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Technical Report Overview

Report: 2019 Calcite Monitoring Program Annual Report and Program Assessment

Overview: This report presents the 2019 results of the calcite monitoring program required under Permit 107517. This report summarizes the degree and extent of calcite formation in specific stream reaches within the Elk Valley watershed.

This report was prepared for Teck by Lotic Environmental Ltd.

For More Information

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Teck Coal Ltd.
2019 Calcite Monitoring Program Annual Report

Elk Valley

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Definitions

- AMP – Adaptive management plan
- Degree – The amount of calcite deposition estimated by the level of concretion.
- EMC – Environmental monitoring committee
- EVWQP – Elk Valley water quality plan
- Exposed – Stream locations with mine-influenced water. Areas downstream of mining.
- Extent – The spatial coverage of calcite deposition which can be expressed as an area covered at a specific location or linear coverage over a stream profile.
- Habitat unit – A distinct channel unit possessing homogeneous geomorphological characteristics (e.g., riffle, pool, glide, cascade). Also referred to as channel unit or mesohabitat.
- KUs – Key uncertainties
- MQs – Management questions
- Reach – A relatively homogeneous section of stream in terms of channel morphology, riparian cover and flow (RISC 2001).
- Reference – An area without upstream mining activity.
- Sampling unit – A single unit used to describe a larger entity. For example, a site could be considered the sampling unit for estimating the average calcite coverage over an entire reach.
- Segment - Combines adjacent reaches that have similar calcite indexes identified from previous sampling and have the same exposure to mining.
- Site – A location within a reach where observations of calcite deposition were made. These are replicate observations (sample units) within the treatment unit (reach).

Executive Summary

Teck Coal Ltd. (Teck) continues to conduct an annual Calcite Monitoring Program (the Program) in part to satisfy monitoring and reporting requirements of the *Environmental Management Act* Permit 107517 (the Permit), but also to inform management actions to address calcite formation as per Site Performance Objectives (SPOs) of the Permit. Sampling in 2019 was consistent with the updates made to the Program following a review and assessment in 2018, which was submitted to the British Columbia (BC) Ministry of Environment and Climate Change Strategy (ENV) and the Environmental Monitoring Committee (EMC) as required by Section 12.2 by Permit 107517. The review marked the second three-year review since initiating the regional Calcite Monitoring Program in 2013 (Robinson et al. 2013).

The work plan for 2019 used a hybrid approach of the full "reach-by-reach" program (2013-2015) and the indicator reach/stream segment approach (2016-2017) to estimate spatial distribution of calcite relative to each of the mines. This approach was developed following the 2018 program to provide more customization of effort, in that it allowed for higher-resolution monitoring in key areas of interest, as well as surveillance monitoring in other areas with lower potential of either calcite deposition or calcite management requirements. Combined, this continued to provide an effective means of accurately and directly describing calcite deposition values (e.g., Calcite Index or *CI*) across the spatially large Elk River Watershed.

The 2019 Program was conducted between September 30 – November 20, 2019. In total, 78 reaches were assessed with 205 sites surveyed. This is in contrast to 2018 where 117 reaches and 312 sites were surveyed. Calcite distribution was consistent with previous years wherein the majority of exposed stream kilometers surveyed were classified as low calcite deposition (i.e., *CI* values from 0.00-0.50) for both mainstem and tributary categories. However, there were significant decreasing trends detected in both mainstem ($p<0.001$; df=6) and tributaries ($p=0.03$; df=6) in the 0.00-0.50 bins, as well as a significant increase in mainstem kilometers in the 0.51-1.00 bin ($p <0.001$; df=6). A total of 26 of 78 reaches were above the 0.5 calcite concretion score (CI_c) Site Performance Objective listed in Permit 107517.

Mann-Kendall analyses were run on all reaches without constant values over the period of record (n=75). A total of 31 reaches (41%) were found to have significant changes in *CI* from 2013-2019 ($\alpha=0.10$). This increased from 2018 where 19% of reaches surveyed had significant trends over time, which was proportionally similar to 2017 (12/85 or 14%). An ANOVA assessment was completed to test for step-wise changes in the data. A total of 40 reaches of the 64 (63%) tested in 2019 had a significant effect ($\alpha = 0.05$) by *Year*. Qualitatively, this is higher than the 2018 results where 42/88 reaches assessed produced significant ANOVA results (48%).

Inter-program comparison results indicated large variations in mean *CI* values between data collected under the Biological and Regional sampling programs in some reaches. This was similar to 2018 where there was high variability in some reaches between sampling programs. Habitat unit analysis results, based on *CI,* suggested that there was no significant difference between habitat type (cascade, glide, pool, or riffle) and *CI* values. These findings were consistent with the initial calcite monitoring program in 2013 and suggest additional factors may be influencing the results of these programs. Teck will continue to investigate factors such as crews, training, and sampling methods.

1 Introduction

Calcite is a calcium carbonate deposit that precipitates on organic and inorganic substrate in freshwater streams. Although naturally occurring, the degree and extent of calcite formation can increase as a result of open pit mine runoff (Teck 2017). Calcite formation can lead to hardening of substrate, which alters streambeds by concreting rocks together, affecting sediment transport and hyporheic flows. This in turn can adversely influence fish spawning and benthic invertebrate communities (Robinson 2010).

Teck Coal has been documenting calcite occurrence in streams downstream of its coal mine operations since 2008 (Berdusco 2009). This resulted in a formal Calcite Monitoring Program (the Program) implemented at Teck Coal's sites in the Elk Valley in 2013. The Program was conducted from 2013-2015 and concluded with an assessment in 2015. A revised Program was implemented from 2016-2018 to sample stream segments consisting of one or more reaches grouped based on historical calcite survey results and similar exposure to mining from a water quality perspective (Robinson and Atherton 2016). Following the three-year sampling period (2016-2018), the Program was again reassessed and modified based on recommendations from the 2016-2018 report and the Environmental Monitoring Committee (EMC). Sampling efforts in 2019 were conducted using a hybrid approach of the full "reach-by-reach" Program (2013-2015) and the stream segment/indicator reach approach (2016-2018) to estimate spatial distribution of calcite relative to each of the mines. This approach was developed to provide customization of effort and allowed for higher-resolution monitoring in key areas of interest and surveillance monitoring in other areas with lower potential of either calcite deposition or calcite management activities.

Since 2017, Teck Coal has been actively working towards stabilizing calcite levels at their operations (Daniel Bairos, *pers com*). In October 2017, antiscalant addition was initiated in lower Greenhills Creek to inhibit calcite precipitation. Since then, initial qualitative results suggest that this approach appears to be stabilizing calcite levels (Smithson et al 2018). Following the Greenhills calcite initiative, Line Creek Operations (LCO) starting injecting antiscalant in October 2018. The results and effectiveness of these treatments is reliant on appropriate and accurate monitoring from the Program and the Monitoring Program associated with the operation of the modules.

Overall, the results of this Program assist in determination of the state of the environment based the extent of regional calcite and active calcite management initiatives (Teck 2016). As a result, this report supports Teck's Adaptive Management Plan (AMP, Permit 107517) in monitoring and evaluation while prioritizing streams for calcite management (Section 1.2; Robinson and Atherton 2016; Teck 2016).

1.1 *Program Objectives*

Key objectives of the Elk Valley Calcite Monitoring Program are to:

1. Document the extent and degree of calcite deposition in streams downstream of Teck's coal operations (e.g., streams influenced by mining, calcite treatment, water treatment and in reference streams).
2. Satisfy the requirements for annual calcite monitoring in *Environmental Management Act* Permit 107517.

3. Provide data to support the re-evaluation of Management Question 4 (“*Is calcite being managed effectively to meet site performance objectives and protect aquatic ecosystem health?*”) and related Key Uncertainties in Permit 107517 as they relate to calcite.

Table 1. Permit 107517 annual reporting requirements

Requirement Number	Description	Report Section Reference
i	A map of monitoring locations	Appendix 3
ii	A summary of background information on that year’s Program, including discussion of Program modifications relative to previous years	2.1 & 2.5
iii	Results of stream selection reassessment – highlight streams added/removed	2.3 & 2.4
iv	Summary of where sampling followed the methodology in the monitoring plan document, and details where sampling deviated from the approved methodology	3.1
v	Statement of results for the period over which sampling was conducted	3.1
vi	Reference to the raw data, provided as appendices	2.6
vii	General discussion of observations, including summary tables of sites with increasing and decreasing deposition indices	3.1, 0
viii	Interpretation of location, extent, and any other observations	3.1
ix	A summary of any QA/QC issues during the year	3.1
x	Recommendations for sites to add, sites to remove, modifications to methodology, monitoring frequency adjustments	5

Table 2. Management Question 4 Key Uncertainties (Teck, 2018)

Key Uncertainty Number	Key Uncertainty
4.1	Are the calcite SPOs protective of fish and aquatic life?
4.2	What are the most effective management methods for calcite?
4.3	Are there interrelationships with calcite and select constituents of interest in surface water that need to be considered for calcite management?
4.4	Can early-warning trigger (EWTs) be established for calcite that support calcite management?

1.2 *Linkage to Adaptive Management*

As required in Permit 107517 Section 11, Teck has developed an Adaptive Management Plan (AMP) to support implementation of the Elk Valley Water Quality Plan (EVWQP) to achieve water quality targets (including calcite), ensure that human health and the environment are protected, and where necessary, restored, and to facilitate continuous improvement of water quality in the Elk Valley. Following an adaptive management framework, the AMP identifies six Management Questions (MQs) that are re-evaluated at regular intervals. The need for early warning triggers (as well as for calcite early warning triggers specifically) also have been identified for specific MQs, which if reached, initiate action under the AMP Response Framework. The AMP also identifies Key Uncertainties (KUs) that must be reduced to fill gaps in current understanding and support the EVWQP objectives.

The results presented in this report provide information relevant to one of the six MQs and address many of the key uncertainties identified in the AMP. Calcite monitoring data along with data collected from other programs are used to re-evaluate the answer to MQ 4 ("*Is calcite being managed effectively to meet site performance objectives and to protect the aquatic ecosystem*?"). Results from this report will be used in the development of calcite early warning triggers. Reaching a trigger, or an answer of "no" or "uncertain" to a Management Question, would lead to actions under the Response Framework in the AMP. This report is not the main report for the development of calcite triggers. Progress on calcite trigger development was reported in the Calcite Management Plan Update, July 2019.

Calcite monitoring data assist in reducing KU 4.1 ("*Are the calcite SPOs protective of fish and aquatic life?"), KU 4.2 ("What are the most effective management methods for calcite*"), KU 4.3 ("*Are there interrelationships with calcite and select constituents of interest in surface water that need to be considered for calcite management?*") and KU 4.4 ("*Can early-warning trigger (EWTs) be established for calcite that support calcite management*?"). Progress on reducing these key uncertainties, and associated learnings, will be described in Annual AMP Reports.

2 Methods

2.1 *Study area*

Consistent with study areas from 2013-2018, sites were selected in areas downstream of Teck's five Elk Valley coal mining operations in southern British Columbia: Fording River Operations (FRO), Greenhills Operations (GHO), Line Creek Operations (LCO), Elkview Operations (EVO), and Coal Mountain Operations[1] (CMO) (Figure 1).The study area extended to the downstream limit of the Elk River reach 8 in Fernie, BC (Figure 1).

[1] Coal Mountain Operations is no longer operating and is in a Care and Maintenance status.

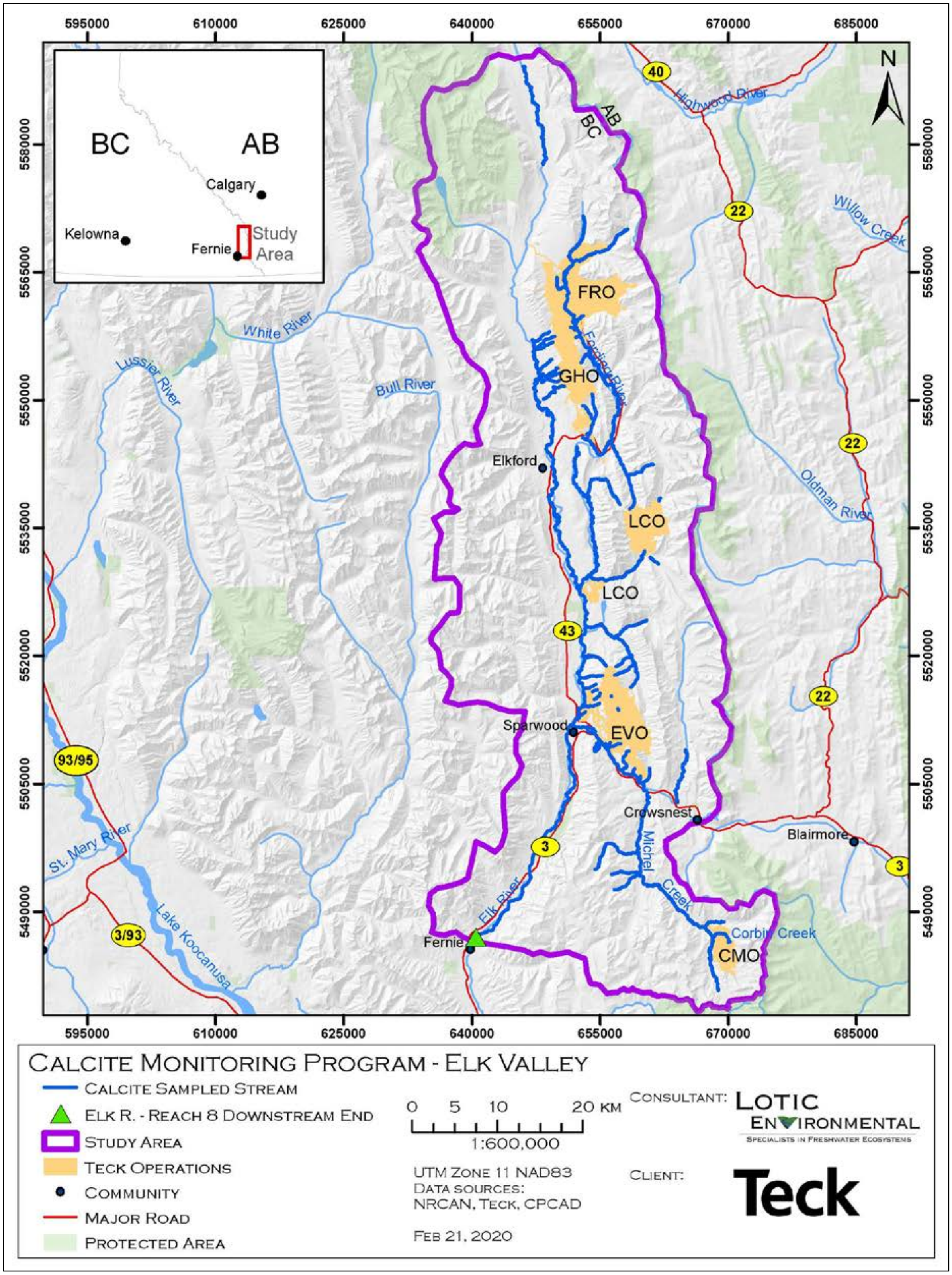

Figure 1. Elk River watershed study area map.

2.2 *Sample Locations*

The 2019 Regional Calcite Monitoring Program study design proposed that 257 sites be sampled (Appendix 1). The number of sites sampled per reach were again dependant on Calcite index (*CI)* values from the previous year in that more sites were sampled at intermediate *CI* values (1.00-2.00) where intra-reach *CI* variability has been documented to be higher (Table 3) (Smithson and Robinson 2017)

Table 3. Number of sample sites per stream reach by CI bin (modified from Robinson and Atherton 2016).

***CI* Bin**	**N**
0.00-0.25	3
0.25-1.00	3
1.00-1.50	6
1.50-2.00	6
2.00-2.50	3
2.50-3.00	3

The field program largely adhered to this plan with some minor deviation. After completion of the field Program, 205 sites were sampled from 78 reaches. This was the result of some sites that could not be sampled, as well as the addition of new sites as the program progressed.

Sites were not sampled primarily for the reasons of being frozen, dry, or due to safety concerns (Table 4). While each annual sampling program is conducted at similar times of year, the Elk Valley experienced colder temperatures earlier than is typically observed in the fall of 2019. This resulted in heavy ice cover on smaller tributaries that persisted through the remainder of the field season.

Two sites (ETRI1-0 and ETRI1-50) were added to the East Tributary (tributary to Dry Creek LCO) to better document changes in the Dry Creek watershed. Two sites were added to Reach 9 of the Fording River (FORD9-37.5. and FORD9-62.5) and one sites was added to Swift Creek (SWIF1-25) to increase the resolution of monitoring in the Fording River during changes in discharge locations of Cataract Creek and Swift Creek. Additional sampling (e.g. repeatedly sampling sites from September 24-November 19, 2019) was also done on Fording River Reach 9 (sites FORD25, FORD37.5, FORD50, FORD60, FORD62.5, and FORD75) to monitor calcite below the Swift Creek/Cataract Creek diversion. However, only the results of the first sampling event were considered for the purposes of this report.

Table 4: Sites not surveyed (frozen, dry, or safety considerations) and additional sites added to 2019 Program.

Frozen	Dry	Safety or Construction*	Added
• GATE2 (all sites) • LIND1 (all sites) • MILL1 (all sites) • OTTO1 (all sites) • SIXM1 (all sites) • USOS1 (all sites) • QUAL1-0 • LINE7 (all sites) • GARD1-25 • MICK2-25 MICK2-50 MICK2-75 • SWOL1-16 SWOL1-25 SWOL1-32 • WILN2-25 WILN2-50 • WILS1-25 WILS1-50	• MICK1-12.5, MICK1-25 • PENG1 (all sites) • THRE1 (all sites) • SAWM1-50 SAWM2-25 SAWM2-50 • DRYE3-25 • BALM1-25 • NWOL1-25	• ALEX3-75 • FORD5-75 • ELKR8-25 • CATA3-0* • SWIF2-25* SWIF2-75* • EPOU1**	• FORD9-37.5 • FORD9-62.5 • SWIF1-25 • ETRI1-0 • ETRI1-50

*Construction resulting in sites dropped due to construction at the Swift-Cataract diversion
**Dropped from the Program based on results from Smithson et al. (2019) indicating reach was dry from 2018 onwards and did not have a well-defined channel

2.3 *Field surveys*

Field survey methods followed those reported in Robinson and Atherton (2016). Every site had a pebble count completed regardless of calcite presence or absence. The pebble count was a modified Wolman pebble count (Wolman 1954) to quantify the degree of calcite presence using two metrics to calculate a site-specific Calcite Index (*CI*):

$$CI_p = Calcite\ Presence\ Score = \frac{Sum\ of\ pebbles\ with\ calcite}{Number\ of\ pebbles\ counted}$$

$$CI_c = Calcite\ Concretion\ Score = \frac{Sum\ of\ pebble\ concretion\ scores}{Number\ of\ pebbles\ counted}$$

$$CI = Calcite\ Index = CI_p + CI_c$$

Teck requested an addition to the 2019 Program (relative to previous years) in that habitat unit type (pool, riffle, glide, cascade) was recorded for each pebble sampled. This was initially completed in earlier monitoring Programs (e.g., 2013). However, habitat unit recording was removed from previous Program's after no statistical significance was found between habitat unit and calcite deposition at a site level (Robinson and MacDonald 2014).

2.4 *Data analysis*

2.4.1 2019 general distribution

Results were summarized for four stream categories:

- Fording and Elk mainstems (reference);
- tributaries (reference);
- Fording and Elk mainstems (exposed); and,
- tributaries (exposed).

The same *CI* ranges or “bins” used in previous years to report the distribution of *CI* by stream length were used in 2019. Six bins of 0.5 *CI* intervals were used to divide the range of *CI* scores from 0.00 – 3.00 (representing low to high calcite levels). Reach mean *CIs* were mapped to depict the spatial distribution of calcite relative to each of the mines, which are presented in Appendix 3. *CI* values were calculated for reaches sampled in 2019 and added to the long-term dataset (Appendix 1). The 2019 *CI*, CI_p, and CI_c scores for indicator reaches are presented in Appendix 2. Maps of calcite distribution were prepared to provide a spatial reference to the Program results. These maps show the mean *CI* value for a segment, as calculated at the indicator reach for that segment and are provided in Appendix 3.

2.4.2 Permit 107517 Site Performance Objectives

The EVWQP (Permit 107517) provides Site Performance Objectives (SPOs) for various water quality related constituents, including calcite. The EVWQP defines short-term (December 31, 2024) and long-term (December 31, 2029) SPOs for calcite. The short-term SPO states that “streams that are fish bearing, provide fish habitat or flow directly into fish bearing streams and are not scheduled by an Environmental Assessment Certificate or Mines Act Permit to be buried” must be managed to a $CI_c \leq 0.5$.Results from the Program, including streams with concretion scores above 0.5, will form part of the criteria for informing calcite management associated with section 6.1 of Permit 107517.

2.4.3 Rate of change in calcite deposition (Mann-Kendall and ANOVA)

Two methods were used to assess changes in *CI* over time. First, Mann-Kendall tests were run to assess for linear trends over time, with the caveat that the current data set is likely temporarily limited, although improving (Smithson *et al.* 2018). ANOVA with Tukey’s HSD post-hoc analysis was used to analyze the effect of *Year* on mean *CI* values per reach to test for step-wise changes. Analysis of co-variance (ANCOVA) was run on those reaches with significant Mann-Kendall results to investigate if the rate of change varied significantly between reference and exposed reaches.

2.4.4 Effect of habitat unit type

Habitat unit type was added back into the Program in 2019 to reassess the effect of habitat unit type on *CI*. Habitat units were classified into four main types: pools, riffles, glides, and cascades. The occurrence and proportions of these varies by reach based on channel morphology. For example, higher gradient, step-pool reaches would be expected to have higher proportions of cascades and riffles than lower gradient reaches that typically lack cascades and have higher proportions of pool and glide habitat. The potential for calcite to form also differs among reaches based on factors such as the degree of upstream mine influence. Therefore, this assessment needed to control for differences in channel morphology when assessing the effect of habitat unit type over a range of reach-mean *CI* values. To do this, the assessment included only reaches containing at least one glide, pool, and riffle, to capture calcite in each habitat unit type. ANOVA analysis was run to test for a significant effect of habitat unit type on this subset of reaches that contained each of the three main habitat unit types.

2.4.5 Inter-program comparisons

Teck collects calcite data as part of its Regional and Local Aquatic Effects Monitoring Programs (RAEMP and LAEMP, respectively), conducted by Minnow Environmental Ltd. (Minnow). Together, these are referred to as Biological programs in this report. Data collected under these Programs follow the same field protocol as the Regional Calcite Monitoring Program, with the exception of spatial coverage at a site level. Where the Regional Calcite Monitoring Program collects data at sites ~100 m long and containing multiple habitat unit types, the Biological Programs collect calcite data within an individual riffle so that the resulting *CI* values are spatially correlated with the biological data also obtained at a single habitat unit scale. At Teck's request, the results of these two Programs were compared to investigate if there different Programs and methods were capable of producing different results.

Biological site locations were first mapped overtop of regional calcite reaches so that program data were compared within a reach. Program-specific data were then compared using two approaches. First, the relative difference of *CI* across both Programs was calculated within each reach as the Regional Calcite Program reach-mean *CI* value minus the Biological Program *CI* value (mean if multiple sites existed). These results were qualitatively discussed. Differences of 0.25 *CI* or less were considered "acceptable" given the observed inter-reach variability over the regional dataset. Second, *CI* values were graphed and grouped by stream reach. Values were compared qualitatively based on *CI* values to determine how well inter-program values compared and whether there were spatial patterns where notable differences occurred.

2.4.6 Data quality assurance

Data quality assurance steps follow that of the earlier Programs (Robinson *et al.* 2016). Quality assurance steps included:

- *CI* scores were calculated in the field and compared to Table 3 to determine if additional sampling sites were required.
- A computer script using R Programming Language was written to confirm that cells were populated with acceptable values (e.g., calcite presence score can only be 0 or 1; concreted scores can only be 0, 1, or 2; concreted score must be 0 if calcite presence is 0). Any cells that had errors or were left blank, flagged, and corrected.

3 Results

3.1 *Data quality assurance*

Data quality assurance steps were completed as described in Section 2.4.6. All raw pebble count data were screened for data entry errors using an R QA/QC script to confirm that cells were populated with acceptable (i.e., valid) values. No data entry errors were detected.

3.2 *2019 Calcite Index and general distribution*

The Program was conducted from September 30 - November 20, 2019. In 2019, a total of 78 reaches and 205 sites were surveyed. This was in comparison to 117 reaches and 312 sites surveyed in 2018. Combined, these reaches totaled 297 stream kilometers assessed and mapped, compared to 354.2 km in 2018 (Table 5). Results are presented by four stream categories as either mainstem Fording River and Elk River sections versus tributaries and reference versus exposed.

Table 5. Stream calcite distribution (km) estimates for the four stream categories, by *CI* ranges for 2019.

	Reference				*Exposed*			
	Fording and Elk		*Tributaries*		*Fording and Elk*		*Tributaries*	
CI Range	***km***	***%***	***km***	***%***	***km***	***%***	***km***	***%***
0.00 - 0.50*	21.8	100%	31.4	79%	109.8	72%	44.0	53%
0.51 - 1.00	0	0%	8.1	21%	38.0	25%	10.0	12%
1.01 - 1.50	0	0%	0	0%	5.3	3%	2.0	2%
1.51 - 2.00	0	0%	0	0%	0.0	0%	9.1	11%
2.01 - 2.50	0	0%	0	0%	0.0	0%	4.9	6%
2.51 - 3.00	0	0%	0	0%	0.0	0%	12.9	16%
Overall Total (2019)	**21.8**	**100%**	**39.5**	**100%**	**153.0**	**100%**	**82.9**	**100%**
Total (2018)	**21.8**		**44.4**		**153.0**		**135.0**	
Total (2017)	**21.8**		**41.6**		**153.0**		**142.1**	
Total (2016)	**21.8**		**41.6**		**153.0**		**139.8**	
Total (2015)	**21.8**		**57.2**		**153.0**		**148.9**	
Total (2014)	**21.8**		**56.3**		**153.1**		**136.7**	

*The *CI* range of 0.00-0.50 includes sites where calcite was not detected.

Distribution of exposed stream kilometers among *CI* bins remains similar to previous years, with the majority of mainstem and tributary kilometers having *CI* scores within the 0.00-0.50 bin (Figure 2). The continued decreasing trend in total stream kilometers of both mainstem ($p<0.001$; df=6) and tributaries ($p=0.03$; df=6) in the 0.00-0.50 bin was found to be highly significant through linear regression. The observed increase in mainstem kilometers in the 0.51-1.00 bin was also found to be highly significant ($p < 0.001$; df=6).

Similar to previous years, 100% of the reference mainstem stream kilometers were categorized into the 0.00 - 0.50 *CI* bin (Figure 3). 2019 marked the first year where a portion (8.1%) of the reference tributary stream kilometers were categorized in a higher bin (*CI* range 0.51-1.00). Alexander Creek – Reach 3 has been sampled as a reference for this Program since 2013 and typically reports the highest calcite values for reference streams. In 2019, The 8.1% represented by ALEX3 had an average *CI* value of 0.86 and was the only reference tributary reach with a *CI* score higher than the lowest (0.00-0.50) bin.

The consequence of frozen site conditions precluded assessment of approximately 21 stream kilometers. Of this 20.5 km were exposed tributary and 0.5 km were reference km. From previous years it is possible that approximately half of these 20.5 km may have classified into the lowest *CI* bin in 2019. This means that the percentage of exposed tributaries in the lowest bin would have essentially remained unchanged (i.e., 54/102.9 km).

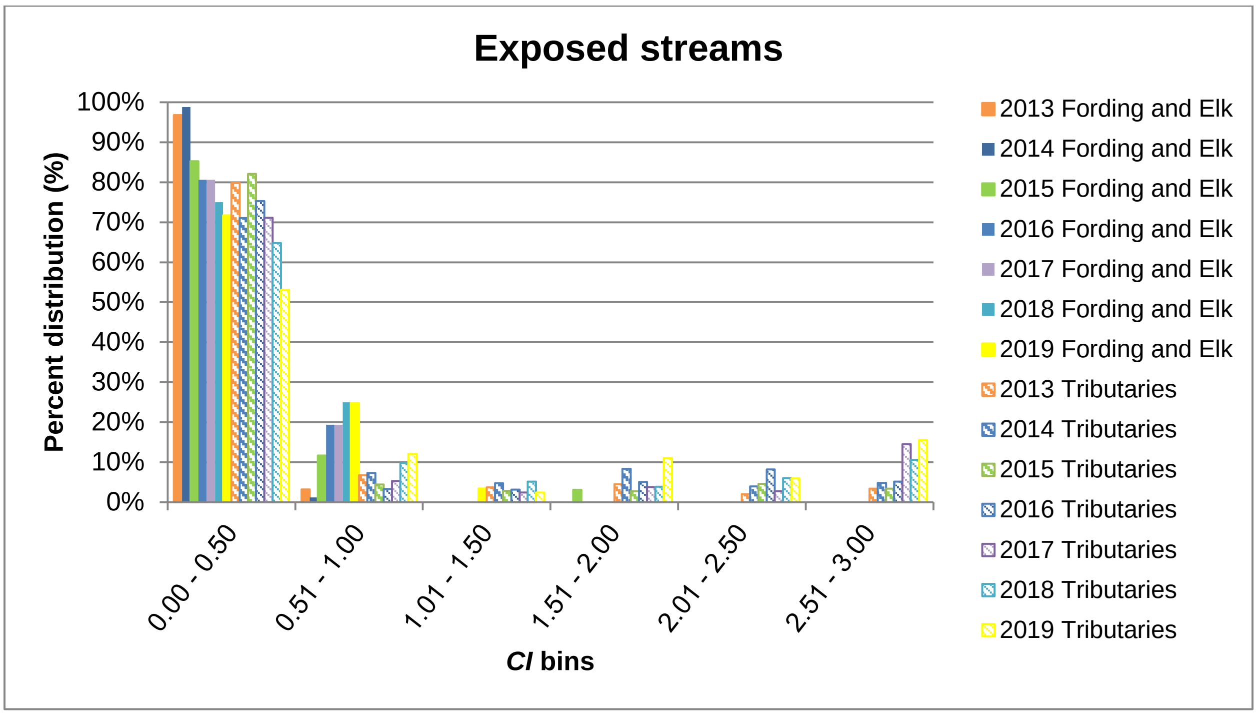

Figure 2. Percent distribution of exposed stream kilometers among *CI* bins by stream category and year (each year sum to 100% for the stream category).

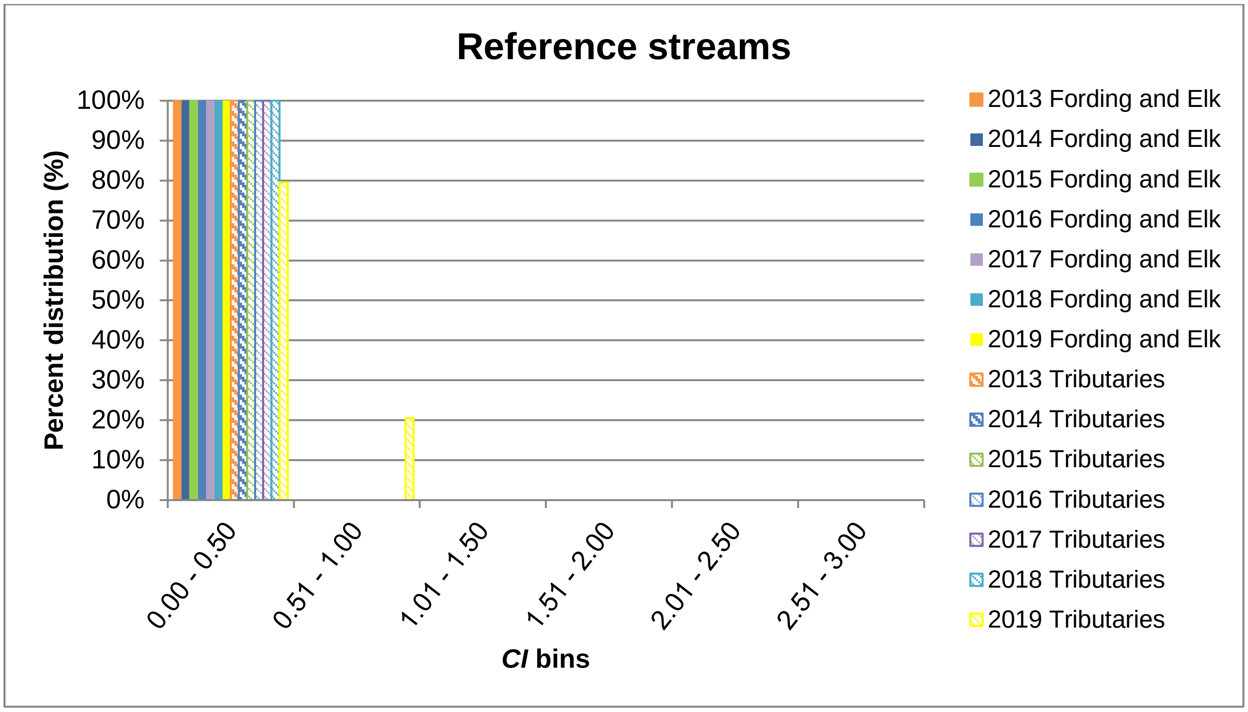

Figure 3. Percent distribution of reference stream kilometers among *CI* bins by stream category and year (each year sum to 100% for the stream category).

3.2.1 Permit 107517 Site Performance Objectives

A total of 26 reaches in 18 streams had mean reach CI_c ≥0.5 (Table 6), compared to 30 reaches in 22 streams in 2018. Three reaches (GODD2, MICK1, and THOM3) were new to this list in 2019, with only MICK1 of these being non-fish bearing. Six reaches were on this list in 2018, but not 2019. Of these two reaches (COUT1 and DRYL1) had CI_c scores slightly above 0.5 in 2018, but then slightly below in 2019, showing some inter-annual variability in this metric. Two reaches (GATE2 and MILL1) were unable to be sampled as they were frozen. Lastly, CATA1 was not sampled in 2019 as flows had been diverted from the channel.

Table 6. Reaches with mean CI_c ≥0.5

Stream	Reach	Mean reach CI_c
Bodie	BODI3	1.59
Corbin	CORB1	1.50
Corbin	CORB2	1.88
Dry (EVO)	DRYE1	1.20
Dry (EVO)	DRYE3	1.25
Dry (EVO)	DRYE4	1.51
Erickson	ERIC1	1.90
Erickson	ERIC2	1.52
Erickson	ERIC3	1.96
Erickson	ERIC4	0.81
Goddard	GODD2*	1.54
Goddard	GODD3	1.69
Greenhills	GREE3	0.92
Greenhills	GREE4	1.32
Kilmarnock	KILM1	1.65
Leask	LEAS2	1.79
Mickelson	MICK1*	0.86
North Thompson	NTHO1	0.64
Porter	PORT3	0.78
Site18	SITE	1.93
Smith Pond Outlet	SPOU1	1.09
South Pit	SPIT1	1.43
South Wolfram	SWOL1	1.96
Swift	SWIF1	0.91
Thompson	THOM3*	0.66
Wolfram	WOLF3	1.86

*new reaches in 2019 where CI_c ≥0.5

3.3 *Rate of change in calcite deposition*

3.3.1 Mann-Kendall

Mann-Kendall analysis was run on all reaches without constant values (between years) where two or more sites were surveyed each year from 2013-2019 (n=75). The tau value represents the "strength" of the correlation between two variables; in this case *CI* and *Year*. A tau of 1 shows a strong and positive (i.e. increasing) agreement while a value of -1 shows a strong and negative (i.e. decreasing) disagreement. A total of 31 reaches were found to have statistically significant changes in *CI* over the 7 year period from 2013-2019 (α=0.10) (Figure 4). An α-value of 0.10 was selected to account for the data from a shorter time period (i.e. it is more difficult to accurately detect trends with shorter time periods). Having this larger alpha value allows for a more conservative interpretation of significance while not overlooking potential significant trends at an early stage in monitoring Programs.

Of the 31 reaches found to be significant using Mann-Kendall, 5 reaches occurred on the mainstem Fording River. This included FORD12; a reference reach that was also found to have a statistically significant increase in *CI* when accounting for data from 2013-2018 (Smithson et al. 2018). Four other reference reaches (ANDY1, CHAU1, ELKR15, and SLIN2) were all found to have significantly increasing linear trends. Three of the four reaches on Dry Creek (LCO) were found to have significantly increasing trends since 2013 (DRYL1, DRYL2, and DRYL3). The remaining 19 reaches were exposed and showed significantly increasing trends with the exception of Porter Creek Reach 3, which showed a tau value of -0.62, indicating a significantly decreasing trend (Figure 4). These results show that some of the increases are systemic in some streams (e.g., Fording River) and not spatially distributed reaches. They also indicate that significant trends are occurring in both reference and exposed reaches.

Table 7. Reaches with significant changes in *CI* from 2013 – 2019 using Mann-Kendall.

Reach	Exposure	P value	tau value	Change
ANDY1 (R)	Reference	0.06	0.72	Increasing
BODI1	Exposed	0.04	0.72	Increasing
CHAU1 (R)	Reference	0.09	0.62	Increasing
CLOW1	Exposed	0.06	0.73	Increasing
COUT1	Exposed	0.07	0.62	Increasing
DRYE4	Exposed	0.09	0.80	Increasing
DRYL1	Exposed	0.02	0.85	Increasing
DRYL2	Exposed	0.06	0.72	Increasing
DRYL3	Exposed	0.02	0.85	Increasing
ELKR15 (R)	Reference	0.08	0.69	Increasing
ELKR9	Exposed	0.06	0.72	Increasing
ERIC1	Exposed	0.04	0.71	Increasing
ERIC4	Exposed	0.09	0.80	Increasing
FORD12 (R)	Reference	0.02	0.82	Increasing
FORD2	Exposed	0.02	0.85	Increasing
FORD4	Exposed	0.06	0.73	Increasing
FORD5	Exposed	0.01	0.91	Increasing
FORD9	Exposed	0.05	0.73	Increasing
FPON1	Exposed	0.02	0.78	Increasing
GODD1	Exposed	0.04	0.72	Increasing
GODD3	Exposed	0.01	0.91	Increasing
GRAS1	Exposed	0.05	0.68	Increasing
HENR1	Exposed	0.02	0.85	Increasing
LEAS2	Exposed	0.02	0.81	Increasing
LINE4	Exposed	0.07	0.62	Increasing
LMOU1	Exposed	0.05	0.68	Increasing
MICH4	Exposed	0.05	0.73	Increasing
PORT3	Exposed	0.07	-0.62	Decreasing
SLIN2 (R)	Reference	0.02	0.85	Increasing
SPIT1	Exposed	0.02	0.78	Increasing
SWOL1	Exposed	0.10	0.59	Increasing
THOM3	Exposed	0.10	0.84	Increasing

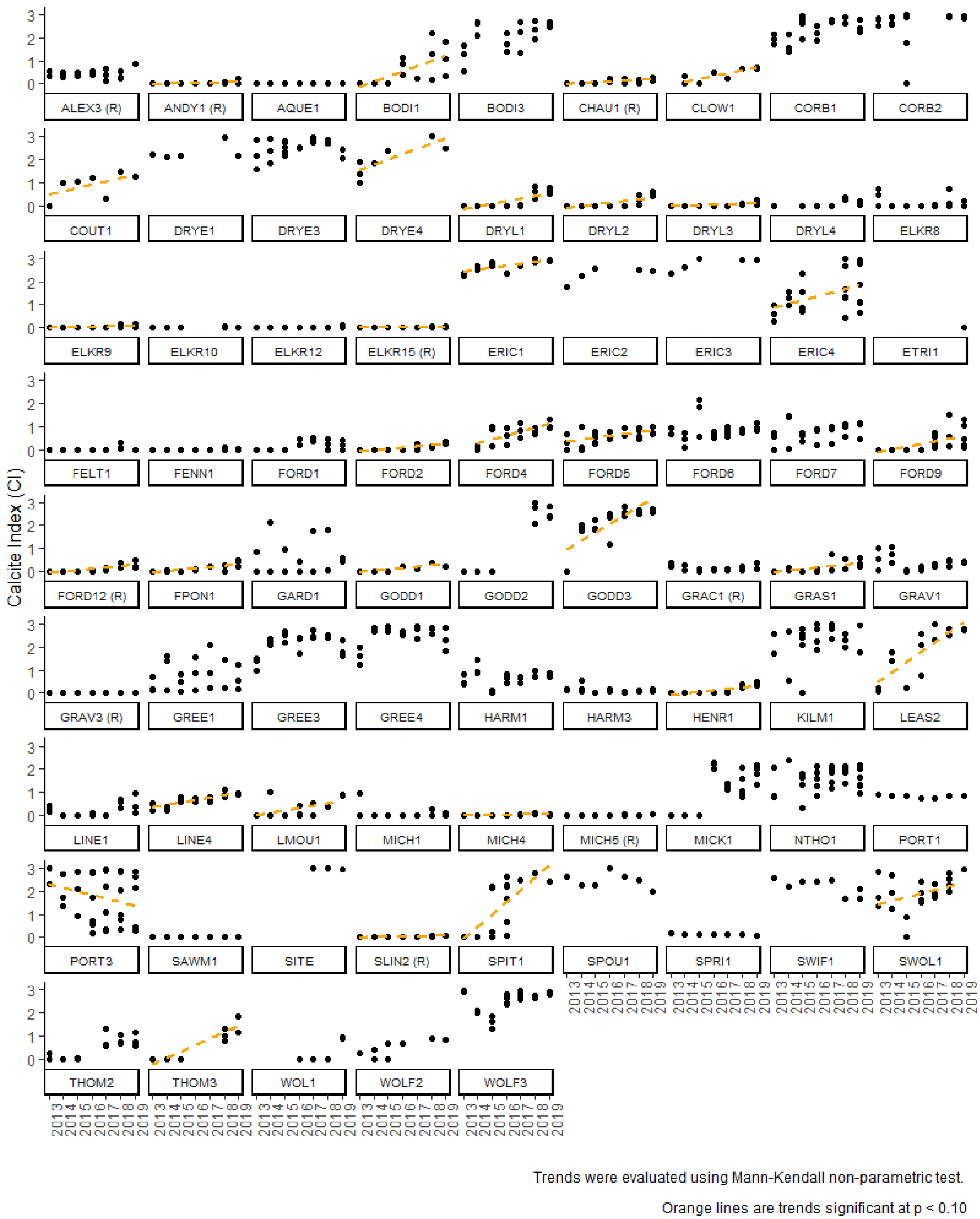

Figure 4. Reach mean *CI* from 2013 – 2019 from the Mann-Kendall test.

Significant increases have been noted in both reference and exposed locations. Analysis of co-variance (ANCOVA) was run on those reaches with significant Mann-Kendall results to investigate if the rate of change varied significantly by site type. While the effect of year was found to be significant (p=0.05), the interaction term of year by type did not have a significant effect on *CI* (p=0.182). The slopes of these type-pooled regressions were 0.12 *CI*/year and 0.02 *CI*/year for exposed and reference site types, respectively (Figure 5). This suggests that on average both reference and exposed streams are increasing over time (2013-2019) and are doing so at a similar (i.e. not statistically different) rate. The qualitative observation of these two trends however, suggests that this is something to continue monitoring.

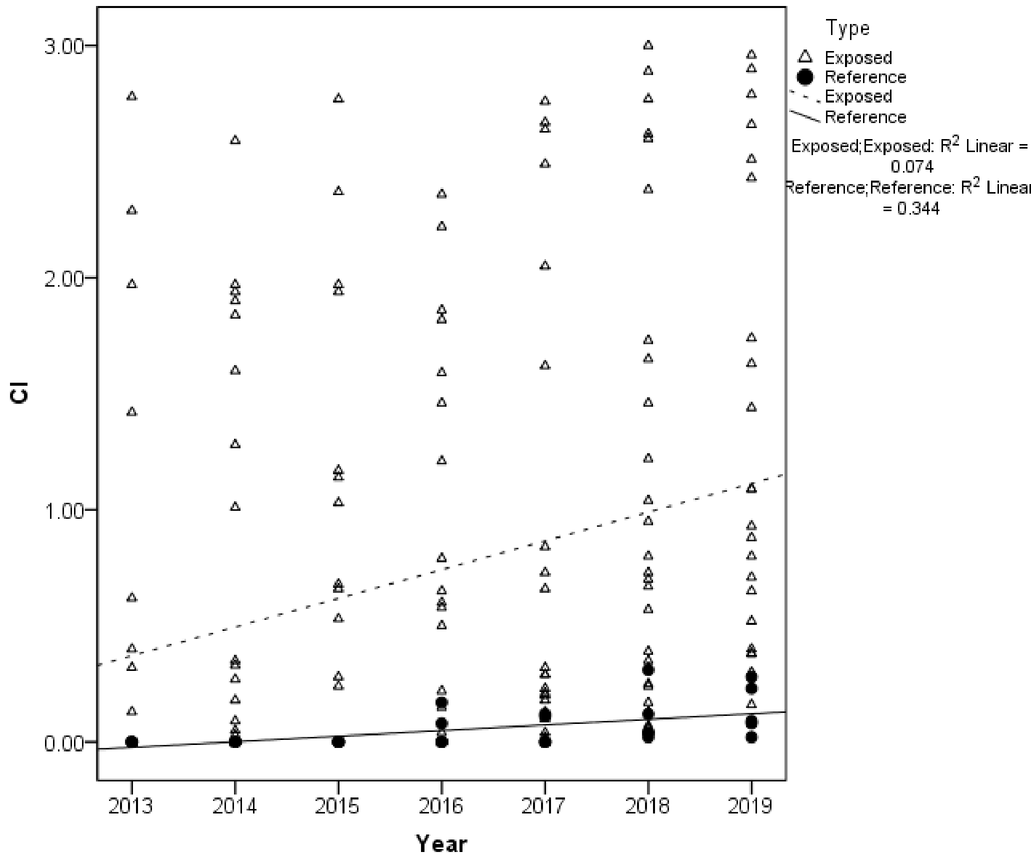

Figure 5. ANCOVA graph of *CI* versus *Year* by site type (reference and exposed).

3.3.2 ANOVA (Tukey's HSD post-hoc)

An ANOVA assessment was completed on 64 of the 78 reaches sampled in 2019 (Appendix 5). These 64 reaches were selected for assessment as they were sampled with two or more sites across seven years (2013 - 2019) and did not have constant *CI* values (i.e., identical values each year) over the period of record. Results showed that 40 of the 64 reaches varied significantly in mean *CI* (α = 0.05) by Year (Table 8). An α-value of 0.05 was chosen for this test as it is analyzing step-wise variation as opposed to trends, which do not require the same length of dataset as a Mann-Kendall trend analysis does. Notable results of interest include significant changes in many of the Fording River mainstem reaches over the record and significant changes in Dry Creek LCO Reaches 2 - 4 between 2018 - 2019 (Figure 6). All reaches classified as significant in both the ANOVA and Mann Kendall tests showed increasing linear trends from 2013 - 2019 (Table 7). This means that accounting for data from 2013-2019 (where assumptions are met for ANOVA and Mann Kendall tests) there were 19 reaches that were significant in both tests (i.e. p<0.05 for ANOVA and p<0.10 for Mann Kendall) (Table 7). 80% of sites (both significant in ANOVA and Mann Kendall) were classified as exposed streams with 20% classified as reference streams (Table 7).

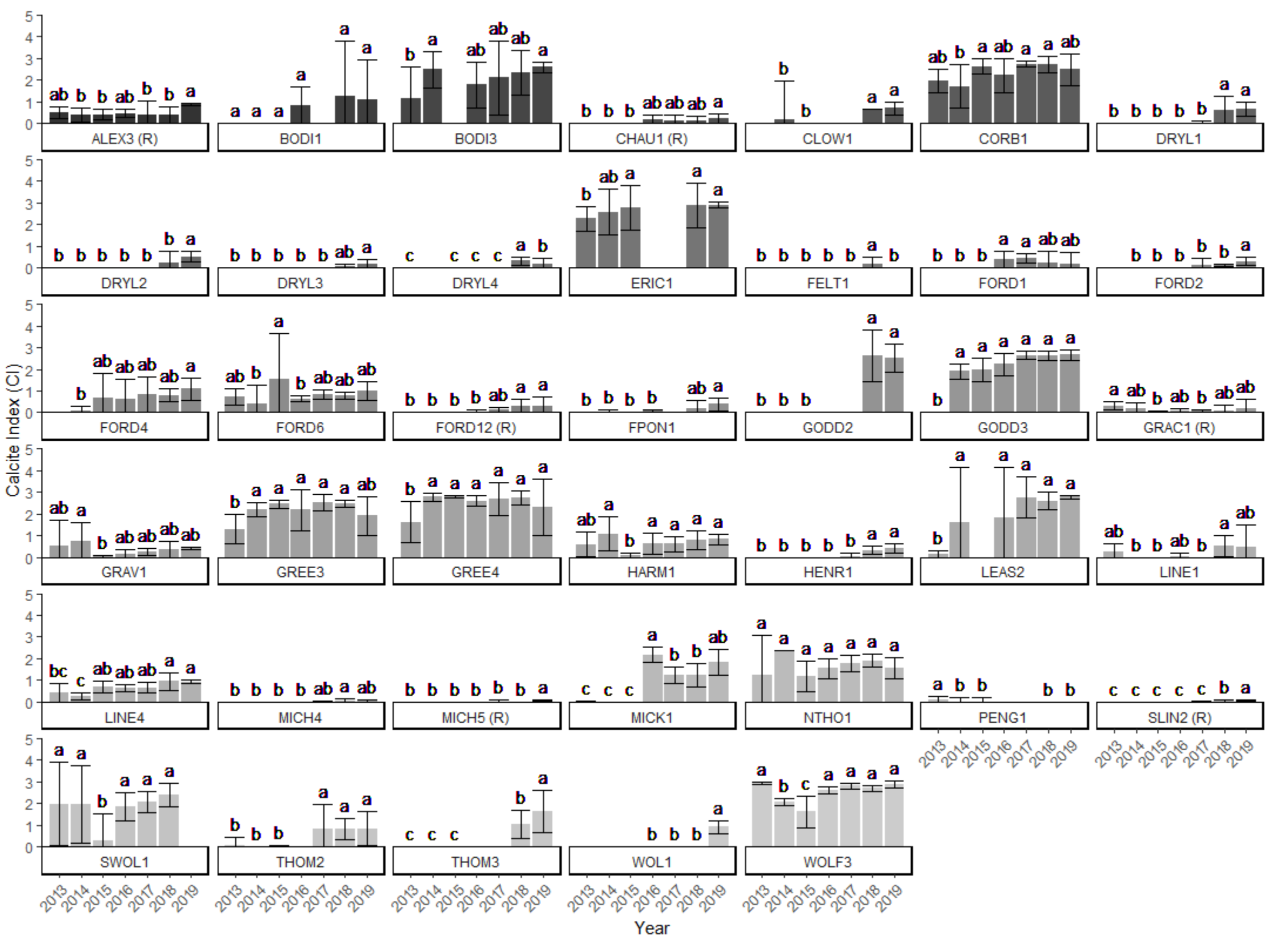

Figure 6. Bar graphs showing results of significant one-way ANOVA tests. Same letters on bars denotes no significant differences in mean *CI* among years, with reach.

Table 8. Summary of reaches with both significant Mann-Kendall and ANOVA results from 2013-2019.

Site	Direction of Trend*	Type (Reference or Exposed)
BODI1	Increasing	Exposed
CHAU1 (R)	Increasing	Reference
CLOW1	Increasing	Exposed
DRYL1	Increasing	Exposed
DRYL2	Increasing	Exposed
DRYL3	Increasing	Exposed
ERIC1	Increasing	Exposed
FORD12 (R)	Increasing	Reference
FORD2	Increasing	Exposed
FORD4	Increasing	Exposed
FPON1	Increasing	Exposed
GODD3	Increasing	Exposed
HENR1	Increasing	Exposed
LEAS2	Increasing	Exposed
LINE4	Increasing	Exposed
MICH4	Increasing	Exposed
SLIN2 (R)	Increasing	Reference
SWOL1	Increasing	Exposed
THOM3	Increasing	Exposed

(R) indicates reference site
*Direction of trend is in reference to Mann-Kendall test

3.3.3 Effect of Habitat Unit

ANOVA results suggest that habitat unit had no significant effect on mean *CI* (p=0.54) (Figure 7). This suggests that sampling an individual habitat unit should return a similar *CI* value to a *CI* values obtained from sampling the entire reach. The 10 reaches that met the habitat diversity criteria presented above (i.e. containing at least one of each of glide, pool, or riffle units) included Corbin Creek Reach 1, Dry Creek (LCO) Reach 1, Fording River Reach 6, Harmer Creek Reach 1, Lake Mountain Creek Reach 1, Michel Creek reaches 4/5, Smith Pond Outlet Reach 1, and Swift Creek Reach 1. These reaches represent both mainstem and tributaries, exposed and reference (e.g., MICH5), a spatial distribution covering CMO to FRO, and include a range of reach mean *CI* values ranging from 0.02 to 2.47. We are confident that the data used in this analysis are accurately describing the relationship between *CI* and habitat unit, while accounting for potential bias based on morphologic variability.

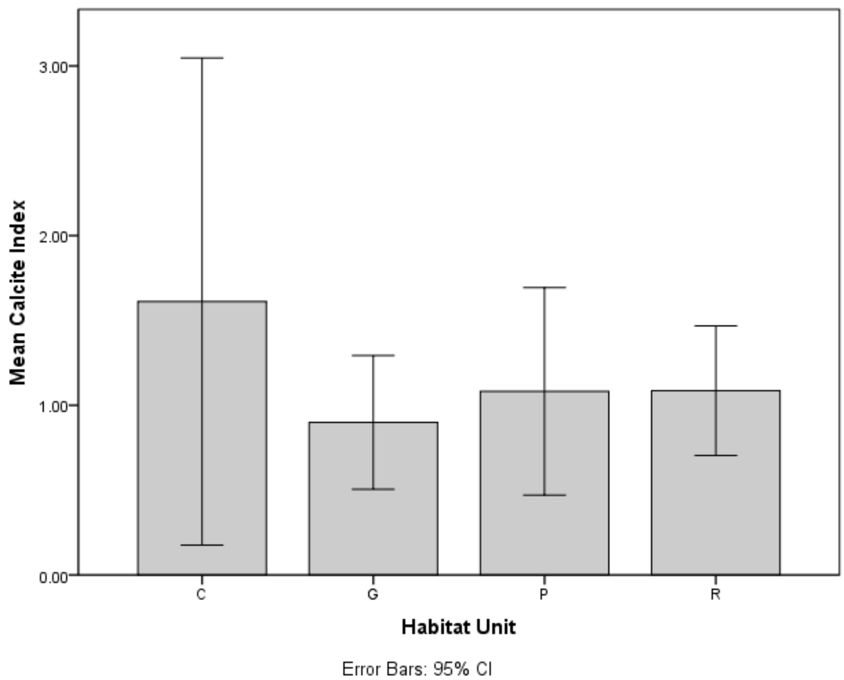

Figure 7: **Habitat unit versus mean *CI* for 2019 calcite sampling efforts. C, G, P, and R represent cascade, glide, pool, and riffle habitat types respectively**

3.3.4 Inter-program comparisons

Inter-program comparison results show variable differences in mean *CI* values between Regional Calcite and Biological sampling Programs within the same reach. Relative differences in *CI* values ranged from 0.03-2.36 (Table 9). The mean difference was 0.46. A total of 31 reaches had sites in common between both monitoring Programs. A total of 16 reaches (52%) varied by >0.25 *CI* and 11 of these (32%) varied by >0.5. Results suggest that there is acceptable similarity (i.e. <0.25 CI difference) between monitoring results across programs in approximately half of the reaches assessed (Figure 8).

Differences were further investigated by plotting concretion (CI_c) and presence (CI_p). Concretion scores agreed quite well between Programs (Figure 9). For example, KILM1 showed a higher degree of difference that warrants further investigation. Assessing calcite presence only suggests that presence/absence is the component that produces the larger differences in *CI* between Programs (Figure 10). Dry Creek (LCO) was a stream of notable difference between programs. Here the Biological results suggest 100% calcite presence while the regional data are low-moderate (CI_p = 0.03-0.65). In the same watershed, Biological results reported East Tributary to have 100% calcite presence, while regional Program reported calcite on 1% rocks sampled. Sampling at each of these locations was closely correlated spatially between Programs. The cause of these discrepancies is unknown and further investigation into the potential sources of these inter-program differences is recommended (Section 5). Other notable differences were at Kilmarnock Creek, Elk River Reach 10, and again within Michel Creek (reported in 2018). Maps showing site of both Programs are available in (Appendix 7).

Table 9: Relative differences in *CI* values between Regional Calcite and Biological Monitoring programs.

Reach name	Relative Difference (Regional - Biological)	Reach name	Relative Difference (Regional - Biological)
ANDY1	0.09	FORD9	0.04
CORB1	0.03	FORD12	0.70
COUT1	0.48	FPON1	0.12
DRYL1	0.35	GRAV1	0.69
DRYL3	0.84	GREE1	0.94
DRYL4	0.85	HARM1	0.18
ELKR10	0.65	HARM3	0.14
ELKR12	0.17	KILM1	2.36
ELKR8	0.09	LINE1	0.46
ERIC1	1.30	LINE4	0.07
ERIC4	0.56	MICH1	0.54
ETRI1	1.04	MICH4	0.30
FORD1	0.20	MICH5	0.06
FORD2	0.30	SLINE2	0.08
FORD5	0.12	THOM2	0.43
FORD7	0.03		

*Light grey indicates reaches with >0.25 CI difference between Programs. Dark grey indicates reaches with >0.5 CI difference between Programs.

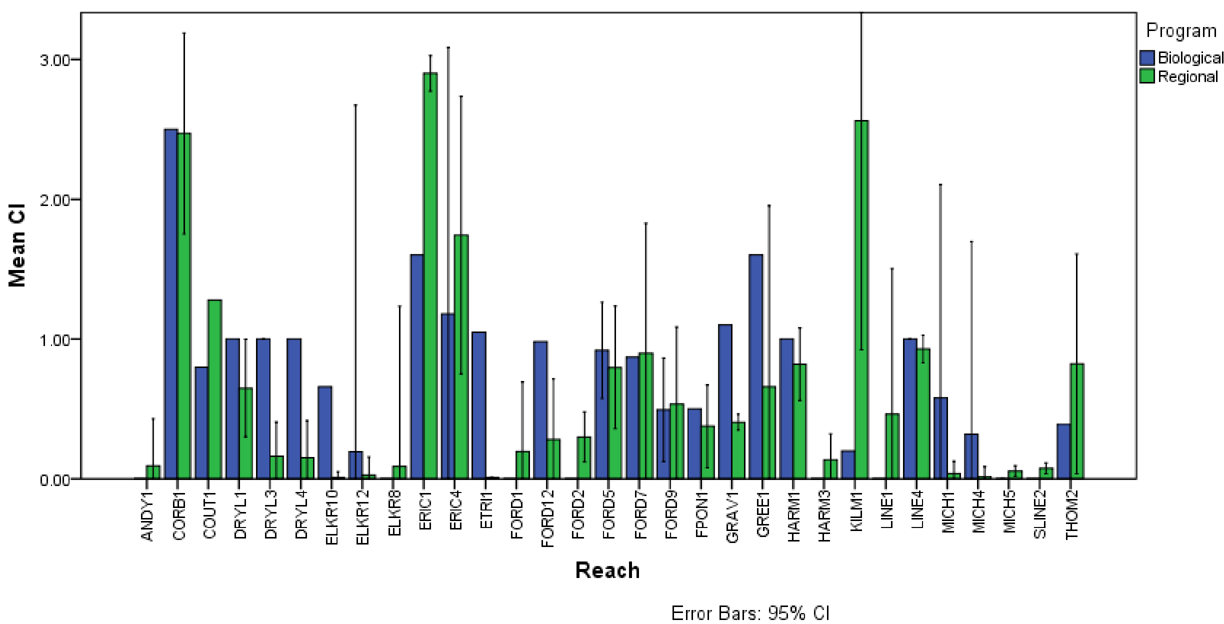

Figure 8. Inter-program comparison of common locations between regional (reach mean *CI*) and Biological (site-level *CI*). (x-axis set to maximum *CI* value of 3; bars without error bars are values from single sites within one reach).

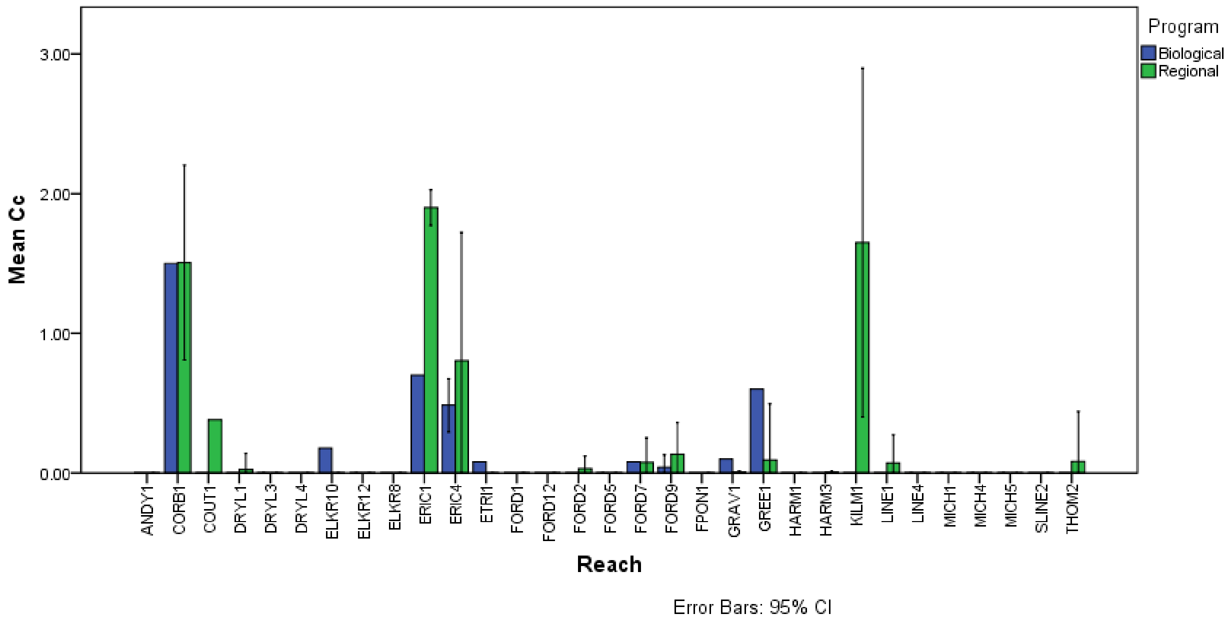

Figure 9. Inter-program comparison of common locations between regional (reach mean C_c) and Biological (site-level C_c).

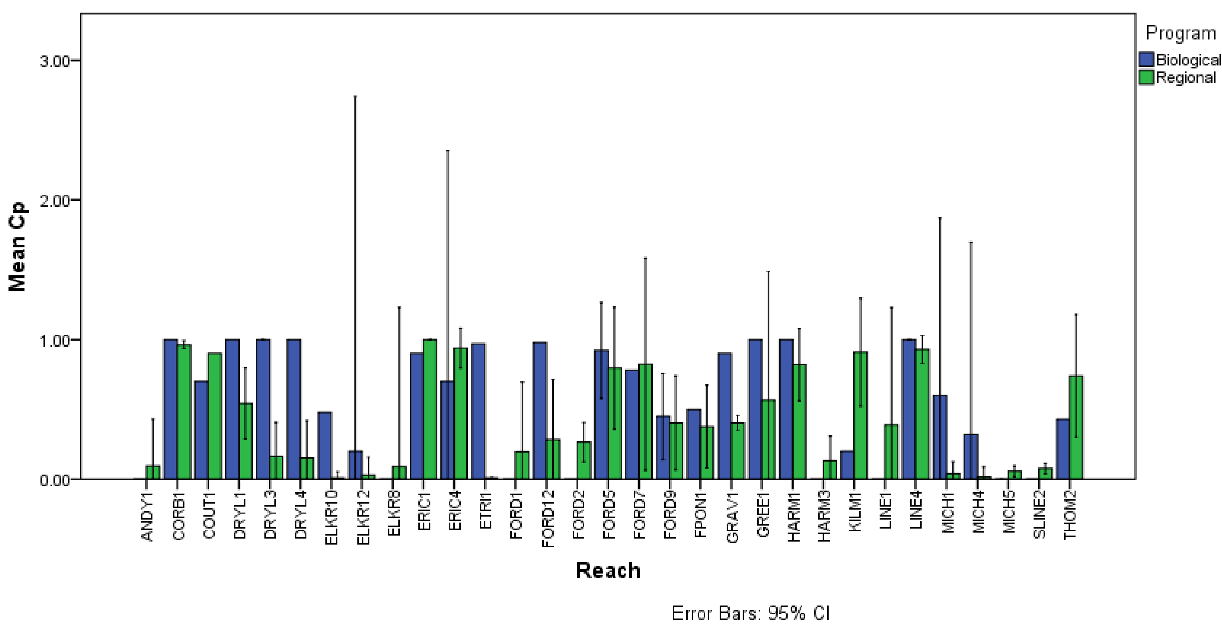

Figure 10. Inter-program comparison of common locations between regional (reach mean C_p) and Biological (site-level C_p).

4 Discussion

The 2019 Regional Calcite Monitoring Program generally followed the work plan with a total of 78 reaches and 205 sites sampled encompassing 45 stream segments. This work plan was completed using a combination of the stream segment and indicator reach approach, which has been successfully used to monitor *CI* score across the Elk Valley in previous years (Smithson et al. 2019). The largest deviation from the proposed study design came from the 33 sites that could not be sampled due to extensive ice cover from the early onset of winter conditions. These weather conditions occurred during the Regional Calcite Monitoring Program for the first time since 2013. Future years should consider beginning surveys earlier in September to decrease the likelihood of encountering deviations from historical weather patterns while remaining at a time of year similar to all previous years. It is unlikely that this affected results in a substantial way as the observed trends were generally similar to those observed from 2013-2018. The most likely impact to results was in the assessment of percentage of exposed stream kilometers, as it was almost entirely exposed tributaries that were frozen. The results showed that based on 2018 *CI* values, approximately 10 of the 20 exposed stream kilometers would have classified into 0.00-0.50 *CI* bin, but the total stream kilometers assessed would have then increased by 20 km. This is essentially the same ratio as what the assessed kilometers show, resulting in negligible change. Interpretation of the results was not thought to be impacted. Other reaches were not assessed in 2019 due to construction and safety concerns. Exposed tributaries typically classified 135 km of stream length in previous Program years, but only classified 82.9 in 2019. However, we do not consider this change to have affected the general distribution of calcite among the *CI* bins.

The statistical methods used within the 2019 report remain consistent from previous reports in effectively and accurately detecting changes in calcite distribution across stream segments and indicator reaches. Of the reaches tested, 40% (30/75) were found to have significantly increasing trends in *CI* from 2013-2019. While most of these appear accurate, some significant results are suspected as being artifacts of the data. In particular, the significant results in ERIC4 and PORT3 may be occurring as a result of increased variability introduced when transitioning from three to six sites as part of modifications to the program in 2016. However, many of the significant trends appear to be real based on lower variability observed in the data.

The general trends observed in previous years continue to document an overall increasing trend in *CI* throughout the study area. One hypothesis, that increases are in part the result of regional factors unrelated to mining (Smithson and Robinson 2017) remains plausible given that increases have been documented among both reference and exposed streams. A key regional factor under this hypothesis is the effect of the 2013 flood. However, some increases point to a second hypothesis, that calcite is increasing in some stream reaches due to increased upstream mining based on the fact that CI values in exposed streams are higher than reference areas, suggesting calcite is promoted downstream of mining. Specifically, trends in Dry Creek (LCO) may be influenced by new mining within the watershed. It is possible that both of these hypotheses are correct and that increasing trends are both the result of calcite deposition amounts returning to pre-2013 levels while being exacerbated by upstream mining. The ANCOVA assessment in this report, while reporting a non-significant interaction term, does indicate that the rates at which exposed and reference reaches are increasing, does warrant continued monitoring.

The assessment of the effect of habitat unit type indicated that *CI* is not significantly related to habitat unit. Qualitatively, reaches with higher levels of calcite are further up a watershed in reaches of higher gradient and therefore more cascade/riffle habitat. From this, the assessment needed to be limited to reaches that represented a diversity of habitat types to deliver results that were not biased by channel morphology. The results of this analysis repeated those from 2013, suggesting that habitat unit is not significantly related to *CI* (Robinson and MacDonald 2014).

The inter-program comparison results indicated that while similar results where produced between Programs in some areas, there are substantial differences in reach mean *CI* between the Regional Calcite Monitoring Program and Biological (i.e. RAEMP/LAEMP) Programs for some reaches. A total of 81% of 31 reaches in common showed a difference in mean *CI* greater than 25%. Part of this may be related to underlying factors in both study design and sampling effort. We have reported previously that the objectives of the Programs differ and therefore so do the lengths of sites sampled. The Regional Program samples long, multi-habitat unit sites, while the Biological Programs sample individual riffles. This may impact results, however the habitat unit assessments in this Program suggest that is not likely able to explain the magnitude of differences being observed. Results from streams such as Dry Creek (LCO), East Tributary, Michel Creek, and the Elk River suggest something in addition to habitat units sampled is contributing to the observed differences. The data suggest that the main source of these discrepancies is in the way calcite presence is being reported. Complicating this is the co-occurrence of calcite and periphyton. At low levels and initial stages of calcite formation, the sampling crew must decide if what they are observing is periphyton with small amounts of mineralization or a calcite deposit supporting growth of periphyton. The regional program established a standardized method of deciding if what the sampler collected from a rock was primarily periphyton with some mineral (potentially calcite) or calcite with some surficial periphyton. This standardized method is reviewed with crews at the start of each year. It will be important for Teck to determine if methods are being applied in a similar fashion across programs collecting calcite data. Some of the other larger differences may be explained by sampling design/methods. KILM1 is strongly mine influenced and is characterized by laminar calcite throughout areas sampled by under the Regional Program. However, KILM1 has various flow paths and there is the potential for the Biological Programs to have sampled in a location not representative of laminar calcite. ERIC1 is also heavily influenced by calcite, but accompanied with by extensive layers of moss. It may be that the Programs are interpreting the pebble count results differently when they encounter the substrate.

A total of 26 reaches were above the 0.5 CI_c SPO. Results from the Program, including streams with concretion scores above 0.5 will form part of the criteria for informing calcite management associated with section 6.1 of Permit 107517.

5 Conclusions and Recommendations

The 2019 Calcite Monitoring Program reports the results a hybrid sampling approach, which combines both reach based and stream segment approaches. This allowed for higher resolution in priority streams (e.g. impacted by calcite management, or newly exposed) while balancing field effort. Overall, this approach allowed for a customization of effort allowing for higher resolution (for key areas) and surveillance monitoring (for low potential calcite areas).

Overall, the majority of stream kilometers remain in the lowest *CI* bin (0.00 - 0.50). However, trends indicate that lower *CI* values significantly increased in both exposed mainstems and tributaries. There was also a significant increase in mainstem kilometers categorized into the 0.50 - 1.0 *CI* bin. This redistribution of mainstem kilometers appears to be driven by increases in the mainstem Fording River.

The increasing trends are occurring in both exposed and reference reaches. 2019 was also the first year that a reference tributary was in a higher calcite bin (ALEX3 at 0.86). From this, we have presented two hypotheses, both of which may be happening concurrently. The first hypothesis is that a large flood in 2013 resulted in extensive bedload movement and bank erosion introducing new material to the streams and reducing the observed amount of calcite in streams throughout the watershed and regardless of type. Under this hypothesis, the increasing trends are therefore, in part, a result of calcite deposition returning to pre-flood levels. The second hypothesis is that increasing trends are the result of increasing mine activity. Dry Creek (LCO) represents on recent opportunity to study this. However, it alone does not allow for the potential role of both hydrology and mine activity to be differentiated.

Overall, it appears that there are substantial differences between these sampling Programs that cannot be explained by habitat unit sampled. It is important to recall that the Regional Calcite Monitoring Program and the calcite index have been in use for less than 10 years. The Program has always welcomed an element of re-evaluation and modification. The inter-program differences indicate a new aspect of calcite monitoring that requires further evaluation. Through the regional program, Teck will conduct an assessment of potential sources of error in calcite monitoring, including: training, calcite presence determination, concretion reporting, reporting of less common substrates (e.g., silt, moss, and mobile/eroded pieces of calcite).

Unlike in previous years, there was a proportion of reaches (~17%) unable to be sampled due to ice cover (primarily small tributaries) which could have over-estimated the reduction of calcite in exposed tributaries. As discussed above, this deviation from the study design is not expected to have affected the results of the 2019 Regional Calcite Monitoring Program.

From these conclusions, the following recommendations are proposed for subsequent Regional Calcite Monitoring Programs:

1. Conduct a seasonal study to better understand the role of spring freshet in the degree of calcite deposition. The flood hypothesis is somewhat reliant on monitoring the response following a large flood event. However, it may be possible, and more robust, to have pre- and post-freshet to quantify effect of floods over a range of flood magnitude. This recommendation requires subsampling select reaches before freshet 2020 and again in early summer (e.g., July) to quantify the change in *CI* relative to the magnitude of freshet observed. This should be repeated for multiple years to see if a “dose-response” relationship can be derived.
2. Re-evaluate the use of the hybrid sampling approach versus returning to a complete, reach-based approach.
3. Have pre-field planning continue to include discussions with Teck’s Operations and calcite R&D division to confirm adequate spatial resolution. Additional detail in surveys

should be added to Lower Greenhills Creek and Line Creek respectively, which had antiscalant addition come online in October 2017 and October 2018, respectively.

4. Lower the Mann-Kendall alpha value of 0.10 to 0.50 for further Mann-Kendall analyses. 2020 will mark the seventh year of the Program and we suggest the ability to more accurately detect trends will be increased at this point.
5. Continue planning studies around timing that minimizes the potential impact of ice cover on streams.
6. Conduct further investigation to potential causes of inter-program differences. Field programs must be re-evaluated to ensure that established methodology is 1.) Appropriate; and, 2.) being applied in a standardized manner between crews and consultants and that appropriate training is occurring. It seems apparent that future studies must collaborate on both sampling method and study design (i.e. both Program follow identical sampling approach) to draw relevant or similar conclusions per reach, or use regional data to support all Biological Programs.
7. Discuss the value in continuing to collect habitat unit data.
8. Structure the study design to support calcite management objectives in the Elk Valley, including the development of a predictive model while continuing to collaborate with Teck's calcite management team.

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7 Appendices

Appendix 1. Summary of reach-level results by program year.

Notes:

- Grey shading indicate significant Mann-Kendall (2013-2019)
- denotes years where calcite antiscalent treatment was active (Greenhills Creek and Line Creek)

Stream name	Reach Site Code	Site type	Block type	2013 CI	2014 CI	2015 CI	2016 CI	2017 CI	2018 CI	2019 CI
Alexander	ALEX3	Reference	Reference	0.48	0.38	0.40	0.46	0.38	0.36	0.86
Andy Good	ANDY1	Reference	Reference	0.00	0.00	0.00	0.00	0.00	0.04	0.09
Aqueduct	AQUE1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.03	0.00
Aqueduct	AQUE2	Exposed	Historical	0.00	0.00	0.00	-	-	0.00	-
Aqueduct	AQUE3	Exposed	Historical	0.00	0.00	0.00	-	-	0.14	-
Balmer	BALM1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.01	-
Bodie	BODI1	Exposed	Historical	0.00	0.00	0.00	0.79	0.23	1.22	1.09
Bodie	BODI3	Exposed	Historical	1.16	2.47	N/A	1.77	2.09	2.33	2.58
Cataract	CATA1	Exposed	Historical	3.00	3.00	3.00	3.00	3.00	2.96	-
Cataract	CATA3	Exposed	Historical	3.00	2.64	2.56	-	-	2.89	-
Chauncey	CHAU1	Reference	Reference	0.00	0.00	0.00	0.17	0.12	0.12	0.23
Clode Pond Outlet	COUT1	Exposed	Historical	0.00	1.01	1.03	1.21	0.29	1.46	1.28
Clode West Infiltration	CLOW1	Exposed	Historical	N/A	0.18	0.00	0.50	0.21	0.67	0.23
Corbin	CORB1	Exposed	Historical	1.95	1.71	2.62	2.21	2.74	2.70	2.47
Corbin	CORB2	Exposed	Historical	2.72	2.68	2.25	-	-	2.92	2.87
Dry (EVO)	DRYE1	Exposed	Historical	2.23	2.13	2.19	-	-	2.96	2.19
Dry (EVO)	DRYE3	Exposed	Historical	2.20	2.40	2.48	2.51	2.85	2.76	2.25
Dry (EVO)	DRYE4	Exposed	Historical	1.42	1.84	2.37	-	-	3.00	2.51
Dry (LCO)	DRYL1	Exposed	Recent	0.00	0.00	0.00	0.00	0.02	0.57	0.65
Dry (LCO)	DRYL2	Exposed	Recent	0.00	0.00	0.00	0.00	0.00	0.24	0.52
Dry (LCO)	DRYL3	Exposed	Recent	0.00	0.00	0.00	0.00	0.00	0.06	0.16
Dry (LCO)	DRYL4	Proposed	Recent	0.00	N/A	0.00	0.00	0.00	0.32	0.15
Eagle Pond Outlet	EPOU1	Exposed	Historical	1.90	1.31	0.58	0.20	0.25	0.21	-
East Dry Creek	ETRI1	Exposed	Historical	-	-	-	-	-	-	0.01
Elk River	ELKR8	Exposed	Historical	0.40	0.00	0.00	0.00	0.01	0.28	0.09
Elk River	ELKR9	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.07	0.08
Elk River	ELKR10	Exposed	Historical	0.00	0.00	0.00	-	-	0.03	0.01
Elk River	ELKR11	Exposed	Historical	0.00	0.00	0.00	-	-	0.00	-
Elk River	ELKR12	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Elk River	ELKR15	Reference	Reference	0.00	0.00	0.00	0.00	0.00	0.02	0.02
Erickson	ERIC1	Exposed	Historical	2.29	2.59	2.77	2.36	2.67	2.89	2.90

Erickson	ERIC2	Exposed	Historical	1.78	2.27	2.58	-	-	2.50	2.46
Erickson	ERIC3	Exposed	Historical	2.36	2.60	3.00	-	-	2.95	2.96
Erickson	ERIC4	Exposed	Historical	0.62	1.28	1.17	-	-	1.73	1.74
Feltham	FELT1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Fennelon	FENN1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.02	0.02
Fish Pond	FPON1	Exposed	Historical	0.00	0.03	0.00	0.08	0.20	0.17	0.38
Fording River	FORD1	Exposed	Historical	0.00	0.00	0.00	0.37	0.44	0.23	0.20
Fording River	FORD2	Exposed	Historical	0.00	0.00	0.00	0.00	0.10	0.13	0.30
Fording River	FORD3	Exposed	Historical	0.00	0.01	0.00	-	-	0.49	-
Fording River	FORD4	Exposed	Historical	N/A	0.05	0.66	0.60	0.84	0.80	1.09
Fording River	FORD5	Exposed	Historical	0.32	0.35	0.53	0.58	0.73	0.70	0.80
Fording River	FORD6	Exposed	Historical	0.74	0.43	1.53	0.64	0.68	0.79	0.98
Fording River	FORD7	Exposed	Historical	0.43	0.97	0.55	0.63	0.71	0.89	0.90
Fording River	FORD8	Exposed	Historical	0.31	0.49	0.48	-	-	0.61	-
Fording River	FORD9	Exposed	Historical	0.00	0.00	0.00	0.00	0.32	0.73	0.71
Fording River	FORD10	Exposed	Historical	0.00	0.00	0.00	-	-	0.63	-
Fording River	FORD11	Exposed	Historical	0.00	0.00	0.00	-	-	0.27	-
Fording River	FORD12	Reference	Reference	0.00	0.00	0.00	0.08	0.11	0.31	0.28
Gardine	GARD1	Exposed	Historical	0.29	0.70	0.32	0.14	0.60	0.64	0.50
Gate	GATE2	Exposed	Historical	0.15	0.00	0.74	1.47	1.98	1.14	-
Goddard	GODD1	Exposed	Historical	0.00	0.00	0.00	0.22	0.13	0.35	0.24
Goddard	GODD2	Exposed	Historical	0.00	0.00	0.00	-	-	2.62	2.52
Goddard	GODD3	Exposed	Historical	0.00	1.90	1.97	2.22	2.64	2.62	2.66
Grace	GRAC1	Reference	Reference	0.31	0.20	0.05	0.09	0.06	0.10	0.19
Grace	GRAC2	Reference	Reference	0.15	0.10	0.10	-	-	0.06	-
Grace	GRAC3	Reference	Reference	N/A	0.00	0.00	-	-	0.00	-
Grassy	GRAS1	Exposed	Historical	0.00	0.09	0.00	0.04	0.29	0.25	0.38
Grave	GRAV1	Exposed	Historical	0.54	0.72	0.02	0.14	0.24	0.37	0.41
Grave	GRAV2	Exposed	Historical	0.23	0.21	0.00	-	-	0.14	-
Grave	GRAV3	Reference	Reference	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenhills	GREE1	Exposed	Treated	0.35	1.06	0.45	0.86	1.07	0.64*	0.66*
Greenhills	GREE3	Exposed	Historical	1.30	2.22	2.46	2.18	2.55	2.49	1.91
Greenhills	GREE4	Exposed	Historical	1.62	2.78	2.80	2.61	2.68	2.74	2.32

Harmer	HARM1	Exposed	Historical	0.58	1.08	0.07	0.64	0.61	0.80	0.82
Harmer	HARM3	Exposed	Historical	0.15	0.28	0.01	0.12	0.03	0.08	0.14
Harmer	HARM4	Exposed	Historical	0.17	0.70	0.17	-	-	0.35	-
Harmer	HARM5	Exposed	Historical	0.19	0.56	0.22	-	-	0.31	-
Henretta	HENR1	Exposed	Historical	0.00	0.00	0.00	0.00	0.04	0.32	0.40
Henretta	HENR3	Exposed	Historical	0.00	0.00	0.00	-	-	0.00	-
Kilmamock	KILM1	Exposed	Historical	2.16	1.64	1.97	2.59	2.77	2.30	2.56
Lake Mountain	LMOU1	Exposed	Historical	0.00	0.33	0.00	0.15	0.18	0.39	0.88
Leask	LEAS2	Exposed	Historical	0.13	1.60	0.24	1.82	2.76	2.60	2.79
Lindsay	LIND1	Exposed	Historical	0.19	0.26	0.19	0.19	0.15	0.19	-
Line	LINE1	Exposed	Treated	0.27	0.00	0.00	0.03	0.00	0.52	0.46*
Line	LINE2	Exposed	Treated	0.00	0.00	0.00	-	-	0.45	-
Line	LINE3	Exposed	Treated	0.00	0.00	0.00	-	-	0.66	-
Line	LINE4	Exposed	Treated	0.40	0.27	0.68	0.65	0.66	0.95	0.93
Line	LINE7	Reference	Reference	0.00	0.00	0.00	0.00	0.00	0.01	-
Michel	MICH1	Exposed	Historical	0.31	0.00	0.00	0.00	0.00	0.08	0.04
Michel	MICH2	Exposed	Historical	0.05	0.05	0.00	N/A	0.08	0.02	-
Michel	MICH3	Exposed	Historical	0.00	0.00	0.00	-	-	0.01	-
Michel	MICH4	Exposed	Historical	0.00	0.00	0.00	0.00	0.01	0.06	0.02
Michel	MICH5	Reference	Reference	0.00	0.00	0.00	0.00	0.01	0.00	0.06
Mickelson	MICK1	Exposed	Historical	0.01	0.00	0.00	2.18	1.25	1.23	1.84
Mickelson	MICK2	Exposed	Historical	0.05	0.00	0.03	-	-	1.37	-
Milligan	MILL1	Exposed	Historical	0.00	0.00	0.00	N/A	0.36	1.77	-
Milligan	MILL2	Exposed	Historical	0.00	0.00	0.00	1.07	1.06	1.18	-
North Thompson	NTHO1	Exposed	Historical	1.24	2.39	1.18	1.54	1.78	1.91	1.56
North Wolfram	NWOL1	Exposed	Historical	0.70	1.33	0.21	0.14	2.59	2.44	-
Otto	OTTO1	Exposed	Historical	0.30	0.22	0.10	0.23	0.14	0.59	-
Otto	OTTO3	Exposed	Historical	0.02	0.02	0.00	-	-	0.05	-
Pengally	PENG1	Exposed	Historical	0.09	0.02	0.02	0.00	0.00	0.00	-
Porter	PORT1	Exposed	Historical	0.92	0.84	0.85	0.75	0.74	0.85	0.85
Porter	PORT3	Exposed	Historical	2.78	1.94	1.94	1.46	1.62	1.65	1.44
Qualteri	QUAL1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	N/A	-
Sawmill	SAWM1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.01	0.00

Sawmill	SAWM2	Exposed	Historical	0.38	0.54	0.62	0.00	0.00	0.00	-
SITE18	SITE18	Exposed	Historical	N/A	N/A	N/A	N/A	3.00	3.00	2.93
Six Mile	SIXM1	Exposed	Historical	0.80	1.19	0.49	0.65	0.95	0.92	-
Smith Pond Outlet	SPOU1	Exposed	Historical	2.61	2.24	2.24	3.00	2.60	2.45	2.00
South Line	SLINE2	Reference	Reference	0.00	0.00	0.00	0.00	0.00	0.04	0.08
South Pit	SPIT1	Exposed	Historical	0.00	0.00	1.14	1.59	2.49	2.77	2.43
South Wolfram Creek	SWOL1	Exposed	Historical	1.97	1.97	0.28	1.86	2.05	2.38	2.96
Spring	SPRI1	Exposed	Historical	0.20	0.11	0.11	0.12	0.13	0.14	0.05
Stream 02	STR02	Exposed	Historical	N/A	N/A	N/A	N/A	0.68	0.72	-
Stream 14	STR14	Exposed	Historical	N/A	N/A	N/A	N/A	0.00	0.40	-
Swift	SWIF1	Exposed	Historical	2.58	2.18	2.39	2.43	2.45	1.69	
Swift	SWIF2	Exposed	Historical	0.00	1.04	0.82	-	-	1.12	-
Thompson	THOM2	Exposed	Historical	0.08	0.00	0.01	N/A	0.83	0.81	1.88
Thompson	THOM3	Exposed	Historical	0.00	0.00	0.00	-	-	1.04	1.63
Thresher	THRE1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.03	-
Unnamed South of Sawmill	USOS1	Exposed	Historical	0.00	0.00	0.00	0.00	0.00	0.00	-
Willow North	WILN2	Exposed	Recent	N/A	N/A	0.00	0.00	0.00	0.00	-
Willow South	WILS1	Exposed	Recent	N/A	N/A	0.00	0.00	0.00	0.00	-
Wolf	WOL1	Reference	Future	N/A	N/A	0.00	0.00	0.00	0.00	0.90
Wolfram	WOLF2	Exposed	Historical	0.27	0.42	0.70	-	-	0.88	0.84
Wolfram	WOLF3	Exposed	Historical	2.93	2.07	1.60	2.61	2.80	2.69	2.86

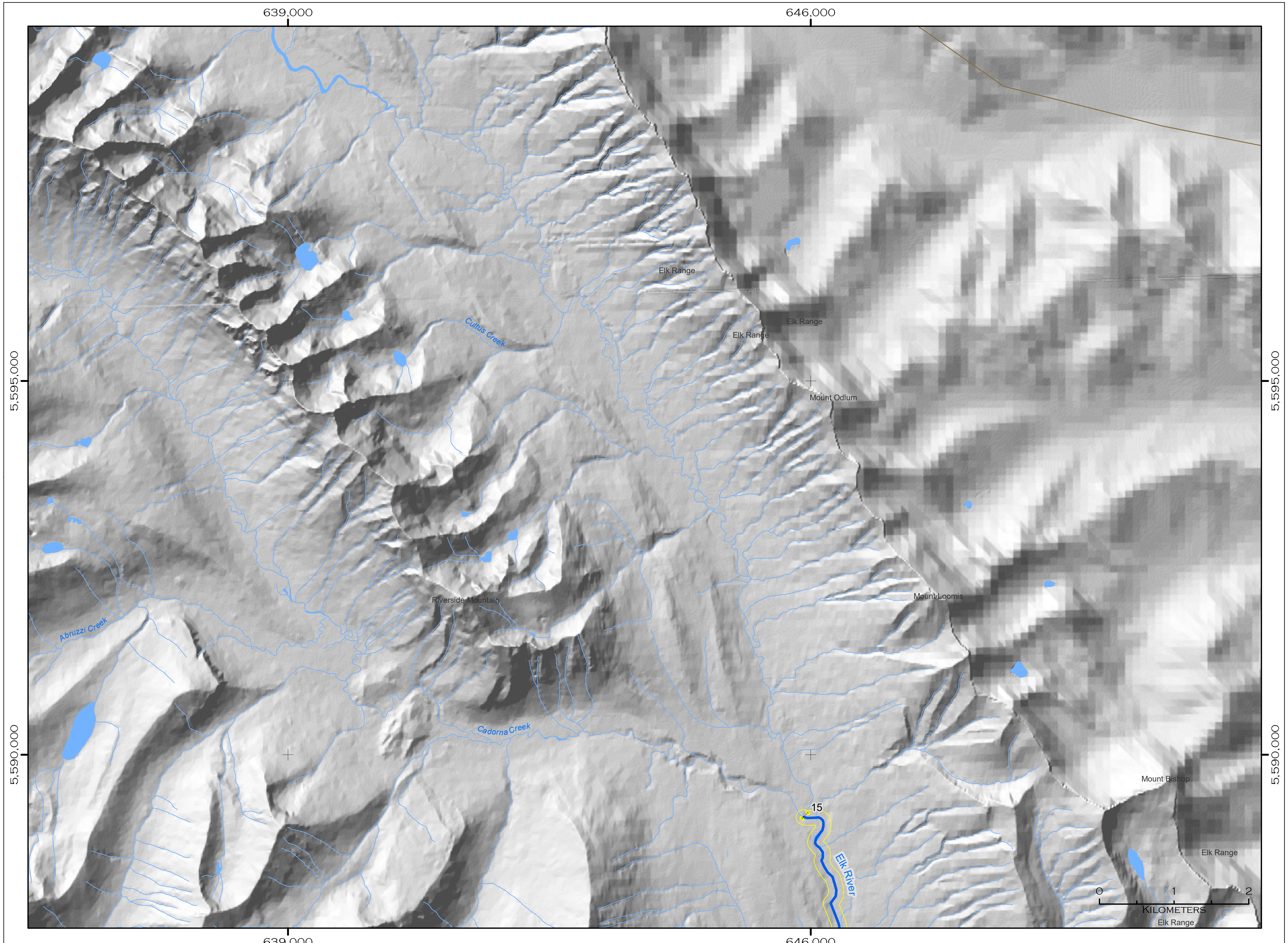
Appendix 2. 2019 Elk Valley calcite monitoring results by stream reach.

Type (exposed or reference)	Stream	Reach	Mean CI_p Score (0-1)	Mean CI_c Score (0-2)	CI (C_p+C_c)
Reference	Alexander	ALEX3	0.82	0.04	0.86
Reference	Andy Good	ANDY1	0.09	0.00	0.09
Exposed	Aqueduct	AQUE1	0.00	0.00	0.00
Exposed	Bodie	BODI1	0.73	0.36	1.09
Exposed	Bodie	BODI3	0.99	1.59	2.58
Reference	Chauncey	CHAU1	0.22	0.01	0.23
Exposed	Clode Pond Outlet	COUT1	0.90	0.38	0.23
Exposed	Clode West Infiltration	CLOW1	0.69	0.00	0.23
Exposed	Corbin	CORB1	0.96	1.51	2.47
Exposed	Corbin	CORB2	0.99	1.88	2.87
Exposed	Dry (EVO)	DRYE1	0.99	1.20	2.19
Exposed	Dry (EVO)	DRYE3	1.00	1.25	2.25
Exposed	Dry (EVO)	DRYE4	1.00	1.51	2.51
Exposed	Dry (LCO)	DRYL1	0.62	0.03	0.65
Exposed	Dry (LCO)	DRYL2	0.52	0.00	0.52
Exposed	Dry (LCO)	DRYL3	0.16	0.00	0.16
Exposed	Dry (LCO)	DRYL4	0.15	0.00	0.15
Exposed	East Dry	ETRI1	0.01	0.00	0.01
Exposed	Elk	ELKR10	0.01	0.00	0.01
Exposed	Elk	ELKR12	0.03	0.00	0.03
Reference	Elk	ELKR15	0.02	0.00	0.02
Exposed	Elk	ELKR8	0.09	0.00	0.09
Exposed	Elk	ELKR9	0.08	0.00	0.08
Exposed	Erickson	ERIC1	1.00	1.90	2.90
Exposed	Erickson	ERIC2	0.94	1.52	2.46
Exposed	Erickson	ERIC3	1.00	1.96	2.96
Exposed	Erickson	ERIC4	0.94	0.81	1.74
Exposed	Feltham	FELT1	0.00	0.00	0.00
Exposed	Fennelon	FENN1	0.02	0.00	0.02
Exposed	Fish Pond	FPON1	0.38	0.00	0.38
Exposed	Fording	FORD1	0.20	0.00	0.20
Reference	Fording	FORD12	0.28	0.00	0.28
Exposed	Fording	FORD2	0.27	0.03	0.30
Exposed	Fording	FORD4	0.98	0.12	1.09
Exposed	Fording	FORD5	0.80	0.00	0.80
Exposed	Fording	FORD6	0.92	0.06	0.98

Type (exposed or reference)	Stream	Reach	Mean CI_p Score (0-1)	Mean CI_c Score (0-2)	CI (C_p+C_c)
Exposed	Fording	FORD7	0.82	0.08	0.90
Exposed	Fording	FORD9	0.08	0.00	0.08
Exposed	Fording	FORD9	0.47	0.16	0.63
Exposed	Gardine	GARD1	0.50	0.01	0.50
Exposed	Goddard	GODD1	0.24	0.00	0.24
Exposed	Goddard	GODD2	0.98	1.54	2.52
Exposed	Goddard	GODD3	0.97	1.69	2.66
Reference	Grace	GRAC1	0.19	0.01	0.19
Exposed	Grassy	GRAS1	0.26	0.12	0.38
Exposed	Grave	GRAV1	0.40	0.00	0.41
Reference	Grave	GRAV3	0.00	0.00	0.00
Exposed	Greenhills	GREE1	0.57	0.09	0.66
Exposed	Greenhills	GREE3	0.99	0.92	1.91
Exposed	Greenhills	GREE4	1.00	1.32	2.32
Exposed	Harmer	HARM1	0.82	0.00	0.82
Exposed	Harmer	HARM3	0.13	0.00	0.14
Exposed	Henretta	HENR1	0.40	0.00	0.40
Exposed	Kilmarnock	KILM1	0.91	1.65	2.56
Exposed	Lake Mountain	LMOU1	0.88	0.00	0.88
Exposed	Leask	LEAS2	1.00	1.79	2.79
Exposed	Line	LINE1	0.39	0.07	0.46
Exposed	Line	LINE4	0.93	0.00	0.93
Exposed	Michel	MICH1	0.04	0.00	0.04
Exposed	Michel	MICH4	0.02	0.00	0.02
Reference	Michel	MICH5	0.06	0.00	0.06
Exposed	Mickelson	MICK1	0.98	0.86	1.84
Exposed	North Thompson	NTHO1	0.92	0.64	1.56
Exposed	Pengally	PENG1	0.00	0.00	0.00
Exposed	Porter	PORT1	0.85	0.00	0.85
Exposed	Porter	PORT3	0.66	0.78	1.44
Exposed	Sawmill	SAWM1	0.00	0.00	0.00
Exposed	Site18	SITE	1.00	1.93	2.93
Exposed	Smith Pond Outlet	SPOU1	0.91	1.09	2.00
Reference	South Line	SLINE2	0.08	0.00	0.08
Exposed	South Pit	SPIT1	1.00	1.43	2.43
Reference	South Wolfram	SWOL1	1.00	1.96	2.96
Exposed	Spring	SPRI1	0.05	0.00	0.05
Exposed	Swift	SWIF1	0.97	0.91	1.88
Exposed	Thompson	THOM2	0.74	0.08	0.82

Type (exposed or reference)	Stream	Reach	Mean CI_p Score (0-1)	Mean CI_c Score (0-2)	CI (C_p+C_c)
Exposed	Thompson	THOM3	0.97	0.66	1.63
Exposed	Wolf	WOL1	0.89	0.01	0.90
Exposed	Wolfram	WOLF2	0.78	0.06	0.84
Exposed	Wolfram	WOLF3	1.00	1.86	2.86

Appendix 3. Calcite distribution maps.



2019 Calcite Monitoring Program

Calcite Index

Elk Valley - Map #1

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

Railway

Teck Coal Operations

Calcite Index Per Site

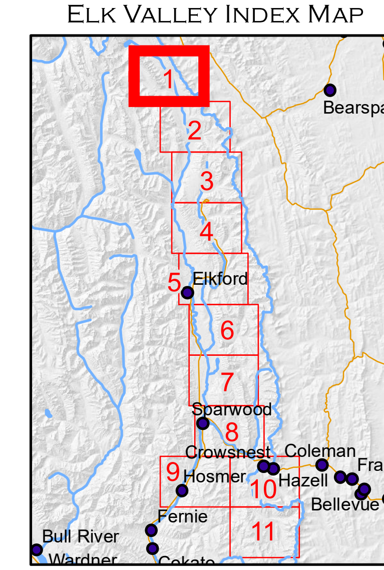
0 - 0.50

0.51 - 1.00

1.01 - 2.00

2.01 - 3.00

Elk Valley Index Map

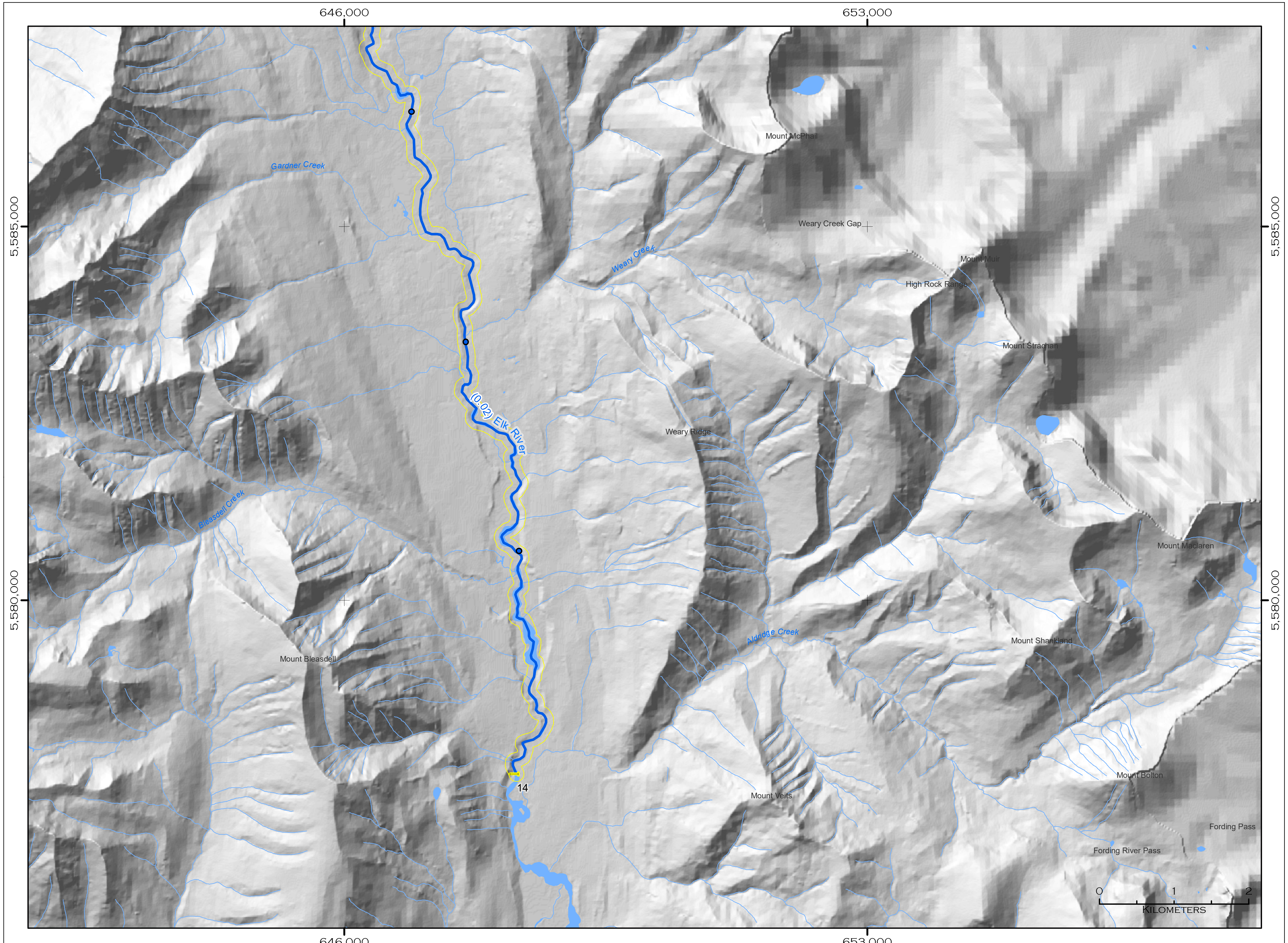


Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

Elk Valley - Map #2

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

Railway

Teck Coal Operations

Calcite Index Per Site

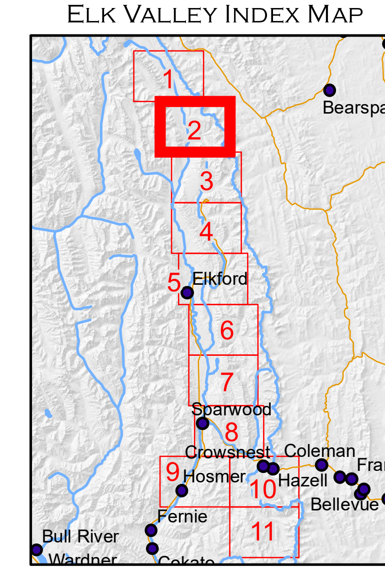
0 - 0.50

0.51 - 1.00

1.01 - 2.00

2.01 - 3.00

Elk Valley Index Map



Client:

Teck

Mapping by:

Lotic Environmental

Specialists in Freshwater Ecosystems

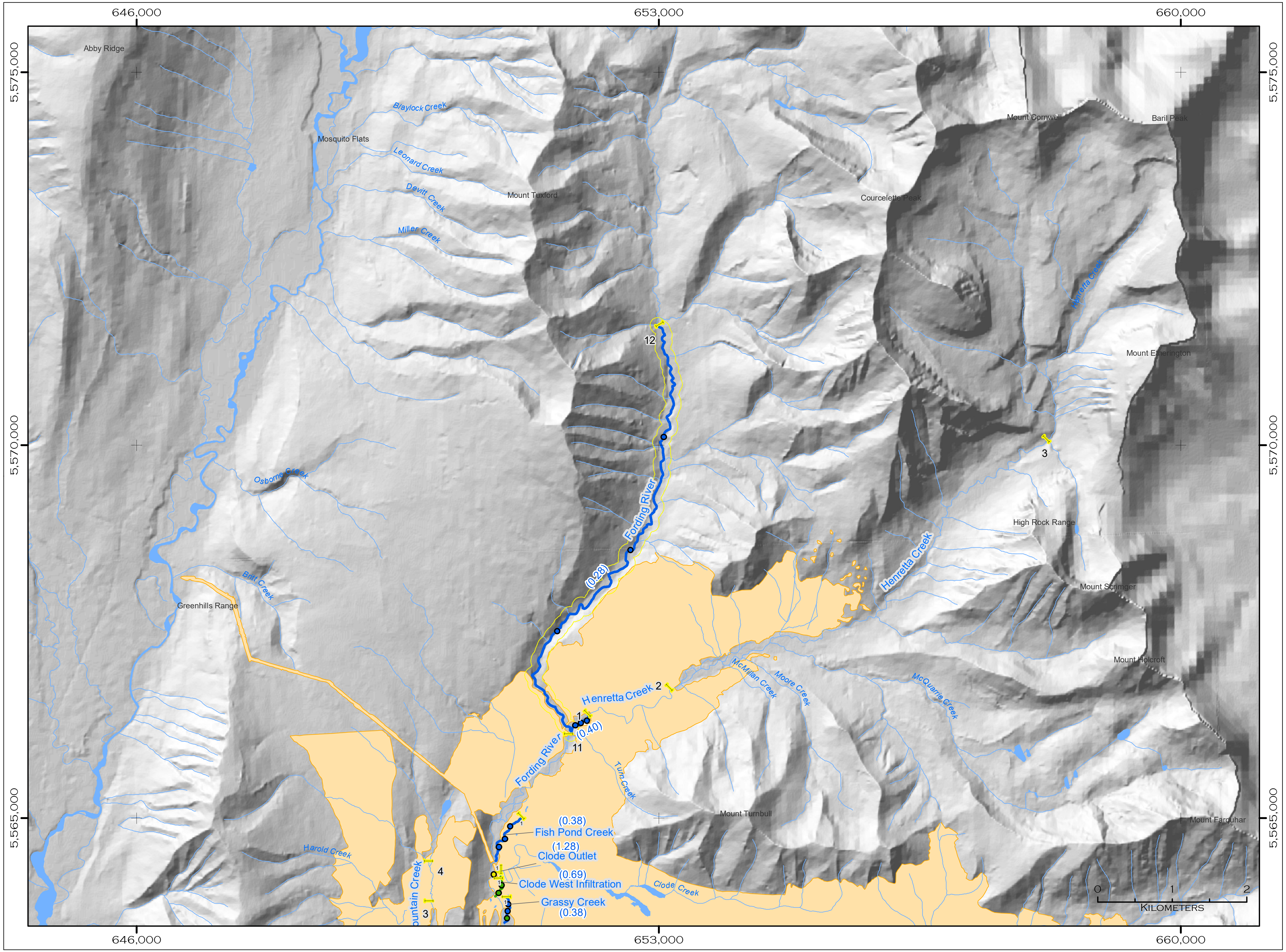
Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020

2019 Calcite Monitoring Program

Calcite Index

Elk Valley - Map #3



Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

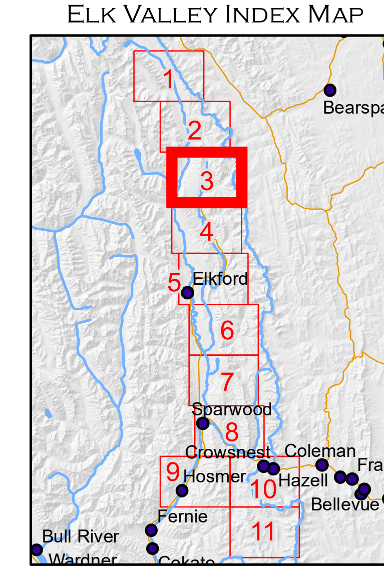
Railway

Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map

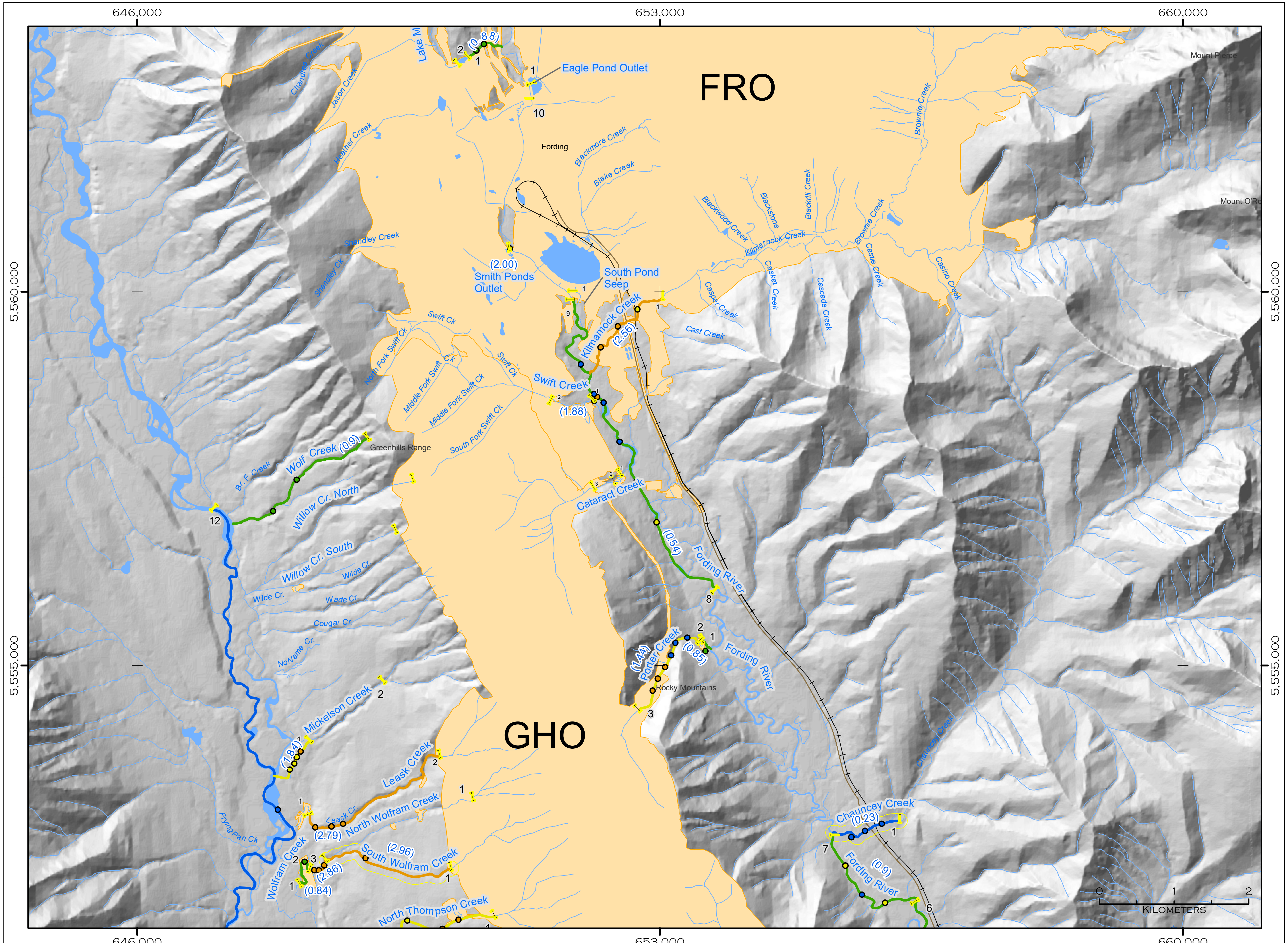


Client: Teck

Mapping by: Lotic Environmental — Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

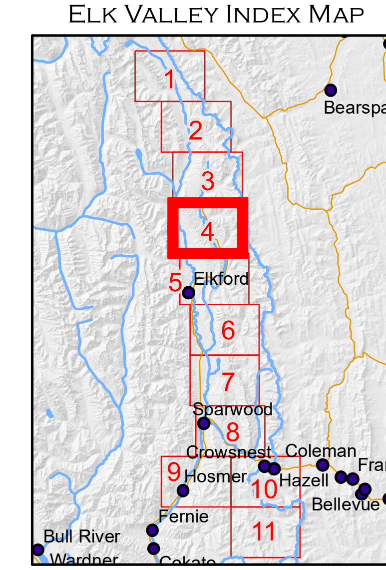
Elk Valley - Map #4

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map

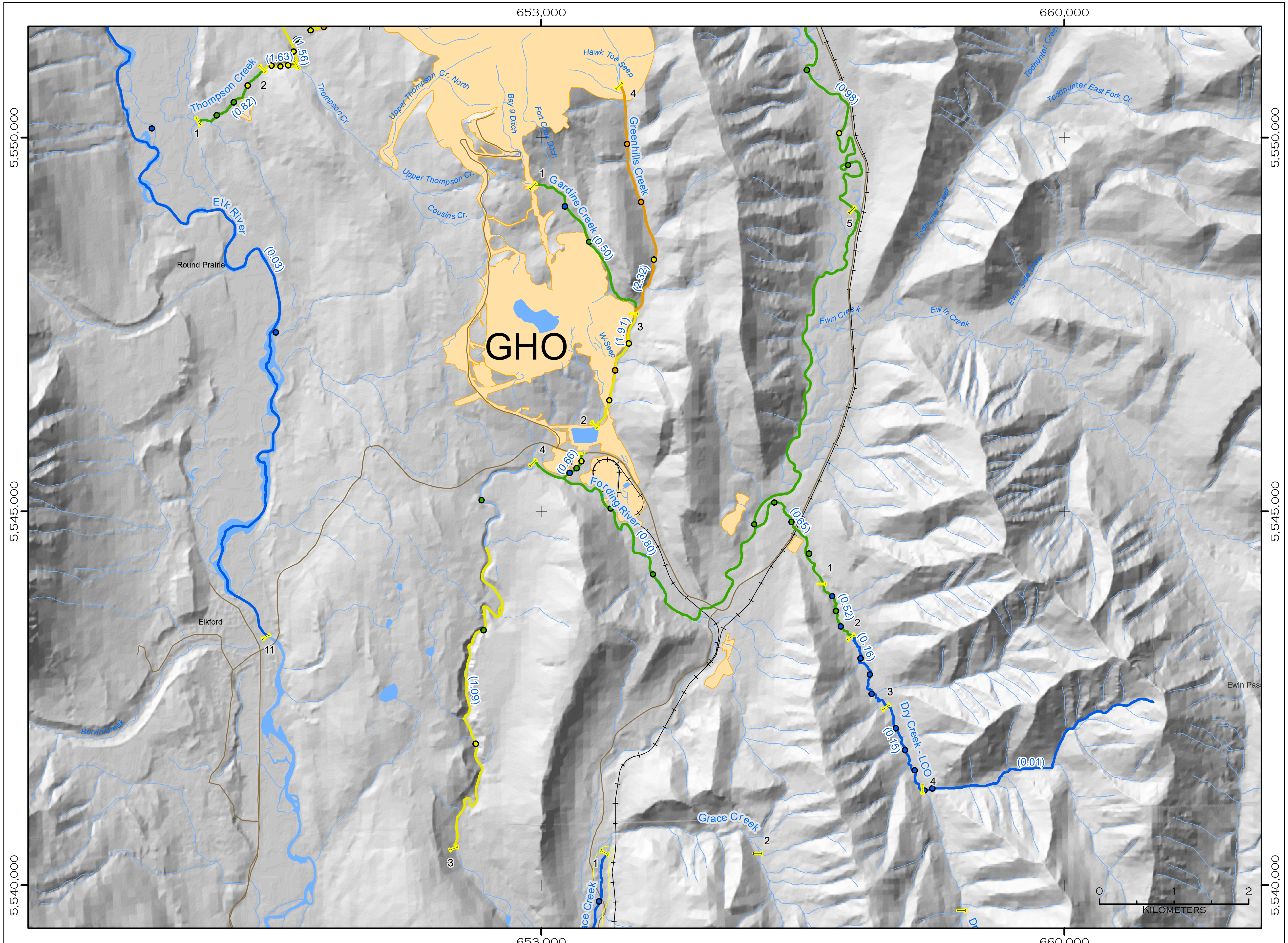


Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

Elk Valley - Map #5

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

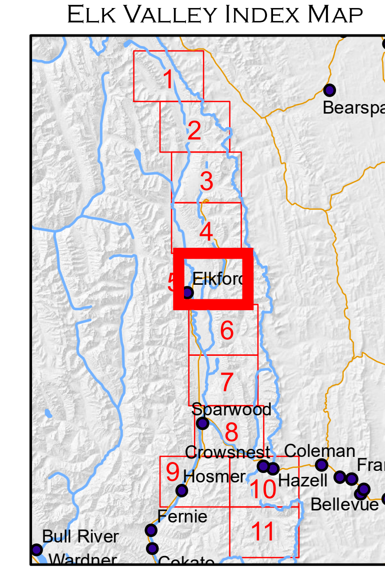
Railway

Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map

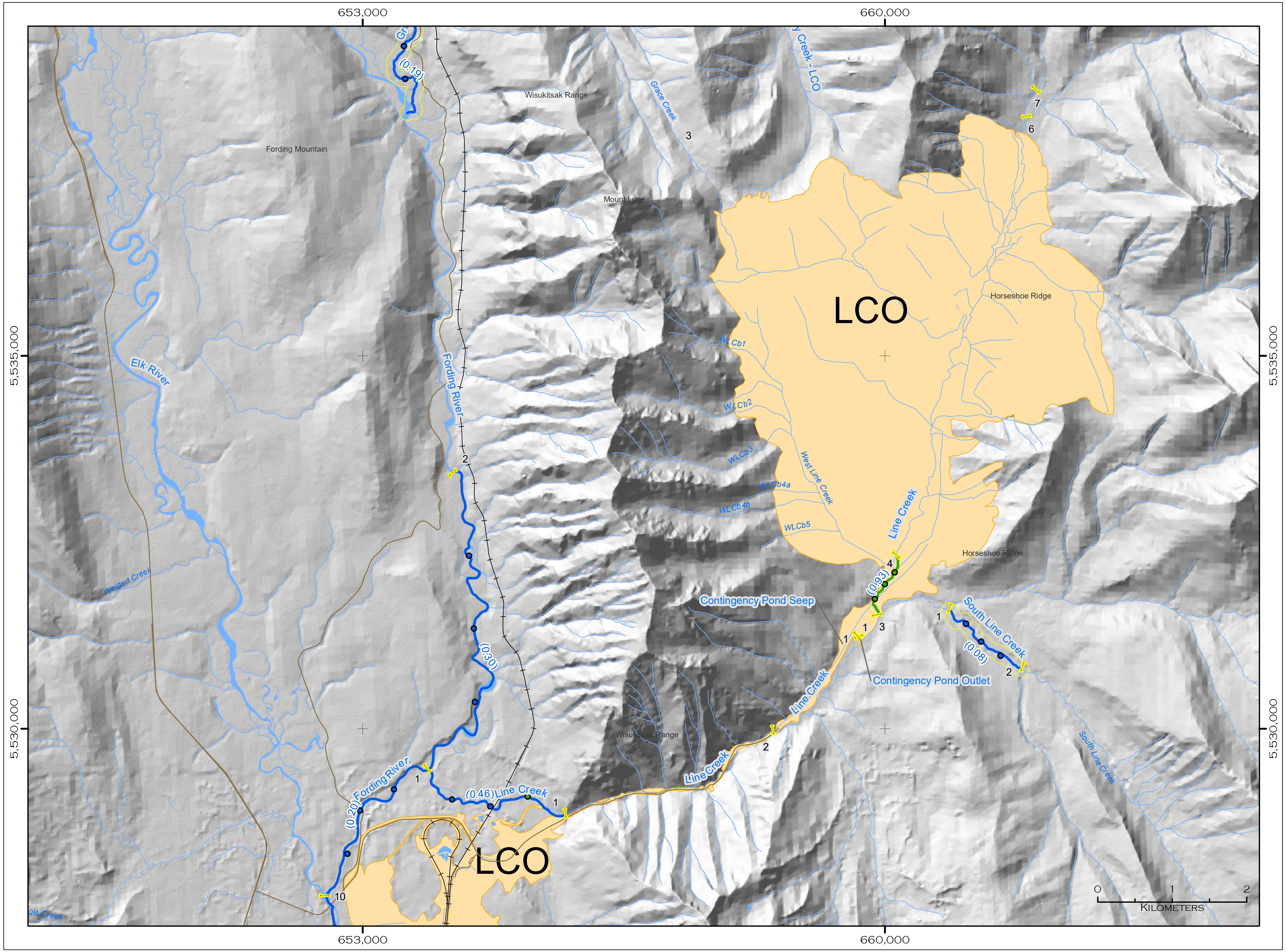


Client: Teck

Mapping by: Lotic Environmental — Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

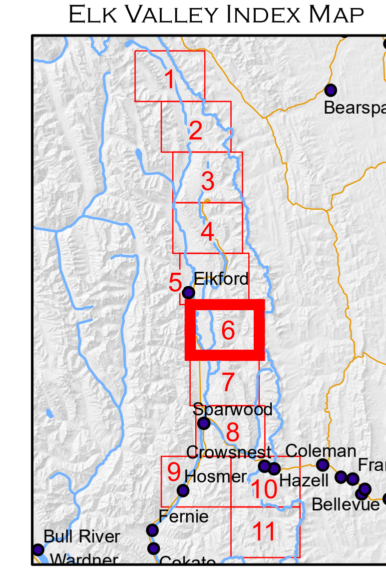
Elk Valley - Map #6

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map

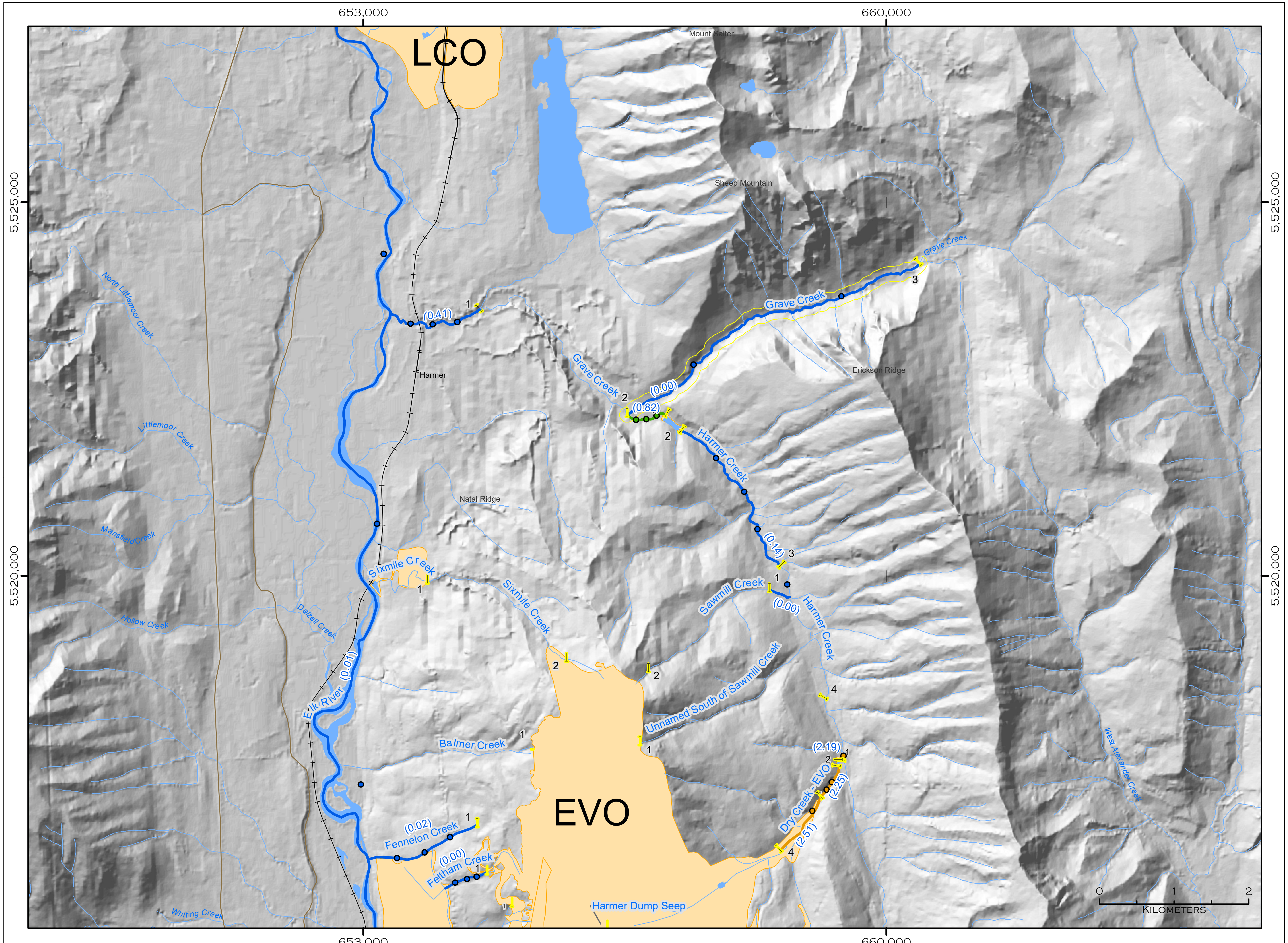


Client: Teck

Mapping by: Lotic Environmental
Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

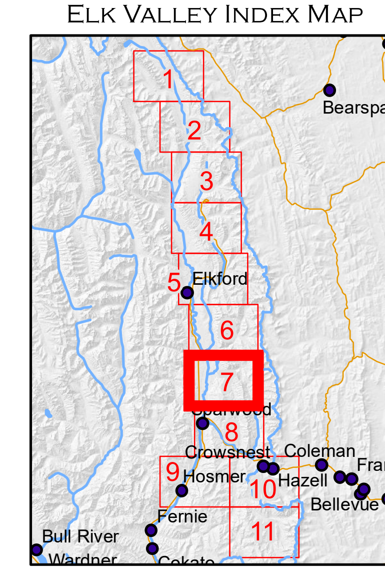
Calcite Index

Elk Valley - Map #7

Reach Break
Reference Stream
Exposed Stream (CI < 0.5)
Exposed Stream (0.5 - 1.0)
Exposed Stream (1.0 - 2.0)
Exposed Stream (CI > 2.0)
Road - Regional
Railway
Teck Coal Operations

Calcite Index Per Site
0 - 0.50
0.51 - 1.00
1.01 - 2.00
2.01 - 3.00

Elk Valley Index Map

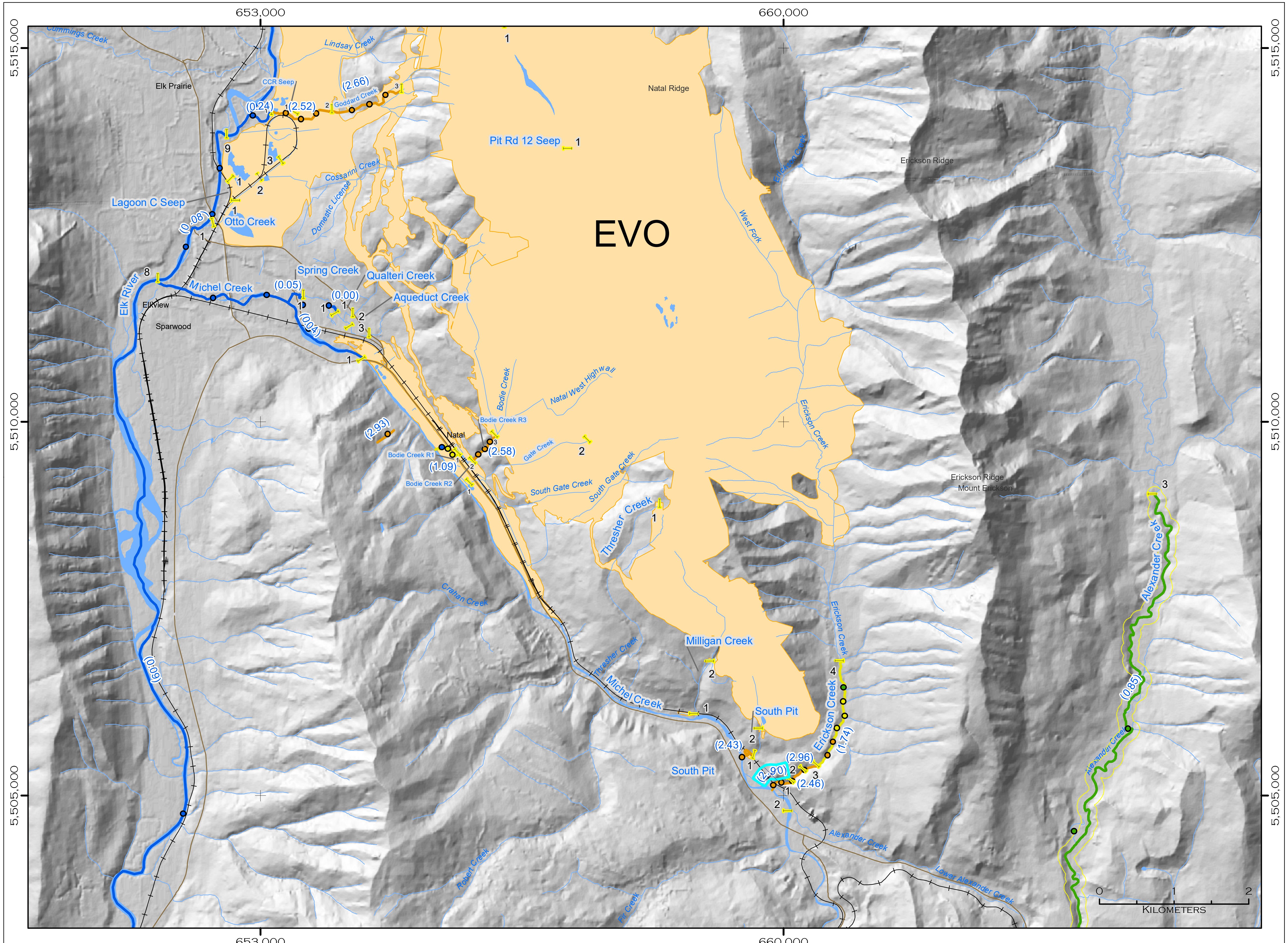


Client: Teck

Mapping by: Lotic Environmental – Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

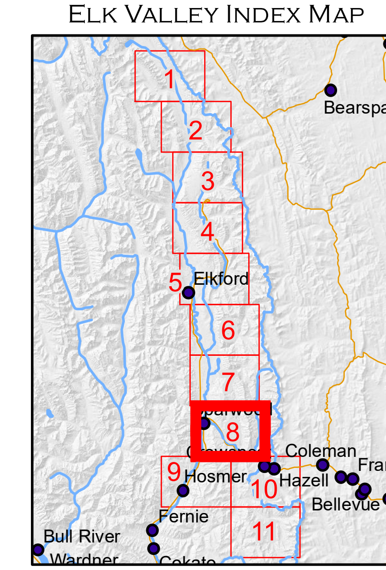
Elk Valley - Map #8

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map

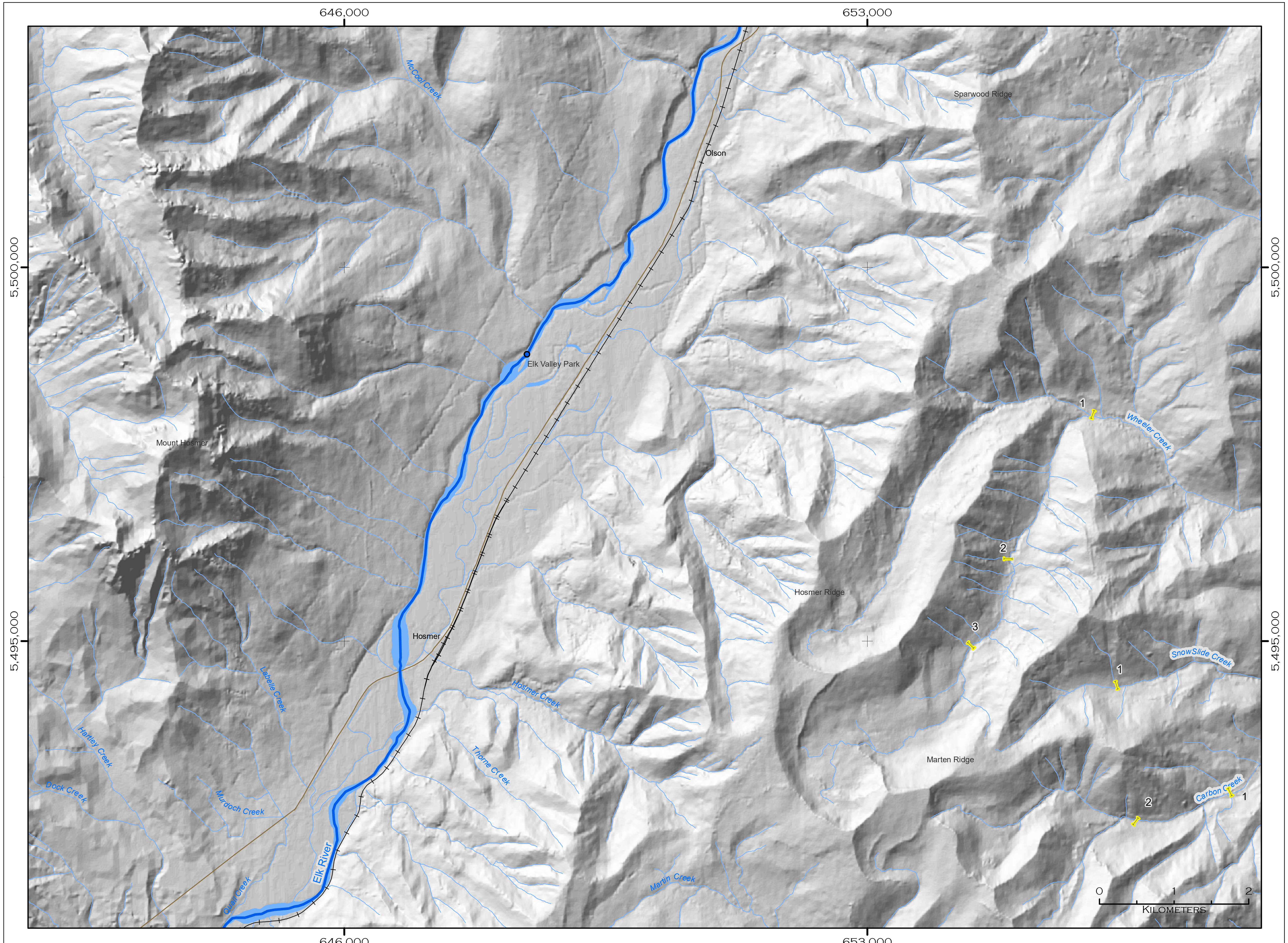


Client: Teck

Mapping by: Lotic Environmental
Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

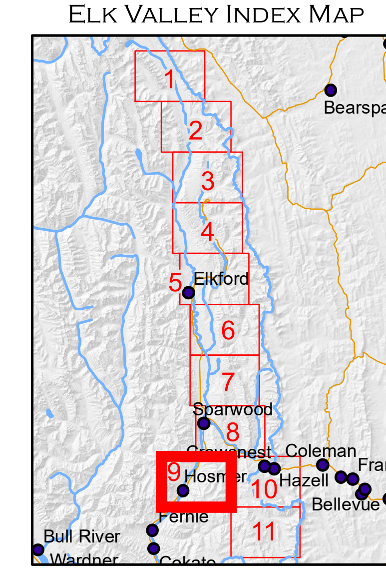
Elk Valley - Map #9

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map

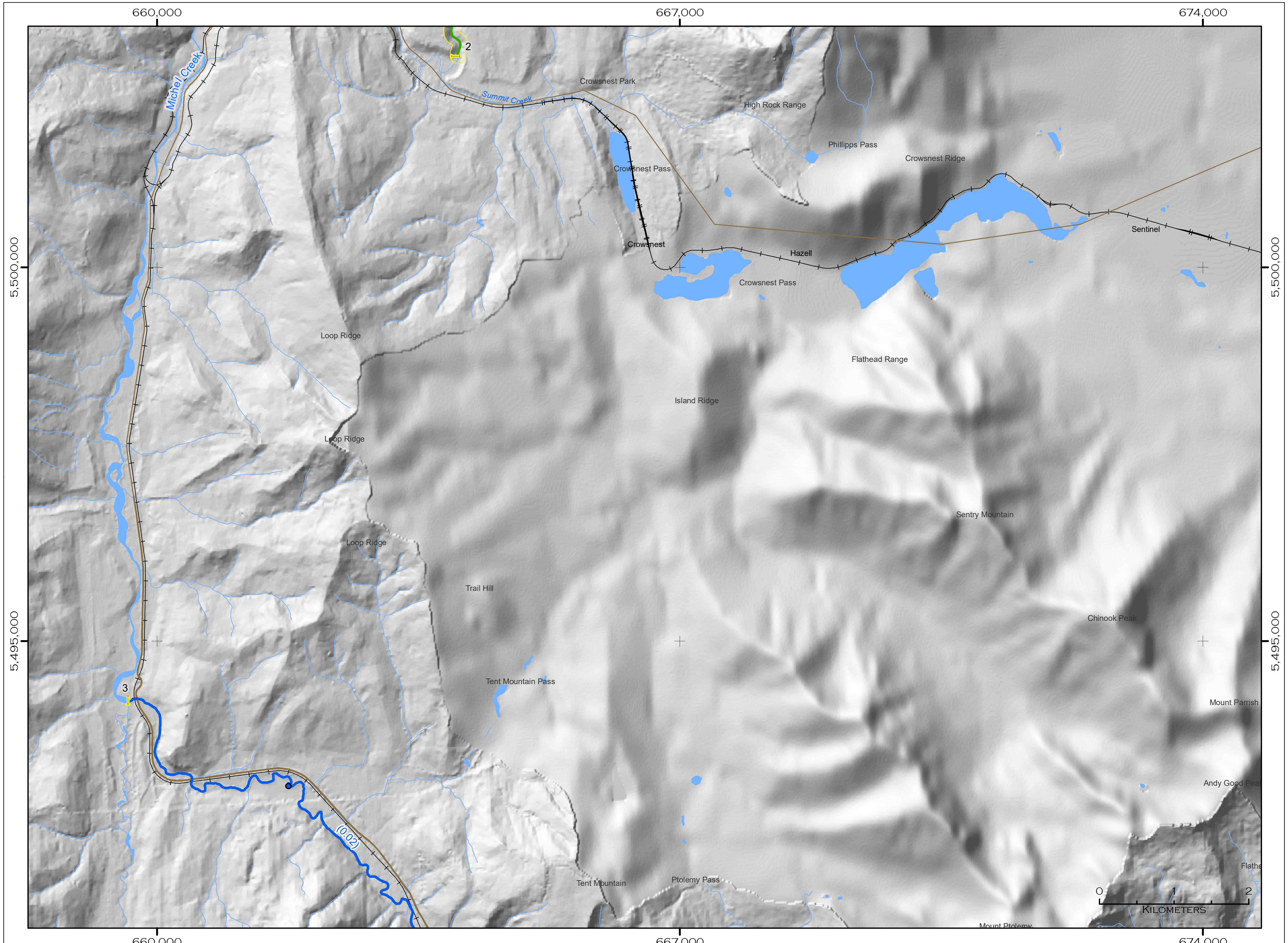


Client: Teck

Mapping by: Lotic Environmental
Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

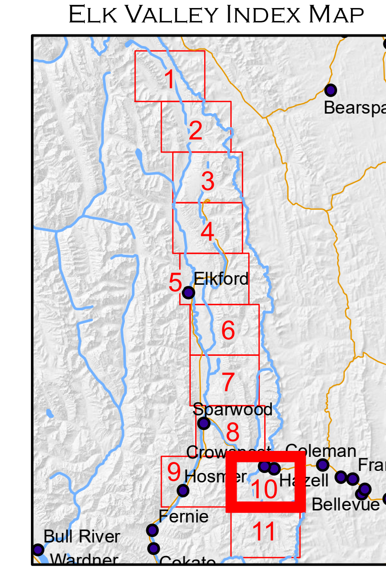
Calcite Index

Elk Valley - Map #10

Reach Break
Reference Stream
Exposed Stream (CI < 0.5)
Exposed Stream (0.5 - 1.0)
Exposed Stream (1.0 - 2.0)
Exposed Stream (CI > 2.0)
Road - Regional
Railway
Teck Coal Operations

Calcite Index Per Site
0 - 0.50
0.51 - 1.00
1.01 - 2.00
2.01 - 3.00

Elk Valley Index Map

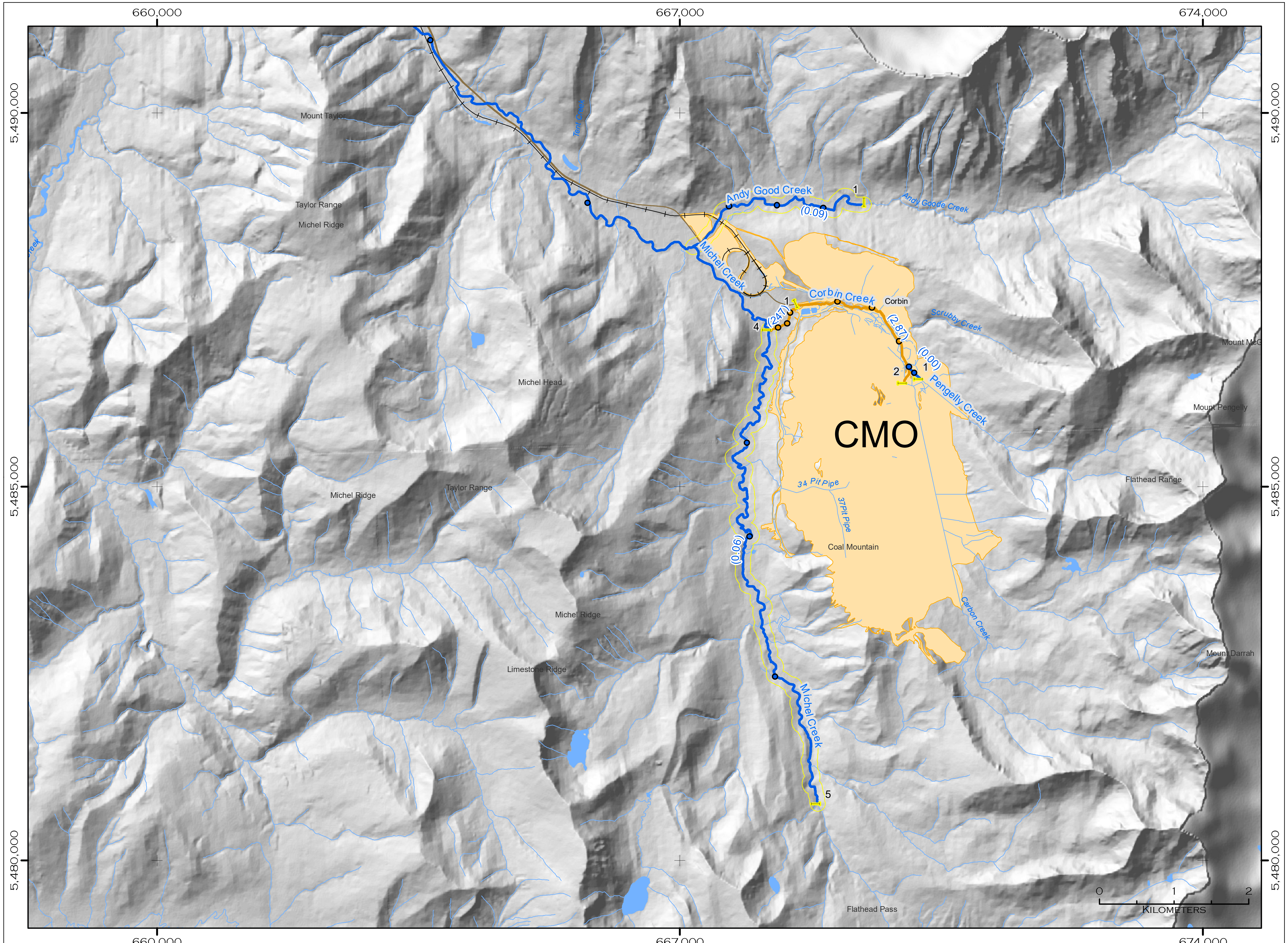


Client: Teck

Mapping by: Lotic Environmental — Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020



2019 Calcite Monitoring Program

Calcite Index

Elk Valley - Map #11

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

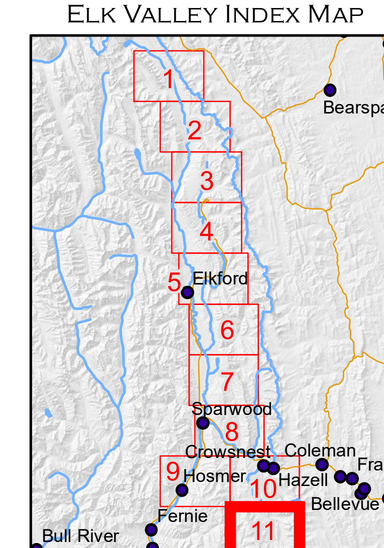
Railway

Teck Coal Operations

Calcite Index Per Site

- 0 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00

Elk Valley Index Map



Client:

Teck

Mapping by:

Lotic Environmental

Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 19, 2020

Appendix 4. 2019 Mann-Kendall results.

Reach	p_val	tau
FORD5	0.01	0.90
GODD3	0.01	0.90
LEAS2	0.02	0.81
FORD12 (R)	0.02	0.82
DRYL1	0.02	0.85
DRYL3	0.02	0.85
FORD2	0.02	0.85
HENR1	0.02	0.85
SLIN2 (R)	0.02	0.85
FPON1	0.02	0.78
SPIT1	0.02	0.78
ERIC1	0.04	0.71
BODI1	0.04	0.72
GODD1	0.04	0.72
FORD9	0.04	0.73
MICH4	0.04	0.73
GRAS1	0.05	0.68
LMOU1	0.05	0.68
ANDY1 (R)	0.06	0.72
DRYL2	0.06	0.72
ELKR9	0.06	0.72
CLOW1	0.06	0.73
FORD4	0.06	0.73
COUT1	0.07	0.62
LINE4	0.07	0.62
PORT3	0.07	-0.62
ELKR15 (R)	0.08	0.69
CHAU1 (R)	0.08	0.62
DRYE4	0.09	0.80
ERIC4	0.09	0.80
SWOL1	0.09	0.59
THOM3	0.10	0.84
FENN1	0.13	0.59
MICH5 (R)	0.13	0.59
BODI3	0.13	0.60
WOLF2	0.13	0.60
FORD7	0.13	0.52
DRYL4	0.18	0.60

ELKR12	0.21	0.53
ERIC3	0.22	0.60
CORB1	0.23	0.43
DRYE3	0.23	0.43
KILM1	0.23	0.43
THOM2	0.26	0.47
ELKR10	0.27	0.60
GODD2	0.27	0.60
FORD1	0.27	0.41
MICK1	0.29	0.39
FORD6	0.37	0.33
HARM1	0.37	0.33
SWIF1	0.37	-0.33
WOL1	0.37	0.71
LINE1	0.43	0.31
SPOU1	0.45	-0.29
AQUE1	0.45	0.36
FELT1	0.45	0.36
SAWM1	0.45	0.36
ERIC2	0.46	0.40
SITE	0.54	-0.82
GREE1	0.55	0.24
GREE3	0.55	0.24
NTHO1	0.55	0.24
WOLF3	0.55	0.24
ELKR8	0.64	0.21
PORT1	0.64	-0.21
GARD1	0.76	0.14
GRAC1 (R)	0.76	-0.14
HARM3	0.76	-0.14
CORB2	0.81	0.20
ALEX3 (R)	0.88	-0.10
SPRI1	0.88	-0.10
DRYE1	1.00	0.11
GRAV1	1.00	0.05
GREE4	1.00	-0.05
MICH1	1.00	0.06

Appendix 5. ANOVA results by reach.

Reach	P-value
ALEX3 (R)	0.04
ANDY1 (R)	0.27
BODI1	0.03
BODI3	0.02
CHAU1 (R)	0.00
CLOW1	0.01
CORB1	0.00
CORB2	0.68
DRYE3	0.26
DRYL1	0.00
DRYL2	0.00
DRYL3	0.00
DRYL4	0.00
ELKR10	0.10
ELKR12	0.46
ELKR15 (R)	0.34
ELKR8	0.22
ELKR9	0.11
ERIC1	0.01
ERIC4	0.25
FELT1	0.02
FENN1	0.56
FORD1	0.00
FORD12 (R)	0.00
FORD2	0.00
FORD4	0.02
FORD5	0.28
FORD6	0.01
FORD7	0.72
FORD9	0.07
FPON1	0.00
GARD1	0.97
GODD2	0.00

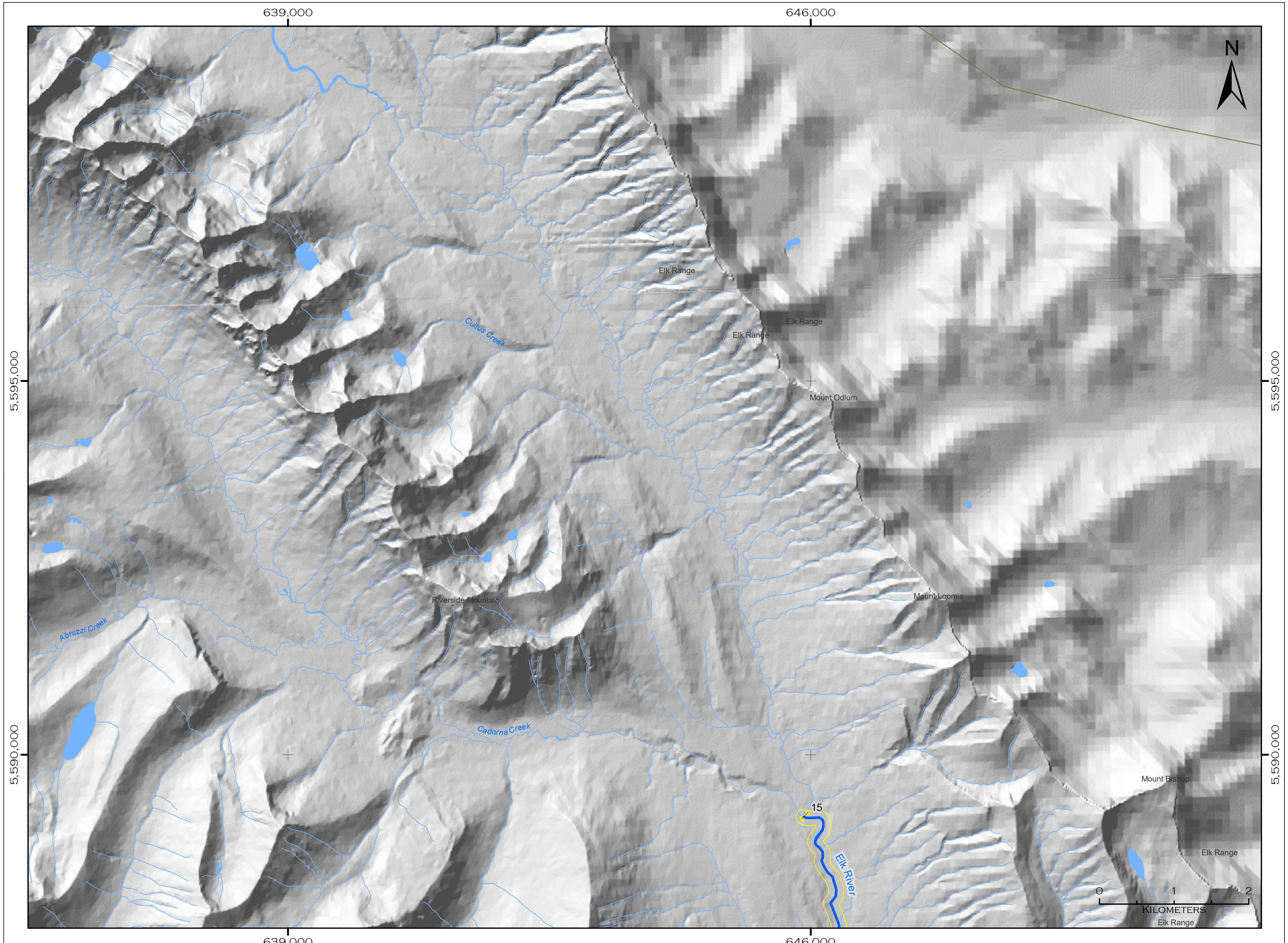
Reach	P-value
GODD3	0.00
GRAC1 (R)	0.01
GRAS1	0.14
ELKR10	
GREE1	0.77
GREE3	0.00
GREE4	0.00
HARM1	0.00
HARM3	0.14
HENR1	0.00
KILM1	0.50
LEAS2	0.00
LINE1	0.01
LINE4	0.00
LMOU1	0.09
MICH1	0.54
MICH4	0.02
MICH5 (R)	0.00
MICK1	0.00
NTHO1	0.05
PENG1	0.02
PORT3	0.70
SAWM1	0.48
SLIN2 (R)	0.00
SPIT1	0.05
SWOL1	0.00
THOM2	0.00
THOM3	0.00
WOL1	0.00
WOLF2	0.75
WOLF3	0.00

Appendix 6. Stream segment summary.

Water feature	Segment Name	Reaches Included	Indicator Reach
Alexander	ALEX_A	ALEX3	ALEX3
Andy Good	ANDY_A	ANDY1	ANDY1
Aqueduct	AQUE_A	AQUE1, AQUE2, AQUE3	AQUE1
Balmer	BALM_A	BALM1	BALM1
Bodie	BODI_A	BODI1	BODI1
	BODI_B	BODI3	BODI3
Cataract	CATA_A	CATA1, CATA3	CATA1
Chauncey	CHAU_A	CHAU1	CHAU1
Clode West Infiltration	CLOW_A	CLOW1	CLOW1
Corbin	CORB_A	CORB1, CORB2	CORB1
Clode Pond Outlet	COUT_A	COUT1	COUT1
CCR Seep	CSEE_A	CSEE1	CSEE1
Dry (EVO)	DRYE_A	DRYE1, DRYE3, DRYE4	DRYE3
Dry (LCO)	DRYL_A	DRYL1	DRYL1
	DRYL_B	DRYL2	DRYL2
	DRYL_C	DRYL3	DRYL3
	DRYL_D	DRYL4	DRYL4
Elk	ELKR_A	ELKR8	ELKR8
	ELKR_B	ELKR9, ELKR10	ELKR9
	ELKR_C	ELKR11, ELKR12	ELKR12
	ELKR_D	ELKR15	ELKR15
Eagle Pond Outlet	EPOU_A	EPOU1	EPOU1
East Dry Creek	ETRI_A	ETRI1	ETRI1
Erickson	ERIC_A	ERIC1, ERIC2, ERIC3, ERIC4	ERIC1
Feltham	FELT_A	FELT1	FELT1
Fennelon	FENN_A	FENN1	FENN1
Fording	FORD_G	FORD12	FORD12
	FORD_A	FORD1	FORD1
	FORD_B	FORD2, FORD 3	FORD2
	FORD_C	FORD4, FORD 5	FORD4
	FORD_D	FORD6	FORD6
	FORD_E	FORD7, FORD 8	FORD7
	FORD_F	FORD9, FORD 10, FORD11	FORD9
Fish Pond	FPON_A	FPON1	FPON1
Gardine	GARD_A	GARD1	GARD1
Gate	GATE_A	GATE2	GATE2
Goddard	GODD_A	GODD1	GODD1
	GODD_B	GODD3	GODD3
Grace	GRAC_A	GRAC1, GRAC2, GRAC3	GRAC1
Grassy	GRAS_A	GRAS1	GRAS1
Grave	GRAV_A	GRAV1, GRAV2	GRAV1
	GRAV_B	GRAV3	GRAV3
Greenhills	GREE_A	GREE1	GREE1
	GREE_B	GREE3	GREE3
	GREE_C	GREE4	GREE4
Harmer	HARM_A	HARM1	HARM1

Water feature	Segment Name	Reaches Included	Indicator Reach
	HARM_B	HARM3, HARM4, HARM5	HARM3
Henretta	HENR_A	HENR1, HENR3	HENR1
Kilmarnock	KILM_A	KILM1	KILM1
Leask	LEAS_A	LEAS2	LEAS2
Lindsay	LIND_A	LIND1	LIND1
Line	LINE_A	LINE1, LINE2, LINE3	LINE1
	LINE_B	LINE4	LINE4
	LINE_C	LINE7	LINE7
Lake Mountain	LMOU_A	LMOU1, LMOU3, LMOU4	LMOU1
Michel	MICH_A	MICH1, MICH2	MICH1
	MICH_B	MICH3, MICH4	MICH4
	MICH_C	MICH5	MICH5
Mickelson	MICK_A	MICK1, MICK2	MICK1
Milligan	MILL_A	MILL1, MILL2	MILL2
North Thompson	NTHO_A	NTHO1	NTHO1
North Wolfram	NWOL_A	NWOL1	NWOL1
Otto	OTTO_A	OTTO1, OTTO3	OTTO1
Pengally	PENG_A	PENG1	PENG1
Porter	PORT_A	PORT1	PORT1
	PORT_B	PORT3	PORT3
Qualteri	QUAL_A	QUAL1	QUAL1
Sawmill	SAWM_A	SAWM1	SAWM1
	SAWM_B	SAWM2	SAWM2
Site 18	SITE_18	SITE18	SITE18
Six Mile	SIXM_A	SIXM1	SIXM1
South Line	SLIN_A	SLIN2	SLIN2
South Pit	SPIT_A	SPIT1	SPIT1
	SPIT_B	SPIT2	SPIT2
Smith Pond Outlet	SPOU_A	SPOU1	SPOU1
Spring	SPRI_A	SPRI1	SPRI1
Stream #02	STR02_A	STR02	STR02
Stream #18	STR18_A	STR18	STR18
Swift	SWIF_A	SWIF1, SWIF2	SWIF1
South Wolfram Creek	SWOL_A	SWOL1	SWOL1
Thompson	THOM_A	THOM1, THOM2, THOM3	THOM2
Thresher	THRE_A	THRE1	THRE1
Unnamed South of Sawmill	USOS_A	USOS1	USOS1
Willow Cr North	WILN_A	WILN2	WILN2
Willow Cr South	WILS_A	WILS1	WILS1
Wolf Creek	WOL1_A	WOL1	WOL1
Wolfram	WOLF_A	WOLF2	WOLF2
	WOLF_B	WOLF3	WOLF3

Appendix 7. Sample site location maps for inter-program comparison of regional sites.



2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #1

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

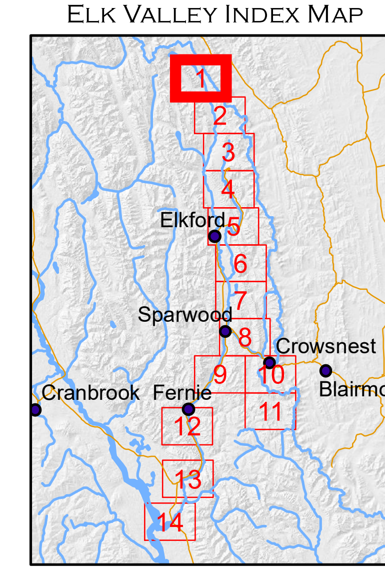
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map



Client: Teck

Mapping by: Lotic Environmental
Specialists in Freshwater Ecosystems

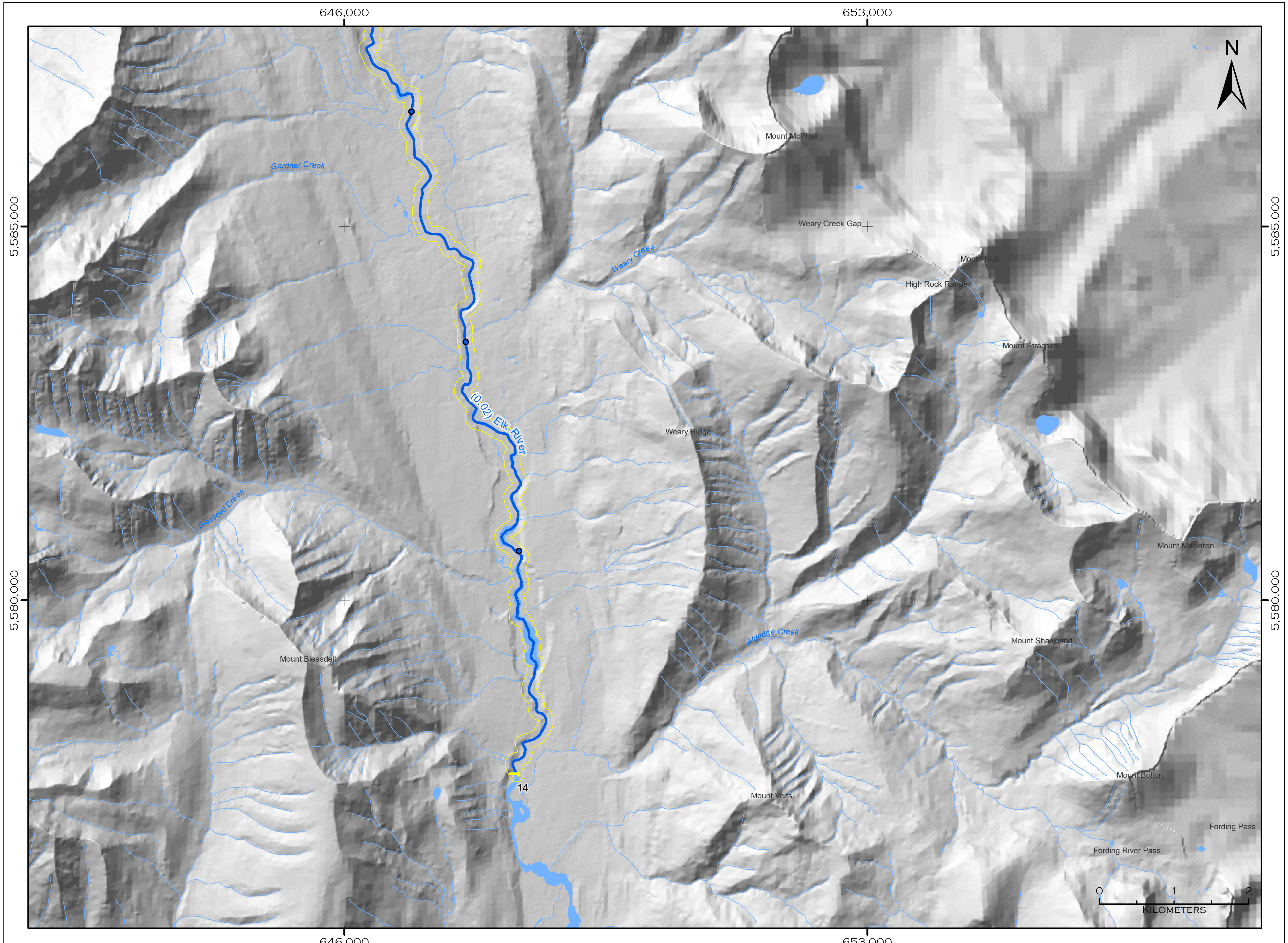
Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020

2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #2



Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

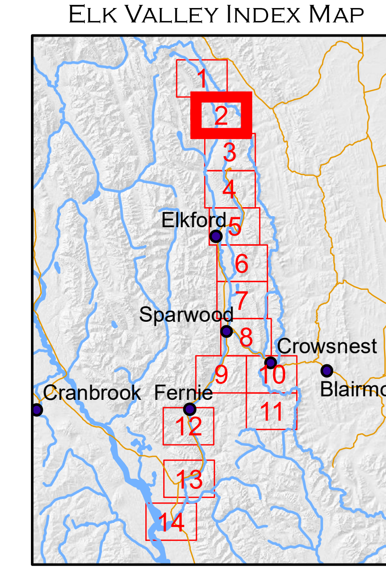
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map



Client:

Teck

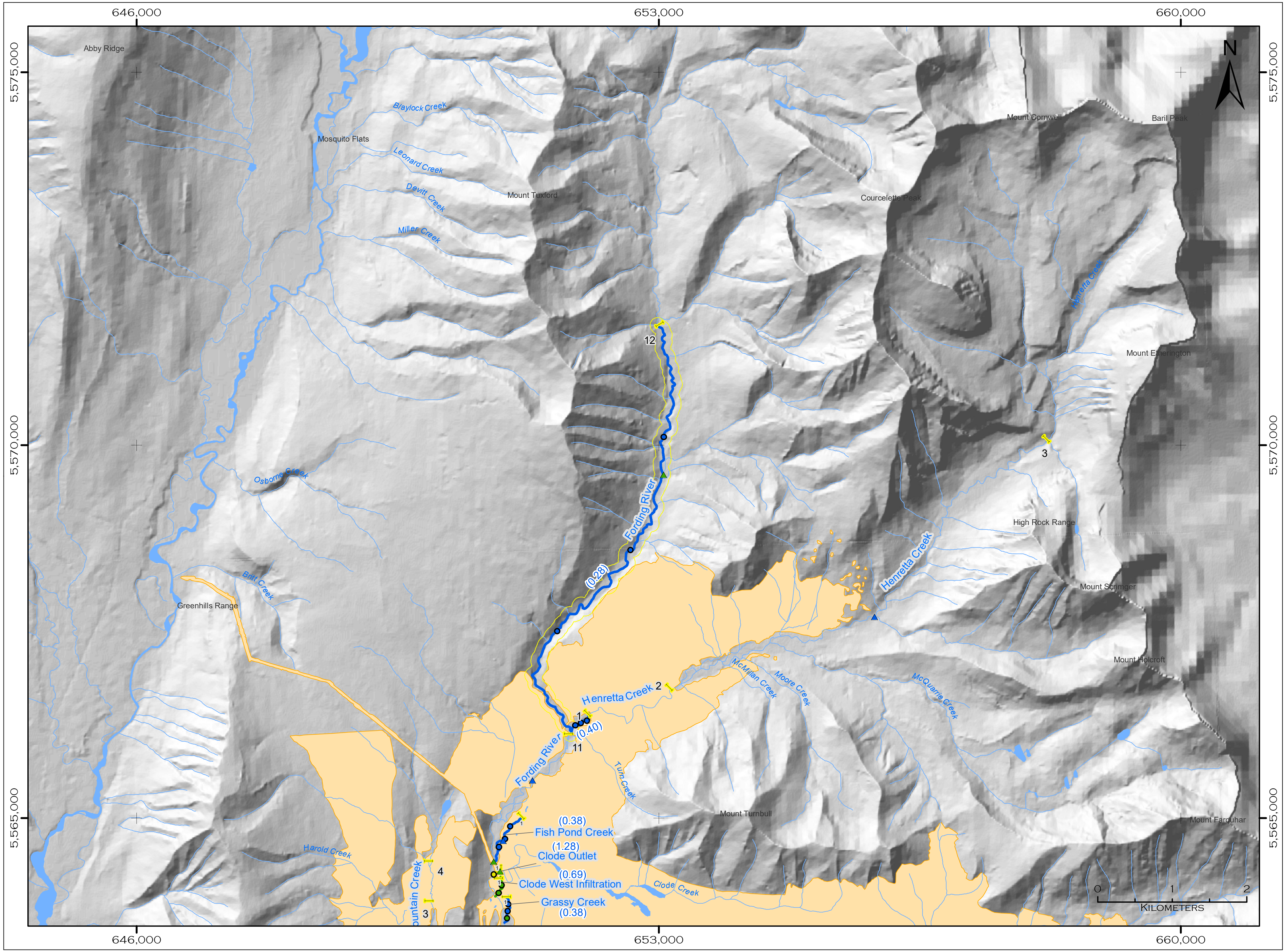
Mapping by:

Lotic Environmental

Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

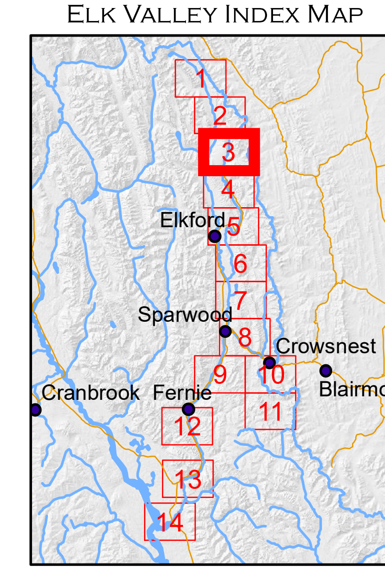
Elk Valley - Map #3

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

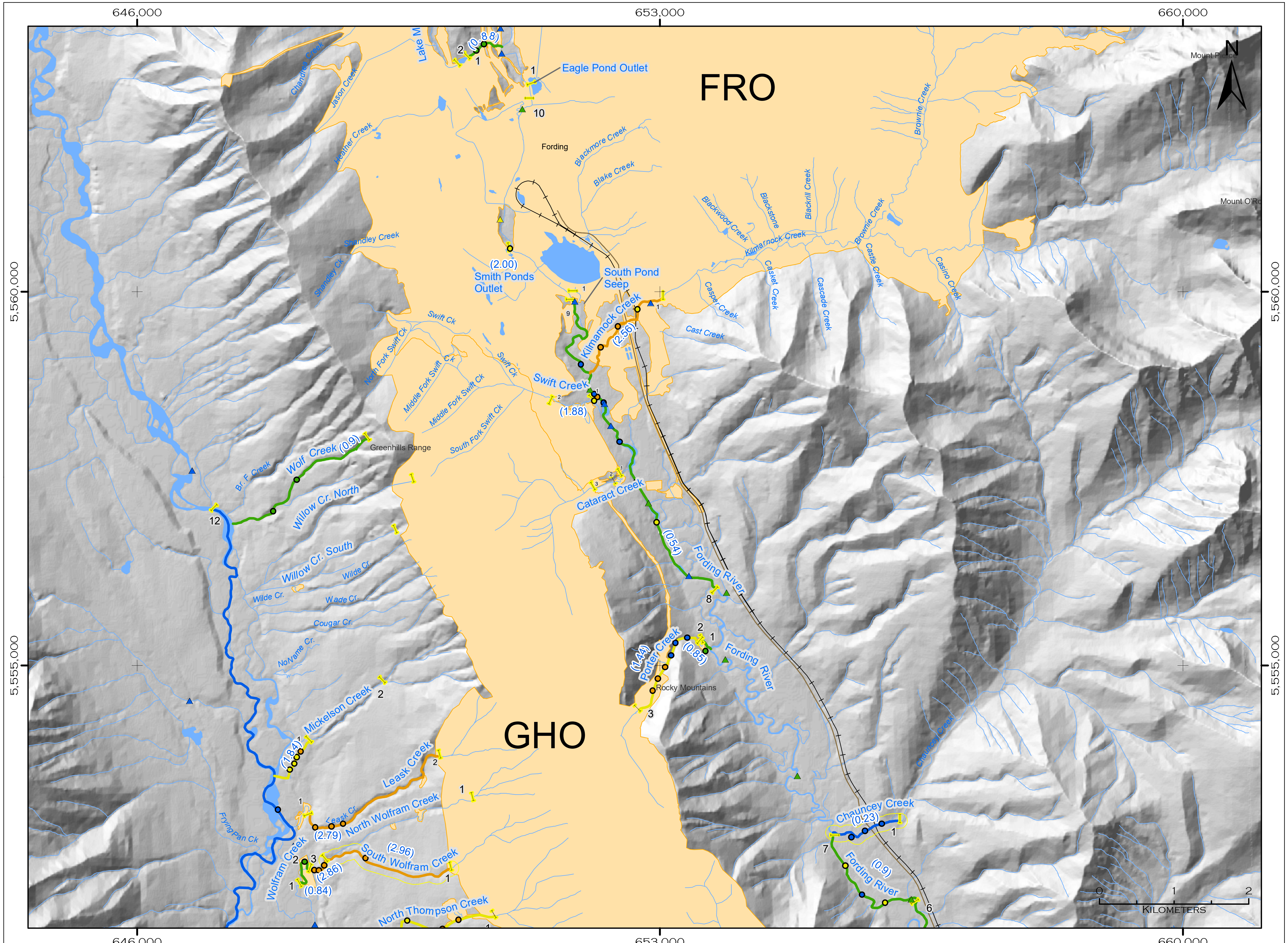


Client: Teck

Mapping by: Lotic Environmental — Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

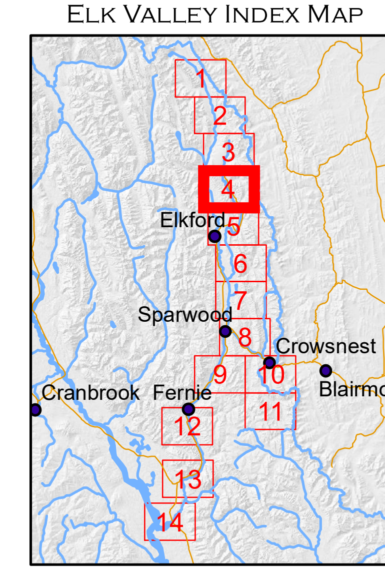
Elk Valley - Map #4

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

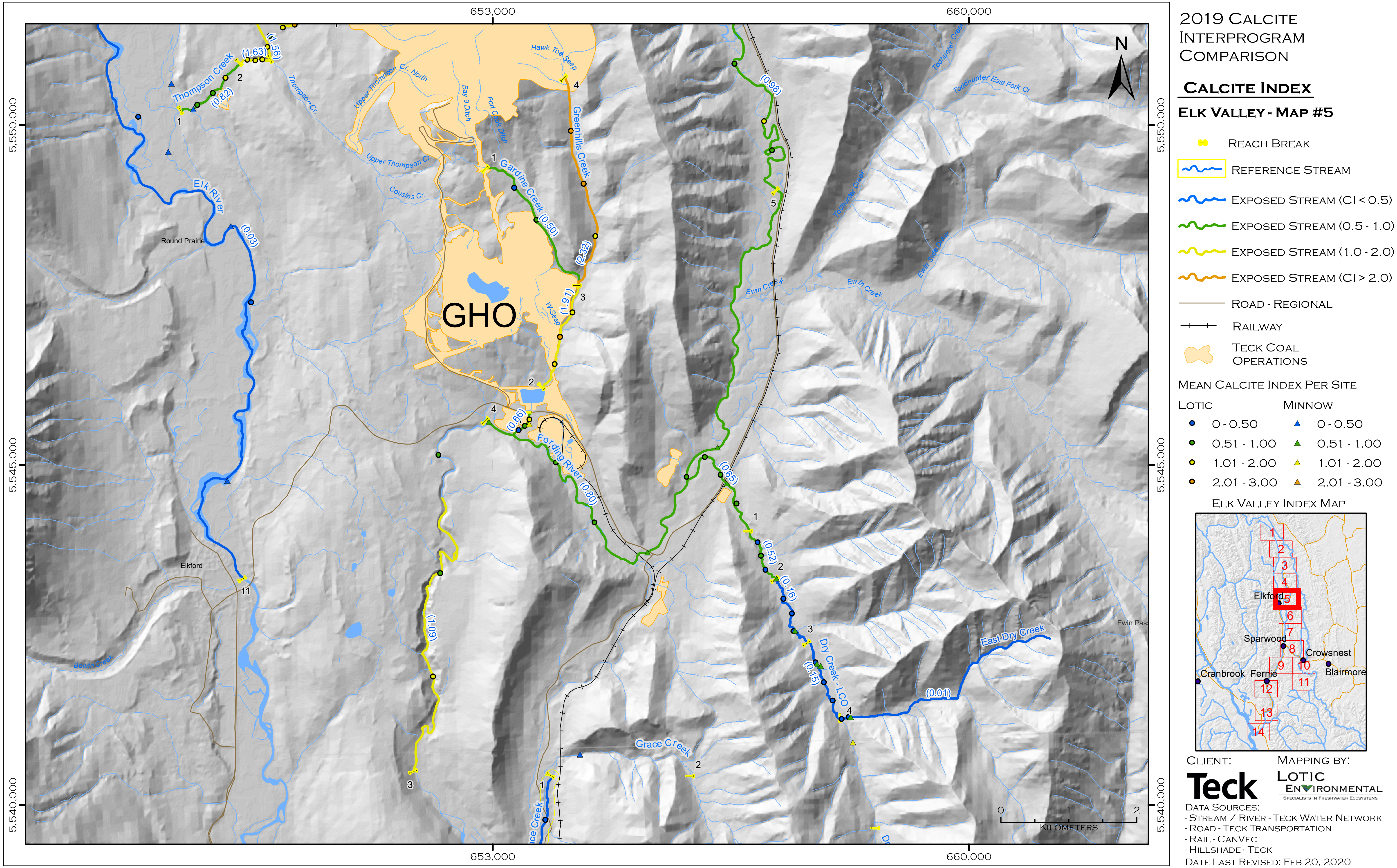


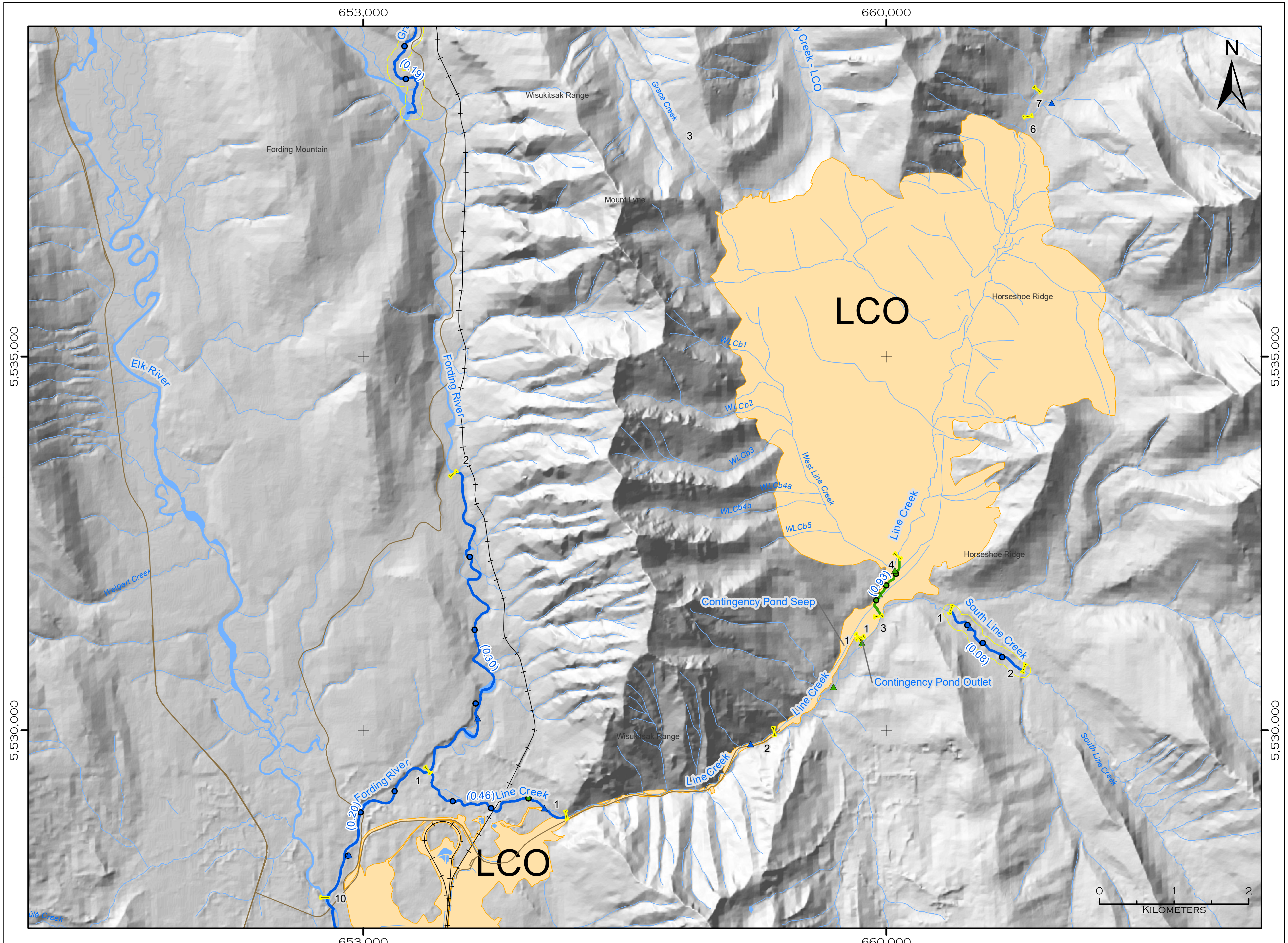
Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020


2019 Calcite Interprogram Comparison
Calcite Index
Elk Valley - Map #5
Reach Break
Reference Stream
Exposed Stream (CI < 0.5)
Exposed Stream (0.5 - 1.0)
Exposed Stream (1.0 - 2.0)
Exposed Stream (CI > 2.0)
Road - Regional
Railway
Teck Coal Operations
Mean Calcite Index Per Site
Lotic
0 - 0.50
0.51 - 1.00
1.01 - 2.00
2.01 - 3.00
Minnow
0 - 0.50
0.51 - 1.00
1.01 - 2.00
2.01 - 3.00
Elk Valley Index Map
Elkford
Sparwood
Crowsnest
Blairmore
Cranbrook
Fernie
Client:
Teck
Mapping by:
Lotic Environmental
Specialists in Freshwater Ecosystems
Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck
Date Last Revised: Feb 20, 2020
GHO
653,000
660,000
5,550,000
5,545,000
5,540,000
N
0 1 2
Kilometers
Elk River
Round Prairie
Elkford
Thompson Creek
Thompson Cr.
Upper Thompson Cr. North
Upper Thompson Cr.
Cousins Cr.
Bay 9 Ditch
Fort Ck Ditch
Hawk Toe Seep
Greenhills Creek
Gardine Creek
W-Seep
Fording River
Ewin Creek
Todhunter Creek
Todhunter East Fork Cr.
Dry Creek - LCO
East Dry Creek
Grace Creek
Ewin Pass
(1.63)
(1.56)
(0.82)
(0.03)
(0.50)
(2.32)
(1.91)
(0.66)
(0.80)
(0.98)
(0.65)
(0.52)
(0.16)
(0.15)
(0.01)
(1.09)



2019 Calcite Interprogram Comparison

Calcite Index

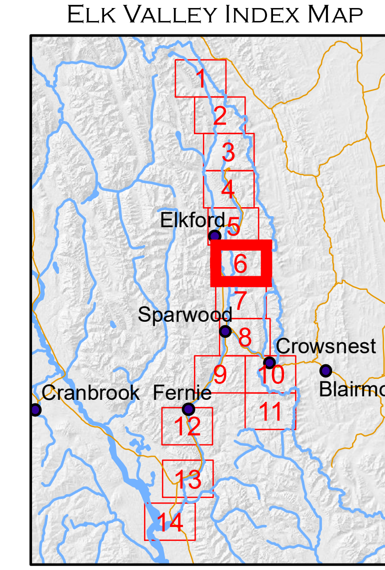
Elk Valley - Map #6

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

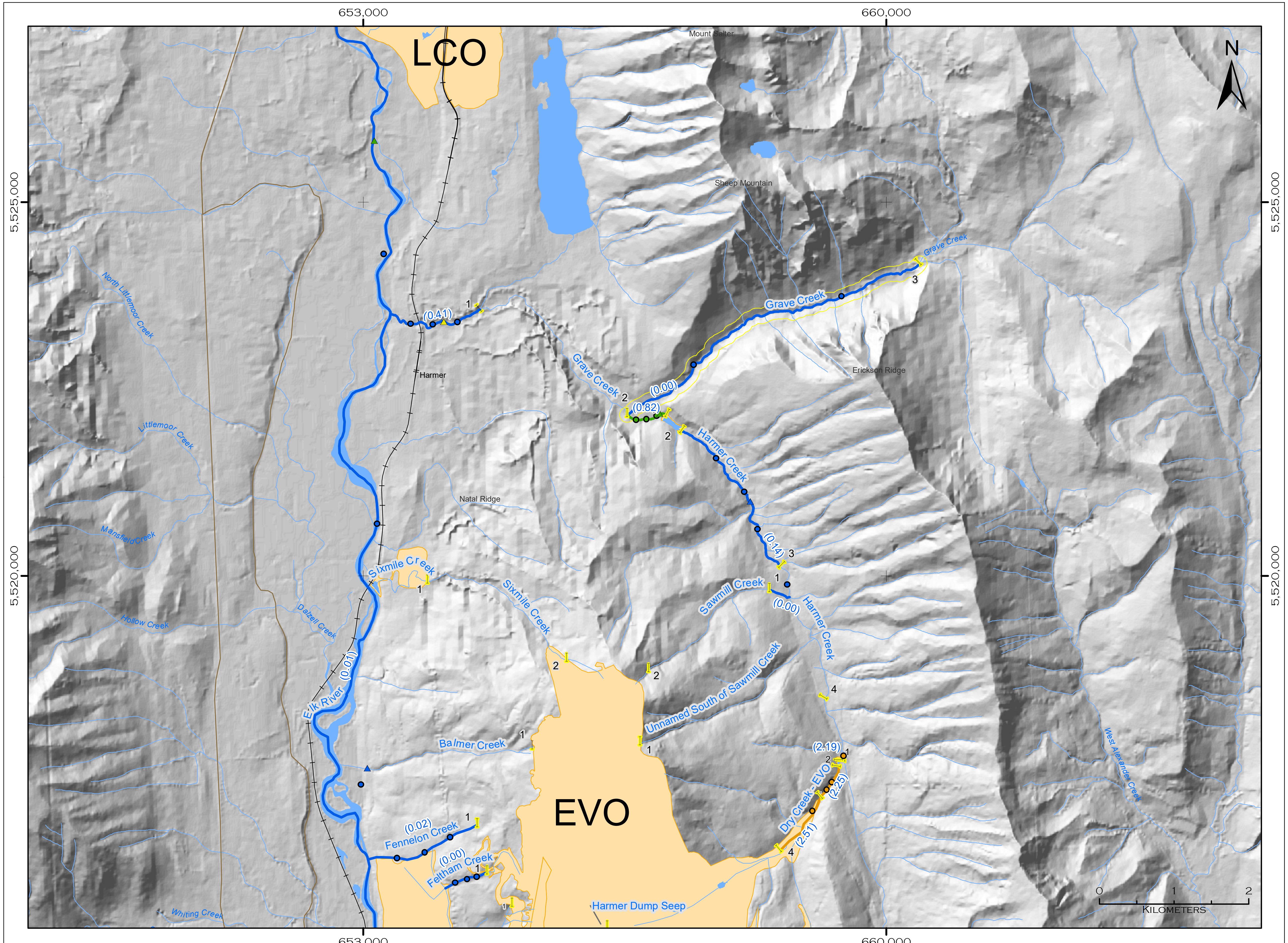


Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #7

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

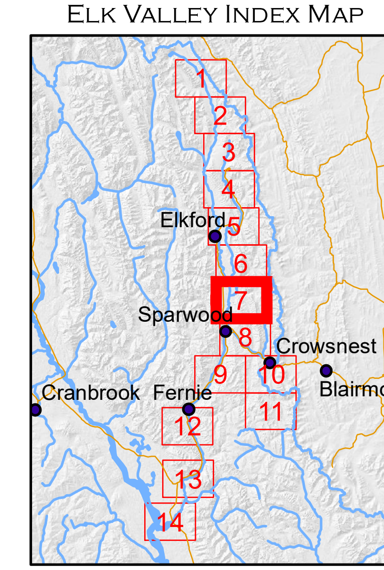
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

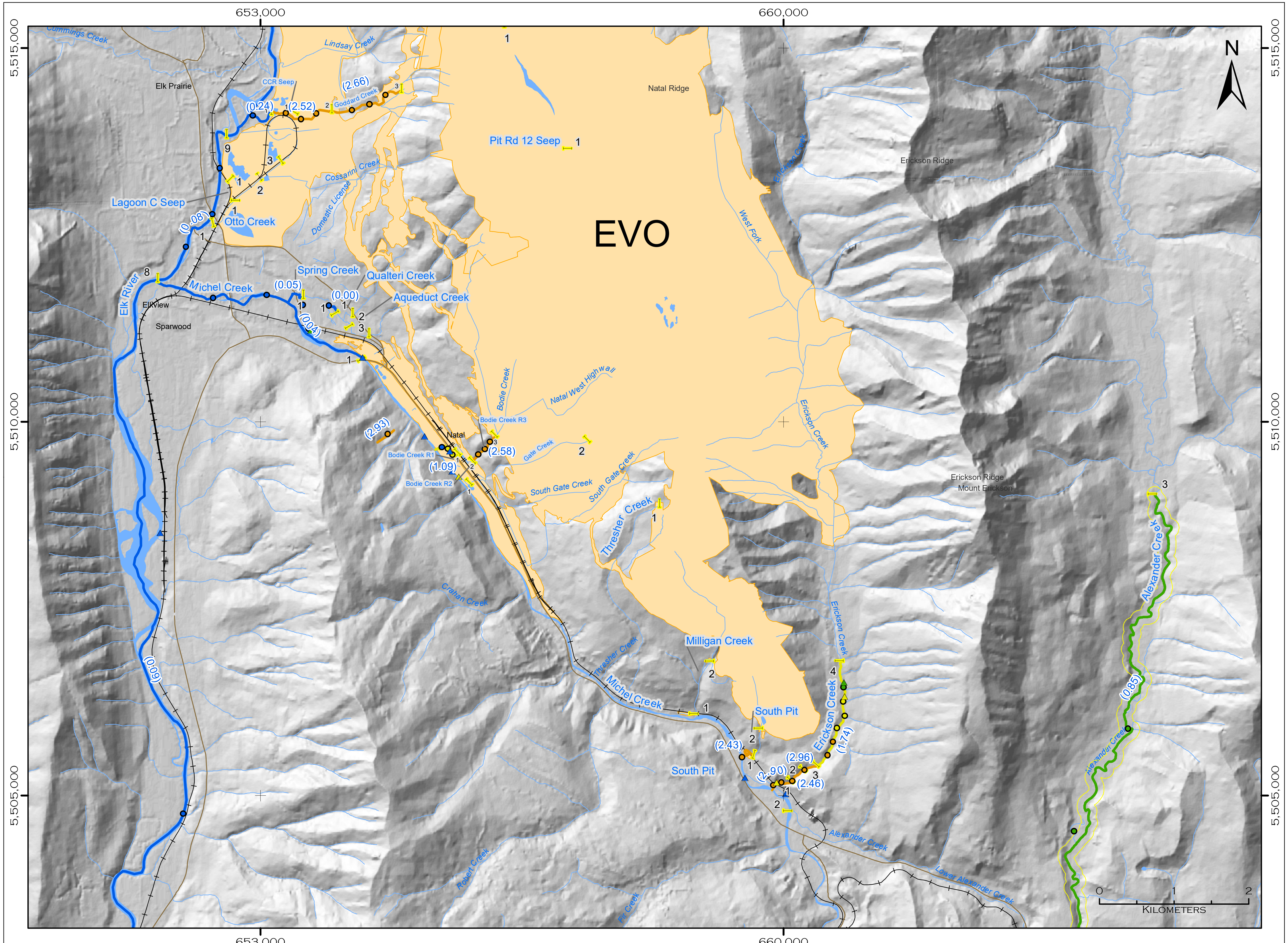


Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

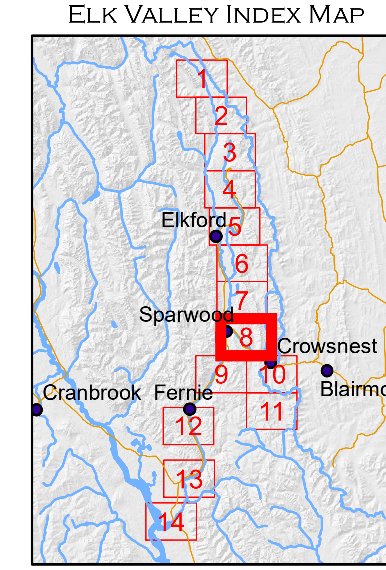
Elk Valley - Map #8

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

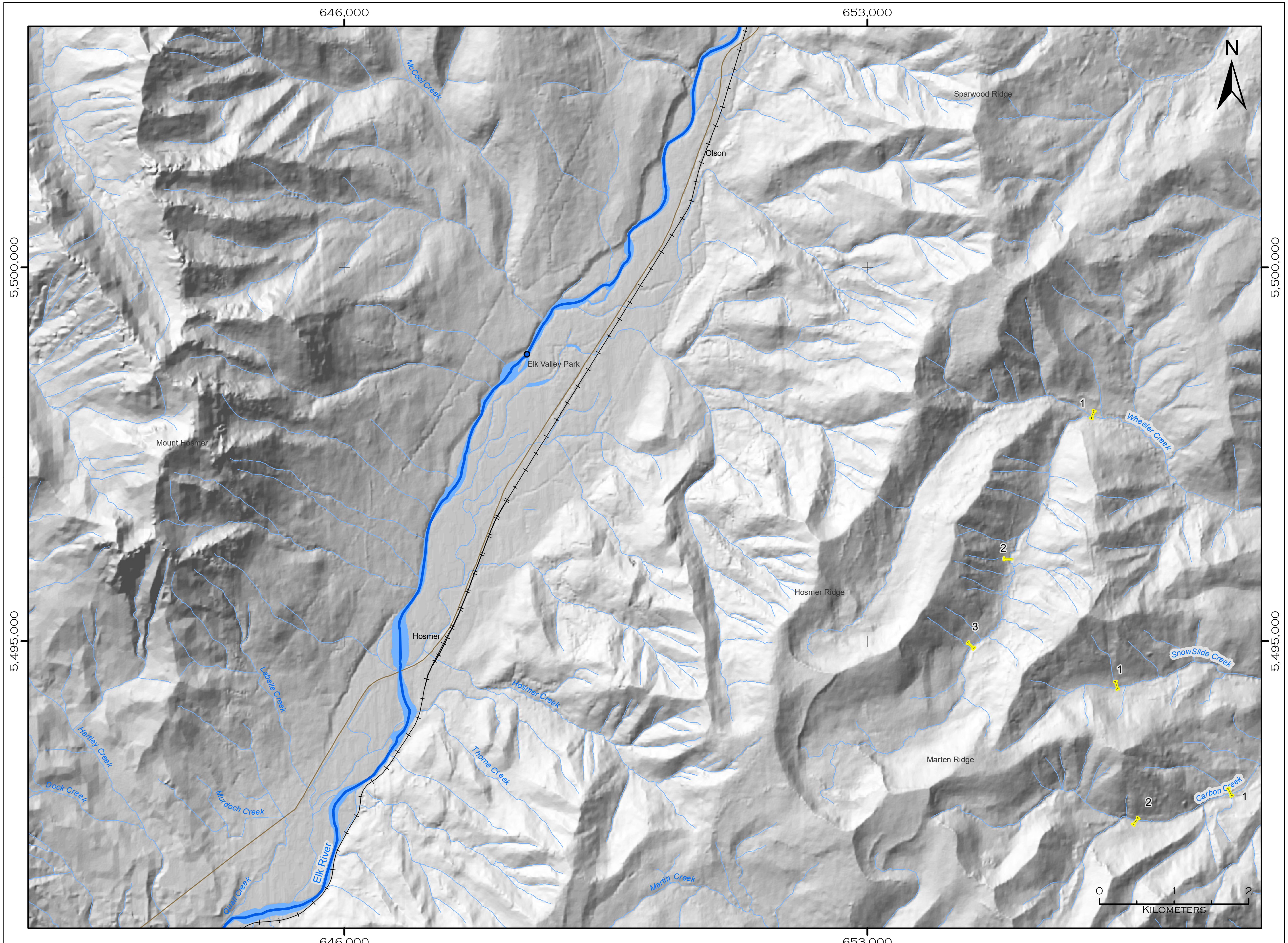


Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #9

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

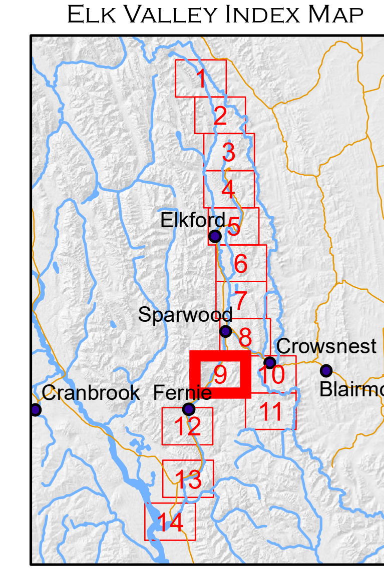
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

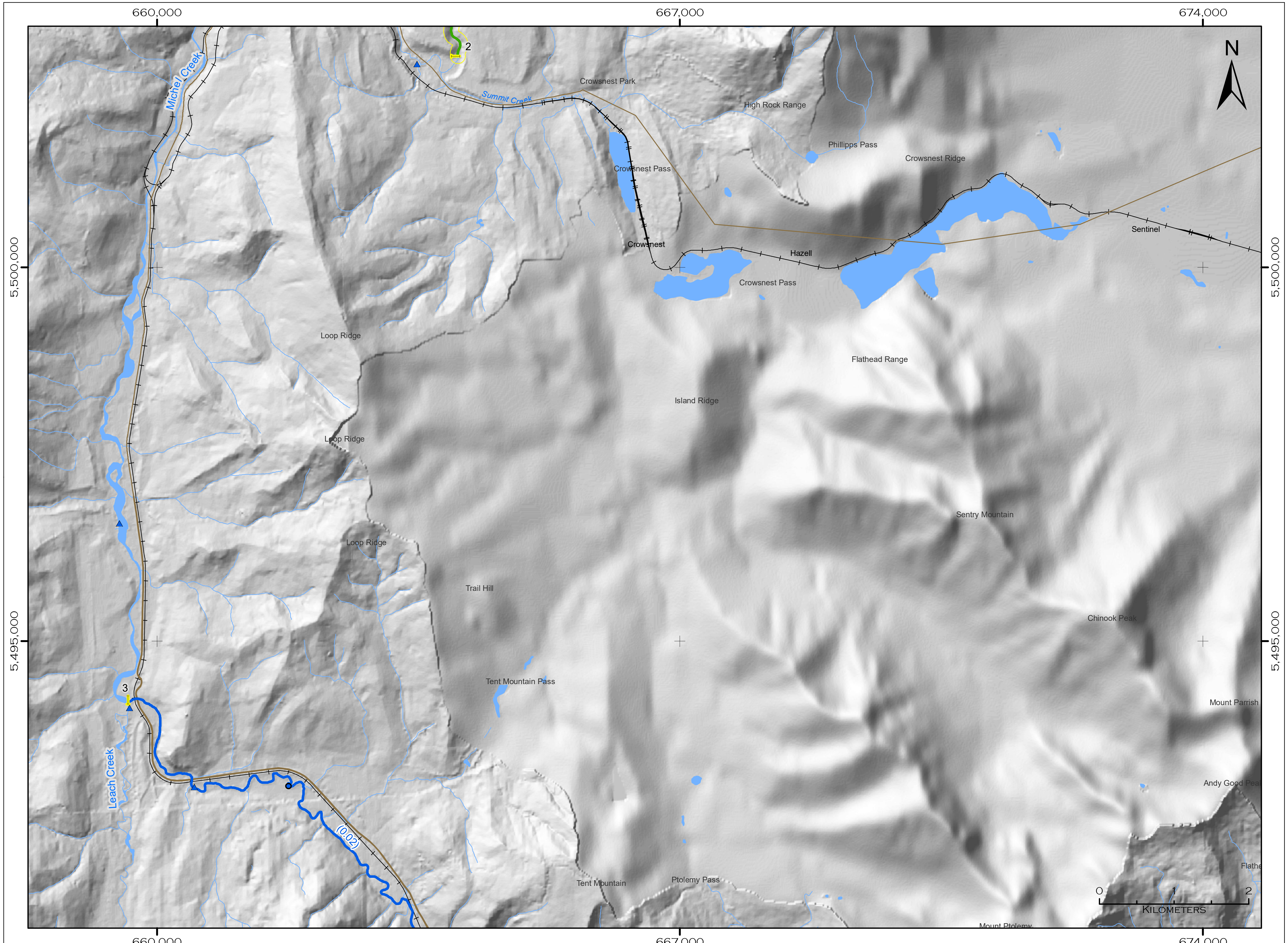


Client: Teck

Mapping by: Lotic Environmental

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #10

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

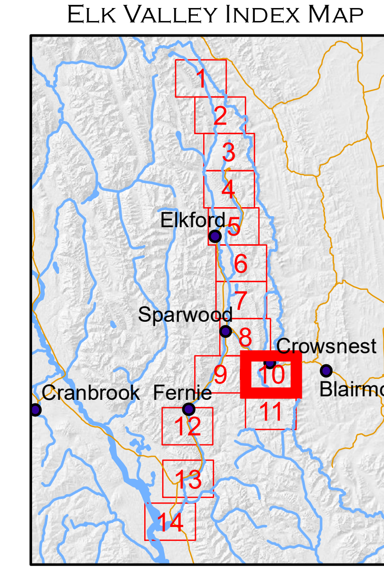
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

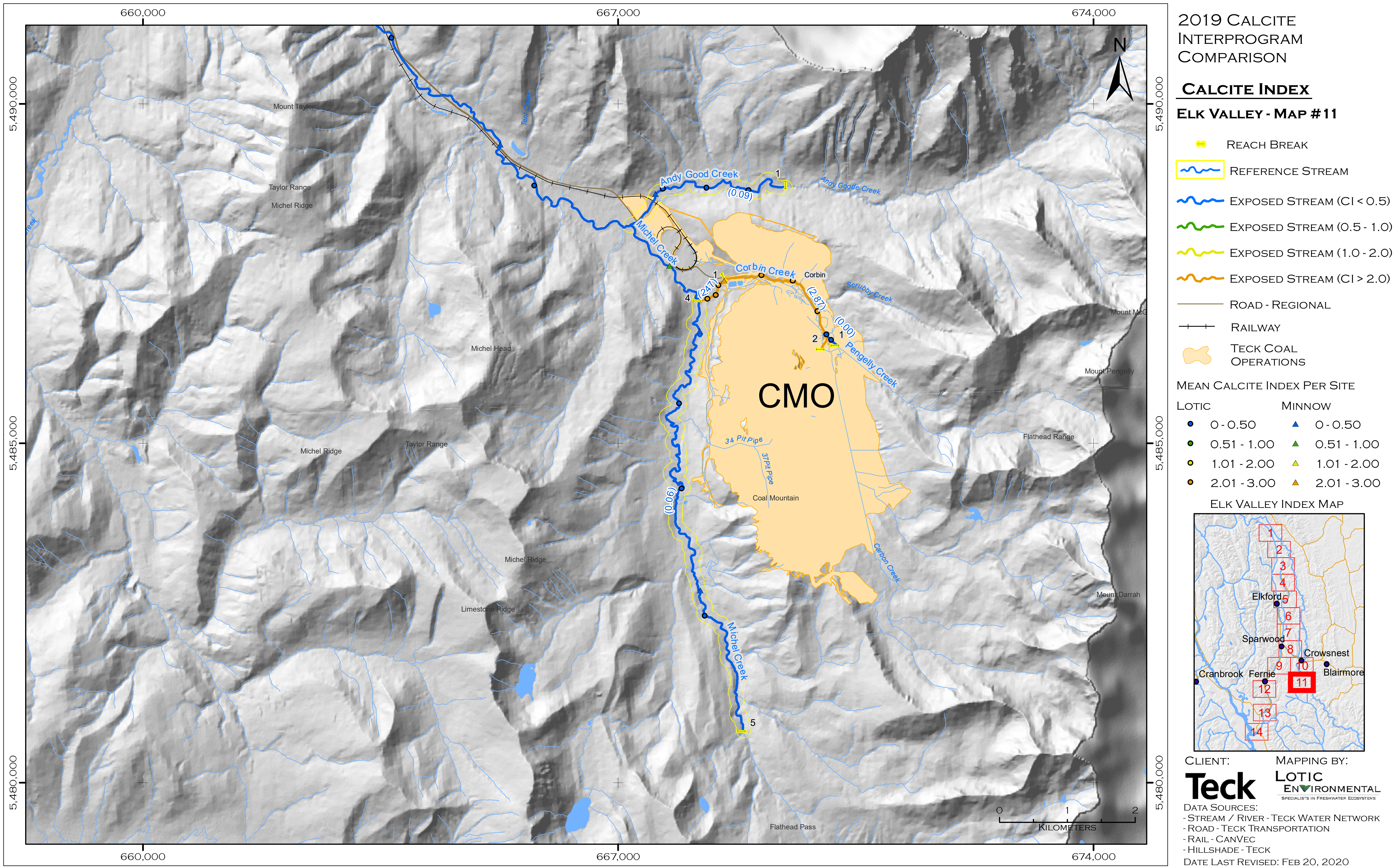


Client: Teck

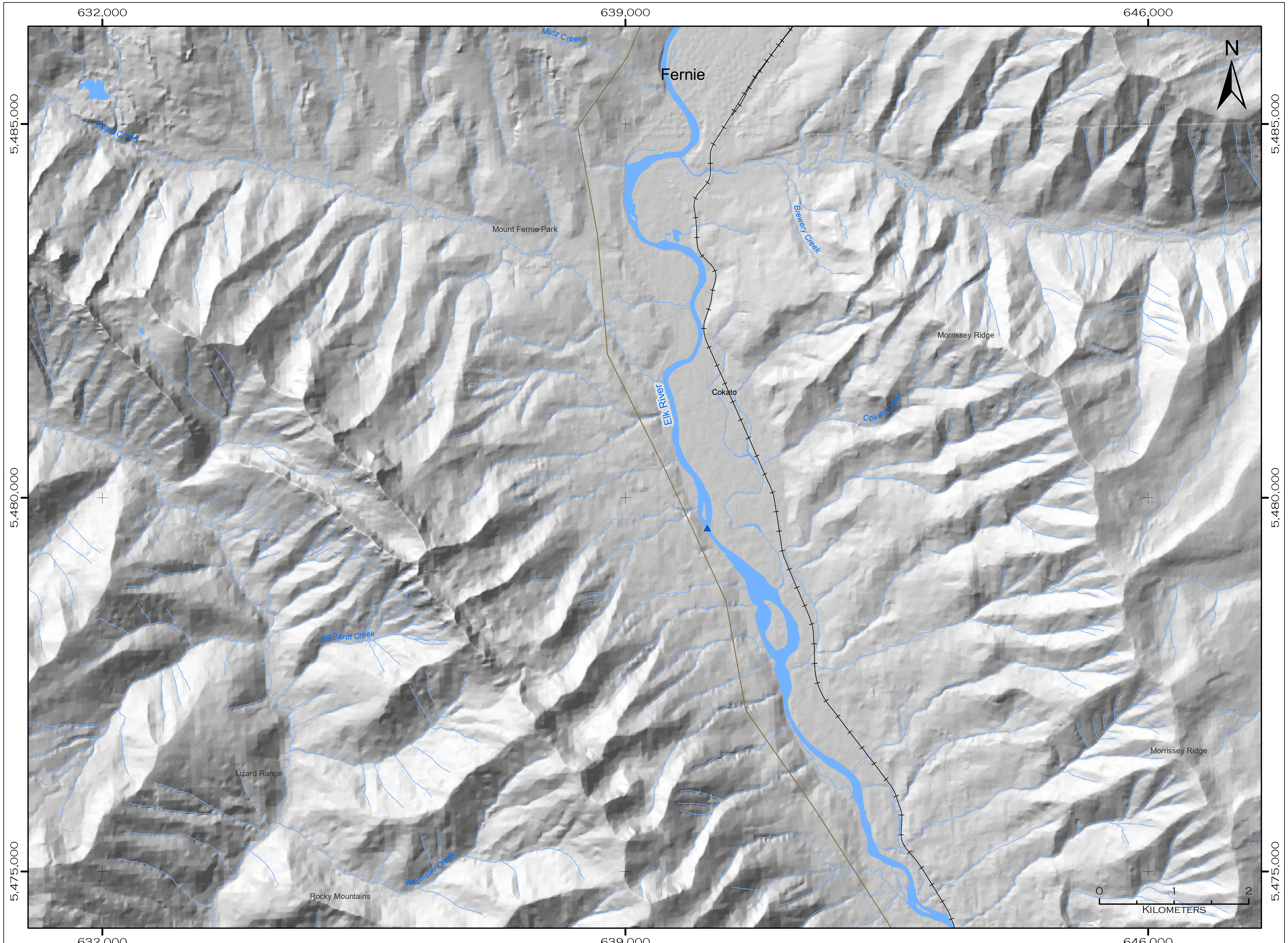
Mapping by: Lotic Environmental — Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison
Calcite Index
Elk Valley - Map #11
Reach Break
Reference Stream
Exposed Stream (CI < 0.5)
Exposed Stream (0.5 - 1.0)
Exposed Stream (1.0 - 2.0)
Exposed Stream (CI > 2.0)
Road - Regional
Railway
Teck Coal Operations
Mean Calcite Index Per Site
Lotic
0 - 0.50
0.51 - 1.00
1.01 - 2.00
2.01 - 3.00
Minnow
0 - 0.50
0.51 - 1.00
1.01 - 2.00
2.01 - 3.00
Elk Valley Index Map
Elkford
Sparwood
Crowsnest
Blairmore
Cranbrook
Fernie
Client:
Teck
Mapping by:
Lotic Environmental
Specialists in Freshwater Ecosystems
Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck
Date Last Revised: Feb 20, 2020
CMO
Michel Creek
Andy Good Creek
Andy Goode Creek
Corbin Creek
Corbin
Scrubby Creek
Pengelly Creek
Carbon Creek
Tent Creek
34 Pit Pipe
37Pit Pipe
Coal Mountain
Mount Taylor
Taylor Range
Michel Ridge
Michel Head
Limestone Ridge
Flathead Range
Flathead Pass
Mount Pengelly
Mount Darrah
(0.09)
(2.47)
(2.87)
(0.00)
(0.06)
660,000
667,000
674,000
5,490,000
5,485,000
5,480,000
N
Kilometers



2019 Calcite Interprogram Comparison

Calcite Index

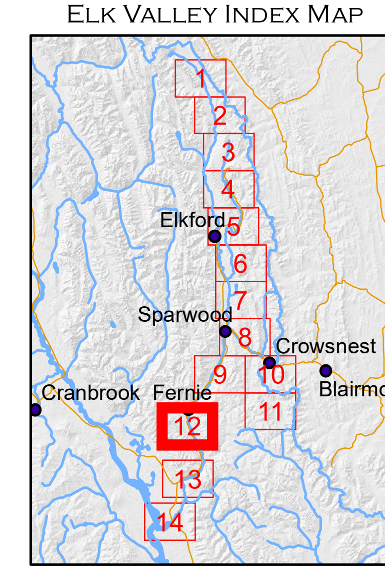
Elk Valley - Map #12

- Reach Break
- Reference Stream
- Exposed Stream (CI < 0.5)
- Exposed Stream (0.5 - 1.0)
- Exposed Stream (1.0 - 2.0)
- Exposed Stream (CI > 2.0)
- Road - Regional
- Railway
- Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map

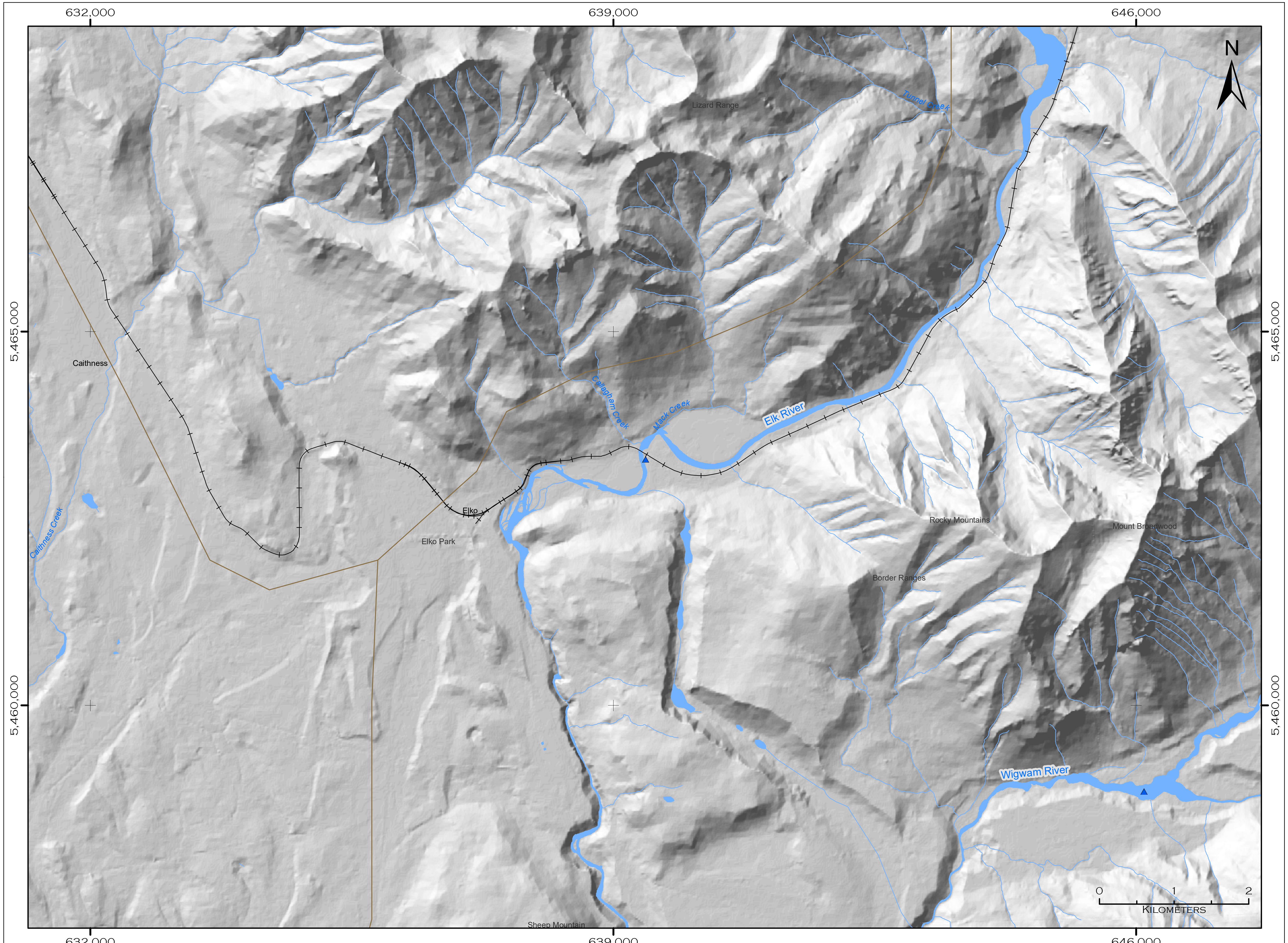


Client: Teck

Mapping by: Lotic Environmental — Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #13

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

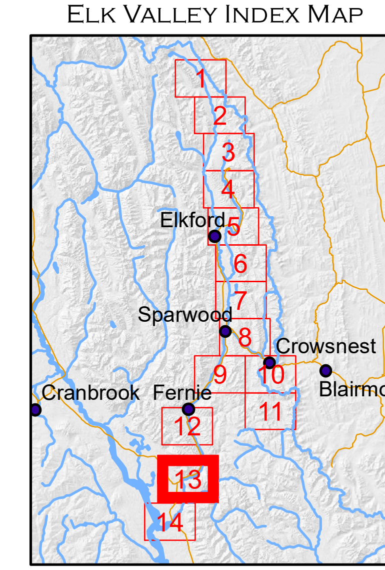
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map



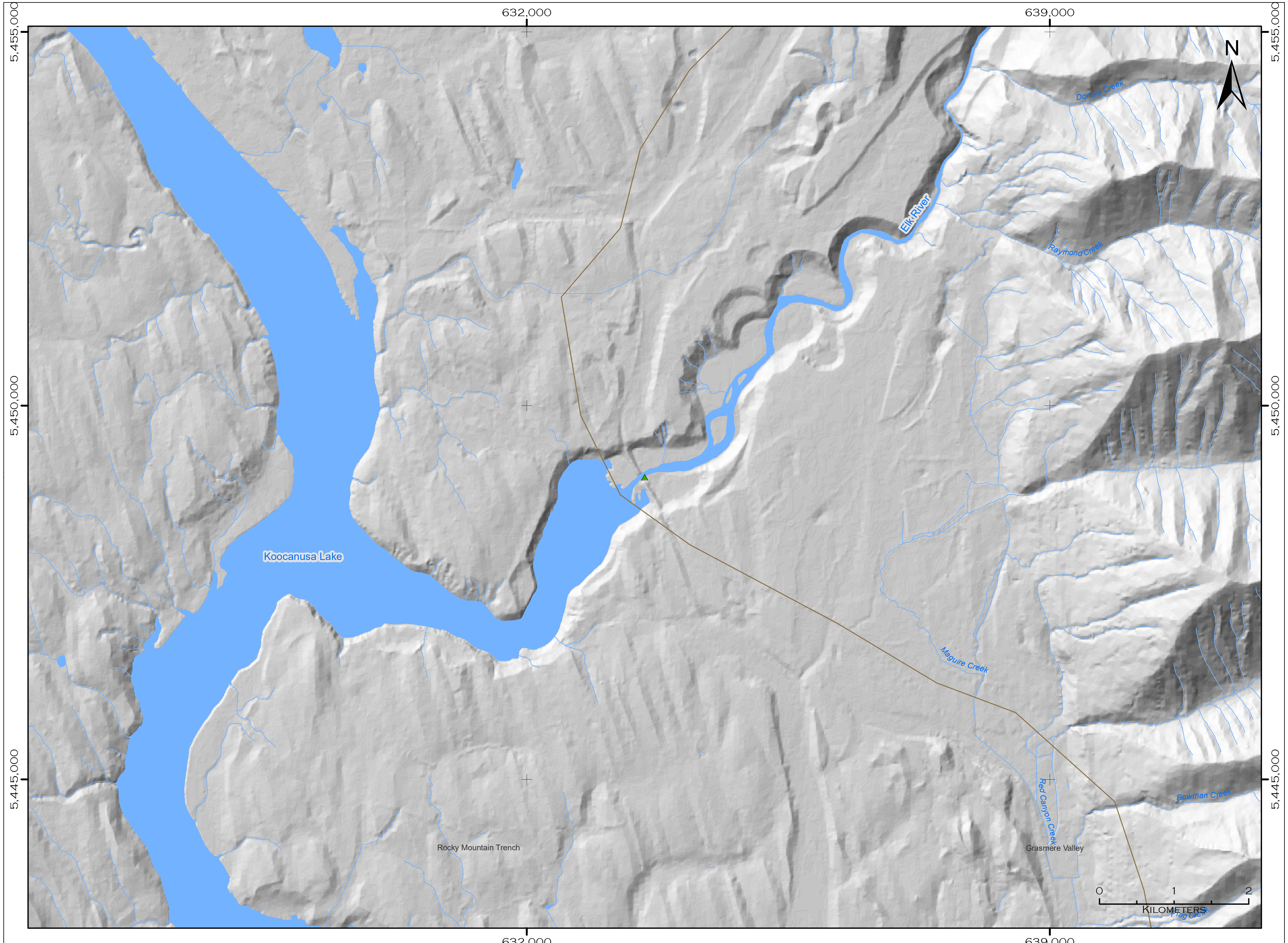
Client: Teck

Mapping by: Lotic Environmental

Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020



2019 Calcite Interprogram Comparison

Calcite Index

Elk Valley - Map #14

Reach Break

Reference Stream

Exposed Stream (CI < 0.5)

Exposed Stream (0.5 - 1.0)

Exposed Stream (1.0 - 2.0)

Exposed Stream (CI > 2.0)

Road - Regional

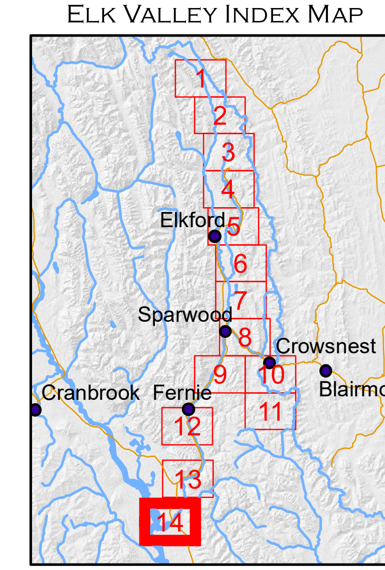
Railway

Teck Coal Operations

Mean Calcite Index Per Site

Lotic	Minnow
0 - 0.50	0 - 0.50
0.51 - 1.00	0.51 - 1.00
1.01 - 2.00	1.01 - 2.00
2.01 - 3.00	2.01 - 3.00

Elk Valley Index Map



Client: Teck

Mapping by: Lotic Environmental
Specialists in Freshwater Ecosystems

Data Sources:
- Stream / River - Teck Water Network
- Road - Teck Transportation
- Rail - CanVec
- Hillshade - Teck

Date Last Revised: Feb 20, 2020