEGEND

- CITY / TOWN / COMMUNITY
- MONITORING STATION / MODELLING NODE
- RAILWAY
- ROAD - PAVED
- SURFACE FLOW WATERCOURSE
- SUBSURFACE FLOW WATERCOURSE
- EVO CATCHMENT
- EVO C-2 PERMIT BOUNDARY
- COARSE COAL REJECTS (CCR)
- HARD MINE AREA
- TAILINGS AREA
- WASTE ROCK AREA (> 10 M TO 50 M THICK)
- WASTE ROCK AREA (> 50 M THICK)
- WASTE WATER/SEDIMENT POND
- WATERBODY

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REFERENCE(S)

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DATUM: NAD 83 PROJECTION: UTM ZONE 11

TECK COAL LIMITED

PROJECT
2022 IMPLEMENTATION PLAN ADJUSTMENT

TITLE
MINE-AFFECTED WATERSHEDS CONSIDERED FOR TREATMENT AT ELKVIEW OPERATIONS

YYYY-MM-DD	2022-07-25
DESIGNED	AS
PREPARED	DR
REVIEWED	CG
APPROVED	JPB

PROJECT NO.	PHASE	REV.	FIGURE
20444037	M_WQ_005	0	2-5

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Table 2-6: Selection and Prioritization of Mine-affected Drainage Areas for Elkview Operations Michel Creek Treatment Area

Mine-affected Drainage Area	Current (2019)[a]			Future (2053)			Priority
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Average Selenium Load (kg/d)	Mean Monthly Average Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Average Selenium Concentration (µg/L)	
Pits							
F2 Pit[b]	86	*2.64*	*355*	87	1.38	1,245	1
Natal Pit[c]	278	*0.71*	*119*	600	2.93	127	2
Baldy Ridge Pits[d]	27	*0.29*	*127*	367	1.59	374	4
Cedar Pit[e]	80	*0.40*	*101*	127	0.70	153	n/a
Adit Pit[f]	0	*<0.01*	*9*	0	-	-	n/a
Tributaries							
Erickson Creek	877	*3.10*	*166*	1,428	8.79	381	3
Lower Erickson Creek	12	*0.02*	*21*	12	0.06	52	n/a
South Pit Creek	19	0.09	158	19	0.26	167	n/a
Milligan Creek	13	0.03	59	13	0.10	61	n/a
Thresher Creek	-	<0.01	13	-	<0.01	1	n/a
Gate Creek	88	0.52	141	73	2.80	192	n/a
Bodie Creek	70	0.34	159	70	0.71	493	n/a
Aqueduct Creek	2	<0.01	6	2	0.03	18	n/a
Total	**1,553**	**4.10**	n/a	**2,672**	**12.74**	n/a	n/a

BCM = bank cubic metres; kg/d = kilograms per day; n/a = not applicable; µg/L = micrograms per litre.

(a) Values in italics are modelled data. Modelled data are presented because measured data were not available. Modelled data are the mean P_{50} monthly average loads or concentrations.

(b) Water from F2 Pit is modelled to be used for dust suppression and to be sent to Erickson Creek upstream of the EVO SRF intake.

(c) Water from Natal Pit is modelled to be sent to the EVO SRF, used for dust suppression and to be sent to Bodie Creek and Gate Creek.

(d) Water from Baldy Ridge Pits is modelled to be sent to Natal Pit.

(e) Water from Cedar Pit is modelled to be sent to the Coal Conveyance Tunnel until December 31, 2041 and to Baldy Ridge Pits from January 1, 2042 onwards.

(f) Water from Adit Pit is modelled to be sent to Erickson Creek upstream of the EVO SRF intake.

Future mining activities in the EVO Michel Creek treatment area include mining of Natal, Baldy Ridge and Adit Ridge pits and placement of associated waste rock. Waste rock is permitted to be placed in Erickson Creek, and EVO Dry Creek, and as backfill in the Cedar, Natal and Baldy Ridge pits. By the end of 2053, most of the waste rock is in Erickson Creek (1,428 million BCM, or 53% of the 2053 total waste rock in the EVO Michel Creek treatment area) and Natal Pit (600 million BCM, 22%). These drainage areas are projected to have the highest selenium loads and concentrations in the EVO Michel Creek treatment area, as shown in Table 2-6.

Projected loadings and concentrations in tributaries at EVO are affected by projected waste rock volumes and management of water in mine pits. In the 2020 RWQM, pit inflows are modelled to be discharged to the receiving environment while each pit is being actively mined (i.e., inflows = outflows). More specifically, mine pit water is modelled as follows:

- During active mining in Natal Pit, incoming water is sent to:
    - EVO SRF - Water is pumped from Natal Pit to the EVO SRF at a flow rate of 5,000 m^3/d from September 1, 2020 to December 31, 2027 and 20,000 m^3/d from January 1, 2028 onwards.
    - Dust suppression - Water is pumped from Natal Pit for use in dust suppression at a rate of 8,700 m^3/d from May 1 to October 14 from 2019 to 2041.
    - Bodie Creek and Gate Creek - up to 3,000 m^3/d of water from Natal Pit is sent to Bodie Creek, with excess flows diverted to Gate Creek.
- During active mining in Baldy Ridge Pits, incoming water is sent to Natal Pit.
- During active mining in Cedar Pit, incoming water is sent to:
    - Coal Conveyance Tunnel until December 31, 2041. Water from the Coal Conveyance Tunnel is sent to Goddard Creek in 2019 and 2053.
    - Baldy Ridge Pits from January 1, 2042 onwards
- During active mining in Adit Pit, incoming water is sent to Erickson Creek upstream of the EVO SRF intake.
- Water from F2 Pit is modelled to be sent to:
    - Dust suppression - Water is pumped from F2 Pit for use in dust suppression at a rate of 1,044 m^3/d from May 1 to October 14 from 2012 to 2036 and 522 m^3/d from May 1 to October 14 from 2037 to 2041.
    - Erickson Creek upstream of the EVO SRF intake.

The mine-affected drainage areas selected for treatment in the EVO Michel Creek treatment area, in order of priority are listed below and shown in Table 2-6:

- F2 Pit
- Erickson Creek
- Natal Pit

F2 Pit is identified as the first priority for treatment because water from the local catchment naturally drains to the EVO SRF. Erickson Creek and Natal Pit are identified as the second and third priorities, respectively. These mine-affected drainage areas account for 80% of the total waste rock volume in the EVO Michel Creek treatment area in 2019 and are expected to account for 79% of the total waste rock volume in the EVO Michel Creek treatment area in 2053. Other mine-affected drainage areas in the EVO Michel Creek treatment area have much lower selenium loads and concentrations and are not selected for treatment.

2.4.2 Elkview Operations Elk River

The EVO Elk River treatment area includes the following mine-affected drainage areas (Figure 2-5):

- EVO Dry Creek
- Lower Harmer Creek
- Six Mile Creek
- Balmer Creek
- Fennelon Creek
- Lindsay Creek
- Goddard Creek
- Otto Creek

An evaluation of the mine-affected drainage areas in the EVO Elk River treatment area in 2019 and 2053 is presented in Table 2-7. Year 2019 corresponds to the end of the calibration period for the 2020 RWQM and Year 2053 corresponds to a time at which all of the waste rock associated with permitted development at all operations has been deposited and the hydraulic lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load). The data summarized in the table include cumulative waste rock volumes in 2019 and 2053, mean monthly average selenium loads and concentrations in 2019, and mean P_{50} monthly average selenium loads and concentrations in 2053.

Most of the historical waste rock in the EVO Elk River treatment area is in the EVO Dry Creek drainage area (305 million BCM, or 96% of the 2019 total waste rock in the EVO Elk River treatment area). The EVO Dry Creek drainage area has the highest selenium loads and concentrations in the EVO Elk River treatment area, as summarized in Table 2-7.

As noted above, future mining activities in the EVO Elk River treatment area will include placement of additional waste rock in EVO Dry Creek. By the end of 2053, most of the waste rock in the EVO Elk River treatment area is in the EVO Dry Creek drainage area (619 million BCM, or 98% of the 2053 total waste rock volume in the EVO Elk River treatment area). The EVO Dry Creek drainage area is projected to have the highest selenium loads and concentrations in the EVO Elk River treatment area, as shown in Table 2-7.

Table 2-7: Selection and Prioritization of Mine-affected Drainage Areas for Elkview Operations Elk River Treatment Area

Mine-affected Drainage Area	Current (2019)[a]			Future (2053)			Priority
	Cumulative Waste Rock Volume (million BCM)	Mean Monthly Average Selenium Load (kg/d)	Mean Monthly Average Selenium Concentration (µg/L)	Cumulative Waste Rock Volume (million BCM)	Mean P_{50} Monthly Average Selenium Load (kg/d)	Mean P_{50} Monthly Average Selenium Concentration (µg/L)	
Lower Harmer Creek	3	*0.01*	*1*	3	0.03	2	n/a
EVO Dry Creek	305	0.94	154	619	1.97	284	1
Six Mile Creek	6	<0.01	2	6	0.01	3	n/a
Balmer Creek	4	0.01	7	4	0.05	18	n/a
Fennelon Creek	-	<0.01	5	-	<0.01	1	n/a
Lindsay Creek	-	*<0.01*	*4*	-	<0.01	4	n/a
Total	318	1.13	n/a	633	2.12	n/a	n/a

BCM = bank cubic metres; kg/d = kilograms per day; n/a = not applicable; µg/L = micrograms per litre.

(a) Values in italics are modelled data. Modelled data are presented because measured data were not available. Modelled data are the mean P_{50} monthly average loads or concentrations.

EVO Dry Creek is the only drainage area selected for treatment in the EVO Elk River treatment area. Other mine-affected drainage areas in the EVO Elk River treatment area have much lower selenium loads and concentrations and are not selected for treatment. Treatment of EVO Dry Creek is required to meet compliance limits at the EVO Harmer Compliance Point (EV_HC1; E102682) if permitted future waste rock is placed in EVO Dry Creek. Treatment of EVO Dry Creek is not required to meet SPOs in the Elk River.

2.5 Summary

Prioritization of mine-affected drainage areas for treatment at FRO, GHO, LCO, and EVO has been updated for the 2022 IPA considering the changes to the permitted mine plans and updated model projections. A summary of the mine-affected drainage areas selected for treatment is shown in Table 2-8. The mine-affected drainage areas selected for treatment account for 90% of the total waste rock volume and 89% of the selenium load in the Elk Valley in 2019 and are expected to account for 97% of the total waste rock volume and 91% of the projected selenium load in the Elk Valley in 2053. The percent loads presented in Table 2-8 are calculated from the mean P_{50} monthly average loads presented in Tables 2-1 to 2-7. The percent load is the load at the source and is not the load removed by treatment. The monthly average loads of nitrate, selenium, and sulphate removed by each treatment system are presented in Annex C.

Table 2-8: Summary of Mine-affected Drainages Selected for Treatment

Treatment Area	Mine-affected Watersheds Selected for Treatment	Current (2019)				Projected (2053)			
		Cumulative Waste Rock Volume		Selenium Load[(a)]		Cumulative Waste Rock Volume		Selenium Load[(a)]	
		% of Treatment Area Total	% of Elk Valley Total	% of Treatment Area Total	% of Elk Valley Total	% of Treatment Area Total	% of Elk Valley Total	% of Treatment Area Total	% of Elk Valley Total
FRO-N	1. Clode Creek 2. Liverpool Ponds / Swift Pit 3. Post Ponds 4. Eagle Pond	74%	14%	40%	7%	81%	20%	68%	13%
FRO-S	1. Swift Creek /Cataract Creek 2. Kilmarnock Creek surface water 3. Kilmarnock Creek groundwater	100%	28%	100%	39%	100%	24%	100%	33%
GHO	1. Cougar South Pit 2. Leask /Wolfram /Thompson 3. Greenhills Creek 4. Porter Creek	99%	13%	100%	11%	98%	11%	95%	7%
LCO Line Creek	1. West Line Creek surface water 2. Mine Services Area West 3. North Line Creek 4. West Line Creek groundwater 5. Line Creek u/s of West Line Creek	100%	11%	100%	12%	100%	8%	100%	9%
LCO Dry Creek	1. LCO Dry Creek	100%	1%	100%	2%	100%	5%	100%	9%
EVO Michel Creek	1. F2 Pit 2. Erickson Creek 3. Natal Pit	80%	20%	93%	14%	79%	23%	92%	17%
EVO Elk River	1.EVO Dry Creek	96%	5%	83%	4%	98%	6%	93%	3%
Total		n/a	**90%**	n/a	**89%**	n/a	**97%**	n/a	**91%**

EVO = Elkview Operations; FRO-N = Fording River Operations North; FRO-S = Fording River Operations South; GHO = Greenhills Operations; LCO = Line Creek Operations; n/a = not applicable; u/s = upstream; % = percent.

(a) Percent load is calculated from the mean P_{50} monthly average loads presented in Tables 2-1 to 2-7. Percent load is the load at the source and is not the load removed by treatment.

3 Identification of Mitigation

The methods used to develop the 2022 IPA are described in this section, based on the mitigation options outlined in the main report. Mitigation required to meet the short, medium and long-term SPOs at Order Stations and, to the extent possible, compliance limits at compliance points were identified. The SPOs and compliance limits defined in EMA Permit 107517 are summarized in Tables 3-1 and 3-2, respectively. Mitigation required to meet targeted receiving environment objectives and discharge criteria in LCO Dry Creek were also identified. The targeted receiving environment objectives and discharge criteria in LCO Dry Creek are summarized in Table 3-3.

The hydraulic capacity and operational dates[1] of the mitigation included in the 2022 IPA were estimated using a four-step modelling process:

1. Identifying the total hydraulic capacity required to meet long-term SPOs and compliance limits for nitrate and selenium at Order Stations and compliance points.
2. Phasing the mitigation over time to meet short- and medium-term SPOs and compliance limits for nitrate and selenium at Order Stations and compliance points.
3. Optimizing the mitigation, as required, to meet the short-, medium- and long-term SPOs and compliance limits for nitrate and selenium at Order Stations and compliance points considering water management opportunities.
4. Repeating Step 1 and Step 2 with a focus on sulphate.

Each step is described in more detail below.

Table 3-1: Site Performance Objectives at Order Stations as Established in Permit 107517

Order Station (EMS Number)	Description	Constituent	Monthly Average Site Performance Objectives and Effective Date		
			Short-term	Medium-term	Long-term
GH_FR1 (0200378)	Fording River downstream of Greenhills Creek	Selenium	-	63 µg/L by December 31, 2019	57 µg/L by December 31, 2023
		Nitrate[(a)]	20 mg/L Immediately	14.0 mg/L by December 31, 2019	11.0 mg/L by December 31, 2023
		Sulphate	429 mg/L Immediately	-	-

[1] The operational date is the date when facility commissioning activities are complete, any subsequent ramp-up activities are complete, and the facility is operating as designed.

Table 3-1: Site Performance Objectives at Order Stations as Established in Permit 107517

Order Station (EMS Number)	Description	Constituent	Monthly Average Site Performance Objectives and Effective Date		
			Short-term	Medium-term	Long-term
LC_LC5 (0200028)	Fording River downstream of Line Creek	Selenium	-	51 µg/L by December 31, 2019	40 µg/L by December 31, 2023
		Nitrate[(a)]	18 mg/L Immediately	10.0 mg/L by December 31, 2019	-
		Sulphate	429 mg/L Immediately	-	-
GH_ER1 (0206661)	Elk River upstream of Boivin Creek	Selenium	19 µg/L Immediately	-	-
		Nitrate	3.0 mg/L Immediately	-	-
		Sulphate	309 mg/L Immediately	-	-
EV_ER4 (0200027)	Elk River upstream of Grave Creek	Selenium	23 µg/L Immediately	19 µg/L by December 31, 2023	-
		Nitrate	4.0 mg/L by December 31, 2019	3.5 mg/L by December 31, 2025	3.0 mg/L by December 31, 2028
		Sulphate	429 mg/L Immediately	-	-
EV_ER1 (0200393)	Elk River downstream of Michel Creek	Selenium	19 µg/L Immediately	-	-
		Nitrate	3.0 mg/L by December 31, 2019	-	-
		Sulphate	429 mg/L Immediately	-	-
RG_ELKORES (E294312)	Elk River at Elko Reservoir	Selenium	19 µg/L Immediately	-	-
		Nitrate	3.0 mg/L by December 31, 2019	-	-
		Sulphate	429 mg/L Immediately	-	-

Table 3-1: Site Performance Objectives at Order Stations as Established in Permit 107517

Order Station (EMS Number)	Description	Constituent	Monthly Average Site Performance Objectives and Effective Date		
			Short-term	Medium-term	Long-term
RG_DSELK (E300230)	Koocanusa Reservoir	Selenium	2 µg/L Immediately	-	-
		Nitrate	3.0 mg/L Immediately	-	-
		Sulphate	308 mg/L Immediately	-	-

mg/L = milligram per litre; µg/L = microgram per litre.

(a) SPOs for nitrate at GH_FR1 as of 2023 and LC_LC5 as of 2019 are hardness dependent based on the following formula: Level 1 benchmark for the Fording River N as mg/L = $10^{1.0003\log 10(\text{hardness})-1.52}$ where hardness is in mg/L of $CaCO_3$. Values in the table above were calculated based on a hardness of 360 mg/L.

Table 3-2: Monthly Average Compliance Limits at Compliance Points as Established in Permit 107517

Compliance Point (EMS Number)	Description	Constituent	Monthly Average Limits and Effective Date		
			Short-term	Medium-term	Long-term
FR_FRABCH (E323753)	FRO Compliance Point	Selenium	-	85 µg/L by March 10, 2021	58 µg/L by December 31, 2023
		Nitrate	-	18.0 mg/L by March 10, 2021	12.0 mg/L by December 31, 2023
		Sulphate	-	577 mg/L by March 10, 2021	605 mg/L by December 31, 2023
GH_FR1 (0200378)	GHO Fording River Compliance Point	Selenium	80 µg/L Immediately	63 µg/L by December 31, 2019	57 µg/L by December 31, 2023
		Nitrate	20 mg/L Immediately	14.0 mg/L by December 31, 2019	11.0 mg/L by December 31, 2023
		Sulphate	429 mg/L Immediately	-	-
LC_LCDSSLCC (E297110)	LCO Compliance Point	Selenium	80 µg/L Immediately	50 µg/L by December 31, 2015	29 µg/L by December 31, 2033
		Nitrate	14 mg/L Immediately	7.0 mg/L by December 31, 2015	3.0 mg/L by December 31, 2033
		Sulphate	429 mg/L Immediately	-	-

Table 3-2: Monthly Average Compliance Limits at Compliance Points as Established in Permit 107517

Compliance Point (EMS Number)	Description	Constituent	Monthly Average Limits and Effective Date		
			Short-term	Medium-term	Long-term
GH_ERC (0300090)	GHO Elk River Compliance Point	Selenium	15 µg/L Immediately	-	8 µg/L by December 31, 2027
		Nitrate	3.0 mg/L Immediately	-	3.0 mg/L by December 31, 2027
		Sulphate	309 mg/L Immediately	-	-
EV_HC1	EVO Harmer Creek Compliance Point	Selenium	45 µg/L Immediately	57 µg/L by December 31, 2017	57 µg/L by December 31, 2021
		Nitrate	4 mg/L Immediately	16.0 mg/L by December 31, 2017	8.0 mg/L by December 31, 2021
		Sulphate	300 mg/L Immediately	380 mg/L by December 31, 2017	450 mg/L by December 31, 2021
CM_MC2	CMO Compliance Point	Selenium	19 µg/L Immediately	-	-
		Nitrate	5.0 mg/L Immediately	-	-
		Sulphate	500 mg/L Immediately	-	-
EV_MC2	EVO Michel Creek Compliance Point	Selenium	28 µg/L Immediately	20 µg/L by December 31, 2021	19 µg/L by December 31, 2025
		Nitrate	6.0 mg/L Immediately	6.0 mg/L by December 31, 2021	6.0 mg/L by December 31, 2025
		Sulphate	429 mg/L Immediately	-	-

CMO = Coal Mountain Operations; EVO = Elkview Operations; FRO = Fording River Operations; GHO = Greenhills Operations; LCO = Line Creek Operations; mg/L = milligram per litre; µg/L = microgram per litre.

Table 3-3: Monthly Average Targeted Receiving Environment Objectives and Discharge Criteria for LCO Dry Creek

Location	Description	Objectives/Criteria	Selenium	Nitrate[(a)]	Sulphate
LC_DCDS	LCO Dry Creek downstream of Sedimentation Ponds	Monthly Average Targeted Receiving Environment Objectives and Effective Date	70 µg/L Immediately	11.0 mg/L Immediately	499 mg/L Immediately
		Monthly Average Discharge Criteria and Effective Date	320 µg/L Immediately	141 mg/L Immediately	1,067 mg/L Immediately

LCO = Line Creek Operations; mg/L = milligram per litre; µg/L = microgram per litre.

(a) Targeted receiving environment objective for nitrate is hardness dependent based on the following formula: N as mg/L = $10^{1.0003\log 10(\text{hardness})-1.52}$ (maximum hardness of 500 mg/L as $CaCO_3$) where hardness is in mg/L of $CaCO_3$. Value in the table above was calculated based on a hardness of 360 mg/L.

3.1 Step 1 - Identifying Total Hydraulic Capacity Required to Meet Long-term Site Performance Objectives and Compliance Limits for Nitrate and Selenium

In the 2020 RWQM, SRF or AWTF sizing is defined primarily by hydraulic capacity. Hydraulic capacity, expressed in terms of cubic metres per day (m^3/d), refers to the maximum flow rate of water that can be treated at an SRF or AWTF. With biological treatment, the projected nitrate load entering a facility influences retention time and removal performance. For AWTFs, there is a limit to the nitrate load a facility can receive while still achieving the desired level of treatment. This limit is referred to as the nitrate design load removal, expressed in terms of kilograms per day (kg/d), and is the maximum nitrate mass that an AWTF can accept and still achieve expected removal rates.

In the 2020 RWQM, source waters targeted for treatment are directed to each treatment vessel sequentially from the source with the highest selenium concentration to the source with the lowest, until the hydraulic capacity is reached, the nitrate design load removal is reached for AWTFs, or all available sources are treated. If the hydraulic capacity or the nitrate design load removal of the treatment vessel is reached before all available sources are treated, then excess water bypasses the intake and is discharged to the receiving environment. Thus, the selenium and nitrate load removed by a given treatment vessel is dependent on the hydraulic capacity and nitrate design load removal assigned to the treatment vessel.

Step 1 involved the following activities:

- Identifying the hydraulic capacity required to meet long-term compliance limits for nitrate and selenium at the FRO Compliance Point, LCO Compliance Point, GHO Elk River Compliance Point, and EVO Michel Creek Compliance Point.
- Identifying the hydraulic capacity required to meet targeted receiving environment objectives and discharge criteria for nitrate and selenium in LCO Dry Creek.
- Combining the hydraulic capacities for FRO, LCO, GHO, and EVO with the hydraulic capacity for Greenhills Creek treatment.

- Adjusting mitigation as required to meet long-term SPOs and compliance limits for nitrate and selenium at Order Stations and Compliance Points.

Initial mitigation planning at each operation could proceed in parallel, with a focus on identifying the hydraulic capacity required to meet the long-term compliance limits for nitrate and selenium in the upper Fording River, Elk River (upstream of the Fording River), Line Creek and Michel Creek. Initial mitigation planning at each operation could proceed in parallel because the majority of the waste rock at each operation is located upstream of their respective compliance points and projected concentrations at these locations are independent of one another (not cumulative). The exception being the GHO Fording River Compliance Point, which is downstream of FRO, LCO Dry Creek and Greenhills Creek.

The 2020 RWQM is configured as outlined below (Table 3-4):

- The hydraulic capacities, nitrate design load removals, and operational dates at the WLC AWTF and EVO SRF Phase I were set to reflect current operations.
- The hydraulic capacity, nitrate design load removal, and operational date[2] at the FRO AWTF-S, including the Kilmarnock Diversion, were set to reflect the *Fording River Operations Active Water Treatment Facility South Operations Application* (Teck 2019b).
- The hydraulic capacity, nitrate design load removal, and operational date at the FRO-N 1 SRF were set to reflect the *Fording River Operations North Saturated Rock Fill Phase 2 Project Operations Application* (Teck 2022a).
- The hydraulic capacity and operational date for treatment of mine-influenced water from Greenhills Creek at GHO were initially set to reflect direction from Environment and Climate Change Canada (ECCC).
- The hydraulic capacity and operational date for treatment of mine-influenced water from EVO Dry Creek were set to reflect the current design basis.
- The maximum hydraulic capacity and operational date for conveyance and supplementation in LCO Dry Creek were set to reflect the *Line Creek Dry Creek Conveyance and Supplementation Project Phase II Construction, Commissioning, and Operations Application* (Teck 2022b).
- The maximum hydraulic capacities for the Upper Line Creek Diversion, Horseshoe Creek Diversion, and No Name Creek Diversion were set to reflect the *Elk Valley Water Quality Plan 2019 Implementation Plan Adjustment* (Teck 2019a).

[2] The operational date for the FRO AWTF-S was updated from December 31, 2021 to September 1, 2022 to reflect the current commissioning schedule.

Table 3-4: Mitigation in the 2020 Regional Water Quality Model used as a Starting Point for the Development of the 2022 Implementation Plan Adjustment for Nitrate and Selenium

Sources Targeted for Treatment / Diversion	Treatment Vessel / Associated Diversions	Maximum Hydraulic Capacity (m^3/d)	Nitrate Design Load Removal (kg/d)	Associated Diversions and Conveyance of Mine-Influenced Water	Operational Date in 2020 RWQM
West Line Creek Mine Services Area West[a] Line Creek	WLC AWTF	7,500	250	• Convey water from West Line Creek, Mine Services Area West, and Line Creek to AWTF • Discharge treated effluent to Line Creek	January 1, 2020
Swift Creek Cataract Creek Kilmarnock Creek	FRO AWTF-S	20,000	1,400	• Convey combined Swift/Cataract and Kilmarnock to the AWTF • Discharge equivalent proportion of treated effluent from Swift and Cataract to the Fording River • Discharge equivalent proportion of treated effluent from Kilmarnock Creek to Kilmarnock Creek	September 1, 2022
Upper Kilmarnock Creek	Kilmarnock Creek Diversion	86,000	-	• Convey upper Kilmarnock Creek downstream of Kilmarnock intake	December 31, 2021
F2 Pit Erickson Creek Natal Pit	EVO SRF Phase I	20,000	-	• Convey mine-influenced water from Erickson Creek and Natal Pit to SRF • Discharge equivalent proportion of treated effluent from Erickson Creek to Erickson Creek • Discharge equivalent proportion of treated effluent from Natal Pit to Bodie Creek	September 1, 2021
EVO Dry Creek	EVO SRF Phase II	4,000	-	• Convey mine-influenced water from EVO Dry Creek to SRF • Discharge equivalent proportion of treated effluent to EVO Dry Creek, with the returned water possibly being subject to sulphate treatment prior to discharge to EVO Dry Creek from December 31, 2033 onward	September 30, 2023
F2 Pit Erickson Creek Natal Pit	EVO SRF Phase III	TBD	-	• Convey mine-influenced water from Erickson Creek and Natal Pit to SRF • Discharge equivalent proportion of treated effluent from Erickson Creek to Erickson Creek • Discharge equivalent proportion of treated effluent from Natal Pit to Bodie Creek	TBD

Table 3-4: Mitigation in the 2020 Regional Water Quality Model used as a Starting Point for the Development of the 2022 Implementation Plan Adjustment for Nitrate and Selenium

Sources Targeted for Treatment / Diversion	Treatment Vessel / Associated Diversions	Maximum Hydraulic Capacity (m^3/d)	Nitrate Design Load Removal (kg/d)	Associated Diversions and Conveyance of Mine-Influenced Water	Operational Date in 2020 RWQM
EVO Dry Creek	EVO SRF Phase IV	3,000	-	• Convey mine-influenced water from EVO Dry Creek to SRF • Discharge equivalent proportion of treated effluent to EVO Dry Creek, with the returned water possibly being subject to sulphate treatment prior to discharge to EVO Dry Creek from December 31, 2033 onward	December 31, 2036
Eagle 4 Pit	FRO-N 1 SRF Phase I	9,500	-[(b)]	• Convey mine-influenced water from Eagle 4 Pit to SRF • Discharge treated effluent to Clode Creek	December 31, 2022
Clode Creek Liverpool Ponds/Swift Pit Post Ponds	FRO-N 1 SRF Phase II	20,500	-[(b)]	• Convey water from Clode, Liverpool Ponds/Swift Pit, and Post Ponds to SRF • Discharge treated effluent to Clode Creek	December 31, 2023
Clode Creek Liverpool Ponds/Swift Pit Post Ponds Eagle Pond	FRO-N 1 SRF Phase III	TBD	-	• Convey water from Clode, Liverpool Ponds/Swift Pit, Post Ponds and Eagle Pond to SRF • Discharge treated effluent to Clode Creek	TBD
Clode Creek Liverpool Ponds/Swift Pit Post Ponds Eagle Pond Kilmarnock Creek	FRO-N 2 SRF	TBD	-	• Convey water from Clode, Liverpool Ponds/Swift Pit, Post Ponds and Eagle Pond to SRF • Convey water from Kilmarnock Creek (not treated at the FRO AWTF-S) to SRF • Discharge equivalent proportion of treated effluent from Clode, Liverpool Ponds/Swift Pit, Post Ponds and Eagle Pond to Clode Creek • Discharge equivalent proportion of treated effluent from Kilmarnock Creek to Kilmarnock Creek	TBD
Eagle 6 Pit North and South	Eagle 6 SRF	TBD	-	• Convey Eagle 6 Pit North and South to SRF • Discharge treated effluent to Kilmarnock Creek	TBD
North Line Creek North Line Extension Pit Mine Services Area West West Line Creek Line Creek	NLC SRF	TBD	-	• Convey water from North Line Creek, North Line Extension Pit, and Mine Services Area West, West Line Creek and Line Creek (water not treated at the WLC AWTF) to SRF • Discharge treated effluent to Line Creek	December 31, 2025

Table 3-4: Mitigation in the 2020 Regional Water Quality Model used as a Starting Point for the Development of the 2022 Implementation Plan Adjustment for Nitrate and Selenium

Sources Targeted for Treatment / Diversion	Treatment Vessel / Associated Diversions	Maximum Hydraulic Capacity (m^3/d)	Nitrate Design Load Removal (kg/d)	Associated Diversions and Conveyance of Mine-Influenced Water	Operational Date in 2020 RWQM
Upper Line Creek Horseshoe Creek No Name Creek	Upper Line Creek Diversion Horseshoe Creek Diversion No Name Creek Diversion	42,000	-	• Convey water from unaffected drainage areas in Upper Line Creek, Horseshoe Creek and No Name Creek downstream of the Line Creek intake	December 31, 2025
LCO Dry Creek	NLC SRF	TBD	-	• Convey water from LCO Dry Creek to SRF • Discharge equivalent proportion of treated effluent to LCO Dry Creek upstream of the conveyance intake	TBD
LCO Dry Creek	Conveyance / Supplementation	30,000	-	• Convey water from LCO Dry Creek to the Fording River • Supplement flow in LCO Dry Creek with water from the Fording River	March 29, 2023
Greenhills Creek	GHC treatment	7,500	-	• Convey mine-influenced water from Greenhills Creek to treatment • Discharge treated effluent to Greenhills Creek	December 31, 2027
Cougar South Pit Leask, Wolfram and Thompson Porter Creek	CSP SRF	TBD	-	• Convey mine-influenced water from Leask Creek, Wolfram Creek, Thompson Creek, and Porter Creek to SRF • Discharge treated effluent to Thompson Creek[(c)]	TBD
Baldy Ridge Pit Erickson Creek Natal Pit	BRP SRF	TBD	-	• Convey mine-influence water from Erickson and Natal (not treated at the EVO SRF) to the BRP SRF • Discharge equivalent proportion of treated effluent from Erickson Creek to Erickson Creek Discharge equivalent proportion of treated effluent from Natal Pit to Bodie Creek	TBD

AWTF = Active Water Treatment Facility; AWTF-S = Active Water Treatment Facility South; BRP = Baldy Ridge Pit; CSP = Cougar South Pit; EVO = Elkview Operations; FRO = Fording River Operations; FRO-N = Fording River Operations North; GHC = Greenhills Creek; LCO = Line Creek Operations; RWQM = Regional Water Quality Model; SRF = Saturated Rock Fill; TBD = to be determined; WLC = West Line Creek; kg/d = kilograms per day; m^3/d = cubic metre per day; "-" = not applicable.

(a) Collection and treatment of Mine Services Area West is planned to begin by June 30, 2023.

(b) FRO-N 1 SRF Phase I and Phase II have temperature dependent nitrate and selenium loading limits consistent with the *Fording River Operations North Saturated Rock Fill Phase 2 Operations Application* (Teck 2022a).

(c) This is a simplified assumption for early planning purposes. The water return conveyance will be assessed during project design.

Hydraulic capacity was then added incrementally, with the 2020 RWQM being run with the 20 individual flow realizations. Model output (i.e., individual weekly estimates) was processed to generate temporally-connected monthly average concentrations for each realization. The resulting monthly datasets were summarized by calculating 10th percentile (P_{10}), 50th percentile (P_{50}), and 90th percentile (P_{90}) values across the 20 realizations for each future month and each future year, and maximum P_{90} monthly average concentrations were identified. The maximum P_{90} monthly average concentrations were compared to long-term compliance limits, targeted receiving environment objectives and discharge criteria, with the objective of identifying the appropriate hydraulic capacity that resulted in maximum P_{90} monthly average concentrations at or below the corresponding long-term compliance limit, targeted receiving environment objective or discharge criterion (Table 3-5).

The timeframe considered was from the date when the corresponding long-term compliance limit was effective to the end of 2140. The timeframe accounted for the full effects of loading from the permitted waste rock and from pit decanting. Year 2140 corresponds to a time at which all waste rock considered in the permitted mine plans has been deposited and the lag associated with that rock has passed (i.e., all waste rock is contributing selenium, nitrate, and sulphate load) and water volumes in all mine pits are either being actively managed or are decanting to the receiving environment.

The 2022 IPA includes active management of the water volume in Natal Pit at EVO (i.e., water from Natal Pit is pumped year-round to the EVO SRF at a rate of 5,000 m^3/d from September 1, 2021 to December 30, 2027 and 20,000 m^3/d from December 31, 2027 onward), thereby controlling the timing of pit filling and decant), and passive management of other pits (i.e., all other pits are allowed to passively fill and decant over time, without active management of pit water volumes).

Once total hydraulic capacity at FRO, GHO, LCO, and EVO was identified, it was combined with 7,500 m^3/d of capacity at Greenhills Creek (Table 3-4). Projected maximum P_{90} monthly average concentrations at Order Stations and remaining Compliance Points were compared to long-term SPOs and compliance limits, respectively. Hydraulic capacities were then adjusted, as required, to produce maximum P_{90} monthly average concentrations that met long-term SPOs and compliance limits. This activity included evaluations of whether hydraulic capacities at Greenhills Creek could be adjusted while still meeting downstream compliance limits and SPOs, as well as whether hydraulic capacities at FRO, GHO, LCO and EVO needed to be increased to meet downstream SPOs.

Nitrate design load removals for future treatment vessels were not estimated following the identification of total hydraulic capacity. Future treatment vessels will be designed to treat the required nitrate load of water entering each treatment vessel and will be based on the best available information at the time that design is underway.

Sources targeted for treatment were those outlined in Table 3-4. Assumed effluent concentrations for nitrate and selenium and water availabilities were those outlined in Tables 3-6 and 3-7.

Table 3-5: Example of How Required Hydraulic Capacities were Identified

Model Run Number	Hydraulic Capacity (m3/d)	Nitrate Design Load Removal (kg/d)	Projected Maximum P90 Monthly Selenium Concentration (µg/L)	Long-Term Compliance Limit (µg/L)
1	20,000	-	65	58
2	25,000	-	62	58
3	30,000	-	58	58
4	35,000	-	57	58
5	40,000	-	55	58

Note: Shading denotes the required hydraulic capacity.

Table 3-6: Selenium and Nitrate Effluent Concentrations

Treatment Vessel	Nitrate as N	Selenium	Sulphate
WLC AWTF	1 mg/L	• 20 µg/L or 95% removal if influent greater than 400 µg/L to December 31, 2024 • 20 µg/L from January 1, 2025 onward	addition of 20 mg/L
FRO AWTF-S	2 mg/L	• 30 µg/L or 95% removal if influent greater than 600 µg/L to December 31, 2026 • 20 µg/L from January 1, 2027 onward	addition of 20 mg/L
FRO-N 1 SRF	95% removal	95% removal	-
FRO-N 2 SRF	95% removal	95% removal	-
EVO SRF	95% removal	95% removal	-
NLC SRF	90% removal	• 90% removal to December 31, 2033 • 95% removal from January 1, 2034 onwards	-
future SRFs(a)	90% removal	90% removal	-
GHC treatment	2 mg/L	20 µg/L	-

AWTF = Active Water Treatment Facility; AWTF-S = Active Water Treatment Facility South; FRO = Fording River Operations; FRO-N = Fording River Operations North; EVO = Elkview Operations, GHC = Greenhills Creek; N = Nitrogen; SRF = Saturated Rock Fill; mg/L = milligrams per litre; µg/L = micrograms per litre; % = percent.

(a) The future SRFs are Eagle 6 SRF, North Line Creek (NLC) SRF, Cougar South Pit (CSP) SRF, and Baldy Ridge Pit (BRP) SRF.

Table 3-7: Water Availabilities and Intake Efficiency

Treatment Vessel	Sources Targeted for Treatment	Water Availability	Intake Efficiency
WLC AWTF	West Line Creek surface water	100%	95%
	West Line Creek groundwater	60%	95%
	Mine Services Area West	90%	95%
	Line Creek	95%	95%
FRO AWTF-S	Swift Creek and Cataract Creek	95%	95%
	Kilmarnock Creek surface water	100%	95%
	Kilmarnock Creek groundwater	75%	95%

Table 3-7: Water Availabilities and Intake Efficiency

Treatment Vessel	Sources Targeted for Treatment	Water Availability	Intake Efficiency
EVO SRF	F2 Pit	100%	95%
	Erickson Creek	95%	95%
	Natal Pit	100%	95%
	EVO Dry Creek	100%	95%
FRO-N 1 SRF	Eagle 4 Pit	95%	95%
	Clode Creek	85%	95%
	Liverpool Ponds/Swift Pit	95%	95%
	Post Ponds	90%	95%
	Eagle Pond	85%	95%
FRO-N 2 SRF	FRO-N 1 SRF sources	- see above	95%
	Kilmarnock Creek surface water	- see above	95%
	Kilmarnock Creek groundwater	- see above	95%
Eagle 6 SRF	Eagle 6 Pit North	85%	95%
	Eagle 6 Pit South	100%	95%
NLC SRF	North Line Creek	92%	95%
	North Line Extension Pit	92%	95%
	LCO Dry Creek	99%	100%
	WLC AWTF sources	- see above	95%
GHC treatment	Greenhills Creek	75%	95%
CSP SRF	Cougar South Pit	67%	95%
	Leask, Wolfram and Thompson	95%	95%
	Porter Creek	85%	95%
BRP SRF	Baldy Ridge Pit	45%	95%
	Erickson Creek	- see above	95%
	Natal Pit	- see above	95%

AWTF = Active Water Treatment Facility; AWTF-S = Active Water Treatment Facility South; BRP = Baldy Ridge Pit; CSP = Cougar South Pit; EVO = Elkview Operations; FRO = Fording River Operations; FRO-N = Fording River Operations North; GHC = Greenhills Creek; LCO = Line Creek Operations; SRF = Saturated Rock Fill; WLC = West Line Creek; % = percent.

3.2 Step 2 - Phasing Mitigation over Time to Meet Short and Medium-Term Site Performance Objectives and Compliance Limits for Nitrate and Selenium

The results of Step 1 provided an estimate of the total hydraulic capacity required to meet long-term SPOs and compliance limits, as well as the targeted receiving environment objectives and discharge criteria in LCO Dry Creek. Step 2 involved phasing the total hydraulic capacity over time to meet, to the extent possible, short- and medium-term SPOs and compliance limits for nitrate and selenium.

This exercise started with setting the timing for treatment vessels where schedules are fixed (Table 3-4):

- WLC AWTF was operational by January 1, 2020.
- EVO SRF Phase I was operational by September 1, 2021.
- FRO AWTF-S set to be operational by September 1, 2022.
- Phase I of the FRO-N 1 SRF set to be operational by December 31, 2022.
- Phase II of the FRO-N 1 SRF set to be operational by December 31, 2023.
- Phase I of EVO Dry Creek treatment set to be operational by September 30, 2023.
- Phase II of EVO Dry Creek treatment set to be operational by December 31, 2036.
- NLC SRF Phase I set to be operational by December 31, 2025.
- Treatment of Greenhills Creek set to be operational by December 31, 2027.

Subsequent phases and treatment at other locations were then added to the 2020 RWQM in time to maintain instream concentrations at or below SPOs and, to the extent possible, compliance limits. This process is illustrated in Figure 3-1. Dates when future mine pits (i.e., Eagle 6 Pit, Cougar South Pit, and Baldy Ridge Pit) would be available for development of SRFs are outlined in the main report and were considered when determining the timing of subsequent phases of mitigation.

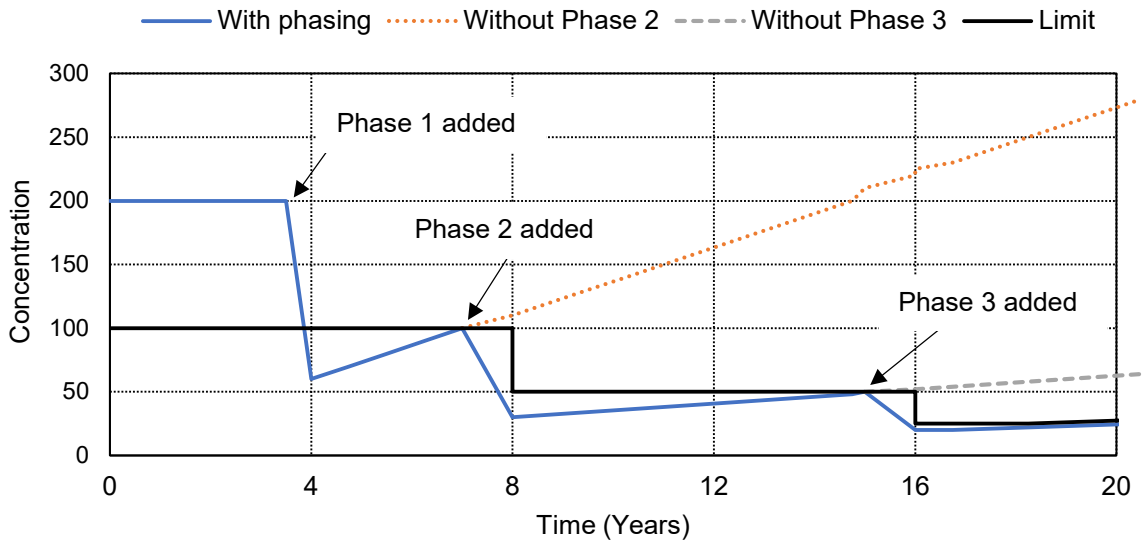

Figure 3-1: Conceptual Illustration of Process used to Phase Mitigation

Phasing was conducted with a focus on selenium. Priority was placed on meeting short, medium, and long-term SPOs, and then meeting short- and medium-term compliance limits to the extent possible. Projected nitrate concentrations were compared to compliance limits and SPOs after an initial phased configuration had been developed, which resulted in no modifications.

3.3 Step 3 - Optimizing Mitigation through Water Management

Step 3 involved adding water management opportunities to the phased configuration developed in Step 2 to meet, to the extent possible, short-, medium-, and long-term SPOs and compliance limits. Water management opportunities were added to address the following:

- Selenium concentrations at the EVO Michel Creek Compliance Point (EV_MC2) were projected to be above the medium-term compliance limit in February 2025 and the long-term compliance limit in February 2026 and January and February 2027.
- Selenium concentrations at the FRO Compliance Point (FR_FRABCH) were projected to be above the long-term compliance limit from August to October in 2039 and from August to December in 2040.

Water management assumptions at Natal Pit at EVO were modified to address selenium concentrations projected to be above compliance limits at the EVO Michel Creek Compliance Point, as follows:

- The flow rate of water from Natal Pit to the EVO SRF was reduced from 10,000 m^3/d to 5,000 m^3/d from January 1, 2020 to December 31, 2027.
- The timeframe over which water remaining in Natal Pit is discharged to Bodie Creek was updated from equally over the year to equally from April 1 to July 31.

Water management assumptions at Swift Pit at FRO were modified to address selenium concentrations projected to be above the long-term compliance limit at the FRO Compliance Point. In the 2020 RWQM, inflows to Swift Pit were modelled to be discharged to the receiving environment while the pit was being actively mined (i.e., inflows = outflows). Mining in Swift Pit is modelled to be completed by the end of the 2040 after which the pit is allowed to fill with water. Water management assumptions at Swift Pit were modified to allow for temporary water storage in Swift Pit beginning in August 2034 as outlined below:

- Inflows to Swift Pit were temporarily stored in the pit from August to December each year from 2034 to 2040.
- Stored water was pumped from the pit from January to July each year from 2035 to 2040.
- A portion of the stored water was pumped from the pit to meet environmental flow needs in the Fording River from August to December each year from 2034 to 2040.

Step 3 also involved altering the timing and sizing of mitigation at EVO and FRO to maintain projected concentrations at or below long-term compliance limits and SPOs in Michel Creek and the Fording River.

3.4 Step 4 - Repeating Step 1 and Step 2 with a Focus on Sulphate

The hydraulic capacity and operational dates of the mitigation included in the 2022 IPA for sulphate were estimated using a two-step modelling process:

4a. Identifying the total hydraulic capacity required to meet long-term SPOs and compliance limits for sulphate at Order Stations and compliance points.

4b. Phasing the mitigation over time to meet short- and medium-term SPOs and compliance limits for sulphate at Order Stations and compliance points.

Sulphate treatment is required at FRO, LCO and EVO Dry Creek because, without mitigation, projected sulphate concentrations are above SPOs, compliance limits, targeted receiving environment objectives, and discharge criteria at the following locations:

- FRO Compliance Point (FR_FRABCH; E223753) from 2029 onwards
- LCO Dry Creek downstream of Sedimentation Ponds (LC_DCDS) from 2022 onwards
- GHO Fording River Compliance Point (GH_FR1; 0200378) from 2026 onwards
- LCO Compliance Point (LC_LCDSSLCC; E297110) from 2023 onwards
- Fording River downstream of Line Creek (LC_LC5; 0200028) from 2032 onwards
- EVO Harmer Compliance Point (EV_HC1; E102682) from 2035 onwards

Sulphate treatment is not projected to be required to meet SPOs or compliance limits in Michel Creek, the Elk River or Koocanusa Reservoir. Projected sulphate concentrations, with and without mitigation are presented in Annex C.

3.4.1 Step 4a - Identifying Total Hydraulic Capacity Required to Meet Long-term Site Performance Objectives and Compliance Limits for Sulphate

Step 4a involved the following activities:

- Identifying the hydraulic capacity required to meet long-term compliance limits at the FRO Compliance Point, LCO Compliance Point, and EVO Harmer Compliance Point.
- Identifying the hydraulic capacity required to meet targeted receiving environment objectives and discharge criteria in LCO Dry Creek.
- Combining the hydraulic capacities for FRO, LCO and EVO and adjusting mitigation as required to meet long-term SPOs and compliance limits at the GHO Fording River Compliance Point and in the Fording River downstream of Line Creek.

The 2020 RWQM was configured as outlined below:

- The maximum hydraulic capacity and operational date for the Kilmarnock Diversion at FRO were set to reflect the *Fording River Operations Active Water Treatment Facility South Operations Application* (Teck 2019b).
- The maximum hydraulic capacity and operational date for conveyance and supplementation in LCO Dry Creek were set to reflect the *Line Creek Dry Creek Conveyance and Supplementation Project Phase II Construction, Commissioning, and Operations Application* (Teck 2022b).
- The maximum hydraulic capacities for the Upper Line Creek Diversion, Horseshoe Creek Diversion, and No Name Creek Diversion were set to reflect the *Elk Valley Water Quality Plan 2019 Implementation Plan Adjustment* (Teck 2019a).

Hydraulic capacity was then added incrementally, with the 2020 RWQM being run with the 20 individual flow realizations. Similar to nitrate and selenium, model output (i.e., individual weekly estimates) was processed to generate temporally-connected monthly average concentrations for each realization. The resulting monthly datasets were summarized by calculating P_{10}, P_{50}, and P_{90} values across the 20 realizations for each future month and each future year, and maximum P_{90} monthly average concentrations were identified. The maximum P_{90} monthly average concentrations were compared to long-term compliance limits, targeted receiving environment objectives and discharge criteria, with the objective of identifying the appropriate hydraulic capacity that resulted in maximum P_{90} monthly average concentrations at or below the corresponding long-term compliance limit, targeted receiving environment objective or discharge criterion.

Similar to nitrate and selenium, the timeframe considered was from the date when the corresponding long-term compliance limit was effective to the end of 2140.

Once total hydraulic capacity at FRO, LCO, and EVO Dry Creek was identified, projected maximum P_{90} monthly average concentrations at GH_FR1 and LC_LC5 were compared to long-term compliance limits and SPOs, respectively. Hydraulic capacities were then adjusted, as required, to produce maximum P_{90} monthly average concentrations that met the long-term compliance limits and SPOs.

Sources targeted for treatment of sulphate are presented in Table 3-8. Assumed water availabilities are presented in Table 3-7. A load removal efficiency of 90% for sulphate is assumed as described in the main report.

3.4.2 Step 4b - Phasing Mitigation over Time to Meet Short and Medium-Term Site Performance Objectives and Compliance Limits for Sulphate

The results of Step 4a provided an estimate of the total hydraulic capacity required to meet long-term SPOs and compliance limits, as well as the targeted receiving environment objectives and discharge criteria in LCO Dry Creek. Step 4b involved phasing the total hydraulic capacity over time to meet, to the extent possible, short- and medium-term SPOs and compliance limits for sulphate.

This exercise started with setting the timing for the first phases of the treatment vessels considering when sulphate concentrations were projected to be above SPOs, compliance limits, targeted receiving environment objectives and discharge criteria, as well as the proposed operational dates for selenium and nitrate treatment (Table 3-8):

- WLC AWTF set to be operational by December 31, 2025.
- FRO AWTF-S set to be operational by December 31, 2026.
- Treatment of LCO Dry Creek set to be operational by December 31, 2029.
- Treatment at FRO-N set to be operational by December 31, 2030.
- Treatment of EVO Dry Creek set to be operational by December 31, 2033.

Subsequent phases were then added to the 2020 RWQM in time to maintain instream concentrations at or below SPOs and, to the extent possible, compliance limits. This process is illustrated in Figure 3-1. Priority was placed on meeting short, medium, and long-term SPOs, and then meeting short- and medium-term compliance limits to the extent possible.

Table 3-8: Mitigation in the 2020 Regional Water Quality Model used as a Starting Point for the Development of the 2022 Implementation Plan Adjustment for Sulphate

Sources Targeted for Treatment / Diversion	Treatment Vessel / Associated Diversions	Maximum Hydraulic Capacity (m^3/d)	Associated Diversions and Conveyance of Mine-Influenced Water	Operational Date in 2020 RWQM
West Line Creek surface water Mine Services Area West[(a)] West Line Creek groundwater[(b)] Line Creek	WLC AWTF Phase I	TBD	• Convey West Line Creek surface water, Mine Services Area West, West Line Creek groundwater, and Line Creek to AWTF • Treated effluent directed to nitrate and selenium treatment	December 31, 2025
Swift Creek Cataract Creek Kilmarnock Creek	FRO AWTF-S	TBD	• Convey combined Swift/Cataract and Kilmarnock to the AWTF • Treated effluent directed to nitrate and selenium treatment	December 31, 2026
Upper Kilmarnock Creek	Kilmarnock Creek Diversion	86,000	• Convey upper Kilmarnock Creek downstream of Kilmarnock intake	December 31, 2021
Clode Creek Liverpool Ponds/Swift Pit Post Ponds Eagle Pond	FRO-N treatment	TBD	• Convey water from Clode, Liverpool Ponds/Swift Pit, Post Ponds and Eagle Pond to treatment • Treated effluent directed to nitrate and selenium treatment	December 31, 2030
LCO Dry Creek	LCO Dry Creek treatment Phase I	TBD	• Convey mine-influenced water from LCO Dry Creek to treatment • Treated effluent directed to nitrate and selenium treatment	December 31, 2029
LCO Dry Creek	Conveyance / Supplementation	30,000	• Convey water from LCO Dry Creek to the Fording River • Supplement flow in LCO Dry Creek with water from the Fording River	March 29, 2023
Upper Line Creek Horseshoe Creek No Name Creek	Upper Line Creek Diversion Horseshoe Creek Diversion No Name Creek Diversion	42,000	• Convey water from unaffected areas in Upper Line Creek, Horseshoe Creek and No Name Creek downstream of the Line Creek intake	December 31, 2025
EVO Dry Creek	EVO Dry Creek treatment Phase I	TBD	• Convey mine-influenced water from EVO Dry Creek to SRF • Discharge treated effluent to EVO Dry Creek	December 31, 2033

AWTF = Active Water Treatment Facility; AWTF-S = Active Water Treatment Facility South; EVO = Elkview Operations; FRO = Fording River Operations; FRO-N = Fording River Operations North; LCO = Line Creek Operations; RWQM = Regional Water Quality Model; TBD = to be determined; WLC = West Line Creek; m^3/d = cubic metre per day.

(a) Collection and treatment of Mine Services Area West is planned to begin by June 30, 2023.

(b) Collection and treatment of West Line Creek groundwater is planned to begin by December 31, 2029.

4 References

Teck (Teck Coal Limited). 2019a. *Elk Valley Water Quality Plan 2019 Implementation Plan Adjustment*. Prepared by Teck Coal Limited and submitted to the British Columbia Minister of Environment, July 31, 2019.

Teck. 2019b. *Operations Application Fording River Operations Active Water Treatment Facility South*. Joint Application for *Mines Act* and *Environmental Management Act* Permits to Authorize Commissioning and Operation Phase Activities. Submitted to Ministry of Energy, Mines and Petroleum Resources and Ministry of Environment and Climate Change Strategy. Submitted by Teck Coal Limited, Sparwood, BC. November 2019.

Teck. 2021. *2020 Elk Valley Regional Water Quality Model Update Report*. Submitted to British Columbia (BC) Ministry of Environment and Climate Change Strategy and the BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI). Submitted by Teck Coal Limited, Sparwood, BC. March 2021.

Teck. 2022a. *Fording River Operations North Saturated Rock Fill Phase 2 Project Operations Application*. Submitted to Ministry of Energy, Mines and Low Carbon Innovation and Ministry of Environment and Climate Change Strategy. Submitted by Teck Coal Limited, Sparwood, BC. May 2022.

Teck. 2022b. *Line Creek Dry Creek Conveyance and Supplementation Project Phase II Construction, Commissioning, and Operations Application*. Joint Application for a *Mines Act* and *Environmental Management Act* Permit Amendments and an Environmental Assessment Certificate Amendment under the *Environmental Assessment Act* to Authorize the Construction, Commissioning and Operations of Phase II Activities. Submitted to Ministry of Energy, Mines and Low Carbon Innovation, Ministry of Environment and Climate Change Strategy, and British Columbia Environmental Assessment Office. Submitted by Teck Coal Limited, Sparwood, BC. March 2022.