PERMIT 107517

ENVIRONMENTAL MONITORING COMMITTEE

2020 Public Meeting Posters

Highlights from 2019

Westslope Cutthroat Trout—Evaluation of Cause

Abundances of Westslope Cutthroat Trout in the upper Fording River above Josephine Falls declined significantly between fall 2017 and fall 2019.

An evaluation of cause process was initiated to understand the most likely causes of the decline with that process concluding in late 2020.

Adaptive Management

- Teck's Adaptive Management Plan (AMP) and related annual reports outline the activities to reduce key uncertainties (KUs), what has been learned, and the next steps for reducing KUs and evaluating management questions (MQs).
- The AMP response framework outlines the process for notification, confirmation, investigation, and adjustments to monitoring and management Teck takes when triggers or unexpected conditions are identified.
- Current and long-term continuous improvement goals were collaboratively developed by Teck and KNC.

Tributary Management

The Tributary Management Plan is intended to support protection and rehabilitation of tributaries in the Elk Valley.

Human Health Risk Assessment

- It is required by Permit 107517.
- It is a collaborative effort between Ktunaxa Nation Council, BC Interior Health Authority, BC Ministry of Environment, and Teck.
- The work is inclusive, grounded, and reciprocal.

Surface Water Quality Monitoring

- The chemistry of mine-influenced waters of the Elk Valley is generally well understood.
- In 2019, water quality at order stations met permit limits 100% of the time and at compliance points 96% of the time.

Groundwater Monitoring

- 17 new monitoring wells were drilled in 2019 to fill gaps in the regional monitoring network to better understand groundwater in the Elk Valley. 16 wells are anticipated to be drilled in 2020.
- **Site-Specific Groundwater Monitoring Programs:** monitoring for each of the five operations to identify and monitor mine-related substances in groundwater and associated transport pathways.
- **Regional Groundwater Monitoring Program:** monitoring in 12 study areas to understand potential regional groundwater and associated pathways of mine-related substances.
- **Drinking Water Sampling Program:** Teck samples private and municipal drinking water wells to assess against British Columbia Approved Drinking Water Quality Guidelines for mine-related substances. To request to have your well sampled under the program, please contact Teck's Social Responsibility office toll-free at 1-855-806-6854.

Calcite Monitoring

- Monitoring is demonstrating modest increases in calcite formation over time.
- Spawning habitat suitability is potentially being reduced by calcite concretion.
- Teck is exploring alternatives for calcite management, including further prevention and remediation.
- Antiscalant addition is anticipated to be in place on ten streams by the end of 2021.
- A calcite remediation pilot project is anticipated to occur in 2021.

Regional Aquatic Effects Monitoring

Results of the RAEMP indicate that there are mine related influences on water quality, calcite, sediment, and benthic invertebrate endpoints, most of which are within the range of what is expected.

Local Aquatic Effects Monitoring

- LAEMPs assess site-specific conditions by monitoring on a more frequent and localized basis than the Regional Aquatic Effects Monitoring Program (RAEMP).
- A LAEMP is initiated in response to local-area effects, uncertainties in the potential for effects at a local level, or change in water management (e.g., operation of a water treatment facility).
- Monitoring occurs as required until sufficient data have been collected to address the study questions; concerns no longer exist; or relevant monitoring can be incorporated into the RAEMP.

Koocanusa Monitoring

- Order constituents met permitted limits in Koocanusa Reservoir in 2019.
- Concentrations of selenium in fish muscle and ovaries were comparable to previous years.

The Environmental Monitoring Committee

Why does this committee exist?

The Environmental Monitoring Committee (also called the EMC) is required by Permit 107517. The permit was issued to Teck in November 2014 by the BC Ministry of Environment under the Environmental Management Act.

What does this committee do?

The purpose of the EMC is to strengthen Teck's aquatic environment monitoring programs required under Permit 107517. The committee does this by reviewing Teck's monitoring submissions that are required by the permit and providing technical advice and Indigenous Knowledge advice.

Who sits on this committee?

In 2019 and 2020, there were nine members on the EMC:

- one independent aquatic scientist
- two representatives from the BC Ministry of Environment
- one representative from the BC Ministry of Energy & Mines
- one representative from the BC Interior Health Authority
- two representatives from the Ktunaxa Nation Council
- two representatives from Teck

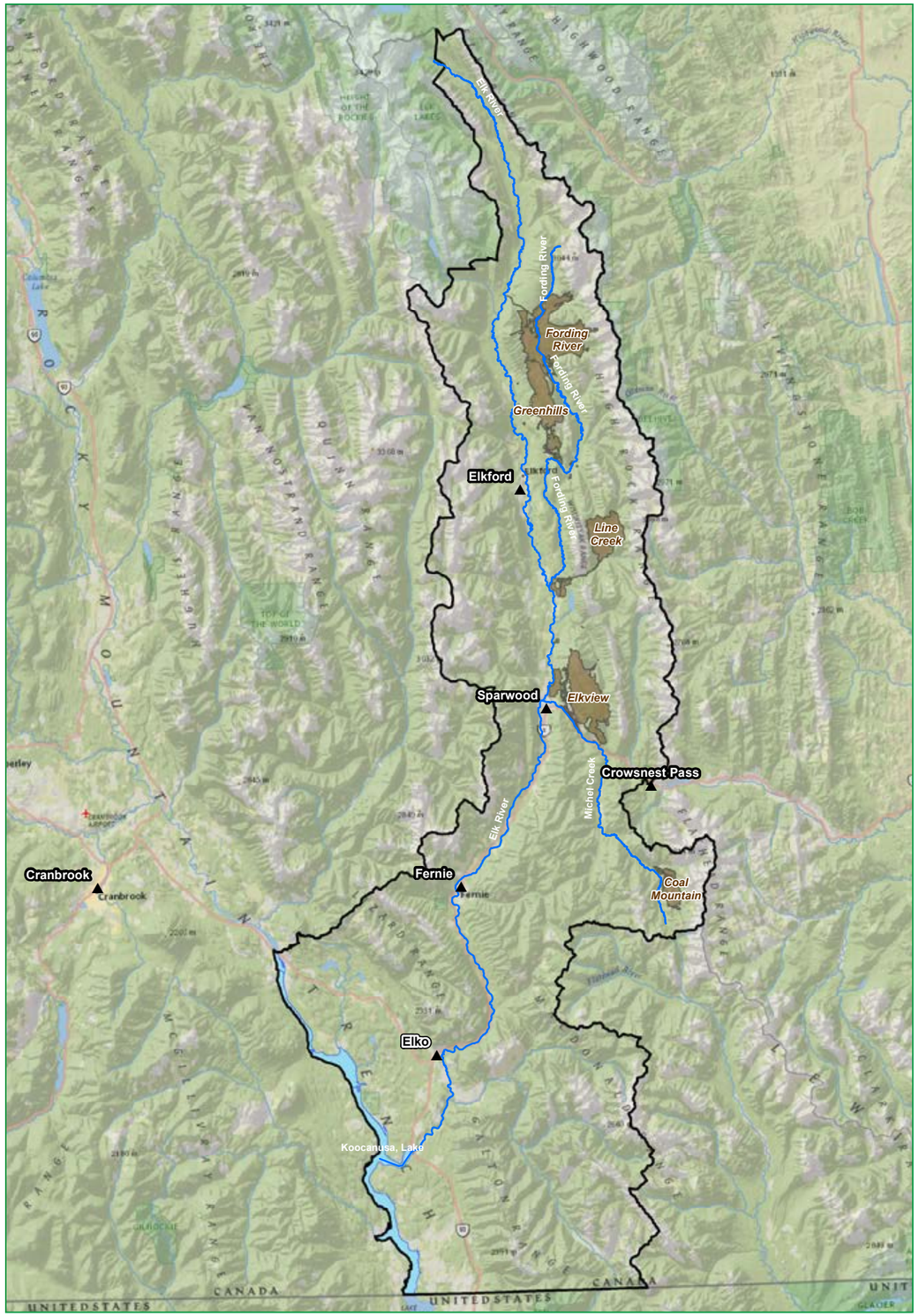

Figure a. Permit 107517 boundary.

Surface Water Quality

The chemistry of mine-influenced waters in the Elk Valley is generally well understood.

Key uncertainties remain about the impacts related to nickel concentrations and about places such as wetlands and sedimentation ponds with organo-selenium—forms of selenium that can rapidly enter the food chain.

In 2019, selenium, nitrate, and sulphate continued to increase in specific locations such as the outfall of Clode Pond and Line Creek Operations Dry Creek (Figure a).

Four acute toxicity test failures were reported in 2019:

- One water flea test failure was reported at Cataract Creek and the cause was attributed to calcite precipitation on the test subjects.
- Three rainbow trout test failures were associated with flocculant dosing problems in Goddard Creek sedimentation pond.

Figure b. A water flea *(Daphnia magna)*.

Figure c. A rainbow trout fry.

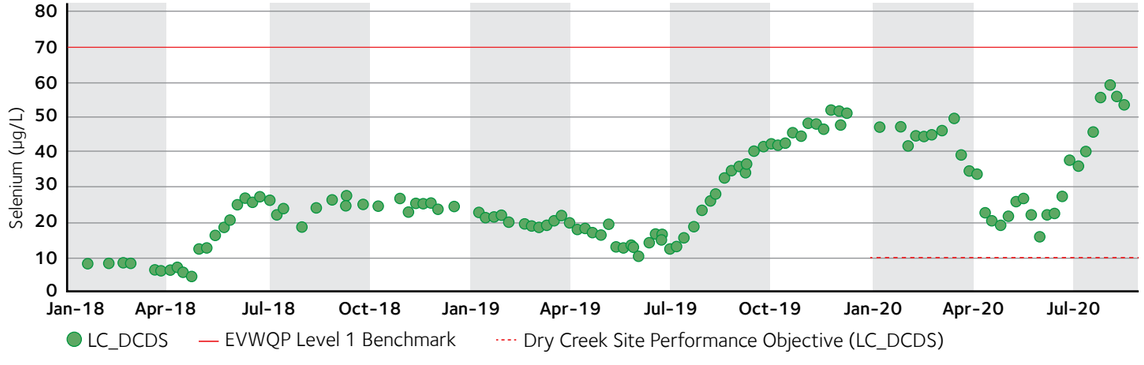

Figure a. LCO Dry Creek total selenium concentrations January 2018 to August 2020

You can access Teck's 2019 annual reports here: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

In 2019, the Fording River Operations compliance point (FR_FRCP1) continued to show non-compliances of selenium (Figure d), nitrate, and sulphate. The chemistry of the Fording River at this location is complicated by the proximity of mine-influenced Cataract Creek and a seasonal lack of mixing within the mainstem.

Despite active water treatment, the Line Creek Operations compliance point (LC_LCDSSLCC) continues to demonstrate regular nitrate non-compliances (Figure e). There were two selenium non-compliances at the Line Creek Operations compliance point in 2019, but these occurred when the water treatment facility was temporarily shut down for maintenance and repairs.

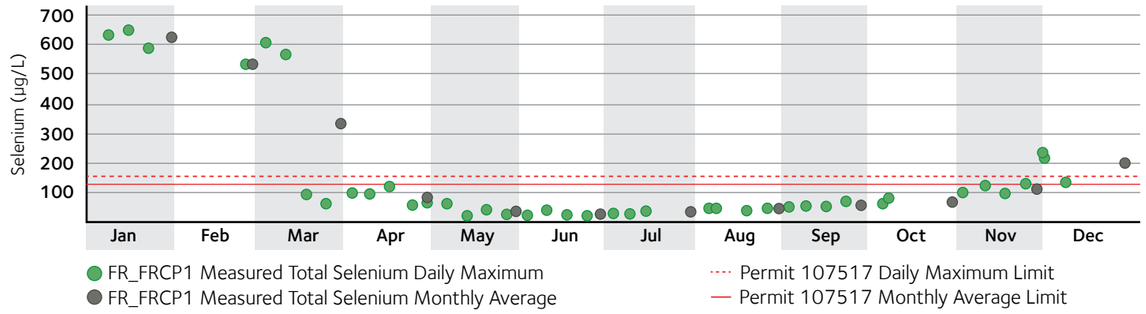

Figure d. Selenium concentrations at the Fording River Operations compliance point in 2019.

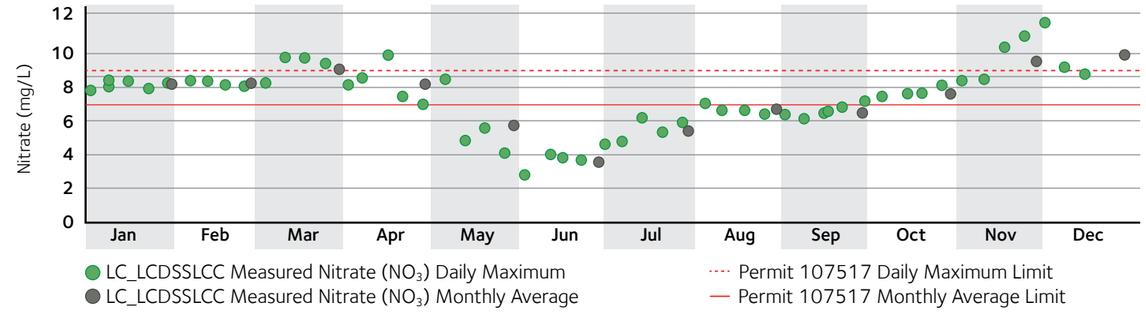

Figure e. Nitrate concentrations at the Line Creek Operations compliance point in 2019.

Teck is required to monitor water quality at 102 locations in the Elk Valley and in Koocanusa Reservoir.

These locations include 8 compliance points and 7 order stations.

In 2019, water quality at order stations met permit limits 100% of the time and at compliance points 96% of the time.

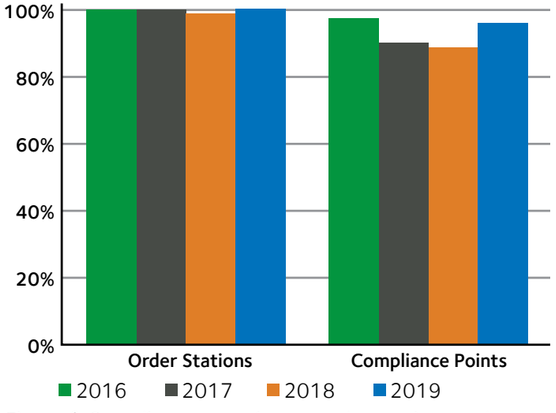

Figure f. Compliance over time at order stations and compliance points.

Groundwater Monitoring Programs

Groundwater monitoring programs are conducted to understand how mine-related substances are influencing aquifers close to mining operations. Mine-related substances can infiltrate the ground from mine sources, can reach aquifers in the valley bottom that are sources of drinking water, and can influence surface water that interacts with these aquifers. Surface water influenced by mine-related substances can also interact with the groundwater. Twelve study areas are identified in the Regional Groundwater Monitoring Program; these areas have been identified as important to understand regional groundwater pathways of mine-related substances.

Groundwater quality is compared to screening criteria focused on mine-related substances (nitrate, sulphate, dissolved cadmium, and dissolved selenium).

The Sparwood Area Supporting Study was conducted in 2019 to improve understanding of surface water influence on drinking water wells in Sparwood.

The 2019 groundwater evaluations enhanced Teck's understanding of groundwater transport pathways of mine-related substances and results were similar to previous years.

17 new monitoring wells were drilled in 2019 to fill gaps in the regional monitoring network to better understand groundwater in the Elk Valley. 16 wells are anticipated to be drilled in 2020.

Site-Specific Groundwater Monitoring Programs: monitoring for each of the five operations to identify and monitor mine-related substances in groundwater and associated transport pathways.

Regional Groundwater Monitoring Program: monitoring in 12 study areas to understand potential regional groundwater and associated pathways of mine-related substances.

Drinking Water Sampling Program: Teck samples private and municipal drinking water wells to assess against British Columbia Approved Drinking Water Quality Guidelines for mine-related substances. To request to have your well sampled under the program, please contact Teck's Social Responsibility office toll-free at 1-855-806-6854.

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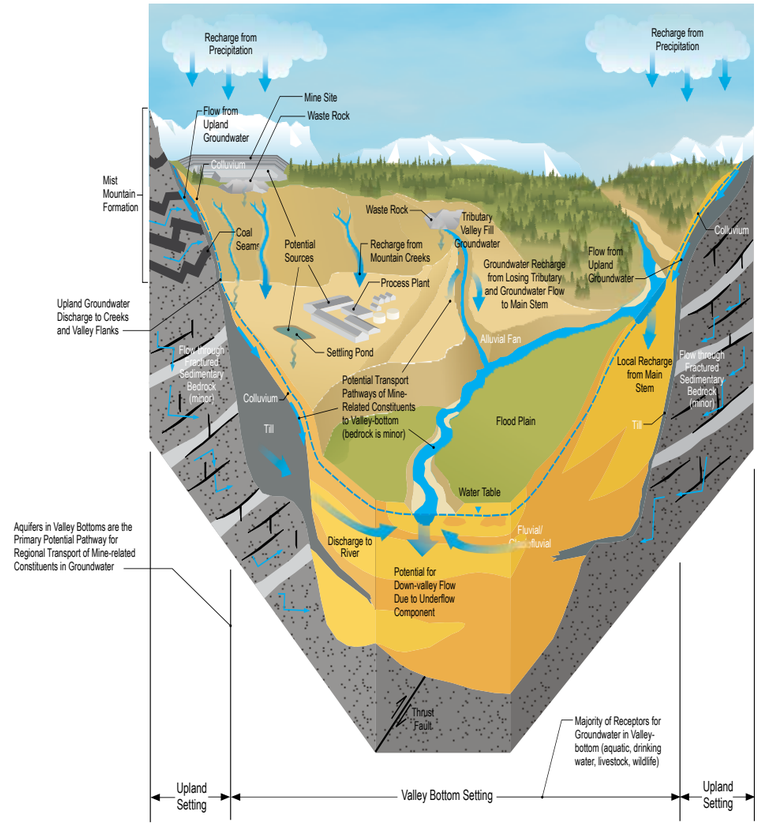


Groundwater Working Group (GWG)

The Groundwater Working Group (GWG) supports the Environmental Monitoring Committee with hydrogeology expertise. Membership of this group includes representatives from Teck Coal Limited, the Ktunaxa Nation Council, Ministry of Environment and Climate Change Strategy, Interior Health, and external consultants (qualified professionals).
The GWG helps steer the continued development of Teck's groundwater monitoring programs.

Figure a. Pathways for mining influences on groundwater.

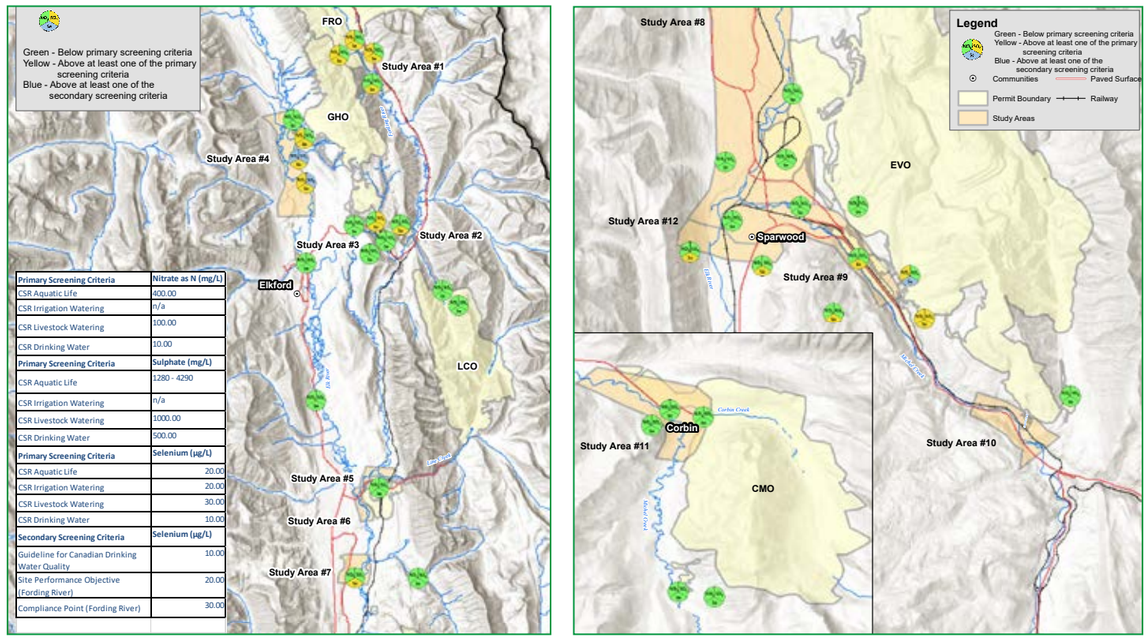


Figure b. Groundwater results from 2019.

Calcite Monitoring

- Monitoring is demonstrating modest increases in calcite formation over time.
- Spawning habitat suitability is potentially being reduced by calcite concretion.
- Teck is exploring alternatives for calcite management, including further prevention and remediation.
- Antiscalant addition is anticipated to be in place on ten streams by the end of 2021.
- A calcite remediation pilot project is anticipated to occur in 2021.

Regional Monitoring

Calcite index levels (Figure a) were monitored in 78 reaches in 2019, down from 117 in 2018. The number of sampling locations differ between years because of changes to sampling programs. Data suggest an increasing trend in levels of calcite formation and concretion in both tributary and mainstem reaches, and in both mine-exposed and reference (non-mine exposed) reaches.

Mining results in elevated calcite development. There is some evidence that levels are increasing in mine-influenced and non-mine influenced reaches since the 2013 flood (which is believed to have caused aggressive erosion of calcite). Monitoring is ongoing annually.

Calcite Significance

By December 2024, Teck must achieve calcite concretion (CI_c) score of ≤ 0.5 in the mainstem and tributaries, meaning that 50% of rocks within a reach will not be stuck to the stream bed.

By December of 2029, Teck must achieve a total calcite index (CI) of ≤ 0.5 in the mainstem and tributaries. CI is generally < 0.5 in non-mine influenced reference tributaries (Figure b).

Calcite Index (CI)

CI = calcite index (total) = CI_p + CI_c

CI_{pres} = number of pebbles with calcite / number of pebbles counted

CI_{conc} = sum of pebble concretion scores / number of pebbles counted

Concretion scores:

0 = not concreted
1 = partially concreted but removable
2 = immovable

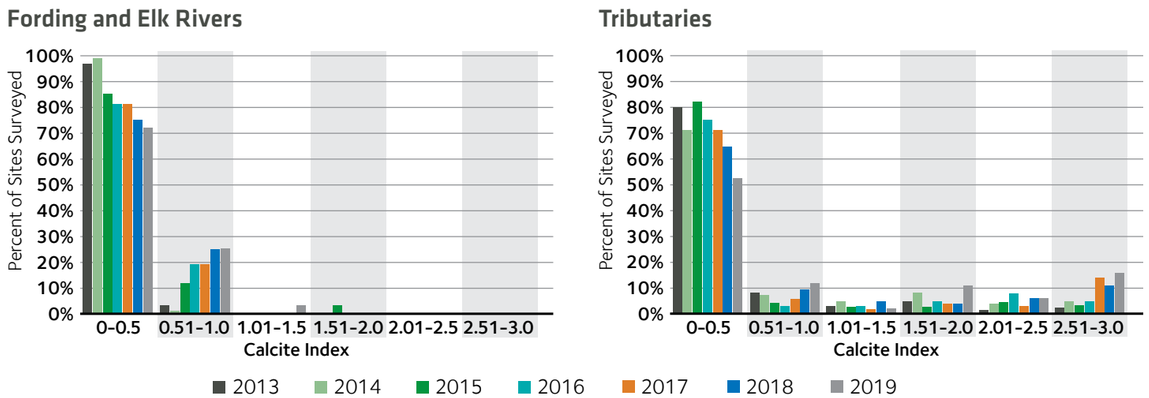


Figure a. Variation in calcite index values among years in the mainstem and tributaries.

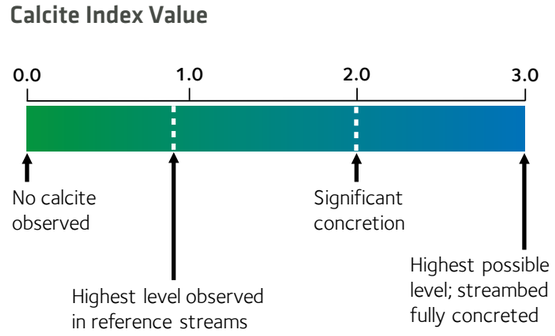


Figure b. The range of calcite index values and what they mean.

Calcite Mitigation

In an attempt to prevent further calcite formation, Teck has been applying antiscalant to lower Greenhills Creek since 2017 (Figure c).

Studies are ongoing at Greenhills Creek to evaluate how well antiscalant chemicals prevent calcite formation, and to determine if there are environmental effects of their use.

Other studies are focused on inducing calcite precipitation in controlled environments (i.e., to get it to precipitate out where it can be collected before it gets to the river).

Spawning Habitat Suitability

Spawning-period data collected in 2018 and 2019 (Figure e) demonstrated a possible relationship between spawning suitability and calcite concretion.

Data obtained so far suggests that spawning potential is lower when calcite concretion is >0.5. This relationship will be further evaluated in 2020 and 2021.

You can access Teck's 2019 annual reports here: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Figure c. Calcite antiscalant dosing skid on lower Greenhills Creek.

Figure d. Westslope Cutthroat Trout redd (circled) in Alexander Creek, July 13, 2019.

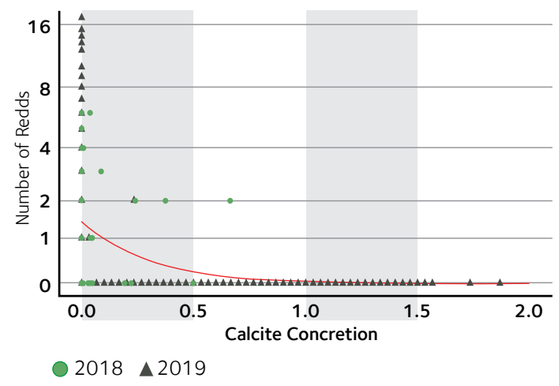
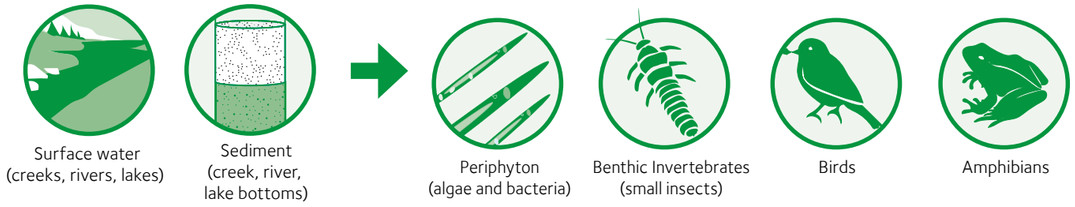


Figure e. Relationship between spawning potential and calcite concretion.

Regional Aquatic Effects Monitoring Program

Results from the Regional Aquatic Effects Monitoring Program (RAEMP) indicate that there are mine-related influences on water quality, calcite, sediment, and benthic invertebrate endpoints, most of which are within the range of what is expected.



The general objective of the RAEMP is to monitor, assess, and interpret indicators of aquatic ecosystem condition related to mine operations, and to inform adaptive management. Specific objectives of the RAEMP were framed as questions to guide data analysis and interpretation, and were developed collaboratively with the EMC. The questions of the 2018 to 2020 RAEMP include:

Has there been a change in condition since previous monitoring cycles with respect to fish and benthic invertebrate population/community indicators, water quality, sediment quality, calcite, and/or tissue selenium concentrations?

Changes in condition since previous monitoring cycles were observed throughout the Elk River watershed in all endpoints for which data were available; however, most unexpected changes related primarily to benthic invertebrate metrics. Most effects to BIC were observed in relative abundance metrics (example - % EPT). Total abundance metrics and taxon richness tended to be within site-specific normal ranges except in more highly mine-influenced tributaries (see Figure a).

Were any identified changes unexpected (i.e., inconsistent with model predictions or general expectations)?

Yes—the selenium in benthic invertebrate tissue concentrations at LCO Dry Creek, Greenhills Creek, Thompson Creek, Harmer Creek, Grave Creek, and Bodie Creek were higher than expected.

Does the weight of evidence indicate the unexpected changes are mine-related?

In most cases, yes. However, there are challenges in separating mine-related impacts from habitat-related effects. A lot of work was done in this cycle to better understand habitat effects—see the grey boxes in Figure b.

What does the weight of evidence indicate about current or future ecosystem conditions in each management unit and regionally, considering the observed type, magnitude, spatial extent, and/or rate of change?

At a regional scale, the upper Fording River (MU1) shows the greatest magnitude and spatial extent of change due to declines in WCT populations and changes in benthic invertebrate communities. There are localized changes in some MUs and changes in benthic invertebrate community in MU4 (Michel Creek downstream of CMO) which are thought to be related to nickel.

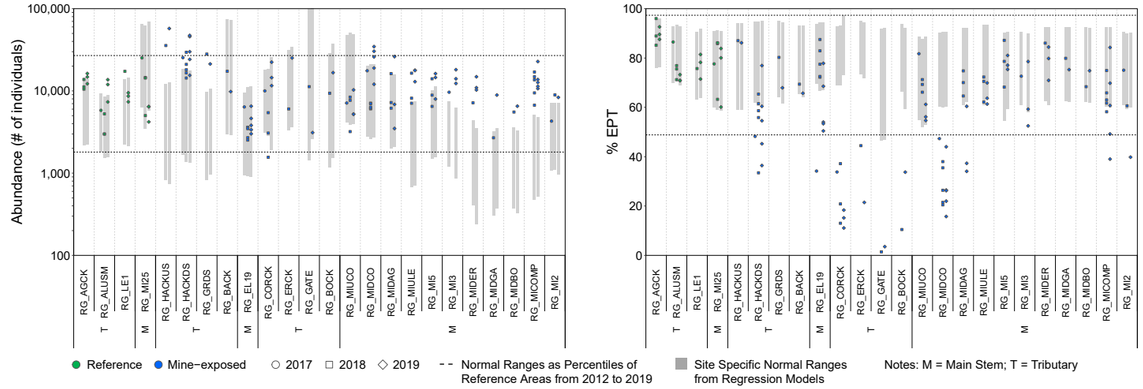


Figure a. Abundance of benthic invertebrates in MU4 2017 to 2019.

Figure b. Percent EPT of benthic invertebrates in MU4 2017 to 2019.

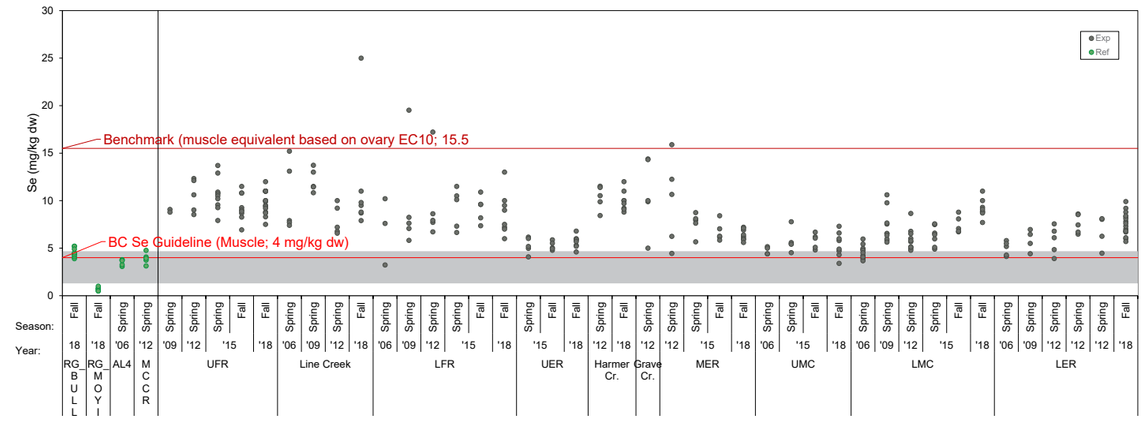


Figure c: Selenium Concentrations in Westslope Cutthroat Trout Muscle Samples Collected in Lotic Habitats, 2006 to 2018

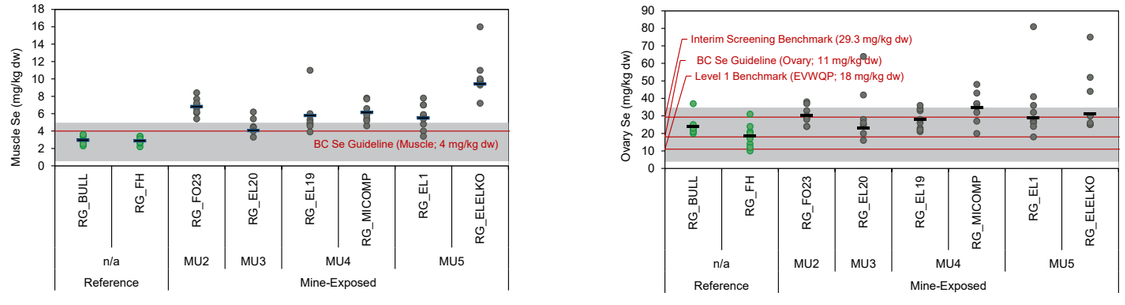


Figure d: Selenium Concentrations in Mountain Whitefish Collected in October 2018

Additional studies were added to the RAEMP in 2018 through 2020 to support regional understanding where the EMC had identified gaps. Reports for the following studies will be included in the RAEMP report and will be available on Teck's website once they are finalized (early 2021):

- Columbia Spotted Frog Selenium Toxicity Study
- Redside Shiner Selenium Toxicity Study
- Mountain Whitefish Selenium Toxicity Study
- Sediment Toxicity Supporting Study
- Lentic Area Supporting Study (including an Amphibian Occurrence and Distribution Study)
- Nutrient Study

Local Aquatic Effects Monitoring

Local aquatic ffects programs (LAEMPs) assess site-specific conditions by monitoring on a more frequent and localized basis than the Regional Aquatic Effects Monitoring Program (RAEMP).

A LAEMP is initiated in response to local-area effects, uncertainties in the potential for effects at a local level, or change in water management (e.g., operation of a water treatment facility).

Monitoring occurs as required until sufficient data have been collected to address the study questions; concerns no longer exist; or relevant monitoring can be incorporated into the RAEMP.

Fording River Operations

Objective is to assess the before and after conditions associated with the active water treatment in the Fording River.

- Active water treatment facility delayed to 2021.
- Nitrate concentrations were above the Level 1 and 2 benchmarks at most mining-influenced monitoring stations in the Fording River.
- Continued decrease in mayflies within the same 4 km section of the Fording River as previous years, plus a new decline in sensitive benthic invertebrates, including mayflies, in the upper watershed.
- Specific cause of mayfly decline still under investigation. Both habitat- and mining-related factors appear to be important; the degree to which habitat variations are attributed to mining continues to be a question that EMC members are interested in understanding.
- Surveys were conducted to delineate areas of the Fording River that dry during low-flow periods. Drying alone was unlikely to impact summer benthic invertebrate communities.

Greenhills Operations

Objective is to assess conditions within a localized area downstream of the GHO west spoil development and Cougar Pit extension.

- Focus is on the Elk River side channel, which recedes annually when the Elk River reaches base flow levels.
- Mine-influenced tributaries flowing into the side channel show elevated and increasing concentrations of various mine-related constituents.
- Some side channel pools are fed by groundwater, remain wetted all year, and are used by juvenile fish for overwintering.
- One section of the side channel remains wetted year-round due to flows from Thompson Creek and shows elevated concentrations of mine-related constituents.
- Impact on biota is minimal at this time.
- Sampling program was reduced in 2020 to focus on remaining uncertainties.

Figure a. A stonefly

Figure b. A caddisfly

Figure c. A mayfly

Coal Mountain Operations

Objective is to assess the cause of changes to benthic invertebrate communities and the chronic toxicity test results.

- This is the first reporting year for the Coal Mountain Operations LAEMP.
- Water management (i.e., pit dewatering) strongly affects water quality.
- The benthic invertebrate community is impacted in Corbin Creek and in near-stream Michel Creek.
- There is significant and increasing calcite formation in Corbin Creek. Calcite is low in Michel Creek with a decrease in 2019 compared to historical values.
- Nickel is the likely cause of effects to the benthic invertebrate community based on toxicity test results to date.
- Teck identified that the BC Water Quality Guideline for nickel was not protective of benthic invertebrates. Teck proactively developed an interim screening value to support nickel treatment considerations, and BC is working on updating its water quality guideline for nickel.

Line Creek–Dry Creek

Objective is to assess the potential effects of Phase II Project of LCO on Dry Creek, Grace Creek, and Unnamed Creek.

- Nitrate is exceeding effects benchmarks and is expected to surpass the Level 3 benchmark (50% effects) during 2020. This increase occurred sooner than projected.
- Nitrate effects are being confirmed by chronic toxicity test results.
- Selenium tissue concentrations are elevated in benthic invertebrates and fish, and are highest in the vicinity of the sediment pond discharge channel; however, the benthic invertebrate community has not changed.
- Selenium bioaccumulation and linkages to sediment ponds was investigated in 2020. Consequently, a bypass of the sediment ponds was completed, which is expected to reduce selenium concentration in benthic invertebrates and fish.
- Dry Creek is currently under a structured decision making (SDM) process to develop a water management plan. The SDM process is a regulatory process outside the scope of the Environmental Monitoring Committee (EMC) that will eventually be integrated with Permit 107517.

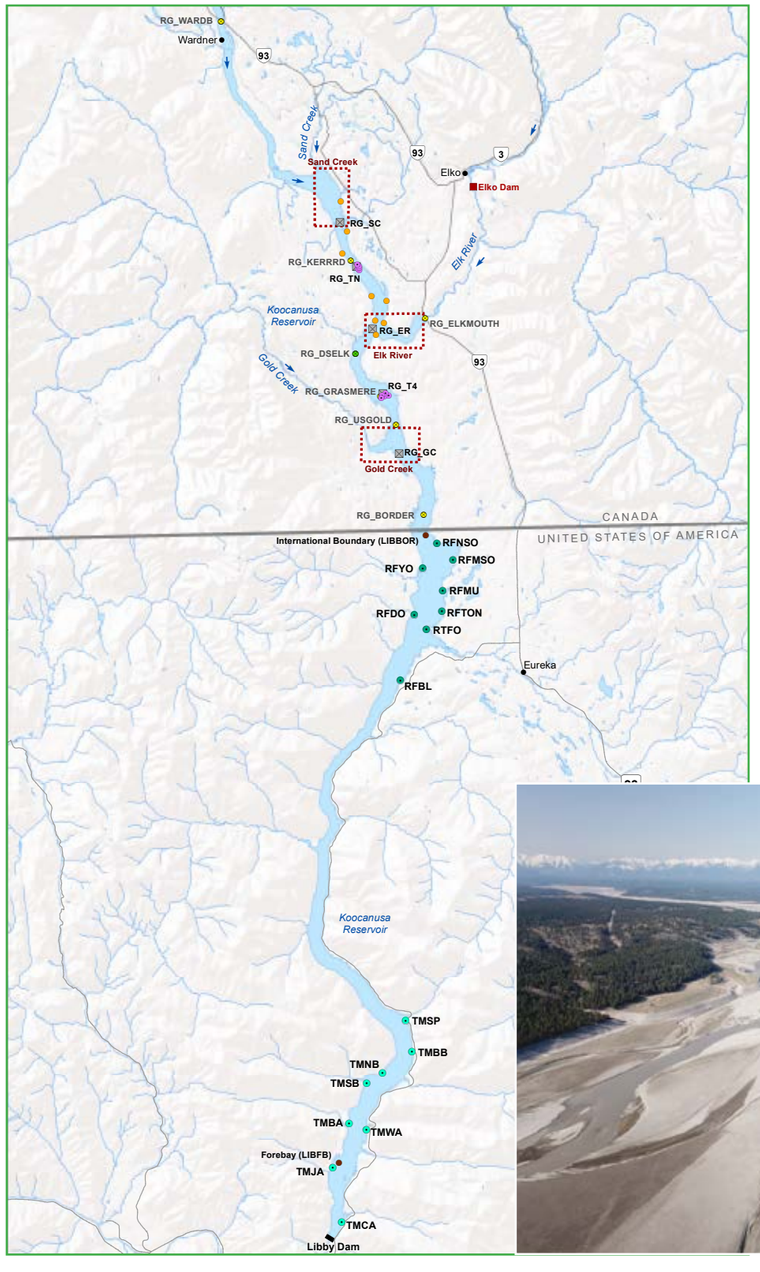
Line Creek Operations

Objective is to assess the conditions downstream of the active water treatment facility.

- Addition of the advanced oxidation process (AOP) to the active water treatment facility has reduced selenium in benthic invertebrate and fish tissue to pre-treatment concentrations (or better).
- Almost all tissue concentrations were below the Level 1 benchmark in Line Creek.
- Nutrient concentrations and productivity have not increased with water treatment.
- There has been no significant impact of the treatment process on dissolved oxygen, water temperature, or other water quality parameters.

You can access Teck's 2019 annual reports here: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

Koocanusa Reservoir Monitoring



The Koocanusa Reservoir, created by the Libby Dam in Montana (Figure a), straddles the border between Canada and the United States and lies within the Ktunaxa Territory. The reservoir was created by damming of the Kootenay River in the 1970s.

Sediment Quality

Concentrations of a number of metals and PAHs were significantly higher downstream of the Elk River compared to upstream and elevated above screening levels; however, no substances exceeded Severe Effects Levels. These trends are similar to previous years.

Figure a. Map of the Koocanusa Reservoir and photo of typical spring conditions at RG_DSELK.

Water Quality

Concentrations of order constituents (cadmium, nitrate, selenium, and sulphate) in Koocanusa Reservoir met the permitted limits at the order station, RG_DSELK (EMS: E300230) in 2019 (Figure b).

Concentrations of other parameters of potential concern were all below provincial water quality guidelines with one exception of zinc during freshet.

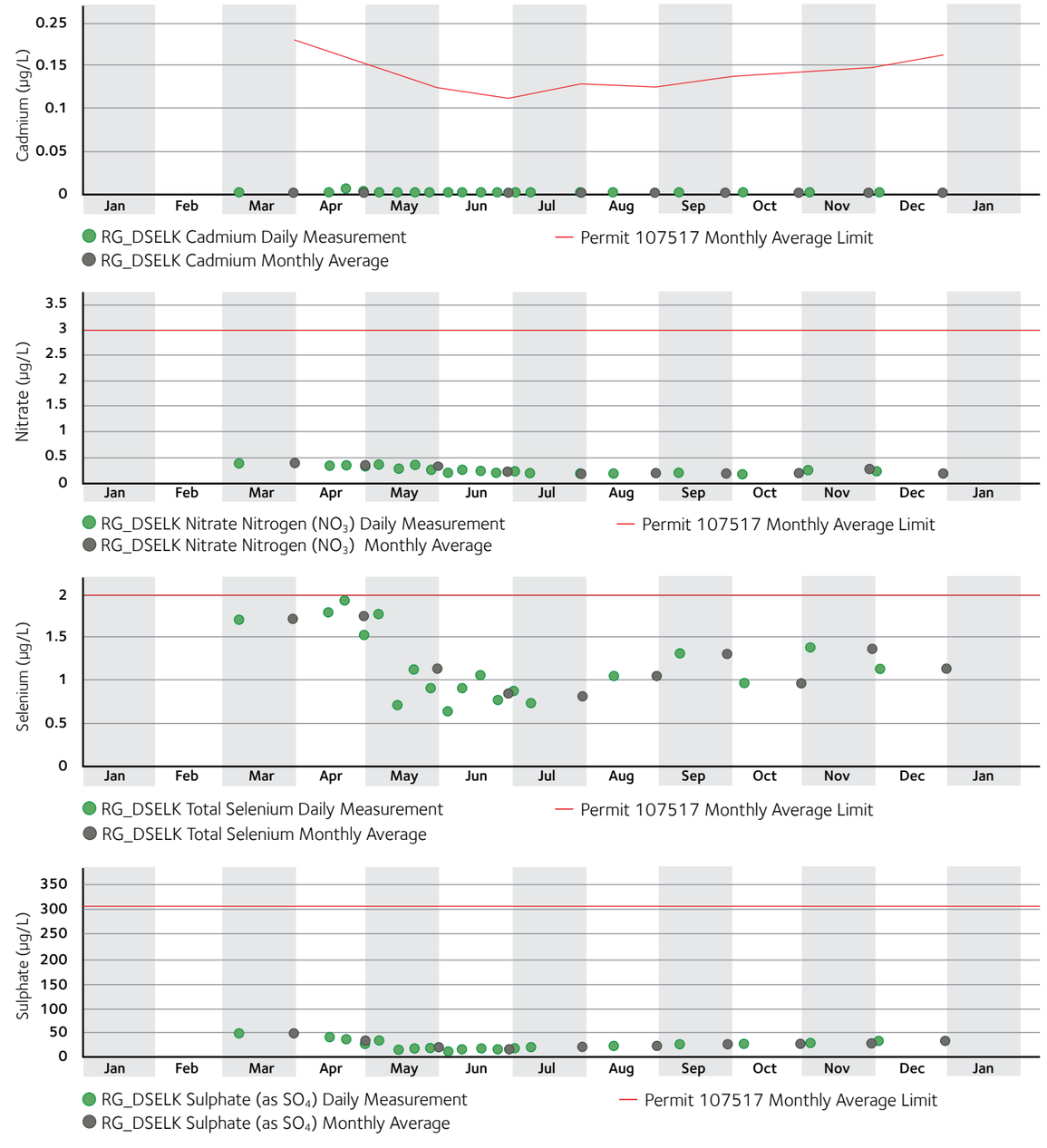


Figure b. Daily and monthly average total selenium, nitrate-N, sulphate, and dissolved cadmium concentrations recorded at the order station (E300230) in 2019.

Koocanusa Reservoir Monitoring

Order constituents met permitted limits in Koocanusa Reservoir in 2019.

Concentrations of selenium in fish muscle and ovaries were comparable to previous years.

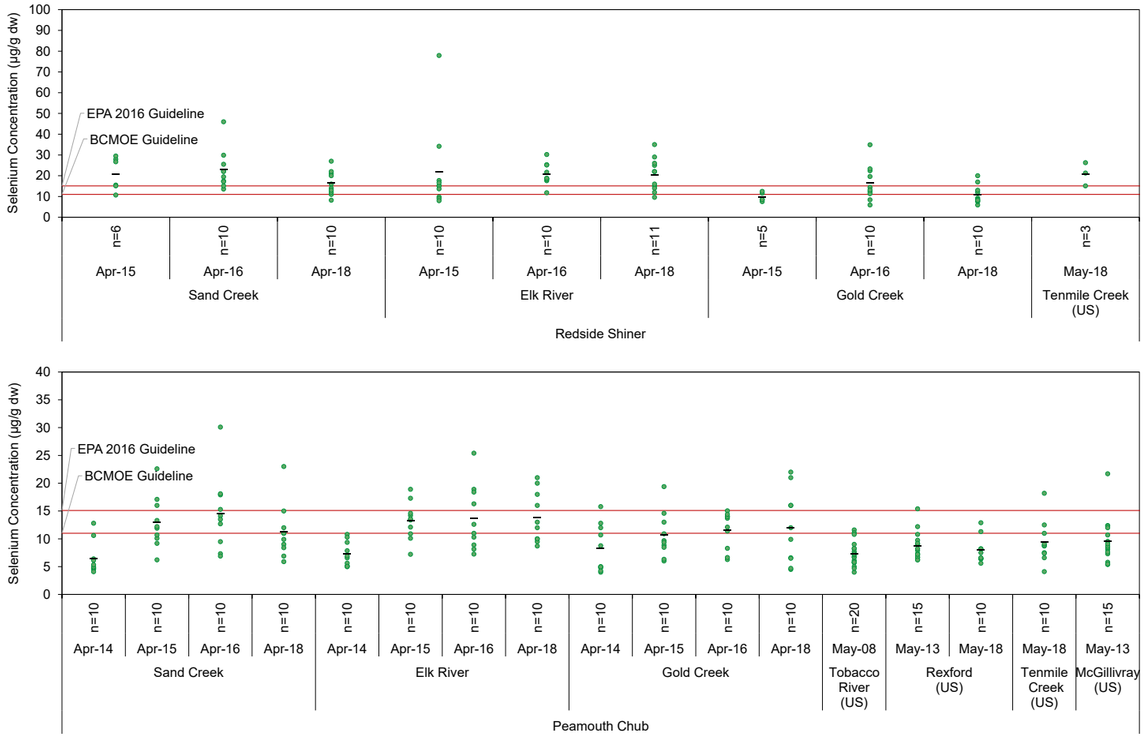


Figure c. Concentration of selenium in ovaries of the Redside Shiner and Peamouth Chub; red lines denote relevant benchmarks for the protection of aquatic life (i.e., fish reproduction).

Figure d. Redside Shiner

Fish

Selenium concentrations in fish muscle samples were within previously measured ranges. Mean concentrations of selenium in fish ovaries of the Redside Shiner and Peamouth Chub were above the provincial guideline for the protection of aquatic life in 2019 (Figure c) with individual fish of other species also above all benchmarks (i.e., Northern Pikeminnow, 11 of 92 or 12%).

In addition, a single Westslope Cutthroat Trout was above the provincial egg/ovary threshold. Concentrations in Redside Shiner, Peamouth Chub, and Northern Pikeminnow, however, were similar upstream and downstream of the Elk River. Results from 2019 sampling suggest that ovary maturation is an important factor in interpreting selenium concentrations with concentrations decreasing as ovaries mature. Future monitoring will include this metric to support interpretation.

To assess the potential for adverse effects on the Redside Shiner due to benchmark exceedances in ovaries, a Redside Shiner recruitment study began in 2018. Results to date suggest that abundances are lower downstream of the Elk River compared to upstream; however, high proportions of young of year were found in both areas, indicating recruitment (i.e., successful reproduction).

Other studies to assess the potential for adverse effects on fish reproduction due to selenium exposure include selenium sensitivity studies for the Redside Shiner and Northern Pikeminnow. Results to date for the Redside Shiner study indicate these fish are relatively tolerant to selenium exposure, while the results of the Northern Pikeminnow work suggest that observed concentrations in ovaries decline as eggs mature—understanding the concentrations in mature eggs is an important next step for assessing their sensitivity. Additional reporting on these studies will be provided in 2020 and 2021, respectively.

What's next?

The current BC provincial guideline for selenium in water is 2 µg/L, while the US national criteria for selenium in water is 1.5 µg/L in lake systems. Since site-specific factors can influence the applicability of provincial or national guidelines, BC ENV and Montana DEQ are developing a site-specific selenium objective for Koocanusa by the end of 2020. ENV and DEQ, working with many other partners and stakeholders, have collected and compiled data for the reservoir over the last five years to inform the development of the site-specific objective. BC and Montana will continue to share current information and results, and to meet with partners, stakeholders, and the public through engagement and consultation forums such as the Koocanusa Reservoir Monitoring and Research Working Group.

You can access Teck's 2019 annual reports here: https://www.teck.com/responsibility/sustainability-topics/water/water-quality-in-the-elk-valley/research-and-monitoring-reports/

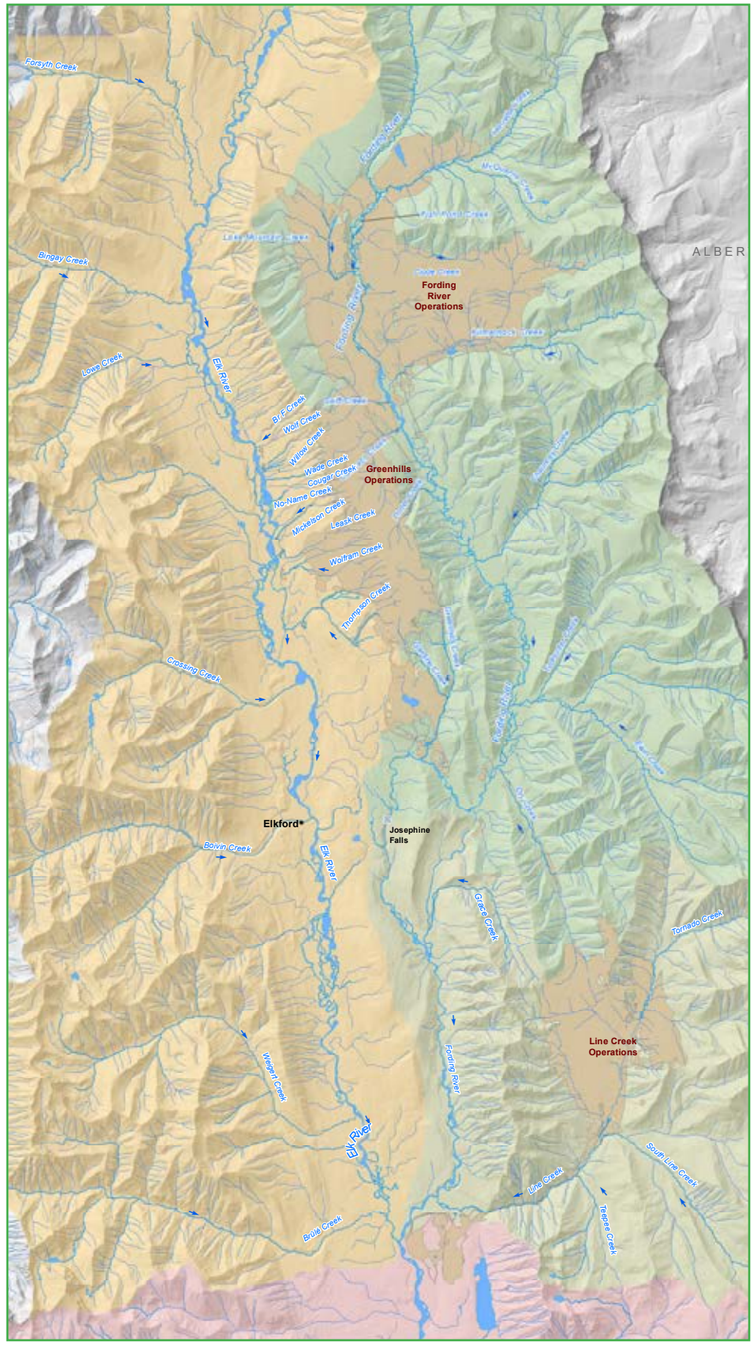
Tributary Management Plan

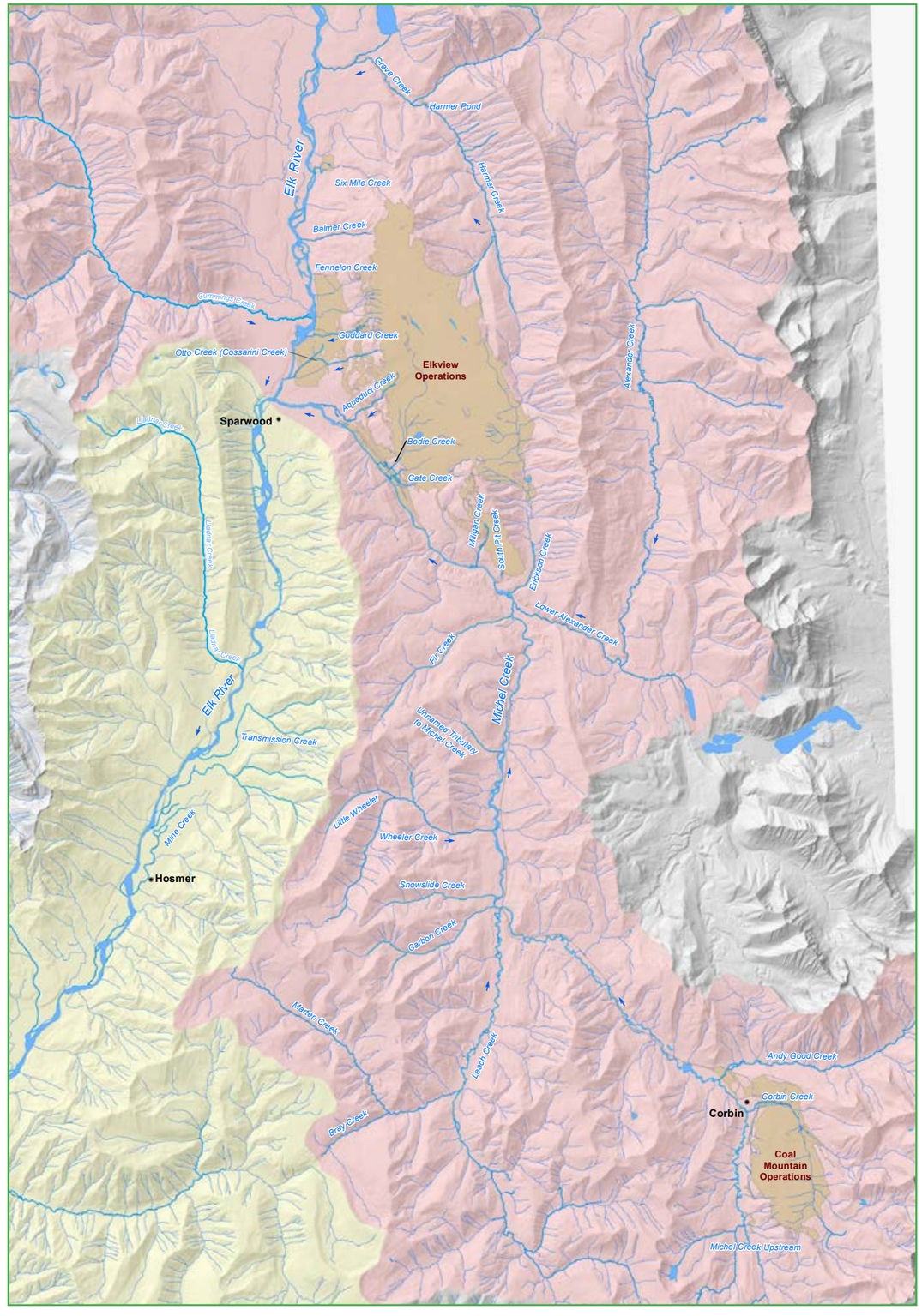
The Tributary Management Plan is intended to support protection and rehabilitation of tributaries in the Elk Valley.

The Tributary Management Plan is intended to guide Teck's environmental management of tributaries and their approach to mine planning. The overall goal of the Tributary Management Plan was developed with the EMC and is as follows:

To protect and rehabilitate tributaries of the Elk River watershed on a priority and feasibility basis to benefit fish, aquatic-dependent wildlife, and vegetation, recognizing biological, social, and economic values, and Ktunaxa worldview.

All the tributaries that flow into the Fording River, Michel Creek, and the Elk River are included in the plan. The mainstem of the Fording River, Michel Creek, and the Elk River are not considered to be tributaries and are managed according to the EVWQP and Permit 107517.





Tributary Management Plan

Teck has been developing the Tributary Management Plan with the EMC since 2016, and submitted the first plan in 2017. This plan was accepted by the Director in February 2018 with conditions for the 2018 plan. EMC discussion and advice on the 2018 plan reflected differing perspectives.

The EMC helped guide the development of the TMP Prioritization Tool—a set of metrics which can be used to help guide Teck's management decisions regarding tributaries.

Objective: 1. Biological

Metric	Metric Type	Score Definition
Sub-Objective: Habitat quantity		
Fish habitat currently connected to mainstem (value in km)	Scoring metric	A normalized habitat value in relation to the greatest potential length of connected fish-habitat in dataset. Formula: Score = (connected habitat for Stream X / max potential connected habitat for all streams) * 3
Total current stream length (value in km)	Scoring metric	A normalized value in relation to the greatest tributary stream length in dataset. Formula: Score = (stream length for Stream X / max stream length for all streams) * 3
Current riparian habitat amount (value in % tributary length)	Scoring metric	A normalized value in relation to the % of the stream length (on both sides) that is buffered with riparian habitat. Formula: Score = (% of stream length with riparian habitat for Stream X) * 3
Current wetland habitat presence	Flag metric	Yes—Wetland habitat is present within the tributary catchment. No—Wetland habitat is absent or unreported within the tributary catchment.
Total historical fish habitat (value in km)	Information metric	A continuous value of the length of fish habitat available in 1980s.
Total historical stream length (value in km)	Information metric	A continuous value of the stream length available in 1980s.
Percentage current stream length with perennial flow (value in %)	Information metric	A continuous value ranging from 0-100% to reflect current conditions within the system.
Percentage historical stream length with perennial flow (value in %)	Information metric	A continuous value ranging from 0-100% to reflect historical (pre-disturbance) conditions within the system.
Current number of riparian habitat patches (value in # of patches)	Information metric	A continuous value of the number of discrete patches of riparian habitat present within the tributary catchment.
Sub-Objective: Habitat quality—water chemistry		
Current Hazard Quotient (HQ) for water quality constituents (Selenium, Nitrate-N, Sulphate, dissolved Cadmium) (HQ value)	Scoring metric	A normalized continuous score based on the maximum monthly Hazard Quotient value for Selenium, Nitrate-N, Sulphate, and dissolved Cadmium. If the HQ value is <1.0, a value of 3.0 is given; if the HQ value is >1.0, then the following formula was applied. Formula: Score = - (((Maximum monthly HQ for Stream X / Maximum monthly HQ for all streams) * 3) - 3)
Current benthic EPT richness (# of species)	Scoring metric	A normalized value in relation to the greatest possible EPT richness according to the Lowest Practical Level (LPL) of taxonomy. If the EPT richness value is >12.8, a value of 3.0 is given; if the EPT richness value is <12.8, then the following formula was applied Formula: Score = (Current EPT LPL richness Stream X / 12.8) * 3
Water quality sampling locations used for current Hazard Quotient calculations (# of sites)	Flag Metric	Yes—Water quality data were collected from multiple stations within the tributary No—Water quality data were collected from a single station within the tributary or were estimated based on reference stream conditions.
Water quality sampling data availability used for current Hazard Quotient calculations (# of months)	Flag metric	Yes—Water quality data were collected for less than nine months of the year and does not provides information regarding temporal variability within a tributary or were estimated based on reference stream conditions. No—Water quality data were collected for nine months or more of the year and provides information regarding temporal variability within a tributary.

Table 1. Example of some of the criteria used in the prioritization tool.

The 2018 update of the Tributary Management Plan was submitted to the Director of ENV on February 28, 2019. The 2018 TMP was not accepted for reasons laid out in a decision letter (dated December 23, 2019) which directed Teck to complete a number of revisions and updates to the TMP.

The EMC continued to discuss the TMP in 2019 and reviewed the updated prioritization tool with more recent monitoring data. Much of the discussion focused around the Fording River (MU1) where tributary habitat has been lost to mining and lost connectivity in the past 50 years. The tool outputs also indicated that MU1 tributaries were of high priority for protection regionally.

The 2019 Tributary Management Plan was submitted July 31, 2020.

Tributary Catchment name	Tributary Section	Option[1]	Final MU Rank	Rationale for Final MU Rank	MU Rank From Tool	ENV Adjusted MU Rank	FLNR Adjusted MU Rank	KNC Category	IS Adjuted MU Rank	Teck Adjusted MU Rank
Potential protection option (unimpacted tributary sections)										
Ewin Creek	207.4 km of tributary (entire tributary)	Protection	1	Highest priority primarily based on large size of tributary	1	1	1	Category 1	1	4
Chauncey Creek	102.4 km of tributary (entire tributary)	Protection	2	Large tributary size with high habitat potential following barrier removal	4	2	2	Category 1	4	2
Henretta Creek	69.9 km of tributary upstream of mine footprint	Protection	3	Important overwintering habitat in Henretta Lake	3	3	3	Category 1	3	1
Upstream Fording River	78.0 km of tributary upstream of mine footprint	Protection	4	Henretta prioritized before upstream Fording River since Henretta Lake provides overwintering habitat	2	4	4	Category 1	2	3
LCO Dry Creek	20.5 km of tributary (East Tributary)	Protection	5	Smaller size and only high elevation compared to other four tributary sections	1	1	2	Category 1	4	1
Potential rehabilitation options (impacted tributary sections and unimpacted tributary sections with anthropogenic barriers)										
Henretta Creek	6.7 km within mine footprint	Connectivity Rehabilitation	1	Provides improved passage for multiple WCT life stages to important overwintering habitat in Henretta Lake	1	1	2	Category 1	4	1
Chauncey Creek	Barrier in affected tributary	Connectivity Rehabilitation	2	Provides improved passage for multiple WCT life stages to unimpacted habitat	7	2	1	Category 1	1	2
Henretta Creek	6.7 km within mine footprint	Habitat Rehabilitation	3	Provides improvements to important overwintering habitat in Henretta Lake and riparian habitat	5	9	4	Category 1	6	1
Fish Pond Creek	0.7 km within mine footprint	Habitat Rehabilitation	4	Provides improvements to overwintering, spawning and juvenile rearing habitat and riparian habitat	6	10	5	Category 1	7	2
Greenhills Creek	22.8 km downstream of mine footprint	Water Quality Rehabilitation (Calcite Management)	5	Provides improvements to spawning and rearing habitat in lower section, with potential improvements to biological value in upper section	10	4	10	Category 2	10	1

Table 2. Summary of 2018 ranks for the upper Fording River watershed (MU1).

Human Health Risk Assessment

An HHRA is required by Permit 107517

It is a collaborative effort between Ktunaxa Nation Council, BC Interior Health Authority, BC Ministry of Environment, Teck.

The work underway for this HHRA is inclusive, grounded, and reciprocal.

A human health risk assessment (HHRA) determines the potential risks to human health posed by certain substances. It considers how toxic the substance is, how much of the substance humans are exposed to, and how often.

This risk assessment will focus on mining-related substances found in the water, sediment, fish, wild plants, and wild game in the Elk Valley.

This risk assessment will evaluate the risk to human health based on the diet of valley residents and the Ktunaxa practice of **sukiɬ ik naɬsa** (eating well).

This risk assessment will tell us which mining-related substances in the Elk Valley could be a concern for human health and should be investigated more deeply.

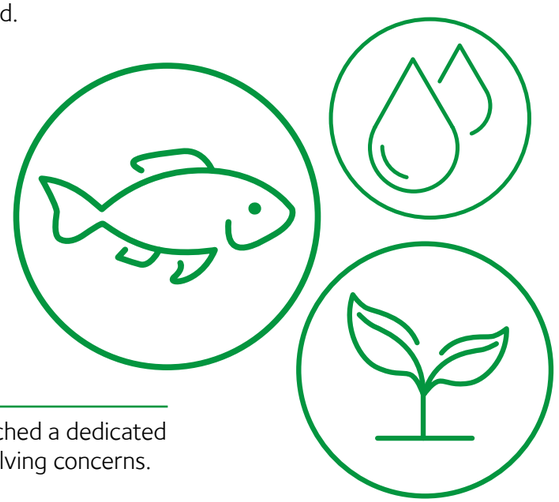
With respect to fish consumption, the BC Ministry of Environment and the BC Ministry of Health recommend the following screening values to protect human health: (see page 156 in https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg.pdf)

- high fish intake: 7.3 µg/g dw
- moderate fish intake: 14.5 µg/g dw
- low fish intake: 75 µg/g dw

However, exceeding a screening value only means that a detailed evaluation of human health risk should be conducted. To adequately assess human health risk in an area, all exposure pathways must be evaluated. This is what the Elk Valley HHRA will do. There are no fish consumption advisories in place for the Elk Valley at this time.

2015
- A work plan for a human health risk assessment was reviewed by the EMC and approved by ENV.

2016
- Wild food samples donated by KNC for analysis.
- A human health risk assessment was completed and reviewed by the EMC.
- EMC members concerned that potential health risks to Ktunaxa citizens were not adequately addressed.



2017
- Wild food samples donated by KNC for analysis.

2018
- Teck, KNC, IHA, and ENV launched a dedicated workgroup committed to resolving concerns.

2019
- Workgroup members worked to increase their collective understanding of the technical aspects of human health risk assessments in general, and the unique challenges of this risk assessment in particular.
- KNC launched an expanded diet study to understand preferred consumption rates of Ktunaxa citizens.
- Teck launched a wild game sample donation program for local hunters.
- Wild foods samples donated by KNC and local hunters for analysis.

2020
- Workgroup members collaborate on the various inputs to the risk assessment by sharing knowledge, expertise, and resources.
- KNC worked with Ktunaxa citizens to develop a conceptual site model that reflects Ktunaxa lifeways.
- KNC completed the Ktunaxa Diet Study Expansion.
- Wild foods samples donated by KNC for analysis.
- Teck re-launched its wild game sample donation program for local hunters.

2021
- An updated human health risk assessment is expected to be completed and submitted to ENV by mid-year.

Westslope Cutthroat Trout – Evaluation of Cause –

Abundances of Westslope Cutthroat Trout declined significantly between fall 2017 and fall 2019.

An evaluation of cause process was initiated to understand the most likely causes of the decline with that process concluding in late 2020.

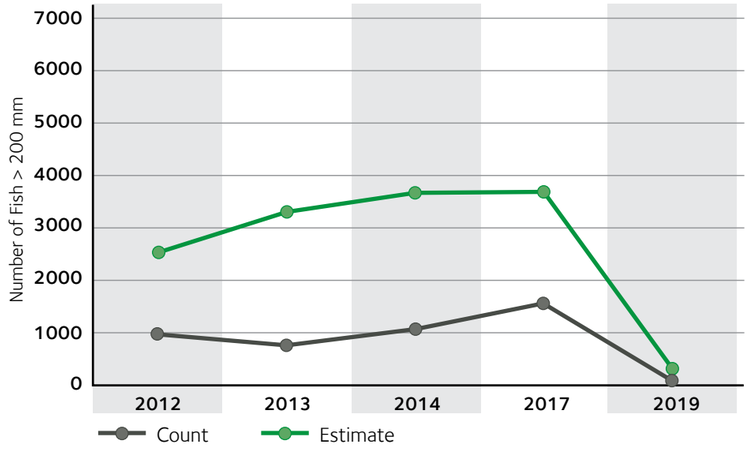


Figure a. Adult Westslope Cutthroat Trout snorkel counts and associated population estimates for the Upper Fording River. From Cope , S. 2020. Upper Fording River Westslope Cutthroat Trout Population Monitoring Project.

The Issue

Westslope Cutthroat Trout is the only fish species in the Fording River upstream of Josephine Falls. The species is Listed as Special Concern in BC. Monitoring in fall of 2019 (Figure a) found that abundance of adults and sub-adults had declined significantly from previous sampling in 2017. Teck immediately implemented an *evaluation of cause* process to determine likely causes. Follow-up monitoring in 2020 has confirmed the low counts.

Impact Hypotheses

The study team (which includes Teck and several subject-matter experts) has identified a number of potential causes of the population decline (Figure b). The potential causes include those related to mining (e.g., fish handling, ramping and channel dewatering, calcite, water quality, coal dust in sediment), those that may be more natural (e.g., climate related variations in water temperature and flow volumes, infectious disease, predation), and those that may be human-activity related but just not mining (e.g., poaching). The study team is considering the individual and combined effects of these various potential causes.

The Evaluation of Cause Process

The evaluation of cause is the process used to investigate, evaluate, and report on the reasons for the Westslope Cutthroat Trout population decline. The process, which is led by Teck and several external subject-matter experts, has had input from government representatives and an independent scientist through various committees. The subject-matter experts are developing individual reports on each of the potential stressors and impact hypotheses (see Figure b). The evaluation of cause process is anticipated to conclude in late 2020 and final reports of findings are expected to be available early 2021.

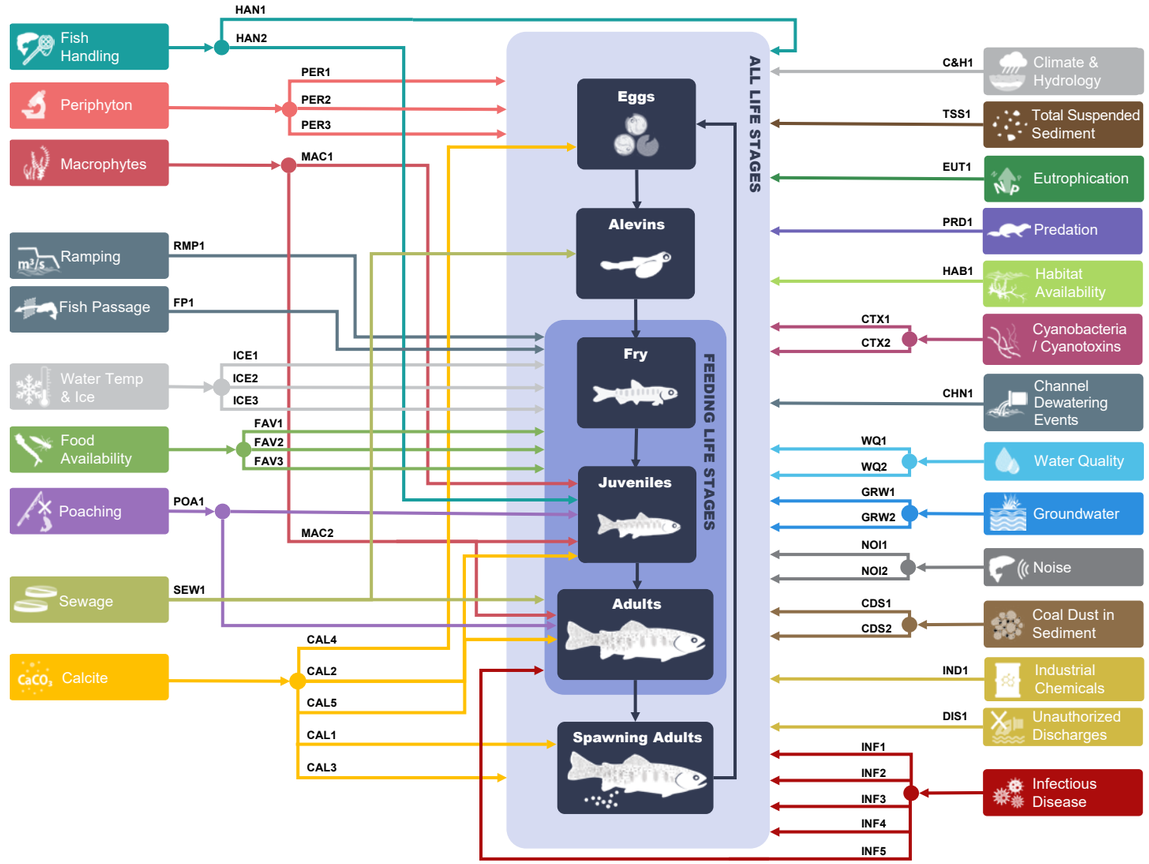


Figure b. Proposed impact hypotheses to be considered in the evaluation of cause process.

Ongoing Monitoring and Analysis

The study team (which includes Teck and several external subject-matter experts) has enhanced the monitoring of the WCT population in the upper Fording River with activities such as: (1) remote operated vehicle surveys of Henretta Lake; (2) spawning surveys (completed in May); (3) snorkel surveys (completed in July and September); (4) angling survey (August); (5) recruitment survey (September); (6) continued operation of PIT tag arrays to track fish movements.

A population model is being developed and it will support the evaluation of cause process, as well as anticipated mitigation and restoration activities.

Figure c. Snorkeler counting fish.

Adaptive Management

Teck's Adaptive Management Plan (AMP) and related annual reports outline the activities to reduce key uncertainties (KUs), what has been learned, and the next steps for reducing KUs and evaluating management questions (MQs).

The AMP response framework outlines the process for notification, confirmation, investigation, and adjustments to monitoring and management Teck takes when triggers or unexpected conditions are identified.

Current and long-term continuous improvement goals were collaboratively developed by Teck and KNC.

Adaptive management is a systematic, rigorous approach to environmental management that maximizes learning about key uncertainties while simultaneously striving to meet multiple management objectives, and adapts management actions from what is learned (Figure 1).

Teck's water quality adaptive management plan (AMP) is structured around six management questions (MQs):

MQ1: Will water quality limits and site performance objectives be met for selenium, nitrate, sulphate and cadmium?

MQ2: Will the aquatic ecosystem be protected by meeting the long-term site performance objectives?

MQ3: Are the combinations of methods for controlling selenium, nitrate, sulphate and cadmium included in the implementation plan the most effective for meeting limits and site performance objectives?

MQ4: Is calcite being managed effectively to meet site performance objectives and to protect the aquatic ecosystem?

MQ5: Does monitoring indicate that mine-related changes in aquatic ecosystem conditions are consistent with expectations?

MQ6: Is water quality being managed to be protective of human health?

Collectively, the MQs address Teck's regulatory requirements and the environmental management objectives of the Elk Valley Water Quality Plan. For example, MQ 5 is shown in Figure 2.

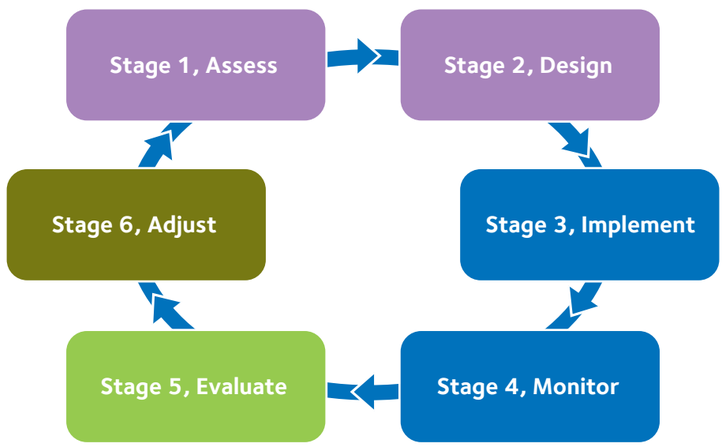


Figure 1. The six stages of the adaptive management cycle: assess, design, implement, monitor, evaluate, and adjust.

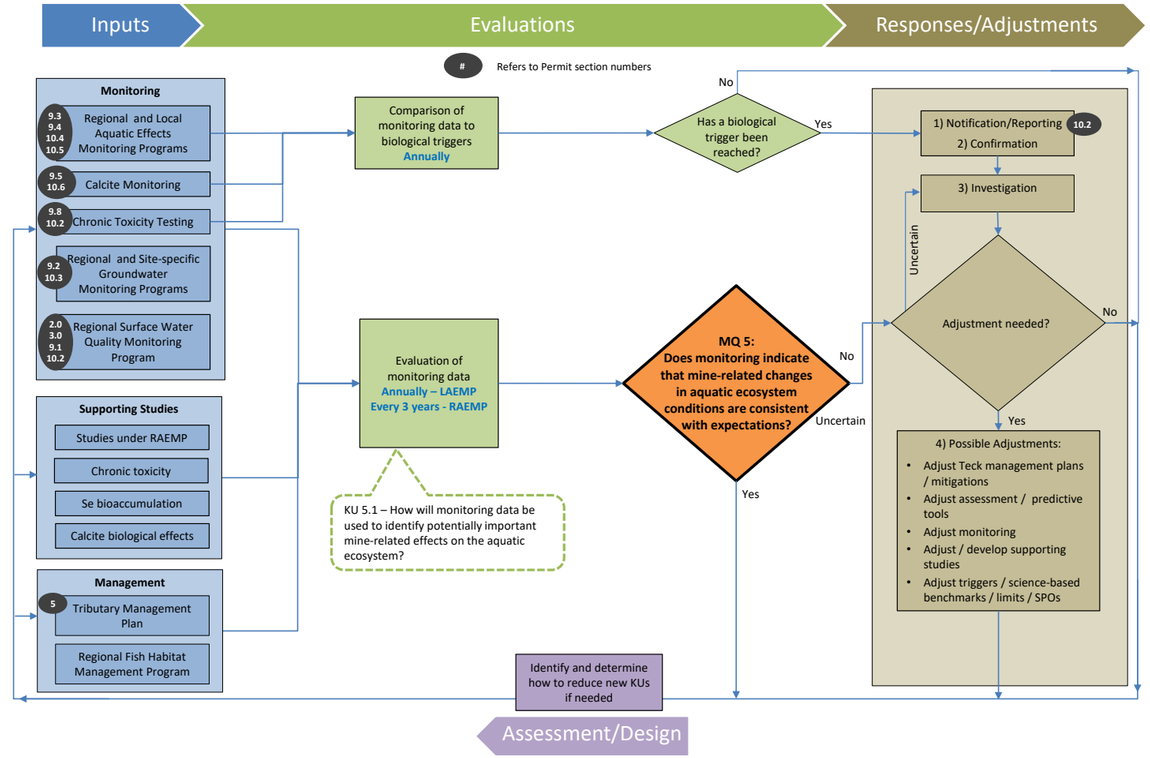


Figure 2: Adaptive management process flow diagram for re-evaluating management question (MQ) 5.

Continuous Improvement

In 2018, Teck and the Ktunaxa Nation Council (KNC) developed continuous improvement goals for each management question.

The activities Teck undertook in 2019 to meet these continuous improvement goals can be grouped into three categories:

- Improvements in water quality conditions
- Improvements in understanding water quality and ecological conditions
- Improvements in water quality mitigation

Teck and KNC also worked together to develop several data-driven metrics for measuring progress on the continuous improvement goals. These metrics were shared with the EMC for input and refinement.

The Elk Valley and the Ktunaxa Nation

The Elk Valley is located in the southeast corner of British Columbia and contains the main stem Elk River and many tributaries, including the Fording River.

Archaeological evidence indicates that for more than 10,000 years the Ktunaxa (pronounced 'k-too-nah-ha') people have occupied the lands adjacent to the Kootenay and Columbia Rivers and the Arrow Lakes of British Columbia.

The Ktunaxa Territory is divided into Land Districts, and the Elk Valley falls within one of these districts, called **Qukin ʔamakʔis**, or Raven's Land.

The Ktunaxa people have continuously used and occupied the Elk Valley area within **Qukin ʔamakʔis**, and the formation of the geography of the Elk Valley is described in the final events of the Ktunaxa Creation story.

Because of their deep connection to the Elk Valley, the Ktunaxa Nation Council (KNC) has three seats on the Environmental Monitoring Committee—two scientific seats and one Indigenous Knowledge seat.

The Elk Valley has a long history of mining activity and the regional economy is heavily dependent on steelmaking coal mining and related activities. Evidence demonstrates that the Ktunaxa were the first to mine the earth in the Elk Valley, and the Ktunaxa word for Raven's rock (coal) is **qukin nuʔkiy**.

With the arrival of the southern branch of the Canadian Pacific Railway at the end of the 19th century, larger scale industrial mining began and brought families from across Canada, America and Europe to settle in the Elk Valley.

In 2003, Teck and Fording Coal Ltd. combined five coal mines into the Elk Valley Coal Partnership, which was operated by Teck, and in 2008, Teck acquired 100% of Fording Coal.

In 2016, the Ktunaxa Nation and Teck signed an Impact Management and Benefits Agreement (IMBA)—a comprehensive agreement that sets out commitments and obligations for both parties and that supports sustainable mining in the Elk Valley.

For more information on the Ktunaxa Nation please visit: **www.ktunaxa.org**

Yaqaƚ Hankatiƚiƚki na ʔamak