Azimuth Consulting Group Partnership
218-2902 West Broadway
Vancouver, BC
Canada V6K 2G8

Phone: 604-730-1220
www.azimuthgroup.ca

Memorandum

Date: **October 28, 2019**

To: **Manon Turmel, Michel Groleau, and Jamie Quesnel**

From: **Eric Franz and Gary Mann**

Our File: **AEM-19-07/WTP Streams**

RE: **Whale Tail Permitting Support – Stream Tributary Water Quality Data Summary (KivIA-Aquatic-TC#3)**

This technical memorandum is a compilation of water quality data collected in 2015 and in August 2019 at various tributary streams within the Whale Tail Pit Study Area. The memo was prepared by Azimuth Consulting Group Partnership (Azimuth) on behalf of Agnico Eagle Mines Limited – Meadowbank Division (Agnico Eagle) and is in response to a request from the Kivalliq Inuit Association (KivIA-Aquatic-TC#3) for additional sampling of streams within the Whale Tail Pit Study Area to characterize natural variability in the tributaries and better distinguish project related impacts from natural variability in local water quality inputs. For streams that have been impacted by construction or other site-related activities, Agnico Eagle committed to comparing the 2019 water quality data against water quality predictions in the Final Environmental Impact Statement (FEIS).

Report Version

Version	Dates	Distribution
Draft for client review	Report issued: September 15, 2019	Agnico Eagle (e-copy)
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Final	Report issued: October 28, 2019	Agnico Eagle (e-copy)

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1. INTRODUCTION

1.1. Whale Tail Project

The Amaruq property is a 408 square kilometre (km^2) site located on Inuit-Owned Land approximately 150 kilometres (km) north of the hamlet of Baker Lake and approximately 50 km northwest of Meadowbank Mine in the Kivalliq Region of Nunavut. The initial phase of mining (i.e., the Approved Project) applies to the Whale Tail Pit deposit located at the north end of Whale Tail Lake. Mining the satellite deposit was approved under Nunavut Impact Review Board (NIRB) Project Certificate No. 008 (March 15, 2018) and Nunavut Water Board (NWB) Type A Water Use Licence 2AM-WTP1826 (July 11, 2018). Ore from the Project will be hauled to the Meadowbank Mine for milling under the existing Project Certificate (No. 004) and Water Use Licence (2AM-MEA1526).

1.2. Overview of the Stream Monitoring Program

This memorandum is a compilation of the 2015 and 2019 water quality data collected from stream stations within the Whale Tail Pit Study Area (**Figure 1**). Baseline water quality sampling was conducted in August and September 2015 by Golder Associates as part of the original Final Environmental Impact Statement (FEIS) submission (Volume 6; Agnico Eagle, 2016). These data were included in the report titled *Core Receiving Environment Monitoring Program (CREMP): 2014-2017 Baseline Studies* submitted in February 2018 (Azimuth, 2018). At the request of the Kivalliq Inuit Association (KIA), Agnico Eagle agreed to collect another year of water quality data during the open water season of 2019 at locations that were sampled in August and September 2015 (see list of stations in **Table 1**).

Prior to the field program, updated information on the status of each stream monitoring location within the project area was provided by Golder[1]. With the exception of A81-A80, the streams listed in **Table 1** are no longer considered 'baseline' because of dike construction or effluent discharge.

- **Whale Tail Impoundment** – Construction of the Whale Tail dike began in July 2018. Rising water levels in 2018/2019 resulted in Lakes A55, A20, and A18 being fully connected to the south basin of Whale Tail Lake prior to the August 2019 sampling event (**Figure 1**).
- **Effluent Discharge to Mammoth Lake** – Discharge to Mammoth Lake from the temporary diffuser started on June 17, 2019, and installation of the permanent diffuser in Mammoth Lake was completed on July 27, 2019.
- **Contact Water Discharge to Nemo Lake** – A change to the water management strategy was implanted in the summer 2019 to allow temporary discharge of contact water to Nemo Lake. The

[1] Jennifer Range, personal communication by email on May 28, 2019.

revised water management strategy was required as a result of high precipitation in 2019 and was approved by the Nunavut Water Board (NWB) and inspector prior to implementation. Future discharge to Nemo Lake is not anticipated.

Table 1. Streams assessed in the August 2019 field program.

Station	Area	Easting	Northing	Baseline?	Sampled[1]
A14-A13	Small stream connecting two lakes downstream of Mammoth Lake (A16).	602978	7255643	No	Yes
A15-A14	Not sampled given the proximity to A14-A13.	603003	7255649	No	No
A17-A16	Stream connecting Mammoth Lake (A16) and the North Basin of Whale Tail Lake (A17). This stream was removed by construction of the Mammoth dike.[1]	606269	7255286	No	No
A18-A17	Small stream connecting Lake A18 and the South Basin of Whale Tail (A17). Higher water levels due to the impoundment resulted in full connectivity between Lake A18 and Lake A17.[1]	606637	7253084	No	No
A21-A20	Small stream flowing into Lake A20. Higher water levels due to the impoundment resulted in full connectivity between Lake A21 and Lake A20.[1]	604557	7252299	No	No
A55-A17	Small stream connecting Lake A55 and the South Basin of Whale Tail (A17). Higher water levels due to the impoundment resulted in full connectivity between Lake A55 and Lake A17.[1]	608010	7254529	No	No
A5-A4	Small stream connecting Lake A5 and Lake A4 downstream from Lake A12 and Lake A76.	600130	7260456	No	Yes
A76-A75	Outlet of Lake A76.	601358	7256775	No	Yes
A81-A80	Outlet of Lake A81.	598340	7255446	Yes	Yes
A69-DS1	Outlet of Lake A69. Stream flowing into the south end of Lake DS1.	598452	7256756	No	Yes
C38-C12	Outlet stream at the north end of Nemo Lake.	606635	7258187	No	Yes
C8-C7	Outlet of Lake C8, downstream of Nemo Lake.	604266	7260887	No	Yes
DS1 Outlet	Outlet at the north end of Lake DS1.	599253	7268300	No	Yes

1. Stream locations were not sampled in 2019 due to rising water levels (i.e., "full connectivity" means that lake levels were now essentially the same, so no connecting stream present) or to construction-related activities.

2. METHODS

2.1. Sample Collection

Stream sampling was completed on August 19th and 20th, 2019. All the stations were accessed by helicopter with the exception of C38-C12 (outlet of Nemo Lake) which was accessed by boating across Nemo Lake and hiking to the sampling location. In-situ measurements of temperature, pH, specific conductance, and dissolved oxygen were recorded at each location using a YSI ProPlus multimeter. The in-situ water quality readings were recorded on datasheets along with qualitative observations about the substrate type, water depth, and periphyton coverage. The field datasheets are included in **Appendix A**. Photos of the stream and surrounding area were taken at each location and are included in **Appendix B**.

Water samples for chemistry were collected using a 60 mL syringe to draw water from below the surface of the stream. Samples were collected from areas where the total water depth was between 10 cm and 20 cm. Sample bottles for unfiltered analyses were filled directly from the syringe. Dissolved parameters (metals, DOC, and dissolved nutrient parameters) were collected in the field by filtering the surface water through a 0.45 µm disk filter provided by ALS Environmental.

The water samples were shipped to ALS Environmental (Burnaby, BC) for analysis of routine parameters (pH, hardness, conductivity, TSS, TDS, and turbidity), major ions, nutrients, total and dissolved metals (including mercury), and cyanides (total and free). The certificate of analysis from ALS is provided in **Appendix C**.

One duplicate water sample was collected at C38-C12 to assess the precision of the sampling and analytical methods. Relative percent differences (RPDs) between the sample and duplicate were evaluated using an acceptability criterion of less than 40%. There were three parameters that exceeded the RPD limit of 40%: total ammonia (138%), total aluminum (59%) and total titanium (55%). Concentrations of all three parameters were less than 10-times the detection limit. At low concentrations, there is less analytical precision, and higher variability between duplicate field samples is not uncommon. The field duplicate results indicate good precision and reliable data for decision-making.

3. RESULTS

Tabulated stream chemistry results from the August 2019 sampling event are presented in **Table 4**. August and September 2015 sampling events are presented in **Table 5** (August) and **Table 6** (September); these data were originally published in the 2014-2017 baseline CREMP report (Azimuth,

2018; refer to that report for detailed information on the sample collection methods used by Golder as well as specifics of the quality assurance / quality control assessment).

A brief discussion of the stream water quality results is provided below. Detailed analysis of the CREMP water quality data will be included in the 2019 annual report.

3.1. Water Quality Guideline Comparison

Water quality triggers and thresholds for the Whale Tail study area are currently being developed for the 2019 CREMP reporting cycle (i.e., due at the end of March 2020). In the interim, water quality results from the 2019 sampling event were tabulated and compared against *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (Canadian Council of Ministers of the Environment) and *Guidelines for Canadian Drinking Water Quality* (Federal-Provincial-Territorial Committee on Health and the Environment).

The screening results are presented in **Table 4** (August 2019), **Table 5** (August 2015) and **Table 6** (September 2015). With the exception of phosphorus at C8-C7, there were no exceedances of the water quality guidelines for protection of aquatic life or drinking water quality. Phosphorus (total) at C8-C7 exceeded the oligotrophic guideline (0.004 mg/L) slightly, but the concentration was lower at the upstream stream station C38-C12, suggesting the result at C8-C7 is indicative of natural variability.

3.2. Natural Variability in Stream Water Quality at Station A81-A80

One of the main objectives of the August 2019 program was to assess naturally annual variability in water quality during the open water season. As outlined previously in this memorandum, the only station sampled in 2019 that was unaffected by site-related activities was A81-A80. **Table 7** presents the results from A81-A80 and the relative percent difference as a measure of the natural variability in stream water quality. For simplicity, the RPD was calculated for parameters that were detected in at least one sample in 2015 or 2019.

Concentrations of routine water quality parameters and nutrients measured in August 2019 were generally consistent with results reported in August 2015. The relative percent difference was <40% between the 2015 and 2019 samples for all routine parameters and nutrients with the exception of ammonia where an increase of 133% was observed in 2019 compared to the 2015 results. Metals concentrations (total and dissolved) were generally higher in samples collected in 2019 compared to 2015. Aluminum showed the highest natural variability in background concentrations with reported RPDs of 90% and 77% for total and dissolved aluminum, respectively. Most of the other metals showed less natural variability than aluminum (generally within ±50%).

3.3. FEIS Water Quality Predictions

Table 8 presents the August 2019 water chemistry results compared against available water quality predictions in the FEIS[2] for the stream stations except A81-A80 (still in baseline) and C38-C12 and C8-C7 (no water quality predictions for the Nemo Lake drainage). Stream stations were paired with the closest upstream location where water quality predictions were developed (see **Table 2**). Most of the stream locations sampled in 2019 are located downstream from Mammoth Lake and were compared against the water quality predictions for the outlet of Mammoth Lake. Father downstream, predictions were developed at two locations (DS1 nodes) where water flows into Lake DS1 (**Figure 1**). The two locations represent water quality of the streams that enter into Lake DS1, but do not represent water quality in Lake DS1 itself. In the absence of water quality predictions for Lake DS1, the stream station DS1-Outlet was compared against DS-Node1 and Node2 water quality predictions.

Table 2. Lake and stream groupings for comparing against available water quality predictions for the Expansion Project.

Lake	Creek Station	Baseline?	Sampled[1]	FEIS WQ Prediction Grouping
Mammoth	A14-A13	No	Yes	Mammoth Outlet
Mammoth	A76-A75	No	Yes	Mammoth Outlet
Mammoth	A5-A4	No	Yes	Mammoth Outlet
Mammoth	A69-DS1	No	Yes	Mammoth Outlet
Mammoth	A81-A80	Yes	Yes	None
Nemo	C38-C12	Yes	Yes	None
Nemo	C8-C7	Yes	Yes	None
Lake DS1	DS1 Outlet	No	Yes	DS Node1 and Node2

Notes
1. Station A81-A80 is a headwater stream located upstream of source loading from Mammoth Lake and the Whale Tail Impoundment. For simplicity, this location was also screened against the predictions for the outlet of Mammoth Lake

Concentration plots of a subset of routine water quality parameters (i.e., conductivity, hardness, pH, and TSS), selected nutrients and dissolved metal parameters are included in **Appendix D.** Parameters for plotting were selected based on two conditions: 1) water quality predictions were developed (Golder, 2019), and 2) the parameter was detected in at least one stream sample in 2019.

[2] Monthly water quality predictions were developed for Mammoth Lake, the outlet of Mammoth Lake, Whale Tail South Basin, and two streams flowing into Lake DS1 (Node1 and Node2) as part of the Expansion Project (Golder, 2019). The water quality model was designed to estimate water quality as a monthly average concentration, from construction (2018 – 2019), through operations (2019 – 2026), closure (2026 – 2042), into post-closure (2042+) (Golder, 2019).

There were several cases of water quality measurements exceeding their respective FEIS predictions in August 2019 (e.g., for samples collected at A14-A13, A76-A75, A69-DS1, A5-A4, and DS1-Outlet). Some parameters, such as TDS, ammonia, and dissolved aluminum were consistently measured above the predicted whole-lake average concentrations for Mammoth Lake and at DS1-Outlet. For samples collected at A14-A13 and DS1-Outlet, other parameters, including some ions and dissolved metals, occasionally measured slightly above predictions. Despite the occurrences of parameter concentrations measured above predictions, all concentrations remained below CCME guidelines.

At this early stage of the Mine operation, it is not unusual for some parameters to be measured outside of modelled predictions. Within the natural Mammoth Lake watershed, measured data, particularly those collected daily, will almost certainly vary with respect to predicted conditions. To develop predictions for water quality in the receiving environment that would aid in the understanding of any potential risk to the receiving environment from the operation of the Mine, the FEIS water quality model used assumptions to address the inherent variability and uncertainty related to the physical and chemical characteristics of the Mine source inputs (e.g., surface flows, groundwater flows and seepage, baseline water quality, geochemical characterization). The measured data will be used to calibrate the model in future updates to reduce uncertainty.

4. SUMMARY

Several stream monitoring stations established in 2015 were impacted by hydrological changes and other site-related activities prior to the August 2019 sampling event, which precluded a more thorough analysis of the natural background variability in water quality at the stream monitoring locations. Instead of assessing the natural variability in water quality at these locations, the 2019 chemistry results were used to confirm FEIS predictions. Most parameters were below their respective predicted concentrations, but in the case of TDS, ammonia, and aluminum, concentrations were consistently elevated relative to predicted concentrations for the Project. Updates to the water quality predictions, if required, will be included in the annual report.

Detailed analysis and discussion of project-related changes in water quality compared natural variability will be done as part of the 2019 annual report for the Whale Tail Pit Expansion Project.

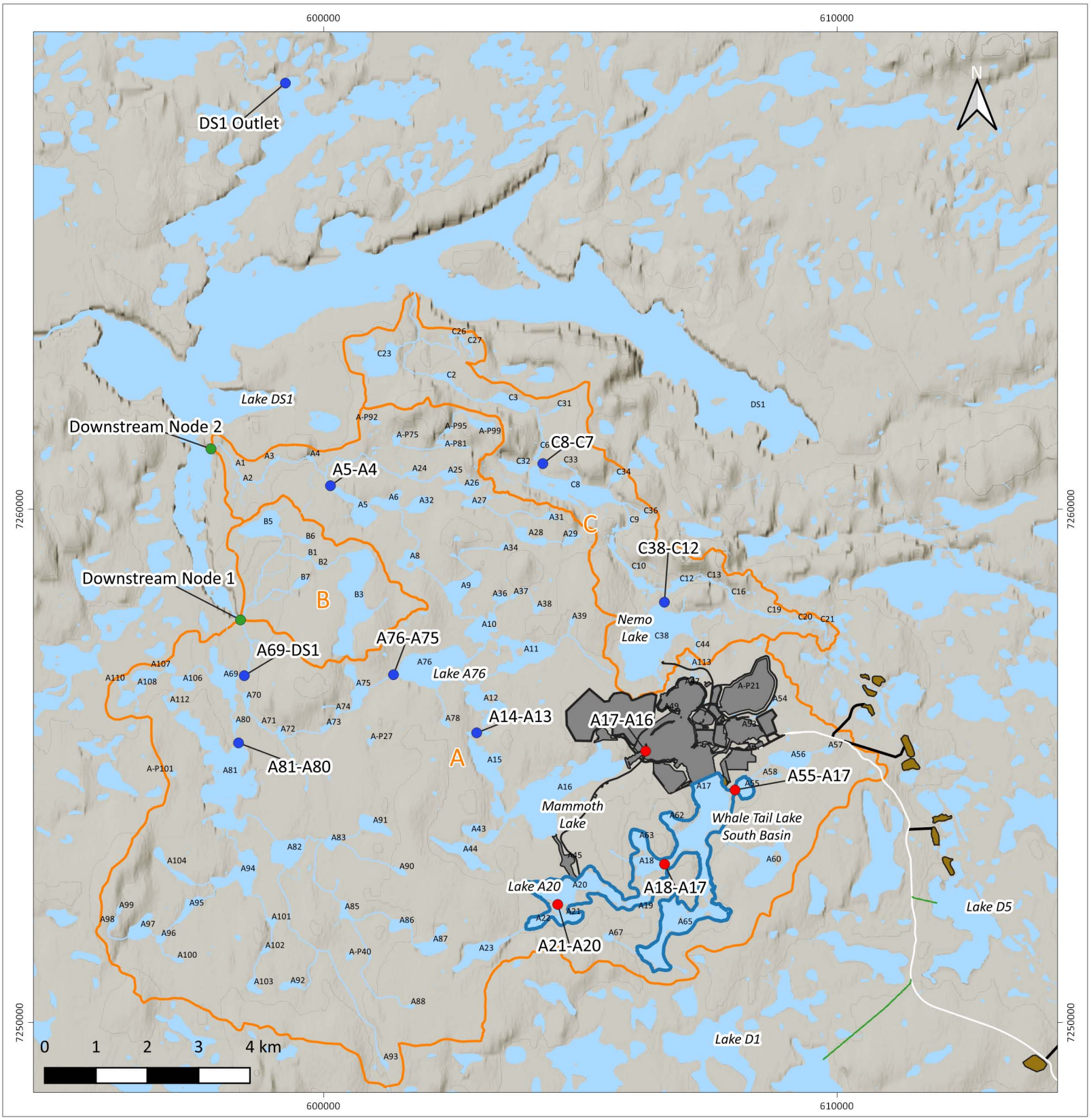
5. REFERENCES

Agnico Eagle. 2016. Whale Tail Pit Project - Meadowbank Mine Final Environmental Impact Statement and Type A Water Licence Amendments. Amendment/Reconsideration of the Project Certificate (No. 004/ File No. 03MN107) and Amendment to the Type A Water Licence (No. 2AM-MEA1525). Submitted to the Nunavut Impact Review Board. June 2016.

Azimuth Consulting Group (Azimuth). 2018. Whale Tail Pit Core Receiving Environment Monitoring Program (CREMP): 2014-2017 Baseline Studies. Report prepared by Azimuth Consulting Group, Vancouver, BC for Agnico Eagle Mines Ltd., Baker Lake, NU. February, 2018.

Azimuth. 2012. Core Receiving Environment Monitoring Program (CREMP): Design Document 2012, Meadowbank Mine. Report prepared by Azimuth Consulting Group, Vancouver, BC for Agnico Eagle Mines Ltd., Baker Lake, NU. December, 2012.

Golder Associates Ltd. (Golder). 2019. Mine Site and Downstream Receiving Water Quality Predictions. Whale Tail Pit – Expansion Project. May 2019.



Legend

- Watershed Boundaries
- Watercourse

Stream Water Quality Sampling Stations

- Sampled in 2019
- Not sampled in 2019 (flooded/impacted)

Project Features

- Esker / Quarry
- Infrastructure
- Proposed Road
- Road - Esker
- Max Impoundment Area

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CLIENT	Agnico Eagle Mines Limited - Meadowbank Division
FIGURE 1	Stream Water Quality Stations
PROJECT	2019 Stream Water Quality Sampling Program Whale Tail Pit Study Area

Date: October 24, 2019
Datum: NAD 83 UTM Zone 14N
Scale: 1:100,000
Software: QGIS version 3.8.2

REFERENCES:
1. Project feature and detailed water course shapefiles from Agnico Eagle
2. Watercourse and waterbody data from NRC (all rights reserved)
3. Basemap imagery from Google and ESRI

Table 3. Field duplicate water quality results from the August 2019 sampling event.

Year / Month	2019 / August								
Station	C38-C12								
Analyte	MDLs	Sample	Duplicate	RPD	Analyte	MDLs	Sample	Duplicate	RPD
Physical Tests					**Total Metals, Con't (mg/L)**				
Conductivity (µS/cm)	2	58.6	58.1	0.9	Selenium	0.00005	*<0.000050*	*<0.000050*	
Hardness (mg/L)	0.5	22.2	22.7	-2.2	Silicon	0.1	0.22	0.23	-4.4
pH (Laboratory)	0.1	7.18	7.2	-0.3	Silver	0.00001	*<0.000010*	*<0.000010*	
Total Suspended Solids (mg/L)	1	1	*<1.0*		Sodium	0.05	0.758	1.11	-37.7
Total Dissolved Solids (mg/L)	3	51.0	55	-7.5	Strontium	0.0002	0.042	0.042	0.0
Turbidity (NTU)	0.1	0.32	0.28	13.3	Sulfur	0.5	1.20	1.12	6.9
					Tellurium	0.0002	*<0.00020*	*<0.00020*	
Anions and Nutrients (mg/L)					Thallium	0.00001	*<0.000010*	*<0.000010*	
Alkalinity, Bicarbonate (as $CaCO_3$)	1	7.30	7.9	-7.9	Thorium	0.0001	*<0.00010*	*<0.00010*	
Alkalinity, Carbonate (as $CaCO_3$)	1	*<1.0*	*<1.0*		Tin	0.0001	*<0.00010*	*<0.00010*	
Alkalinity, Hydroxide (as CaCO3)	1	*<1.0*	*<1.0*		Titanium	0.0003	0.00034	0.0006	**-55**
Alkalinity, Total (as $CaCO_3$)	1	7.30	7.9	-7.9	Tungsten	0.0001	*<0.00010*	*<0.00010*	
Ammonia, Total (as N)	0.005	0.009	0.047	**-138**	Uranium	0.00001	0.000032	0.000033	-3.1
Bromide (Br)	0.05	0.08	0.076	0.0	Vanadium	0.0005	*<0.00050*	*<0.00050*	
Chloride (Cl)	0.1	10.00	10	0.0	Zinc	0.003	*<0.0030*	0.0051	
Fluoride (F)	0.02	0.03	0.029	9.8	Zirconium	0.0002	*<0.00020*	*<0.00020*	
Nitrate (as N)	0.005	0.09	0.089	0.9					
Nitrite (as N)	0.001	0.00	0.0011	8.7	**Dissolved Metals (mg/L)**				
Total Kjeldahl Nitrogen	0.05	0.15	0.159	-3.8	Aluminum	0.001	0.0038	0.0036	5.4
Orthophosphate-Dissolved (as P)	0.001	*<0.0010*	*<0.0010*		Antimony	0.0001	*<0.00010*	*<0.00010*	
Phosphorus (P)-Total Dissolved	0.002	*<0.0020*	*<0.0020*		Arsenic	0.0001	0.00039	0.00039	0.0
Phosphorus (P)-Total	0.002	0.002	0.0022	4.4	Barium	0.0001	0.011	0.010	1.0
Silicate (as SiO_2)	0.5	*<0.50*	*<0.50*		Beryllium	0.0001	*<0.00010*	*<0.00010*	
Sulfate (SO_4)	0.3	3.62	3.58	1.1	Bismuth	0.00005	*<0.000050*	*<0.000050*	
					Boron	0.01	*<0.010*	*<0.010*	
Cyanides (mg/L)					Cadmium	0.000005	*<0.0000050*	*<0.0000050*	
Total Cyanide	0.001	*<0.0010*	*<0.0010*		Calcium	0.05	6.42	6.60	-2.8
Free Cyanide	0.001	*<0.0010*	*<0.0010*		Cesium	0.00001	*<0.000010*	*<0.000010*	
					Chromium	0.0001	*<0.00010*	*<0.00010*	
Organic / Inorganic Carbon (mg/L)					Cobalt	0.0001	*<0.00010*	*<0.00010*	
Dissolved Organic Carbon	0.5	1.5	1.6	-7.6	Copper	0.0002	0.00029	0.00027	7.1
Total Organic Carbon	0.5	1.8	1.7	4.6	Iron	0.01	*<0.010*	*<0.010*	
					Lead	0.00005	*<0.000050*	*<0.000050*	
Total Metals (mg/L)					Lithium	0.001	0.0011	0.0011	0.0
Aluminum	0.003	0.012	0.021	**-59**	Magnesium	0.005	1.5	1.52	-1.3
Antimony	0.0001	*<0.00010*	*<0.00010*		Manganese	0.0001	0.0016	0.0017	-5.9
Arsenic	0.0001	0.00041	0.00047	-13.6	Mercury	0.000005	*<0.0000050*	*<0.0000050*	
Barium	0.0001	0.0099	0.010	-3.4	Molybdenum	0.00005	0.00015	0.00014	12.5
Beryllium	0.0001	*<0.00010*	*<0.00010*		Nickel	0.0005	0.00063	0.00063	0.0
Bismuth	0.00005	*<0.000050*	*<0.000050*		Phosphorus	0.05	*<0.050*	*<0.050*	
Boron	0.01	*<0.010*	*<0.010*		Potassium	0.05	0.97	0.99	-1.2
Cadmium	0.000005	0.000006	0.000008	-38.2	Rubidium	0.0002	0.0012	0.0012	0.8
Calcium	0.05	6.3	6.5	-3.6	Selenium	0.00005	*<0.000050*	*<0.000050*	
Cesium	0.00001	*<0.000010*	*<0.000010*		Silicon	0.05	0.174	0.18	-5.6
Chromium	0.0001	0.00038	0.00030	23.5	Silver	0.00001	*<0.000010*	*<0.000010*	
Cobalt	0.0001	*<0.00010*	*<0.00010*		Sodium	0.05	0.75	0.75	0.0
Copper	0.0005	*<0.00050*	0.0015		Strontium	0.0002	0.041	0.041	-2.0
Iron	0.01	0.022	0.031	-34.0	Sulfur	0.5	0.85	1.2	-30.0
Lead	0.00005	*<0.000050*	0.00021		Tellurium	0.0002	*<0.00020*	*<0.00020*	
Lithium	0.001	0.0010	0.0011	-9.5	Thallium	0.00001	*<0.000010*	*<0.000010*	
Magnesium	0.005	1.43	1.43	0.0	Thorium	0.0001	*<0.00010*	*<0.00010*	
Manganese	0.0001	0.00	0.00385	-19.4	Tin	0.0001	*<0.00010*	*<0.00010*	
Mercury	0.000005	*<0.0000050*	*<0.0000050*		Titanium	0.0003	*<0.00030*	*<0.00030*	
Molybdenum	0.00005	0.00018	0.00019	-4.4	Tungsten	0.0001	*<0.00010*	*<0.00010*	
Nickel	0.0005	0.00093	0.0012	-22.9	Uranium	0.00001	0.000028	0.000027	3.6
Phosphorus	0.05	*<0.050*	*<0.050*		Vanadium	0.0005	*<0.00050*	*<0.00050*	
Potassium	0.05	0.97	1.1	-12.5	Zinc	0.001	*<0.0010*	*<0.0010*	
Rubidium	0.0002	0.0012	0.0014	-13.1	Zirconium	0.0002	*<0.00020*	*<0.00020*	

Notes:
RPD = Relative Percent Difference (%) = ((original - duplicate) / (original + duplicate)/2) x 100.
RPDs are calculated when both samples are above detection.
The data quality objective (DQO) for field duplicates is an RPD < 40%.
Bolded RPDs exceed 40% but < 10 x MDL.
Shaded RPDs exceed 40% and > 10 x MDL.
Italicized numbers are below detection limits.

Table 4. Water chemistry data collected from the tributary stations in August, 2019.

Sampling Event	Screening Values		August 2019							
Station ID (maps)**	Aquatic Life	Human Health	A14-A13	A76-A75	A81-A80	A69-DS1	A5-A4	DS1-Outlet	C38-C12	C8-C7
Date			19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19
ALS Sample ID	CCME[1]	GCDWQ[2]	L2335615-4	L2335615-1	L2335615-2	L2335615-5	L2335615-7	L2335615-6	L2335615-3	L2335615-8
Field Measurements (Surface)										
Temperature (°C)			13.3	13.8	13.5	14.7	14.4	13.1	13.5	13.0
Specific Conductivity (µS/cm)			61.5	40.3	15.3	20.9	35.40	24.7	59.0	26.7
Dissolved Oxygen (mg/L)			9.7	10.1	10.5	10.9	9.9	10.8	9.7	10.8
pH	6.5 - 9.0		7.08	7.14	7.20	7.34	7.35	7.29	7.37	7.40
Physical Tests (mg/L)										
Conductivity (µS/cm)			61.6	40.1	15.7	21.2	35.1	25.4	58.6	27.1
Hardness			22.9	13.9	5.4	7.6	12.9	10.3	22.2	10.9
pH (Laboratory)	6.5 - 9.0		7.01	7.06	6.98	7.03	7.08	7.25	7.18	7.33
Total Suspended Solids			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	1	1	*<1.0*
Total Dissolved Solids			54	53	16	20	30	21	51	21
Turbidity (NTU)			0.30	0.26	0.34	0.36	0.25	0.31	0.32	0.23
Anions and Nutrients (mg/L)										
Alkalinity - Bicarbonate			5.9	5.4	4.5	5.3	5.6	9.0	7.3	10.0
Alkalinity - Carbonate			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			5.9	5.4	4.5	5.3	5.6	9.0	7.3	10.0
Ammonia (as N)[3]	***equation***		0.15	0.12	0.02	0.03	0.133	0.02	0.01	0.069
Bromide			0.13	0.06	*<0.050*	*<0.050*	*<0.050*	*<0.050*	0.08	*<0.050*
Chloride	120	250	11.20	6.09	0.96	1.72	4.73	1.17	10.00	0.62
Fluoride	0.120	1.5	0.029	0.029	0.032	0.036	0.028	0.038	0.032	0.037
Nitrate (as N)	3.0	10	0.0121	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*	0.0898	*<0.0050*
Nitrite (as N)	0.060	1	*<0.0010*	*<0.0010*	*<0.0010*	0.001	*<0.0010*	*<0.0010*	0.001	*<0.0010*
Total Kjeldahl Nitrogen			0.256	0.214	0.143	0.172	0.238	0.174	0.153	0.175
Ortho Phosphate (as P)			*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Phosphorus (P)-Total Diss.			*<0.0020*	*<0.0020*	*<0.0020*	0.0036	*<0.0020*	*<0.0020*	*<0.0020*	*<0.0020*
Phosphorus (P)-Total	0.0040		*<0.0020*	*<0.0020*	0.0025	0.0030	*<0.0020*	0.0039	0.0023	**0.0057**
Silicate (as SiO_2)			0.85	0.91	1.03	1.20	1.23	*<0.50*	*<0.50*	1.41
Sulphate (SO_4)		500	4.88	3.69	1.05	1.61	3.54	1.52	3.62	2.51
Cyanides										
Total Cyanide			*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Free Cyanide			*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Organic / Inorganic Carbon (mg/L)										
Dissolved Organic Carbon			1.6	1.5	2.2	3.0	1.4	2.4	1.5	1.3
Total Organic Carbon			1.7	2.0	2.6	3.5	1.8	2.7	1.8	1.4
Plant Pigments (µg/L)										
Chlorophyll-*a*										
Total Metals (mg/L)										
Aluminum[3]	***equation***		0.0079	0.0108	0.0268	0.0199	0.0087	0.0112	0.0116	0.0081
Antimony		0.006	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Arsenic	0.0050	0.01	0.0003	0.0002	0.0001	0.0001	0.0002	0.0002	0.0004	0.0004
Barium		1	0.0116	0.0085	0.0022	0.0036	0.0075	0.0030	0.0099	0.0101
Boron	1.5	5	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Cadmium[3]	***equation***	0.005	*<0.0000050*	0.000	0.000	*<0.0000050*	*<0.0000050*	*<0.0000050*	0.00	*<0.0000050*
Calcium			6.49	4.04	1.77	2.10	3.36	2.40	6.30	2.50
Chromium[4]	0.001	0.05	*<0.00010*	0.0001	0.0002	0.0001	*<0.00010*	*<0.00010*	0.0004	0.0001
Cobalt			*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Copper[3]	***equation***	1	*<0.00050*	*<0.00050*	0.0008	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Iron	0.3	0.3	0.015	0.024	0.053	0.069	0.029	0.026	0.022	*<0.010*
Lead[3]	***equation***	0.01	*<0.000050*	*<0.000050*	0.00010	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Lithium			0.00	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	0.00	*<0.0010*
Magnesium			1.41	1.22	0.40	0.59	1.08	1.03	1.43	1.15
Manganese[3]		0.05	0.0007	0.0021	0.0031	0.0019	0.0009	0.0017	0.0032	0.0015
Mercury	0.000026	0.001	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*
Molybdenum	0.073		0.0001	*<0.000050*	0.0001	0.0001	*<0.000050*	*<0.000050*	0.0002	0.0001
Nickel[3]	***equation***		0.0010	0.0005	*<0.00050*	*<0.00050*	0.0006	*<0.00050*	0.0009	0.0005
Phosphorus			*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Potassium			1.07	0.78	0.32	0.39	0.71	0.37	0.97	0.51
Rubidium			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium	0.001	0.01	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Silicon			0.49	0.52	0.57	0.64	0.65	0.29	0.22	0.76
Silver	0.00025		*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*

Table 4. Water chemistry data collected from the tributary stations in August, 2019.

Sampling Event	Screening Values		August 2019							
Station ID (maps)**	Aquatic Life	Human Health	A14-A13	A76-A75	A81-A80	A69-DS1	A5-A4	DS1-Outlet	C38-C12	C8-C7
Date			19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19
ALS Sample ID	CCME[1]	GCDWQ[2]	L2335615-4	L2335615-1	L2335615-2	L2335615-5	L2335615-7	L2335615-6	L2335615-3	L2335615-8
Sodium		200	0.83	0.69	0.80	0.78	0.66	0.72	0.76	0.59
Strontium			0.0491	0.0227	0.0074	0.0100	0.0176	0.0071	0.0415	0.0136
Sulfur			1.57	1.07	0.61	*<0.50*	1.06	0.51	1.20	0.66
Thallium	0.0008		*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Titanium			*<0.00030*	0.00032	0.00047	*<0.00030*	*<0.00030*	*<0.00030*	0.00034	*<0.00030*
Uranium	0.015	0.02	0.000028	0.000025	0.000081	0.000071	0.000034	0.000081	0.000032	0.000027
Zinc[3]		0.5	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*	*<0.0030*
Dissolved Metals (mg/L)										
Aluminum			0.0031	0.0037	0.0077	0.0140	0.0053	0.01	0.0038	0.0049
Antimony			*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Arsenic			0.0003	0.00018	*<0.00010*	0.0001	0.00018	0.00012	0.00039	0.00039
Barium			0.0122	0.0077	0.0020	0.0036	0.0076	0.0029	0.0105	0.0100
Beryllium			*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Bismuth			*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Boron			*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Cadmium			*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*
Calcium			6.66	3.67	1.49	2.04	3.39	2.37	6.42	2.47
Chromium			*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Cobalt			*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Copper			0.00043	0.00033	0.00033	0.00044	0.00038	0.0004	0.00029	0.00034
Iron			*<0.010*	*<0.010*	0.01	0.04	0.01	0.01	*<0.010*	*<0.010*
Lead			*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Lithium			0.00	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	0.00	*<0.0010*
Magnesium			1.52	1.14	0.39	0.62	1.08	1.06	1.50	1.15
Manganese			0.0004	0.0008	0.0005	0.0012	0.0006	0.0006	0.0016	0.0005
Mercury			*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*
Molybdenum			0.0001	*<0.000050*	0.0001	*<0.000050*	*<0.000050*	*<0.000050*	0.0002	0.0001
Nickel			0.0008	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	0.0006	*<0.00050*
Phosphorus			*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*	*<0.050*
Potassium			1.10	0.69	0.29	0.39	0.68	0.36	0.97	0.50
Rubidium			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Selenium			*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Silicon			0.47	0.49	0.55	0.61	0.65	0.25	0.17	0.77
Silver			*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Sodium			0.84	0.62	0.70	0.76	0.62	0.69	0.75	0.56
Strontium			0.0477	0.0195	0.0065	0.0092	0.0159	0.0069	0.0406	0.0124
Sulfur			1.50	0.81	*<0.50*	*<0.50*	0.90	*<0.50*	0.85	*<0.50*
Thallium			*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Tin			*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Uranium			0.00002	0.00002	0.00007	0.00007	0.00003	0.00007	0.00003	0.00002
Vanadium			*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Zinc[5]	***equation***		*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*

Notes:

** Stream stations are ordered left to right to reflect upstream to downstream location in each watershed (i.e. A and C).

1. CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2019.

2. Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment; GCDWQ). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

3. "equation" means that CCME guidelines are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum guidelines vary with pH; the cadmium, copper, lead, and nickel guidelines vary with hardness.

4. Chromium CCME guideline is for Cr VI.

5. The long-term Canadian Water Quality Guideline (CWQG) is for dissolved zinc and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). The CWQG equation is valid between hardness 23.4 and 399 mg $CaCO_3$·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1.

Bolded values exceed the CCME aquatic life guidelines.

Bordered concentrations exceed the GCDWQ.

Table 5. Water chemistry data collected from the tributary stations in August, 2015.

Sampling Event	Aquatic Life	Human Health	August 2015									
Station ID (maps)			A21-A20	A55-A17	A18-A17	A14-A13	A76-A75	A5-A4	A81-A80	A69-DS1	C38-C12	C8-C7	DS1
Date	CCME[1]	GCDWQ[2]	6-Aug-15	7-Aug-15	4-Aug-15	4-Aug-15	5-Aug-15	6-Aug-15	8-Aug-15	4-Aug-15	4-Aug-15	8-Aug-15	5-Aug-15
Field Measurements (Surface)													
Temperature (°C)			17.2	16.6	17.2	14.4	13.1	15.5	15.4	14.6	16.1	12.6	13.6
Sp. Cond.(µS/cm)			13.4	14.9	15.1	23.5	22.0	20.6	12.0	17.1	24.1	25.1	20.8
DO (mg/L)			9.6	10.1	10.1	10.0	9.6	10.0	9.5	10.2	10.4	10.7	11.1
pH	6.5 - 9.0		6.75	**6.48**	6.71	6.53	6.93	**6.23**	6.52	6.60	6.65	6.85	7.02
Physical Tests (mg/L)													
Conductivity (µS/cm)			13.8	14.7	15.0	23.9	23.2	21.6	12.6	16.1	24.4	26.4	22.0
Hardness			4.5	5.2	5.3	9.0	8.2	7.8	4.2	5.8	9.7	10.6	8.4
pH (Laboratory)	6.5 - 9.0		6.84	6.79	6.80	6.81	6.95	6.92	6.74	6.77	6.98	7.15	7.02
Total Suspended Solids			*<1.0*	2	*<1.0*	*<1.0*	*<1.0*	2	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Total Dissolved Solids			16	16	14	18	19	18	14	13	19	22	20
Turbidity (NTU)			0.35	0.57	0.26	0.24	0.24	0.30	0.31	0.29	0.23	0.22	0.37
Anions and Nutrients (mg/L)													
Alkalinity - Bicarbonate			4.8	6.3	5.0	5.8	6.4	5.8	3.9	5.0	7.2	9.4	7.1
Alkalinity - Carbonate			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			4.8	6.3	5.0	5.8	6.4	5.8	3.9	5.0	7.2	9.4	7.1
Ammonia (as N)[3]	***equation***		*<0.005*	*<0.005*	*<0.005*	0.007	*<0.005*	*<0.005*	*<0.005*	0.005	*<0.005*	*<0.005*	0.01
Bromide			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	0.59	0.94	0.68	1.73	0.94	1.11	0.65	0.74	0.51	0.49	0.95
Fluoride	0.120	1.5	0.029	0.025	0.031	0.025	0.025	0.028	0.027	0.028	0.023	0.033	0.038
Nitrate (as N)	3.0	10	0.0123	*<0.005*	*<0.005*	0.0065	*<0.005*	*<0.005*	0.0055	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Nitrite (as N)	0.060	1	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.142	0.193	0.152	0.144	0.150	0.143	0.123	0.144	0.124	0.095	0.157
Ortho Phosphate (as P)			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Phosphorus (P)-Total Diss.			0.0043	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*
Phosphorus (P)-Total	0.0040		0.0026	0.0038	0.0023	*<0.002*	*<0.002*	*<0.002*	0.0026	0.0026	*<0.002*	*<0.02*	0.0028
Silicate (as SiO_2)			1.25	0.88	0.81	0.58	0.87	0.76	0.92	*<0.5*	*<0.5*	1.43	*<0.5*
Sulphate (SO_4)		500	0.73	2.64	0.85	2.57	2.64	2.39	0.71	1.32	3.03	2.26	1.23
Cyanides													
Total Cyanide			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide			*<0.001*	*<0.001*	*<0.001*	0.00	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)													
Dissolved Organic Carbon			2.0	2.3	1.9	1.8	1.7	1.6	1.8	1.9	1.6	1.4	2.2
Total Organic Carbon			2.1	2.4	1.6	1.7	1.6	1.6	1.9	1.9	1.5	1.4	2.3
Total Metals (mg/L)													
Aluminum[3]	***equation***		0.0170	0.0211	0.0085	0.0084	0.0064	0.0088	0.0102	0.0090	0.0049	0.0051	0.0144
Antimony		0.006	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	*<0.0001*	0.0002	0.0001	0.0004	0.0002	0.0002	*<0.0001*	0.0001	0.0003	0.0004	0.0001
Barium		1	0.0036	0.0022	0.0037	0.0047	0.0047	0.0046	0.0017	0.0030	0.0039	0.0099	0.0028
Beryllium			*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth			*<0.00005*	*<0.00005*	0.00	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium[3]	***equation***	0.005	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Calcium			1.21	0.91	1.33	2.30	2.09	1.94	1.24	1.51	2.26	2.47	1.95
Chromium[4]	0.001	0.05	*<0.0001*	0.0002	*<0.0001*	*<0.0001*	*<0.0001*	0.0001	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Cobalt			*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper[3]	***equation***	1	*<0.0005*	0.0007	*<0.0005*	0.0005	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Iron	0.3	0.3	0.038	0.161	0.057	0.017	0.017	0.035	0.031	0.051	0.015	*<0.01*	0.028
Lead[3]	***equation***	0.01	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Lithium			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.41	0.69	0.50	0.79	0.72	0.71	0.29	0.46	1.02	1.09	0.85
Manganese[3]		0.05	0.0008	0.0026	0.0008	0.0008	0.0023	0.0010	0.0024	0.0016	0.0039	0.0027	0.0024
Mercury	0.000026	0.001	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		*<0.00005*	0.0001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.0001	*<0.00005*	*<0.00005*	0.0010	*<0.00005*
Nickel[3]	***equation***		*<0.0005*	0.0008	*<0.0005*	0.0007	0.0005	*<0.0005*	*<0.0005*	*<0.0005*	0.0005	0.0006	*<0.0005*
Phosphorus			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.38	0.37	0.41	0.57	0.53	0.59	0.27	0.37	0.63	0.50	0.34
Selenium	0.001	0.01	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon			0.57	0.34	0.46	0.35	0.37	0.34	0.41	0.27	0.22	0.63	0.20
Silver	0.0001		*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.63	0.61	0.66	0.58	0.54	0.54	0.58	0.62	0.51	0.63	0.73
Strontium			0.0070	0.0052	0.0071	0.0115	0.0090	0.0083	0.0056	0.0073	0.0096	0.0119	0.0061

Table 5. Water chemistry data collected from the tributary stations in August, 2015.

Sampling Event	Aquatic Life	Human Health	August 2015									
Station ID (maps)			A21-A20	A55-A17	A18-A17	A14-A13	A76-A75	A5-A4	A81-A80	A69-DS1	C38-C12	C8-C7	DS1
Date	CCME[1]	GCDWQ[2]	6-Aug-15	7-Aug-15	4-Aug-15	4-Aug-15	5-Aug-15	6-Aug-15	8-Aug-15	4-Aug-15	4-Aug-15	8-Aug-15	5-Aug-15
Sulfur			<0.5	<0.5	<0.5	0.94	0.91	0.82	<0.5	0.56	1.10	0.83	<0.5
Thallium	0.0008		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium			0.00033	0.00048	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Uranium	0.015	0.02	0.000048	0.000069	0.000027	0.000028	0.000021	0.000025	0.000052	0.000035	<0.00001	0.000020	0.000045
Vanadium			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc		0.5	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Zirconium			<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Dissolved Metals (mg/L)													
Aluminum			0.0060	0.01	0.0040	0.0022	0.0027	0.0033	0.0034	0.0040	0.0018	0.0026	0.0054
Antimony			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic			<0.0001	0.0002	<0.0001	0.0003	0.0002	0.0002	<0.0001	<0.0001	0.0003	0.0003	0.0002
Barium			0.0066	0.0038	0.0048	0.0061	0.0075	0.0074	0.0026	0.0035	0.0041	0.0115	0.0031
Beryllium			<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Bismuth			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Boron			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium			<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.00001	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Calcium			1.16	0.92	1.33	2.29	2.11	1.97	1.20	1.54	2.23	2.47	1.98
Chromium			<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper			0.00069	0.0007	0.00032	0.00080	0.00063	0.00082	0.00053	0.00032	0.00026	0.00047	0.00064
Iron			0.01	0.08	0.03	<0.01	<0.01	0.01	<0.01	0.01	<0.01	<0.01	0.01
Lead			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00014	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Lithium			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium			0.38	0.70	0.49	0.79	0.72	0.71	0.28	0.47	1.00	1.08	0.85
Manganese			0.0005	0.0018	0.0004	0.0006	0.0010	0.0006	0.0006	0.0007	0.0004	0.0011	0.0007
Mercury			<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Molybdenum			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001	<0.00005	<0.00005	0.0001	<0.00005
Nickel			<0.0005	0.0007	<0.0005	0.0006	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Phosphorus			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Potassium			0.34	0.44	0.40	0.57	0.54	0.60	0.27	0.37	0.59	0.53	0.32
Selenium			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Silicon			0.54	0.32	0.45	0.36	0.37	0.34	0.39	0.25	0.21	0.64	0.19
Silver			<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Sodium			0.77	0.70	0.67	0.68	0.63	0.65	0.65	0.56	0.51	0.70	0.82
Strontium			0.0067	0.0048	0.0070	0.0110	0.0087	0.0082	0.0053	0.0066	0.0093	0.0124	0.0062
Sulfur			<0.5	<0.5	<0.5	0.93	0.89	0.83	<0.5	<0.5	1.07	0.80	
Thallium			<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin			0.00	<0.0001	<0.0001	0.00	0.00	0.00	0.00	<0.0001	<0.0001	0.00	0.00
Titanium			<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Uranium			0.00004	0.00005	0.00002	0.00002	0.00002	0.00003	0.00005	0.00003	<0.00001	0.00002	0.00004
Vanadium			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc[5]	***equation***		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium			<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003

Notes:

** Stream stations are ordered left to right to reflect upstream to downstream location in each watershed (i.e. A and C).

1. CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2019.

2. Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment; GCDWQ). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

3. "equation" means that CCME guidelines are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum guidelines vary with pH; the cadmium, copper, lead, and nickel guidelines vary with hardness.

4. Chromium CCME guideline is for Cr VI.

5. The long-term Canadian Water Quality Guideline (CWQG) is for dissolved zinc and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). The CWQG equation is valid between hardness 23.4 and 399 mg $CaCO_3$·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1.

Bolded values exceed the CCME aquatic life guidelines.

Bordered concentrations exceed the GCDWQ.

underline = results were given a cautionary flag in the QC assessment (refer to **Appendix A1-1** [Azimuth 2018] for details).

~~strikethrough~~ = results flagged as unreliable in the QC assessment (refer to **Appendix A1-1** [Azimuth 2018] for details).

Table 6. Water chemistry data collected from the tributary stations in September, 2015.

Sampling Event	Aquatic Life	Human Health	September 2015					
Station ID (maps)			A55-A17	A18-A17	A17-A16	A15-A14	C38-C12	A69-DS1
Date	CCME[1]	GCDWQ[2]	17-Sep-15	19-Sep-15	17-Sep-15	21-Sep-15	19-Sep-15	19-Sep-15
Field Measurements (Surface)								
Temperature (°C)			-	4.7	-	1.8	5.5	4.2
Sp. Conductivity (µS/cm)			-	10.5	18	17.7	16.3	12.9
Dissolved Oxygen (mg/L)			13.1	12.5	12.7	12.9	11.8	12.7
pH	6.5 - 9.0		7.25	7.14	7.16	7.08	7.14	7.33
Physical Tests (mg/L)								
Conductivity (µS/cm)			19	17	34	28	28	21
Hardness			6.2	5.9	12.6	10.0	9.6	7.3
pH (Laboratory)	6.5 - 9.0		6.74	6.84	6.70	6.78	7.04	6.85
Total Suspended Solids			11	*<1.0*	3	*<1.0*	*<1.0*	*<1.0*
Total Dissolved Solids			15	10	24	15	16	14
Turbidity (NTU)			14.90	0.22	0.31	0.36	0.25	0.81
Anions and Nutrients (mg/L)								
Alkalinity - Bicarbonate			5.4	5.7	4.3	5.9	6.6	6.3
Alkalinity - Carbonate			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Hydroxide			*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*	*<1.0*
Alkalinity - Total			5.4	5.7	4.3	5.9	6.6	6.3
Ammonia (as N)[3]	***equation***		0.01	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.005*
Bromide			*<0.05*	*<0.05*	0.06	*<0.05*	*<0.05*	*<0.05*
Chloride	120	250	0.64	0.73	5.66	2.08	0.53	0.95
Fluoride	0.120	1.5	0.032	0.032	0.026	0.025	0.024	0.028
Nitrate (as N)	3.0	10	0.0138	0.0068	*<0.005*	0.0139	*<0.005*	0.0107
Nitrite (as N)	0.060	1	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Total Kjeldahl Nitrogen			0.173	0.293	0.150	0.126	0.129	0.179
Ortho Phosphate (as P)			*<0.001*	0.0014	0.0014	0.0012	0.0012	0.0011
Phosphorus (P)-Total Diss.			0.0026	*<0.002*	*<0.002*	*<0.002*	*<0.002*	0.0026
Phosphorus (P)-Total	0.0040		-	-	-	-	-	-
Silicate (as SiO_2)			1.38	1.15	0.65	0.99	*<0.5*	1.01
Sulphate (SO_4)		500	1.36	1.06	1.73	3.33	3.20	2.02
Cyanides								
Total Cyanide			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Free Cyanide			0.00	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Organic / Inorganic Carbon (mg/L)								
Dissolved Organic Carbon			2.8	1.8	~~13.2~~	3.5	1.8	1.9
Total Organic Carbon			2.8	3.0	2.5	1.6	1.7	1.8
Total Metals (mg/L)								
Aluminum[3]	***equation***		~~0.4910~~	0.0053	0.0087	0.0086	0.0039	0.0304
Antimony		0.006	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Arsenic	0.0050	0.01	0.0004	*<0.0001*	0.0003	0.0003	0.0003	0.0001
Barium		1	0.0061	0.0034	0.0051	0.0049	0.0036	0.0038
Beryllium			0.00	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*	*<0.00002*
Bismuth			*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Boron	1.5	5	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Cadmium[3]	***equation***	0.005	*<0.000005*	*<0.000005*	*<0.000005*	0.00001	*<0.000005*	*<0.000005*
Calcium			1.04	1.37	3.07	2.53	2.18	1.85
Chromium[4]	0.001	0.05	~~0.0020~~	*<0.0001*	0.0001	0.0002	*<0.0001*	0.0001
Cobalt			0.00	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Copper[3]	***equation***	1	0.0016	*<0.0005*	*<0.0005*	0.0006	*<0.0005*	*<0.0005*
Iron	0.3	0.3	~~0.793~~	0.030	0.020	0.022	*<0.01*	0.070
Lead[3]	***equation***	0.01	0.00054	*<0.00005*	*<0.00005*	0.00026	*<0.00005*	*<0.00005*
Lithium			*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Magnesium			0.97	0.52	0.92	0.86	0.99	0.59
Manganese[3]		0.05	0.0094	0.0004	0.0031	0.0008	0.0026	0.0015
Mercury	0.000026	0.001	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.000005*
Molybdenum	0.073		0.0001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Nickel[3]	***equation***		0.0020	*<0.0005*	0.0010	0.0007	0.0048	*<0.0005*
Phosphorus			*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*	*<0.05*
Potassium			0.49	0.34	0.40	0.57	0.56	0.45
Selenium	0.001	0.01	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Silicon			1.41	0.52	0.27	0.43	0.21	0.49
Silver	0.0001		*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
Sodium		200	0.61	0.64	0.57	0.58	0.49	0.61
Strontium			0.0063	0.0070	0.0223	0.0112	0.0093	0.0081
Sulfur			*<0.5*	*<0.5*	0.61	1.15	1.12	0.67

Table 6. Water chemistry data collected from the tributary stations in September, 2015.

Sampling Event	Aquatic Life	Human Health	September 2015					
Station ID (maps)			A55-A17	A18-A17	A17-A16	A15-A14	C38-C12	A69-DS1
Date	CCME[1]	GCDWQ[2]	17-Sep-15	19-Sep-15	17-Sep-15	21-Sep-15	19-Sep-15	19-Sep-15
Thallium	0.0008		<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Titanium			0.01560	<0.0003	<0.0003	0.00030	<0.0003	0.00081
Uranium	0.015	0.02	0.000318	0.000017	0.000027	0.000017	<0.00001	0.000033
Vanadium			0.00	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc	0.030	0.5	0.0033	<0.003	<0.003	<0.003	<0.003	<0.003
Zirconium			0.00	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Dissolved Metals (mg/L)								
Aluminum			0.0452	0.0023	0.0039	0.0032	0.0021	0.0072
Antimony			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Arsenic			0.0002	<0.0001	0.0002	0.0002	0.0003	0.0001
Barium			0.0034	0.0042	0.0073	0.0055	0.0039	0.0058
Beryllium			<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002
Bismuth			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Boron			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium			<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Calcium			1.08	1.46	3.40	2.54	2.22	1.93
Chromium			0.00	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper			0.00090	0.00034	0.00043	0.00055	0.00025	0.00056
Iron			0.09	0.01	<0.01	<0.01	<0.01	0.02
Lead			0.00014	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Lithium			<0.001	<0.001	0.0010	<0.001	<0.001	<0.001
Magnesium			0.84	0.54	1.00	0.89	0.99	0.62
Manganese			0.0028	0.0004	0.0018	0.0004	0.0006	0.0008
Mercury			<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Molybdenum			0.0001	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel			0.0011	<0.0005	0.0010	0.0007	<0.0005	<0.0005
Phosphorus			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Potassium			0.38	0.38	0.45	0.58	0.59	0.45
Selenium			<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Silicon			0.68	0.54	0.29	0.44	0.21	0.46
Silver			<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Sodium			0.69	0.80	0.63	0.62	0.49	0.74
Strontium			0.0059	0.0069	0.0225	0.0112	0.0091	0.0080
Sulfur			<0.5	<0.5	0.60	1.11	1.25	0.71
Thallium			<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Tin			<0.0001	<0.0001	0.00	<0.0001	<0.0001	<0.0001
Titanium			0.00	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Uranium			0.00014	0.00001	0.00002	0.00001	<0.00001	0.00002
Vanadium			<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc			0.002	<0.001	<0.001	0.001	<0.001	0.001
Zirconium			<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003

Notes:

** Stream stations are ordered left to right to reflect upstream to downstream location in each watershed (i.e. A and C).

1. CCME (Canadian Council of Ministers of the Environment) Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999, updated up to 2019.

2. Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Health and the Environment; GCDWQ). Standards for the following parameters are aesthetic and meant to protect against taste and odour: chloride, sulphate, copper, iron, manganese, sodium, zinc.

3. "equation" means that CCME guidelines are calculated based on an equation which is either pH or hardness dependent. The ammonia and aluminum guidelines vary with pH; the cadmium, copper, lead, and nickel guidelines vary with hardness.

4. Chromium CCME guideline is for Cr VI.

5. The long-term Canadian Water Quality Guideline (CWQG) is for dissolved zinc and is calculated using the following equation: CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). The CWQG equation is valid between hardness 23.4 and 399 mg CaCO3·L−1, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg·L−1.

Bolded values exceed the CCME aquatic life guidelines.

Bordered values exceed the GCDWQ.

underline = results were given a cautionary flag in the QC assessment (refer to **Appendix A1-1** [Azimuth 2018] for details).

~~strikethrough~~ = results flagged as unreliable in the QC assessment (refer to **Appendix A1-1** [Azimuth 2018] for details).

Table 7. Temporal assessment of baseline water quality data at station A81-A80.

Station ID (maps)**	A81-A80		Percent difference
Date	8-Aug-15	19-Aug-19	
Field Measurements (Surface)			
Temperature (°C)	15.4	13.5	-13
Specific Conductivity (µS/cm)	12.0	15.3	24
Dissolved Oxygen (mg/L)	9.5	10.5	10
pH	6.52	7.20	10
Physical Tests (mg/L)			
Conductivity (µS/cm)	12.6	15.7	22
Hardness	4.2	5.4	25
pH (Laboratory)	6.74	6.98	3
Total Dissolved Solids	14	16	17
Turbidity (NTU)	0.31	0.34	9
Anions and Nutrients (mg/L)			
Alkalinity - Bicarbonate	3.9	4.5	14
Alkalinity - Total	3.9	4.5	14
Ammonia (as N)	*<0.005*	0.02	133
Chloride	0.65	0.96	39
Fluoride	0.027	0.032	17
Nitrate (as N)	0.0055	*<0.005*	-10
Total Kjeldahl Nitrogen	0.123	0.143	15
Phosphorus (P)-Total	0.0026	0.0025	-4
Silicate (as SiO_2)	0.92	1.03	11
Sulphate (SO_4)	0.71	1.05	39
Organic / Inorganic Carbon (mg/L)			
Dissolved Organic Carbon	1.8	2.2	24
Total Organic Carbon	1.9	2.6	32
Total Metals (mg/L)			
Aluminum	0.0102	0.0268	90
Arsenic	*<0.0001*	0.0001	0
Barium	0.0017	0.0022	25
Cadmium	*<0.000005*	0.000	66
Calcium	1.24	1.77	35
Chromium	*<0.0001*	0.0002	75
Copper	*<0.0005*	0.0008	47
Iron	0.031	0.053	52
Lead	*<0.00005*	0.00010	68
Magnesium	0.29	0.40	32

Table 7. Temporal assessment of baseline water quality data at station A81-A80.

Station ID (maps)**	A81-A80		Percent difference
Date	8-Aug-15	19-Aug-19	
Manganese	0.0024	0.0031	26
Molybdenum	0.0001	0.0001	14
Potassium	0.27	0.32	16
Silicon	0.41	0.57	32
Sodium	0.58	0.80	32
Strontium	0.0056	0.0074	28
Sulfur	*<0.5*	0.61	20
Titanium	*<0.0003*	0.00047	44
Uranium	0.000052	0.000081	44
Dissolved Metals (mg/L)			
Aluminum	0.0034	0.0077	77
Barium	0.0026	0.0020	-26
Calcium	1.20	1.49	22
Copper	0.00053	0.00033	-47
Iron	*<0.01*	0.01	26
Magnesium	0.28	0.39	34
Manganese	0.0006	0.0005	-30
Molybdenum	0.0001	0.0001	-4
Potassium	0.27	0.29	6
Silicon	0.39	0.55	36
Sodium	0.65	0.70	7
Strontium	0.0053	0.0065	20
Tin	0.00	*<0.0001*	-26
Uranium	0.00005	0.00007	36

Notes:

Percent Difference (%) = ((2015 result - 2019 result) / (2015 result + 2019 result)/2) x 100.

Italicized numbers are below detection limits.

Table 8. August 2019 stream water quality data compared to predictions in the FEIS.

Sampling Event	Screening Values			August 2019				
Station ID (maps)**	Aug '19 WQ Predictions			A14-A13	A76-A75	A69-DS1	A5-A4	DS1-Outlet
Date				19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19	19-Aug-19
Compared Against	MAM-Outlet	DS-Node1	DS-Node2	MAM-Outlet	MAM-Outlet	MAM-Outlet	MAM-Outlet	DS-Node1
ALS Sample ID				L2335615-4	L2335615-1	L2335615-5	L2335615-7	L2335615-6
Physical Tests (mg/L)								
Total Dissolved Solids	26.9	10.9	12.5	54	53	20	30	21
Turbidity (NTU)				0.30	0.26	0.36	0.25	0.31
Anions and Nutrients (mg/L)								
Alkalinity - Total	8.8	5.7	6.0	5.9	5.4	5.3	5.6	9.0
Ammonia (as N)	0.022	0.006	0.006	0.15	0.12	0.03	0.133	0.02
Chloride	6.72	1.30	2.04	11.20	6.09	1.72	4.73	1.17
Fluoride	0.040	0.027	0.029	0.029	0.029	0.036	0.028	0.038
Nitrate (as N)	0.60	0.01	0.01	0.0121	*<0.0050*	*<0.0050*	*<0.0050*	*<0.0050*
Phosphorus (P)-Total	0.0051	0.0022	0.0024	*<0.0020*	*<0.0020*	0.0030	*<0.0020*	0.0039
Sulphate (SO_4)	3.75	2.20	2.33	4.88	3.69	1.61	3.54	1.52
Dissolved Metals (mg/L)								
Aluminum	0.0023	0.0038	0.0038	0.0031	0.0037	0.0140	0.0053	0.01
Antimony	0.0003	0.0001	0.0001	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Arsenic	0.0044	0.0002	0.0002	0.0003	0.00018	0.0001	0.00018	0.00012
Barium	0.0081	0.0056	0.0060	0.0122	0.0077	0.0036	0.0076	0.0029
Beryllium	0.0000236	0.0000206	0.0000219	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Bismuth	0.0000524	0.0000514	0.0000548	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Boron	0.041	0.010	0.011	*<0.010*	*<0.010*	*<0.010*	*<0.010*	*<0.010*
Cadmium	0.0000078	0.0000053	0.0000056	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*
Calcium	4.09	2.03	2.40	6.66	3.67	2.04	3.39	2.37
Chromium	0.00040	0.00010	0.00011	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Cobalt	0.00025	0.00010	0.00011	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Copper	0.00078	0.00061	0.00061	0.00043	0.00033	0.00044	0.00038	0.0004
Iron	0.036	0.013	0.013	*<0.010*	*<0.010*	0.04	0.01	0.01
Lead	0.00016	0.00006	0.00007	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Lithium	0.001	0.001	0.001	0.00	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*
Magnesium	1.30	0.67	0.77	1.52	1.14	0.62	1.08	1.06
Manganese	0.017	0.001	0.001	0.0004	0.0008	0.0012	0.0006	0.0006
Mercury	0.0000069	0.0000052	0.0000055	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*	*<0.0000050*
Molybdenum	0.00053	0.00005	0.00006	0.0001	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Nickel	0.0022	0.0006	0.0006	0.0008	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Potassium	0.95	0.50	0.55	1.10	0.69	0.39	0.68	0.36
Selenium	0.00014	0.00005	0.00006	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*	*<0.000050*
Silver	0.000015	0.000010	0.000011	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Sodium	2.10	0.66	0.69	0.84	0.62	0.76	0.62	0.69
Strontium	0.026	0.009	0.012	0.0477	0.0195	0.0092	0.0159	0.0069
Thallium	0.000012	0.000010	0.000011	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*	*<0.000010*
Tin	0.00012	0.00014	0.00014	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*	*<0.00010*
Uranium	0.00018	0.00003	0.00003	0.00002	0.00002	0.00007	0.00003	0.00007
Vanadium	0.00066	0.00051	0.00055	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*	*<0.00050*
Zinc[5]	0.0016	0.0011	0.0012	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*	*<0.0010*

Notes:

** Stream stations are ordered left to right to reflect upstream to downstream location in each watershed (i.e. A and C).

Parameters that are underlined are plotted in **Appendix D** against the relevant water quality predictions and lake water quality data.

Shaded values exceed the water quality predictions.

Italicized numbers are below detection limits.

APPENDIX A
FIELD DATASHEETS

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: C38-C12 **Field Crew:** M. Finley, M. DiMauro
Date: Aug 20, 2019 **Time:** 14:00
Weather: sleet, slight wind
Observations:
Easting: 14W 606640 **Northing:** 7258222. **Waypoint:** 085

REACH DATA

Habitat types (check those present):
Riffle ☐ Rapids ☐ Straight run ☒ Pool / Back Eddy ☐

Canopy coverage (check one):
0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):
0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):
Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):
Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):
0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☐ 12.8-25.6 cm (cobble)
8. ☒ >25.6 cm (boulder)
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):
☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☒ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: Top of a straight run. Lots of green stringy algae, & peri matting in deeper pools. See photos. grassy patches on edge.
↳ From MD's phone

WATER CHEMISTRY DATA

Unit (make and model):

Air temp: (°C) Water temp: 13.5 (°C) pH: 7.37
Sp. Cond. 59.0 (µS/cm) DO: 9.73 (mg/L) :

Water collected for chem?: ((Yes) / No)
Phytoplankton collected?: (Yes / (No))
Field Dup collected?: ((Yes) / No)

Sample Depth: 15 cm.
Volume Filtered: NA.
DUP ID: Dup-Stream

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No)
Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes:
No arsenic speciation for Dup.
NaOH not added to Dup Cyanide.

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: DS1 **Field Crew:** M. Finley, M. DiMauro

Date: Aug 19, 2019. **Time:** 14:46

Weather:

Observations:

Easting: 14W 0599155 **Northing:** 7268369. **Waypoint:** 078

REACH DATA

Habitat types (check those present):

Riffle ☐ Rapids ☐ Straight run ☒ Pool / Back Eddy ☐

Canopy coverage (check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):

0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☐ 12.8-25.6 cm (cobble)
8. ☒ >25.6 cm (boulder)
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):

☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☐ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: 40-50 m wide, no exposed cobble, some peri growth

WATER CHEMISTRY DATA

Unit (make and model):

Air temp: (°C) Water temp: 13.1 (°C) pH: 7.29

Sp. Cond. 24.7 (µS/cm) DO: 10.8 (mg/L) :

Water collected for chem?: (Yes / No)

Phytoplankton collected?: (Yes / No)

Field Dup collected?: (Yes / No)

Sample Depth: 15 cm.

Volume Filtered: NA

DUP ID: —

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes: Fast flowing, wide, river. ~~Pool~~ sampled in riffle area upstream from large pool.

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: A76-A75 **Field Crew:** M. Finley, M. DiMauro
Date: Aug 19, 2019 **Time:** 15:57
Weather:
Observations:
Easting: 14W 060 1305 **Northing:** 7256761. **Waypoint:** 082

REACH DATA

Habitat types (check those present):
Riffle ☐ Rapids ☐ Straight run ☐ Pool / Back Eddy ☐ Subterranean flow,

Canopy coverage (check one):
0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):
0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):
Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):
Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):
0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☐ 12.8-25.6 cm (cobble)
8. ☒ >25.6 cm (boulder)
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):
☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☒ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick

Observations: Mostly subterranean, stringy green algae, peri cover
pools between boulders, no defined width, see photos.

WATER CHEMISTRY DATA

Unit (make and model):

Air temp: (°C) Water temp: 13.8 (°C) pH: 7.14
Sp. Cond. 40.3 (µS/cm) DO: 10.14 (mg/L) :

Water collected for chem?: (Yes / No)
Phytoplankton collected?: (Yes / No)
Field Dup collected?: (Yes / No)

Sample Depth: 10 cm.
Volume Filtered: NA
DUP ID: —

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes:

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: A81 - A80 **Field Crew:** M. Finley, M. DiMauro

Date: Aug 19, 2019 **Time:** 9:57 am

Weather:

Observations:

Easting: 14W 0598325 **Northing:** 7255497 **Waypoint:** 071

REACH DATA

Habitat types (check those present):

Riffle ☒ Rapids ☐ Straight run ☐ Pool / Back Eddy ☐

Canopy coverage (check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):

0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☐ 12.8-25.6 cm (cobble)
8. ☒ >25.6 cm (boulder)
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):

☒ 1. Rocks are not slippery, thin layer <0.5 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☐ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: flooding over grasses, stringy green algae (see photos), little to no peri on rocks.

WATER CHEMISTRY DATA

Unit (make and model): YSI

Air temp: (°C) Water temp: 13.5 (°C) pH: 7.20

Sp. Cond. 15.3 (µS/cm) DO: 10.46 (mg/L) :

Water collected for chem?: ((Yes) / No) **Sample Depth:** 15 cm

Phytoplankton collected?: (Yes / (No)) **Volume Filtered:** NA

Field Dup collected?: (Yes / (No)) **DUP ID:**

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes: - faster flow between boulders, wetted area has inundated some grasses. 20 - 30 m wide.

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: ~~SL~~ A69-DS1 **Field Crew:** M. Finley, M. DiMauro

Date: Aug 19, 2019 **Time:** ~~PM~~ 15:39

Weather:

Observations:

Easting: 14W 0598484 **Northing:** 7256755 **Waypoint:** 081

REACH DATA

Habitat types (check those present):

Riffle ☐ Rapids ☐ Straight run ☒ Pool / Back Eddy ☐

Canopy coverage (check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):

0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☐ 12.8-25.6 cm (cobble)
8. ☒ >25.6 cm (boulder) + some cobble in between the boulders
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):

☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☒ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: macrophytes, 2 types of algae green stringy & dark burgundy thick algae. overall depth 20-30, width approx 35-40

WATER CHEMISTRY DATA

Unit (make and model):

Air temp: (°C) Water temp: 14.7 (°C) pH: 7.34

Sp. Cond. 20.9 (µS/cm) DO: 10.93 (mg/L) :

Water collected for chem?: (Yes / No) **Sample Depth:** 15 cm

Phytoplankton collected?: (Yes / No) **Volume Filtered:** NA

Field Dup collected?: (Yes / No) **DUP ID:** —

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes: ~~Fast flowing~~, Lots of exposed boulders

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: A5-A4 Field Crew: M. Finky, M. DiMauro

Date: Aug 19, 2019 Time: 15:23

Weather:

Observations:

Easting: 14W 0600147 Northing: 7260392. Waypoint: 080

REACH DATA

Habitat types (check those present):

Riffle ☐ Rapids ☐ Straight run ☒ Pool / Back Eddy ☐

Canopy coverage (check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):

0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☒ 12.8-25.6 cm (cobble) Boulder & Cobble
8. ☒ >25.6 cm (boulder)
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):

☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☒ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: Shallow, long green algae & peri matting
See photos in avenza

WATER CHEMISTRY DATA

Unit (make and model):

Air temp: (°C) Water temp: 14.4 (°C) pH: 7.35

Sp. Cond. 35.4 (µS/cm) DO: 9.94 (mg/L) :

Water collected for chem?: (Yes / No) Sample Depth: 10 cm

Phytoplankton collected?: (Yes / No) Volume Filtered: NA

Field Dup collected?: (Yes / No) DUP ID: —

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes: lots of capped boulder in stream. sampled nearer to lake outflow.

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: A14 - A13 **Field Crew:** M. Finley, M. DiMauro.
Date: Aug 19, 2019. **Time:** 9:34 am
Weather: partly cloudy, wind <10 km/h.
Observations:
Easting: 14W 0603043 **Northing:** 7255636 **Waypoint:** 070

REACH DATA

Habitat types (check those present):
Riffle ☐ Rapids ☐ Straight run ☑ Pool / Back Eddy ☐

Canopy coverage (check one):
0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):
0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):
Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):
Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):
0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☐ 12.8-25.6 cm (cobble)
8. ☒ >25.6 cm (boulder)
9. ☑ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):
☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☒ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☐ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: Not a lot of periphyton, Stringy green algae growing, Some peri matting (See photos).

WATER CHEMISTRY DATA

Unit (make and model): YSI.

Air temp: (°C) Water temp: 13.3 (°C) pH: 7.08
Sp. Cond. 61.5 (µS/cm) DO: 9.67 (mg/L) :

Water collected for chem?: (Yes / No)
Phytoplankton collected?: (Yes / No)
Field Dup collected?: (Yes / No)

Sample Depth: 20 cm
Volume Filtered: NA
DUP ID: —

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes: low flow between boulders & wetted area covers some rock lichens. width approx 15 m.
Refer to gps location at waypoint 070 (location not covered in aventza)

Stream Water Quality and Habitat Datasheet

LOCATION INFORMATION

Sample ID: C8 - C7 **Field Crew:** M. Finley, M. DiMauro

Date: Aug 19, 2019. **Time:** 15:05

Weather:

Observations:

Easting: 14W 0604266 **Northing:** 7260876 **Waypoint:** 079

REACH DATA

Habitat types (check those present):

Riffle ☐ Rapids ☐ Straight run ☒ Pool / Back Eddy ☐

Canopy coverage (check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Macrophyte coverage (not algae or moss, check one):

0% ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-100% ☐

Stream side vegetation (check those present):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant stream side vegetation (check one):

Ferns/Grasses ☐ Shrubs ☐ Decidudous trees ☐ Coniferous trees ☐

Dominant substrate category (check one):

0. ☐ Organic cover
1. ☐ <0.1 cm (fine sand, silt, clay)
2. ☐ 0.1-0.2 cm (coarse sand)
3. ☐ 0.2-1.6 cm (gravel)
4. ☐ 1.6-3.2 cm (small pebble)
5. ☐ 3.2-6.4 cm (large pebble)
6. ☐ 6.4-12.8 cm (small cobble)
7. ☒ 12.8-25.6 cm (cobble)
8. ☐ >25.6 cm (boulder)
9. ☐ Bedrock

Periphyton Coverage on Substrate (benthic algae, not moss, check one):

☐ 1. Rocks are not slippery, thin layer <0.5 mm thick
☐ 2. Rocks are slightly slippery, 0.5 -1 mm thick
☒ 3. Rocks have noticable slippery feel, 1-5 mm thick
☐ 4. Rocks are very slippery, 5-20 mm thick
☐ 5. Rocks are mostly obscured by algal mat, > 20 mm thick

Observations: Shallow, max depth 15 cm, width 10-15 m. lots of algae and some peri mathing. Lower flow rates

WATER CHEMISTRY DATA

Unit (make and model):

Air temp: (°C) Water temp: 13.0 (°C) pH: 7.4

Sp. Cond. 26.7 (µS/cm) DO: 10.77 (mg/L) :

Water collected for chem?: (Yes / No)

Phytoplankton collected?: (Yes / No)

Field Dup collected?: (Yes / No)

Sample Depth: 10 cm

Volume Filtered: N/A

DUP ID: —

CHANNEL DATA

Bankfull width: (m) Wetted stream width: (m) Bankfull Wetted Depth: (cm)

Velocity measured?: (Yes / No) Unit (make and model):

Measurement #	Distance from shore (m)	Depth (cm)	Velocity (m/s)
1			
2			
3			
4			
5			
6			
		Average =	Average =

Field Notes: shallow, mostly low flow, some backeddies. sampled in thalweg (mid stream).

APPENDIX B
FIELD PHOTOGRAPHS

LIST OF PHOTOS – APPENDIX B

Photo 1. Aerial photo #1 showing stream A14-A13.

Photo 2. Aerial photo #2 showing stream A14-A13.

Photo 3. Stream location A14-A13 looking upstream.

Photo 4. Stream location A14-A13 looking downstream.

Photo 5. Stream location A14-A13 looking across the stream.

Photo 6. Substrate showing periphyton coverage at stream location A14-A13.

Photo 7. Aerial photo #1 of stream A5-A4.

Photo 8. Aerial photo #2 of stream A5-A4.

Photo 9. Aerial photo #3 of stream A5-A4.

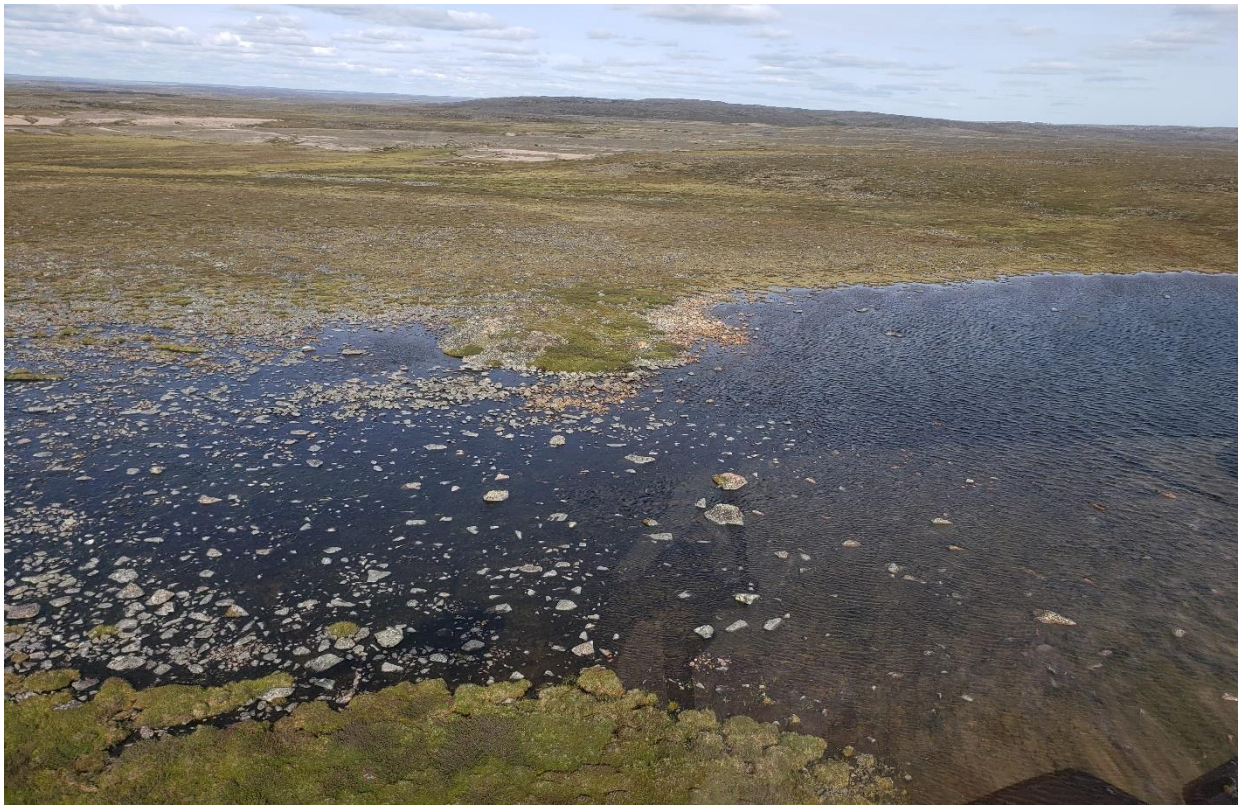


Photo 10. Looking across stream A76-A75.

Photo 11. Looking across stream A76-A75.

Photo 12. Aerial photo of stream location A75-A76.

Photo 13. Aerial photo #1 of stream location A81-A80.

Photo 14. Aerial photo #2 of stream A81-A80.

Photo 15. Aerial photo #3 of stream A81-A80.

Photo 16. Aerial photo approaching stream A69-DS1.

Photo 17. Aerial photo approaching stream A69-DS1.

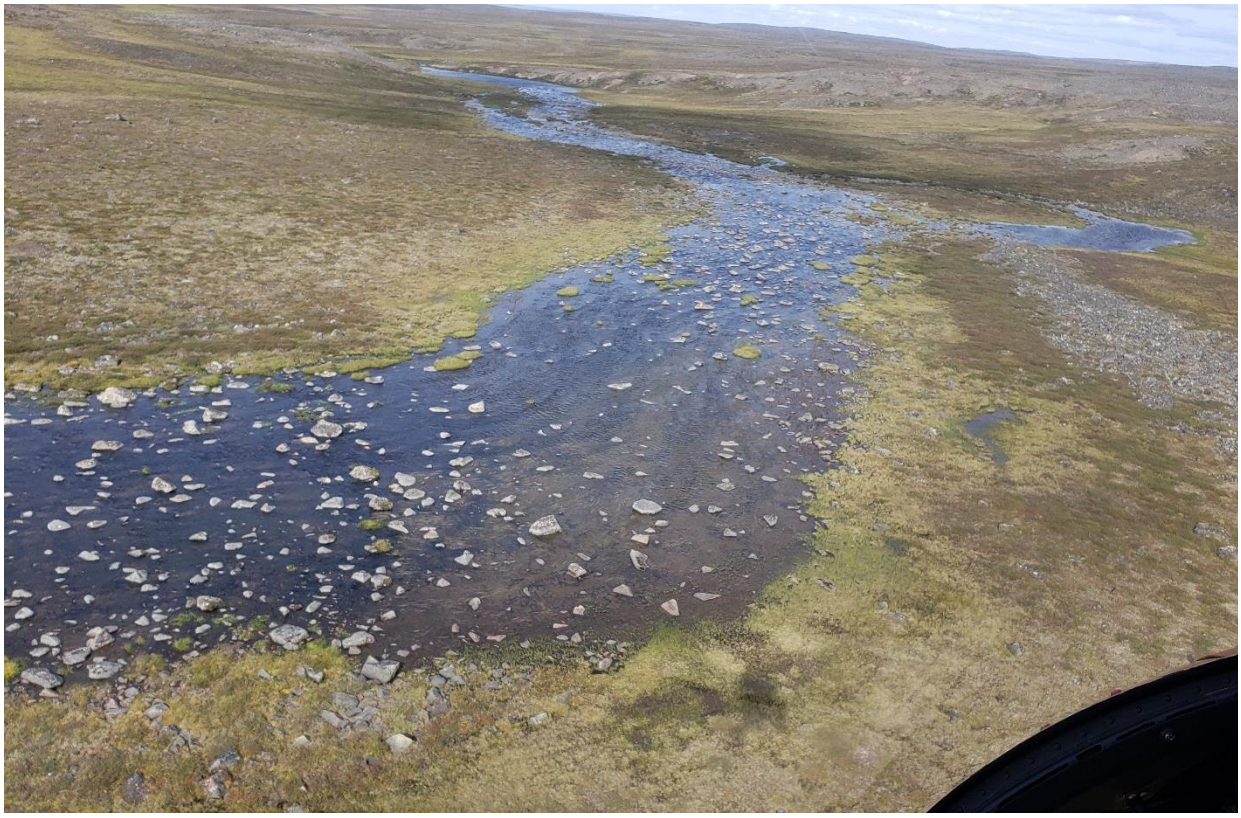


Photo 18. Stream location A69-DS1.

Photo 19. Stream location C38-C12 looking downstream.

Photo 20. Stream location C38-C12 looking upstream.

Photo 21. Stream location C38-C12 looking across the stream.

Photo 22. Substrate showing periphyton coverage at **s**tream location C38-C12.

Photo 23. Aerial photo above stream C8-C7.

Photo 24. Aerial photo approaching stream C8-C7.

Photo 25. Aerial photo approaching stream DS1.

Photo 26. Looking across stream DS1.

APPENDIX C
CERTIFICATE OF ANALYSIS

AZIMUTH CONSULTING GROUP INC.
ATTN: Eric Franz
218 - 2902 West Broadway
Vancouver BC V6K 2G8

Date Received: 26-AUG-19
Report Date: 27-AUG-19 20:11 (MT)
Version: FINAL

Client Phone: 604-730-1220

Certificate of Analysis

Lab Work Order #: L2335615

Project P.O. #: NOT SUBMITTED
Job Reference: AMARUQ STREAM WQ
C of C Numbers:
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2335615-1	L2335615-2	L2335615-3	L2335615-4	L2335615-5
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE
	Sampled Date	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19
	Sampled Time	15:57	09:57	14:00	09:34	15:39
	Client ID	A76-A75	A81-A80	C38-C12	A14-A13	A69-DS1
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	40.1	15.7	58.6	61.6	21.2
	Hardness (as CaCO3) (mg/L)	13.9	5.35	22.2	22.9	7.64
	pH (pH)	7.06	6.98	7.18	7.01	7.03
	Total Suspended Solids (mg/L)	<1.0	<1.0	1.0	<1.0	<1.0
	Total Dissolved Solids (mg/L)	53	16.3	51	54	20.1
	Turbidity (NTU)	0.26	0.34	0.32	0.30	0.36
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	5.4	4.5	7.3	5.9	5.3
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	5.4	4.5	7.3	5.9	5.3
	Ammonia, Total (as N) (mg/L)	0.117	0.0248	0.0087	0.153	0.0309
	Bromide (Br) (mg/L)	0.063	<0.050	0.076	0.132	<0.050
	Chloride (Cl) (mg/L)	6.09	0.96	10.0	11.2	1.72
	Fluoride (F) (mg/L)	0.029	0.032	0.032	0.029	0.036
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.0898	0.0121	<0.0050
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0012	<0.0010	0.0014
	Total Kjeldahl Nitrogen (mg/L)	0.214	0.143	0.153	0.256	0.172
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	0.0036
	Phosphorus (P)-Total (mg/L)	<0.0020	0.0025	0.0023	<0.0020	0.0030
	Silicate (as SiO2) (mg/L)	0.91	1.03	<0.50	0.85	1.20
	Sulfate (SO4) (mg/L)	3.69	1.05	3.62	4.88	1.61
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	1.50	2.22	1.51	1.58	2.95
	Total Organic Carbon (mg/L)	2.04	2.57	1.77	1.66	3.45
Total Metals	Aluminum (Al)-Total (mg/L)	0.0108	0.0268	0.0116	0.0079	0.0199
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00022	0.00010	0.00041	0.00034	0.00012
	Barium (Ba)-Total (mg/L)	0.00849	0.00222	0.00986	0.0116	0.00362
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Total (mg/L)	0.0000131	0.0000099	0.0000055	<0.0000050	<0.0000050
	Calcium (Ca)-Total (mg/L)	4.04	1.77	6.30	6.49	2.10
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	<0.000010	0.000010	<0.000010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2335615-6	L2335615-7	L2335615-8	L2335615-9	
Description	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE	
Sampled Date	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19	
Sampled Time	14:46	15:23	15:05		
Client ID	DS1	A5-A4	C8-C7	DUP-STREAM	
Grouping	**Analyte**				
WATER					
Physical Tests	Conductivity (uS/cm)	25.4	35.1	27.1	58.1	
	Hardness (as CaCO3) (mg/L)	10.3	12.9	10.9	22.7	
	pH (pH)	7.25	7.08	7.33	7.20	
	Total Suspended Solids (mg/L)	1.3	<1.0	<1.0	<1.0	
	Total Dissolved Solids (mg/L)	21.2	30.0	21.1	55	
	Turbidity (NTU)	0.31	0.25	0.23	0.28	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	9.0	5.6	10.0	7.9	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Alkalinity, Total (as CaCO3) (mg/L)	9.0	5.6	10.0	7.9	
	Ammonia, Total (as N) (mg/L)	0.0242	0.133	0.0694	0.0471	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	0.076	
	Chloride (Cl) (mg/L)	1.17	4.73	0.62	10.0	
	Fluoride (F) (mg/L)	0.038	0.028	0.037	0.029	
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.0890	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	0.0011	
	Total Kjeldahl Nitrogen (mg/L)	0.174	0.238	0.175	0.159	
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.0039	<0.0020	0.0057	0.0022	
	Silicate (as SiO2) (mg/L)	<0.50	1.23	1.41	<0.50	
	Sulfate (SO4) (mg/L)	1.52	3.54	2.51	3.58	
Cyanides	Cyanide, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cyanide, Free (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	2.42	1.43	1.34	1.63	
	Total Organic Carbon (mg/L)	2.66	1.77	1.35	1.69	
Total Metals	Aluminum (Al)-Total (mg/L)	0.0112	0.0087	0.0081	0.0212	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00016	0.00022	0.00040	0.00047	
	Barium (Ba)-Total (mg/L)	0.00298	0.00749	0.0101	0.0102	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	0.0000081	
	Calcium (Ca)-Total (mg/L)	2.40	3.36	2.50	6.53	
	Cesium (Cs)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2335615-1	L2335615-2	L2335615-3	L2335615-4	L2335615-5
Description	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE
Sampled Date	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19
Sampled Time	15:57	09:57	14:00	09:34	15:39
Client ID	A76-A75	A81-A80	C38-C12	A14-A13	A69-DS1
Grouping	**Analyte**				
WATER					
Total Metals	Chromium (Cr)-Total (mg/L)	0.00014	0.00022	0.00038	<0.00010	0.00010
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	<0.00050	0.00081	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Total (mg/L)	0.024	0.053	0.022	0.015	0.069
	Lead (Pb)-Total (mg/L)	<0.000050	0.000102	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	0.0010	0.0015	<0.0010
	Magnesium (Mg)-Total (mg/L)	1.22	0.399	1.43	1.41	0.594
	Manganese (Mn)-Total (mg/L)	0.00205	0.00311	0.00317	0.00074	0.00192
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Total (mg/L)	<0.000050	0.000069	0.000179	0.000083	0.000055
	Nickel (Ni)-Total (mg/L)	0.00051	<0.00050	0.00093	0.00100	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Total (mg/L)	0.780	0.316	0.971	1.07	0.392
	Rubidium (Rb)-Total (mg/L)	0.00106	0.00040	0.00121	0.00159	0.00056
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Total (mg/L)	0.52	0.57	0.22	0.49	0.64
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	0.693	0.801	0.758	0.834	0.775
	Strontium (Sr)-Total (mg/L)	0.0227	0.00735	0.0415	0.0491	0.0100
	Sulfur (S)-Total (mg/L)	1.07	0.61	1.20	1.57	<0.50
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.00032	0.00047	0.00034	<0.00030	<0.00030
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Total (mg/L)	0.000025	0.000081	0.000032	0.000028	0.000071
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0037	0.0077	0.0038	0.0031	0.0140
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00018	<0.00010	0.00039	0.00030	0.00010
	Barium (Ba)-Dissolved (mg/L)	0.00765	0.00197	0.0105	0.0122	0.00360
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2335615-6	L2335615-7	L2335615-8	L2335615-9	
Description	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE	
Sampled Date	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19	
Sampled Time	14:46	15:23	15:05		
Client ID	DS1	A5-A4	C8-C7	DUP-STREAM	
Grouping	**Analyte**				
WATER					
Total Metals	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	0.00011	0.00030	
	Cobalt (Co)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	0.00146	
	Iron (Fe)-Total (mg/L)	0.026	0.029	<0.010	0.031	
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	<0.000050	0.000207	
	Lithium (Li)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0011	
	Magnesium (Mg)-Total (mg/L)	1.03	1.08	1.15	1.43	
	Manganese (Mn)-Total (mg/L)	0.00168	0.00094	0.00147	0.00385	
	Mercury (Hg)-Total (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Total (mg/L)	<0.000050	<0.000050	0.000135	0.000187	
	Nickel (Ni)-Total (mg/L)	<0.00050	0.00060	0.00053	0.00117	
	Phosphorus (P)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Total (mg/L)	0.370	0.705	0.514	1.10	
	Rubidium (Rb)-Total (mg/L)	0.00059	0.00109	0.00059	0.00138	
	Selenium (Se)-Total (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Silicon (Si)-Total (mg/L)	0.29	0.65	0.76	0.23	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	0.717	0.658	0.593	1.11	
	Strontium (Sr)-Total (mg/L)	0.00712	0.0176	0.0136	0.0415	
	Sulfur (S)-Total (mg/L)	0.51	1.06	0.66	1.12	
	Tellurium (Te)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.00030	<0.00030	<0.00030	0.00060	
	Tungsten (W)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Total (mg/L)	0.000081	0.000034	0.000027	0.000033	
	Vanadium (V)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0051	
	Zirconium (Zr)-Total (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0072	0.0053	0.0049	0.0036	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00012	0.00018	0.00039	0.00039	
	Barium (Ba)-Dissolved (mg/L)	0.00294	0.00758	0.00999	0.0104	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2335615-1 SURFACE WATE 19-AUG-19 15:57 A76-A75	L2335615-2 SURFACE WATE 19-AUG-19 09:57 A81-A80	L2335615-3 SURFACE WATE 19-AUG-19 14:00 C38-C12	L2335615-4 SURFACE WATE 19-AUG-19 09:34 A14-A13	L2335615-5 SURFACE WATE 19-AUG-19 15:39 A69-DS1
WATER						
Dissolved Metals	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Calcium (Ca)-Dissolved (mg/L)	3.67	1.49	6.42	6.66	2.04
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00033	0.00033	0.00029	0.00043	0.00044
	Iron (Fe)-Dissolved (mg/L)	<0.010	0.013	<0.010	<0.010	0.037
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	0.0011	0.0016	<0.0010
	Magnesium (Mg)-Dissolved (mg/L)	1.14	0.394	1.50	1.52	0.616
	Manganese (Mn)-Dissolved (mg/L)	0.00079	0.00046	0.00164	0.00042	0.00117
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	0.000052	0.000153	0.000078	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00063	0.00078	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Potassium (K)-Dissolved (mg/L)	0.686	0.287	0.973	1.10	0.388
	Rubidium (Rb)-Dissolved (mg/L)	0.00105	0.00040	0.00122	0.00161	0.00052
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Silicon (Si)-Dissolved (mg/L)	0.486	0.554	0.174	0.473	0.614
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	0.619	0.696	0.746	0.844	0.757
	Strontium (Sr)-Dissolved (mg/L)	0.0195	0.00653	0.0406	0.0477	0.00917
	Sulfur (S)-Dissolved (mg/L)	0.81	<0.50	0.85	1.50	<0.50
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Uranium (U)-Dissolved (mg/L)	0.000023	0.000065	0.000028	0.000021	0.000065
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2335615-6	L2335615-7	L2335615-8	L2335615-9	
	Description	SURFACE WATE	SURFACE WATE	SURFACE WATE	SURFACE WATE	
	Sampled Date	19-AUG-19	19-AUG-19	19-AUG-19	19-AUG-19	
	Sampled Time	14:46	15:23	15:05		
	Client ID	DS1	A5-A4	C8-C7	DUP-STREAM	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Bismuth (Bi)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Calcium (Ca)-Dissolved (mg/L)	2.37	3.39	2.47	6.60	
	Cesium (Cs)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)	0.00041	0.00038	0.00034	0.00027	
	Iron (Fe)-Dissolved (mg/L)	0.012	0.013	<0.010	<0.010	
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0011	
	Magnesium (Mg)-Dissolved (mg/L)	1.06	1.08	1.15	1.52	
	Manganese (Mn)-Dissolved (mg/L)	0.00059	0.00060	0.00051	0.00174	
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050	<0.0000050	<0.0000050	<0.0000050	
	Molybdenum (Mo)-Dissolved (mg/L)	<0.000050	<0.000050	0.000121	0.000135	
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00063	
	Phosphorus (P)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Potassium (K)-Dissolved (mg/L)	0.358	0.678	0.500	0.985	
	Rubidium (Rb)-Dissolved (mg/L)	0.00054	0.00094	0.00046	0.00121	
	Selenium (Se)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	
	Silicon (Si)-Dissolved (mg/L)	0.247	0.654	0.767	0.184	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	0.693	0.624	0.563	0.746	
	Strontium (Sr)-Dissolved (mg/L)	0.00688	0.0159	0.0124	0.0414	
	Sulfur (S)-Dissolved (mg/L)	<0.50	0.90	<0.50	1.15	
	Tellurium (Te)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Thorium (Th)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Tungsten (W)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Uranium (U)-Dissolved (mg/L)	0.000070	0.000027	0.000023	0.000027	
	Vanadium (V)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Zinc (Zn)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Zirconium (Zr)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2335615-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L2335615-2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2335615-2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L2335615-2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BR-L-IC-N-VA Water Bromide in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CARBONS-DOC-VA Water Dissolved organic carbon by combustion APHA 5310B

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310B TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

CL-L-IC-N-VA Water Chloride in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CN-FREE-L-CFA-VA Water Low Level Free Cyanide in water by CFA ASTM 7237

This analysis is carried out using procedures adapted from ASTM Method 7237 "Free Cyanide with Flow Injection Analysis (FIA) Utilizing Gas Diffusion Separation and Amperometric Detection". Free cyanide is determined by in-line gas diffusion at pH 6 with final determination by colourimetric analysis.

CN-T-L-CFA-VA Water Low Level Total Cyanide in water by CFA ISO 14403:2002

This analysis is carried out using procedures adapted from ISO Method 14403:2002 "Determination of Total Cyanide using Flow Analysis (FIA and CFA)". Total or strong acid dissociable (SAD) cyanide is determined by in-line UV digestion along with sample distillation and final determination by colourimetric analysis. Method Limitation: This method is susceptible to interference from thiocyanate (SCN). If SCN is present in the sample, there could be a positive interference with this method, but it would be less than 1% and could be as low as zero.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

F-IC-N-VA Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA Water Diss. Mercury in Water by CVAAS or CVAFS APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA Water Total Mercury in Water by CVAAS or CVAFS EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Reference Information

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-PRES-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

P-TD-PRES-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.
Samples with very high dissolved solids (i.e. seawaters, brackish waters) may produce a negative bias by this method. Alternate methods are available for these types of samples.

Arsenic (5+), at elevated levels, is a positive interference on colourimetric phosphate analysis.

SILICATE-COL-VA Water Silicate by Colourimetric analysis APHA 4500-SiO2 E.

This analysis is carried out using procedures adapted from APHA Method 4500-SiO2 E. "Silica". Silicate (molybdate-reactive silica) is determined by the molybdosilicate-heteropoly blue colourimetric method. Arsenic (5+) above 100 mg/L is a negative interference on this test.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-LOW-VA Water Low Level TDS (3.0mg/L) by Gravimetric APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-LOW-VA Water Total Suspended Solids by Grav. (1 mg/L) APHA 2540D

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

Reference Information

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L2335615-COFC

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Report To		**Report Format / Distribution**	**Service Requested** (Rush for routine analysis subject to availability)
Company:	Azimuth Consulting Group	☑ Standard ☐ Other	○ Regular (Standard Turnaround Times - Business Days)
Contact:	Eric Franz	☑ PDF ☑ Excel ☐ Digital ☐ Fax	○ Priority (2-4 Business Days) - 50% Surcharge - Contact ALS to Confirm TAT
Address:	218-2902 West Broadway	Email 1: efranz@azimuthgroup.ca	◉ Emergency (1-2 Bus. Days) - 100% Surcharge - Contact ALS to Confirm TAT
	Vancouver, BC V6K2G8	Email 2: mfinley@azimuthgroup.ca	○ Same Day or Weekend Emergency - Contact ALS to Confirm TAT
Phone:	604-730-1220 Fax:	Email 3:	**Analysis Request**
Invoice To	Same as Report ? ☑ Yes ☐ No	**Client / Project Information**	Please indicate below Filtered, Preserved or both (F, P, F/P)
Hardcopy of Invoice with Report?	☐ Yes ☑ No	Job #: Amaruq stream WQ	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #: Q39503	

Lab Work Order # (lab use only)		**ALS Contact:** Brent Mack	**Sampler:** M. DiMauro, M. Finley

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOC, Ammonia, TKN, Total P (P)	DOC (F/P)	T-CN (Low), Free CN (Low) (P)	Total mercury	Dissolved mercury (F)	Total Metals	Dissolved Metals (F)	Conventionals** see notes	TSS-Low, TDS-Low	Arsenic speciation (F/P)			Number of Containers
	A76-A75	19-Aug-19	15:57	Surface Water	X	X	X	X	X	X	X	X	X				10
	A81-A80	19-Aug-19	9:57	Surface Water	X	X	X	X	X	X	X	X	X				10
	C38-C12	20-Aug-19	14:00	Surface Water	X	X	X	X	X	X	X	X	X				10
	A14-A13	19-Aug-19	9:34	Surface Water	X	X	X	X	X	X	X	X	X				10
	A69-DS1	19-Aug-19	15:39	Surface Water	X	X	X	X	X	X	X	X	X				10
	DS1	19-Aug-19	14:46	Surface Water	X	X	X	X	X	X	X	X	X				10
	A5-A4	19-Aug-19	15:23	Surface Water	X	X	X	X	X	X	X	X	X				10
	C8-C7	19-Aug-19	15:05	Surface Water	X	X	X	X	X	X	X	X	X				10
	DUP-Stream			Surface Water	X	X	X	X	X	X	X	X	X				9

Special Instructions / Regulations with water or land use (CCME-Freshwater Aquatic Life/BC CSR - Commercial/AB Tier 1 - Natural, etc) / Hazardous Details

HOLD samples for arsenic speciation analysis until we confirm which samples are being analyzed.
**Conventionals includes: Alk Species, pH, EC, Turbidity, Conductivity, Anions (F, NO2, NO3, Br, SO4), low-level Chloride, Silicate, TD-P, and Ortho-PO4.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as provided on a separate Excel tab.
Also provided on another Excel tab are the ALS location addresses, phone numbers and sample container / preservation / holding time table for common analyses.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date (dd-mmm-yy)	Time (hh-mm)	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Morgan Finley	21-Aug-19		JG	26Aug19	8:40AM	20 °C				

APPENDIX D
WATER CHEMISTRY SCREENING PLOTS

LIST OF FIGURES – APPENDIX D

Figure D.1. Routine water quality measurements for surface water collected at stream stations in 2015 and 2019.

Note. Units for conductivity = µS/cm; units for hardness and TSS = mg/L. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

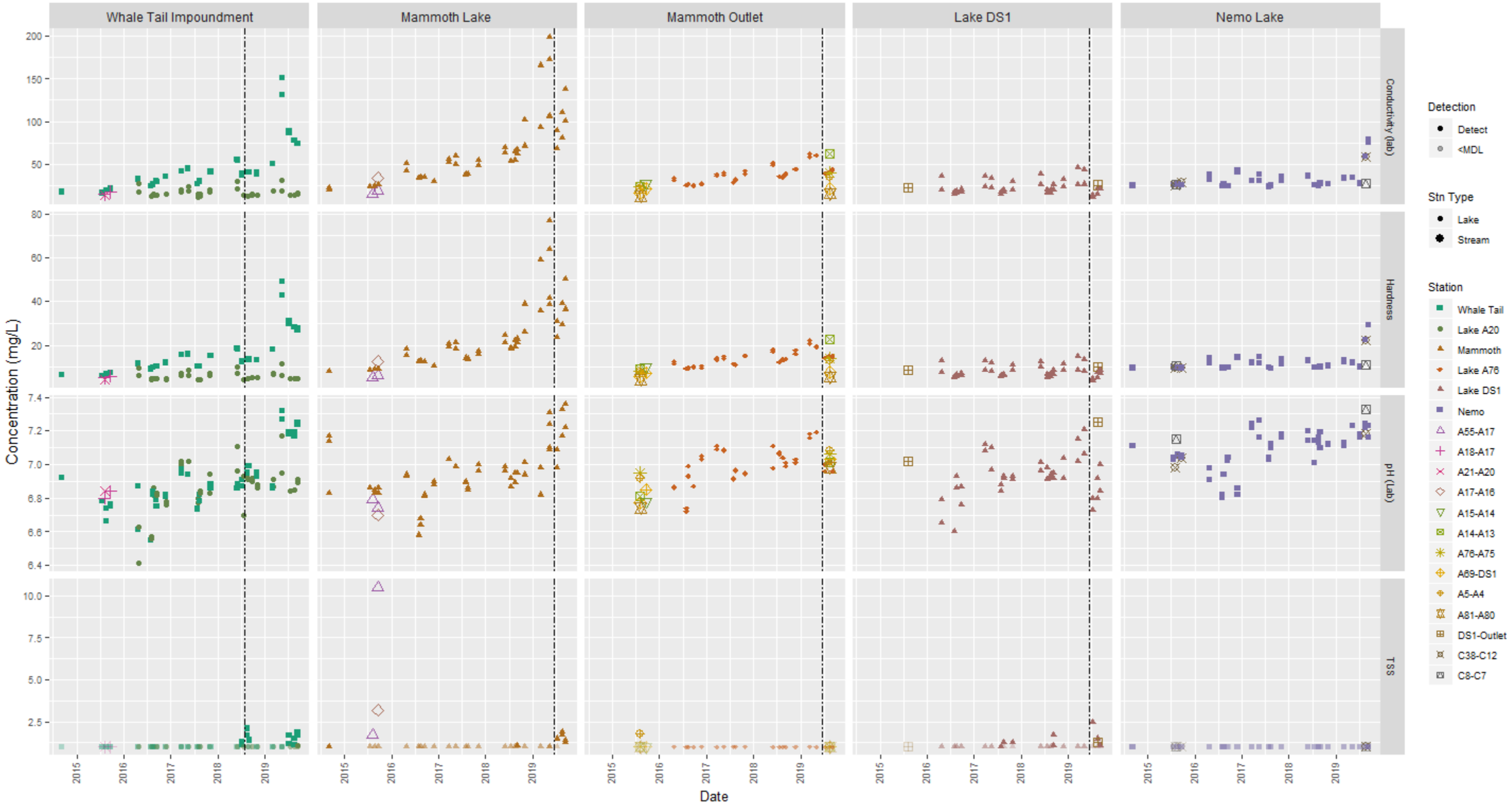


Figure D.2. Total dissolved solids (TDS) concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

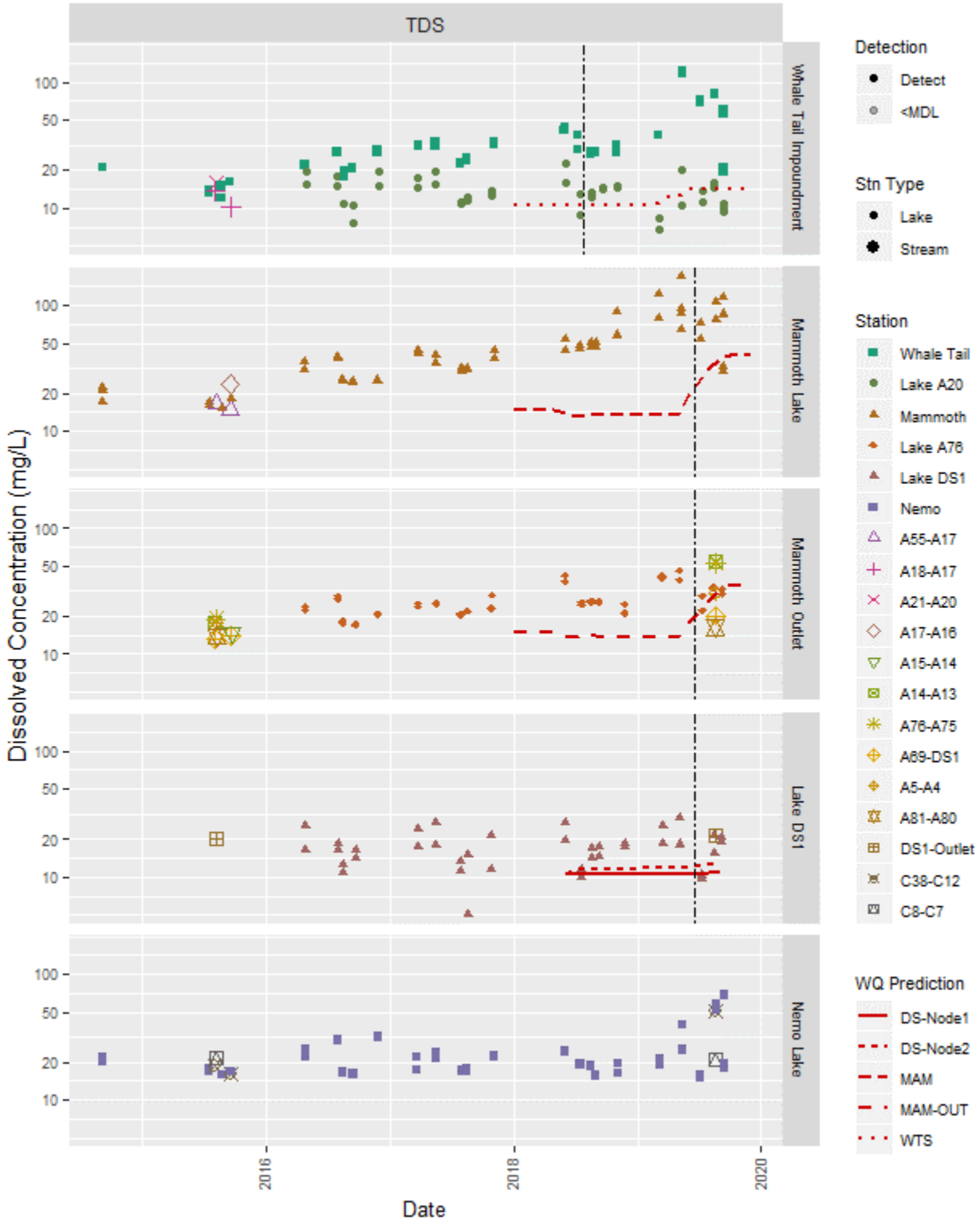


Figure D.3. Total alkalinity concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

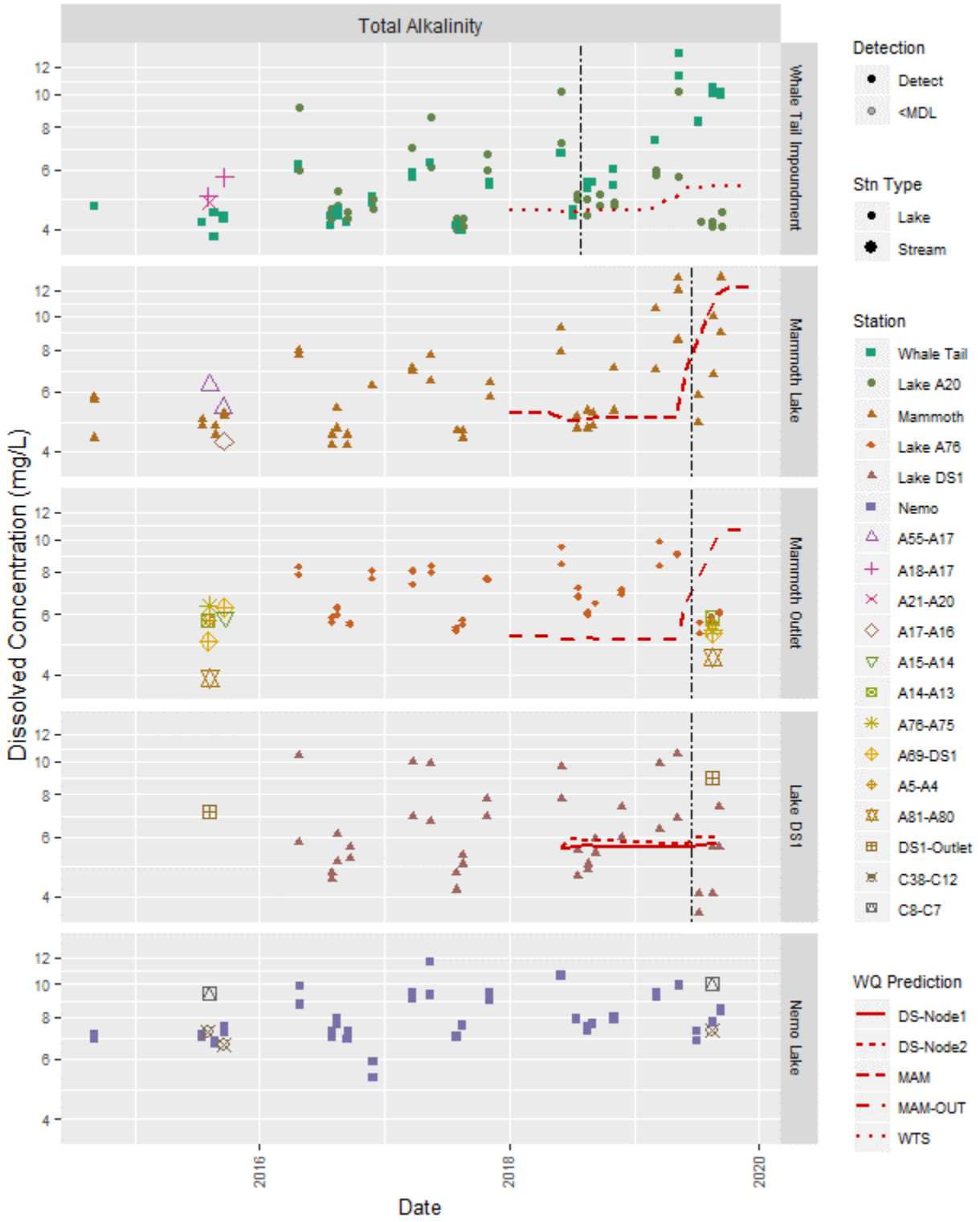


Figure D.4. Ammonia concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

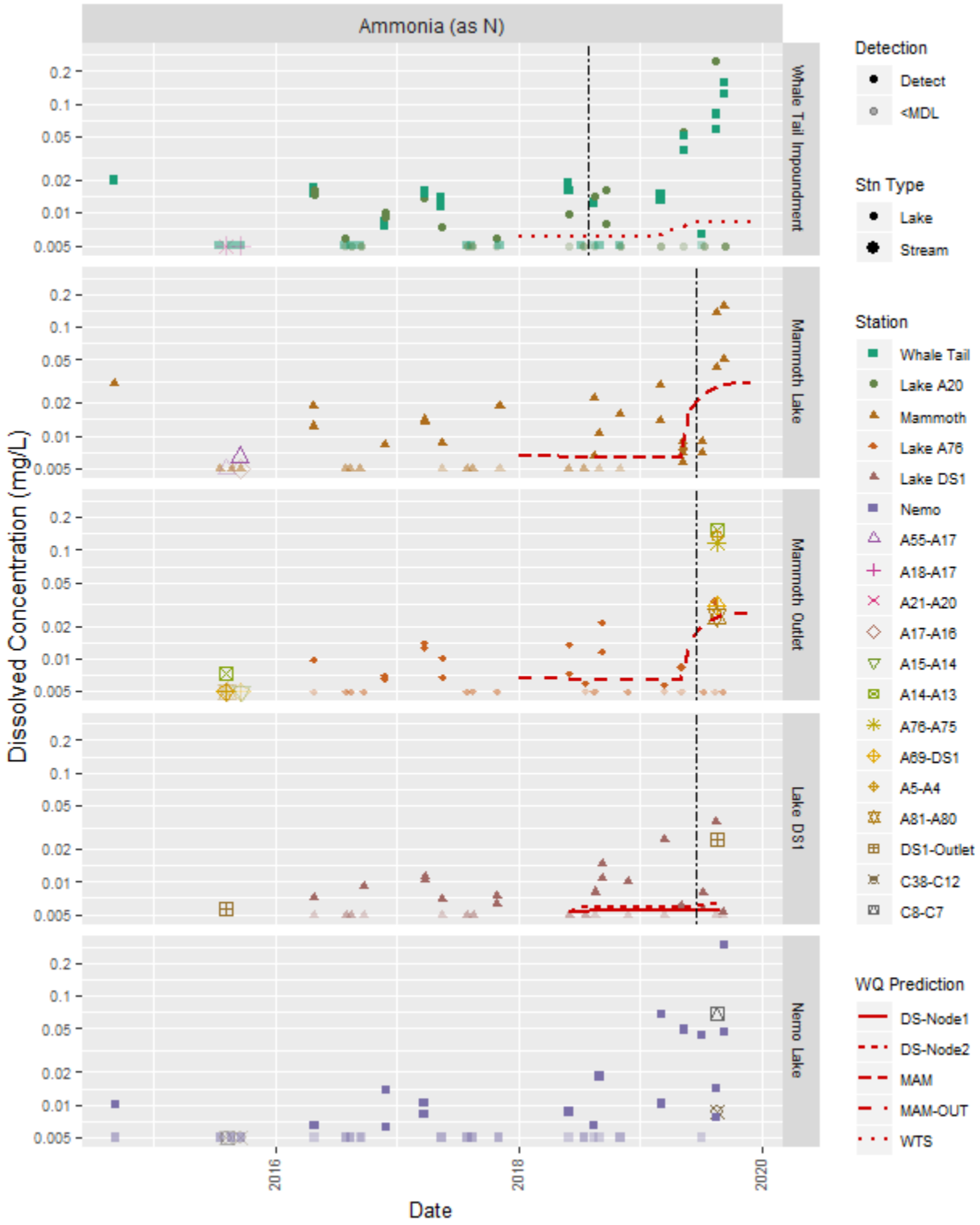


Figure D.5. Chloride concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

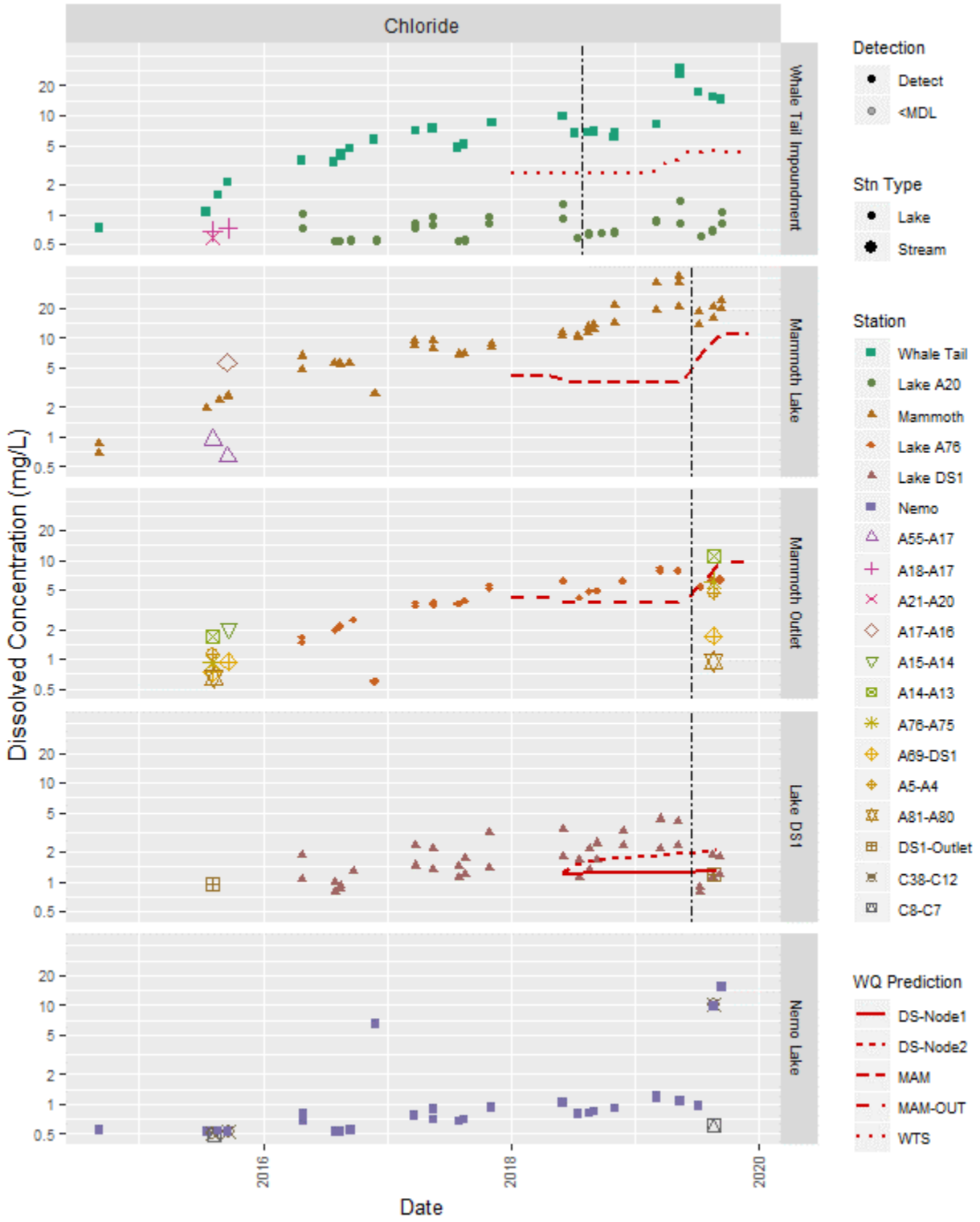


Figure D.6. Fluoride concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

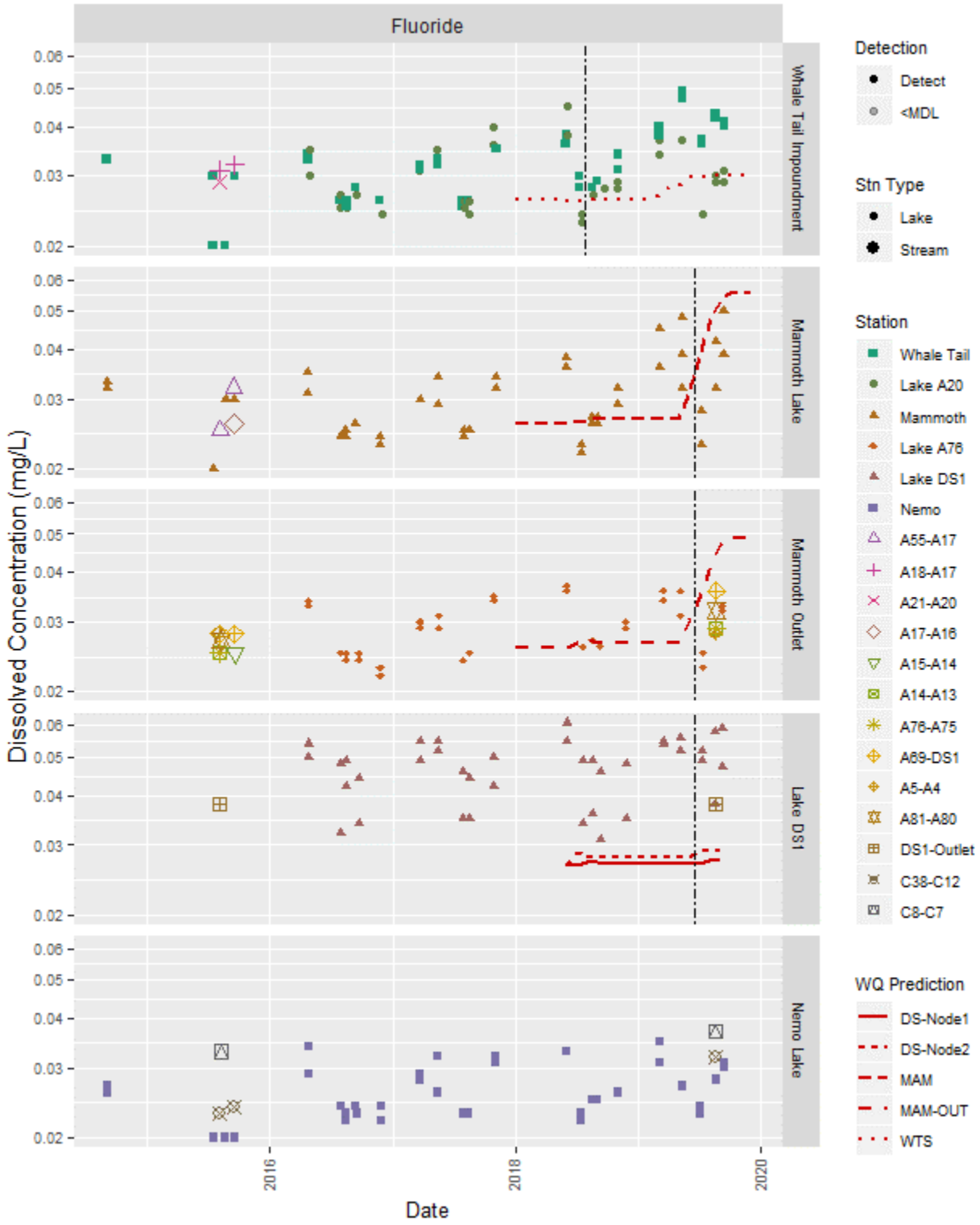


Figure D.7. Nitrate (as N) concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

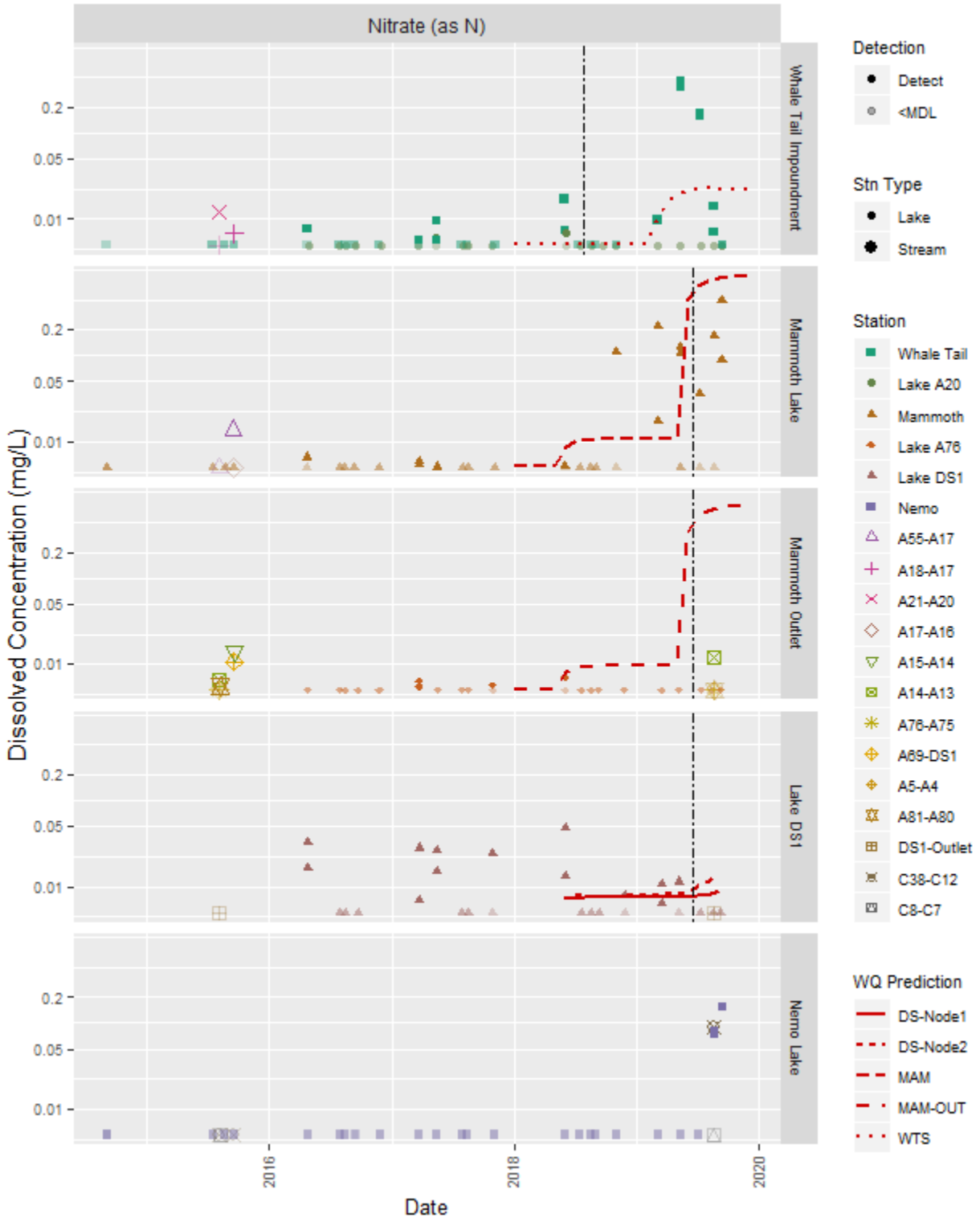


Figure D.8. Total phosphorus concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

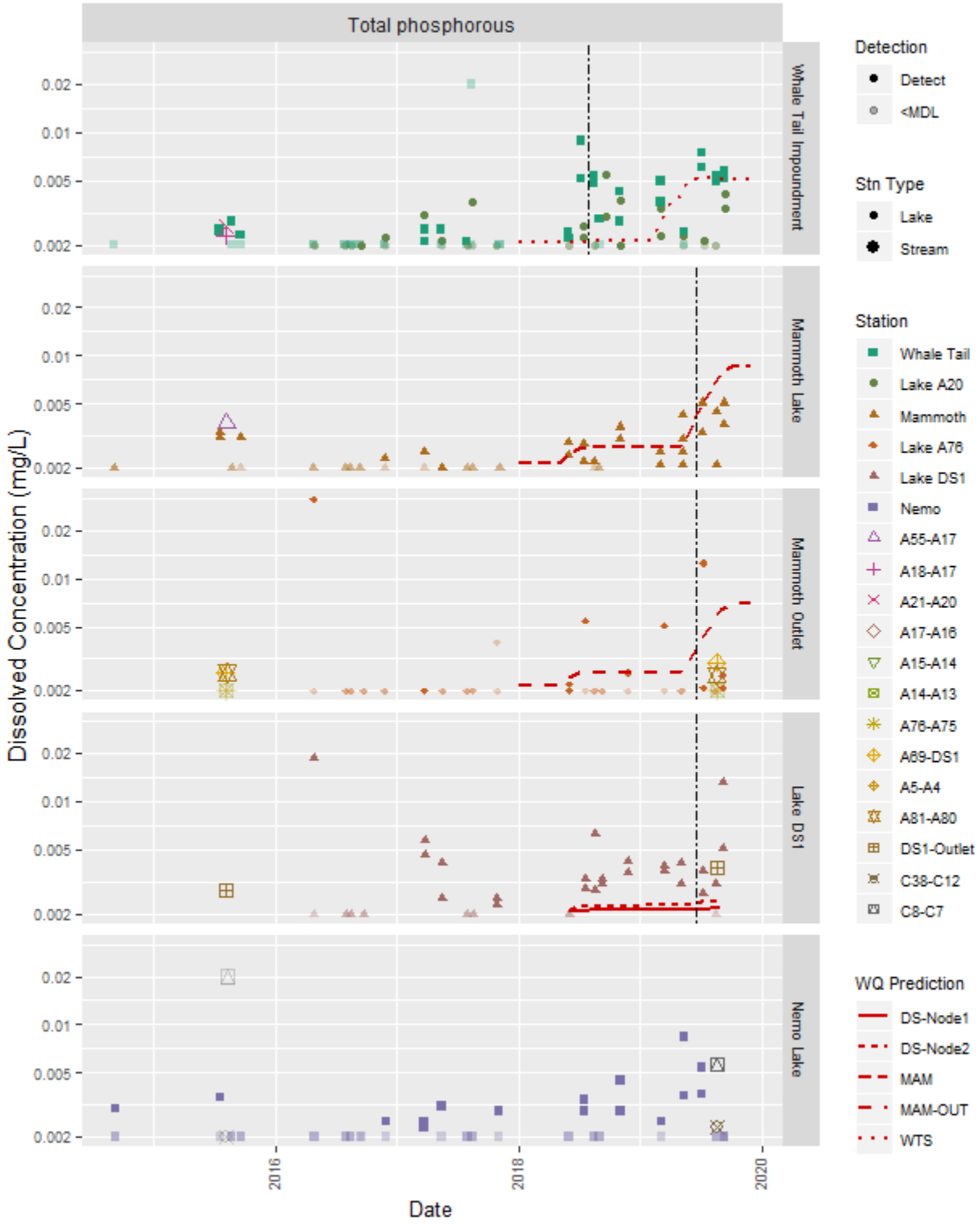


Figure D.9. Sulphate concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

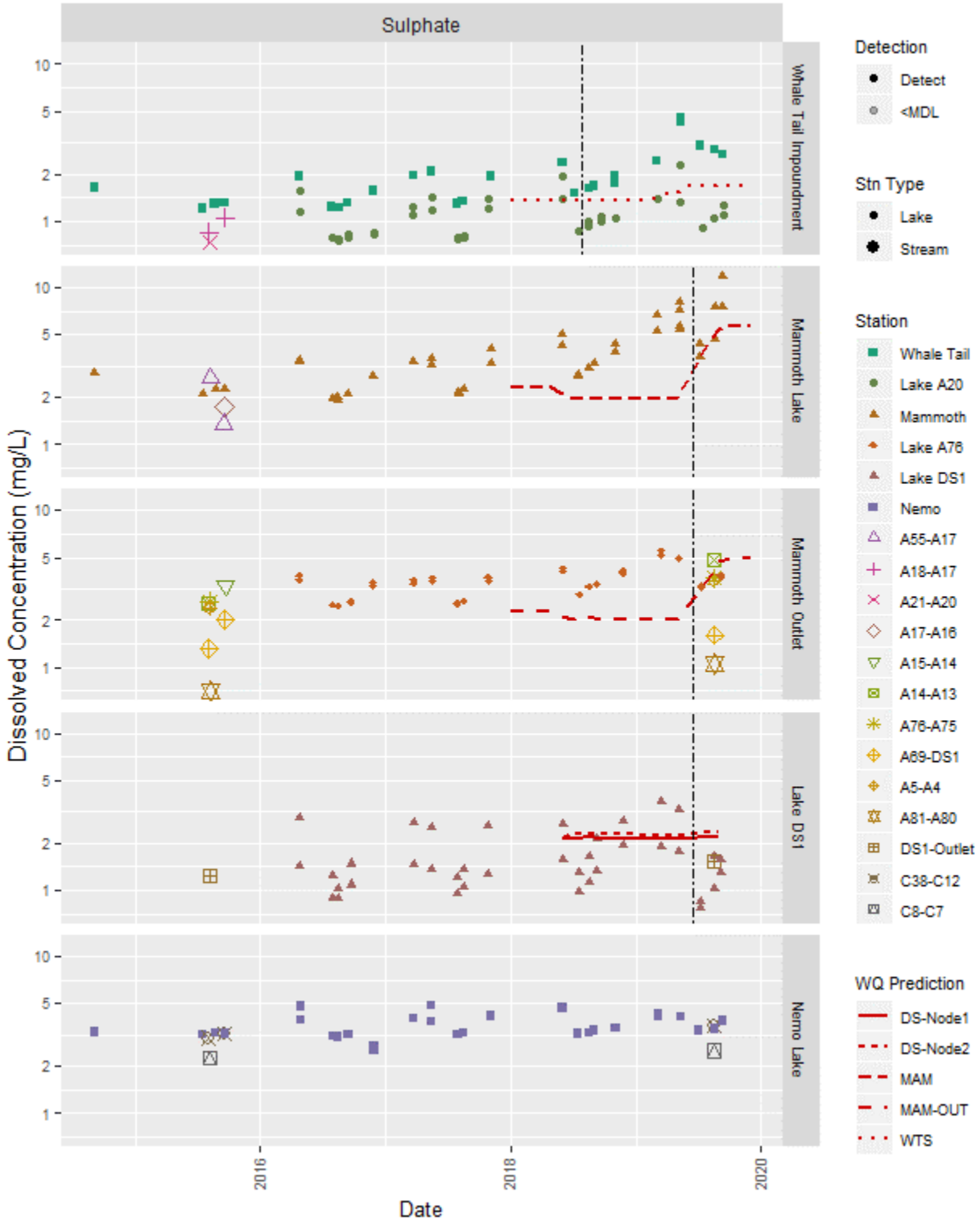


Figure D.10. Dissolved aluminum concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

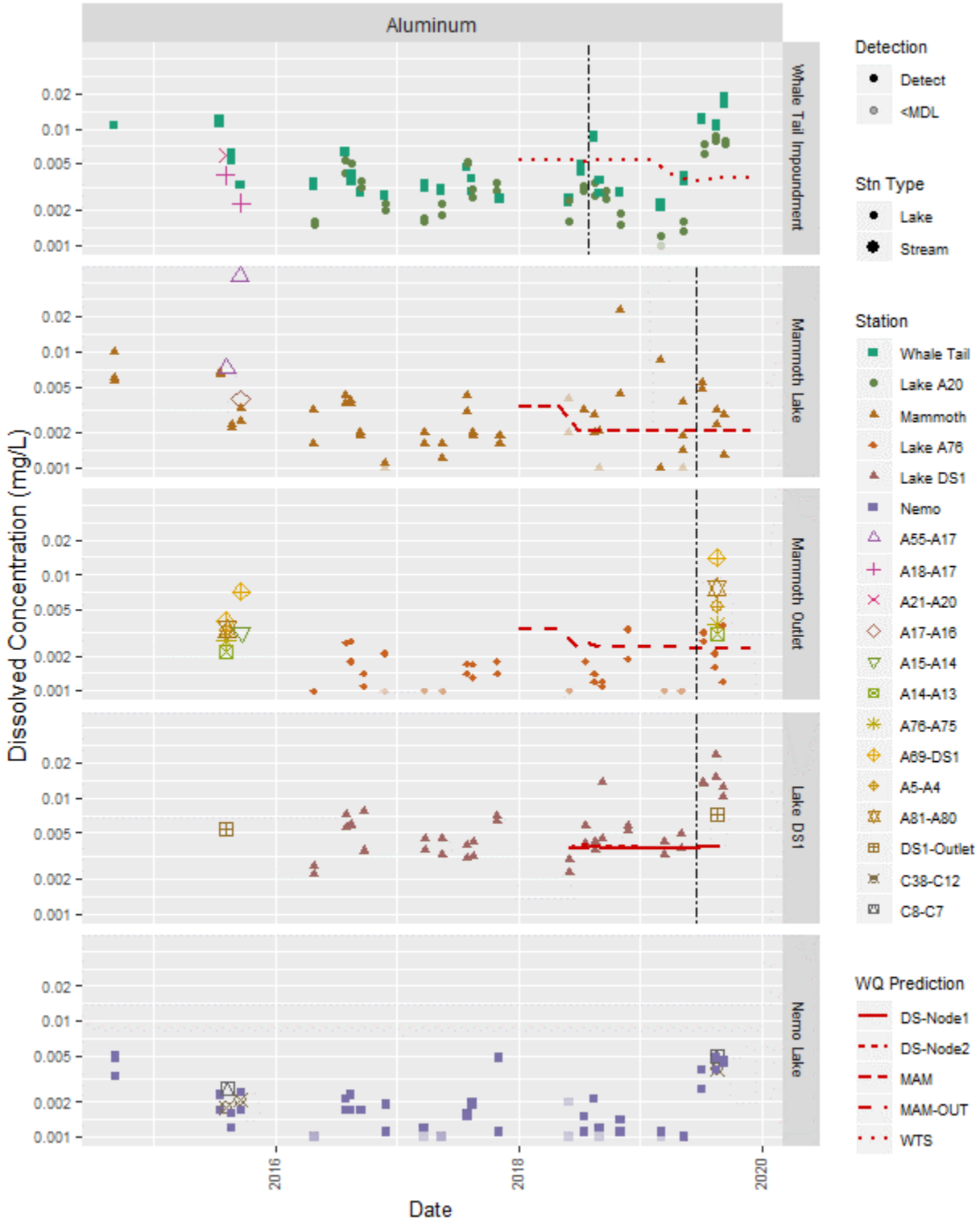


Figure D.11. Dissolved arsenic concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

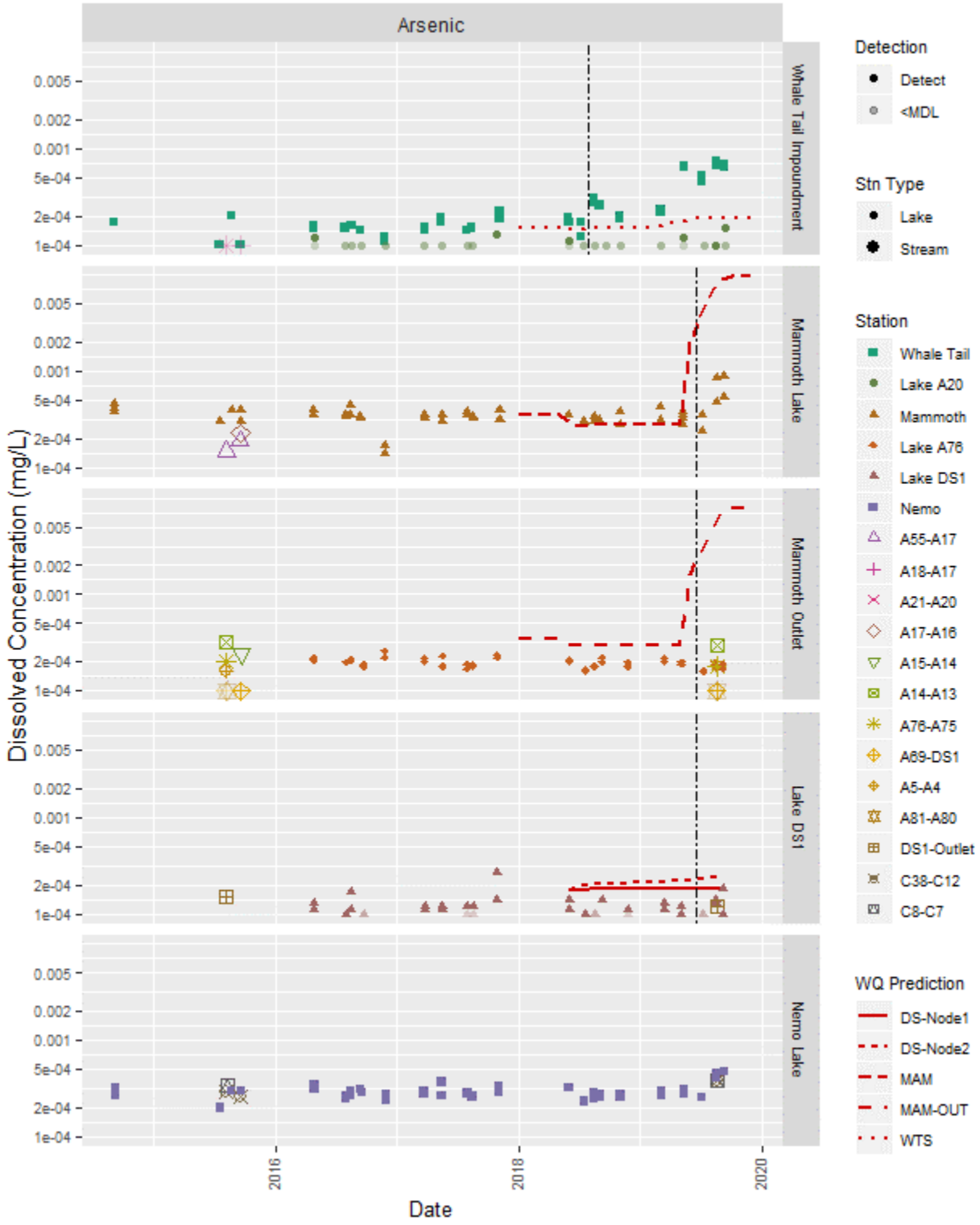


Figure D.12. Dissolved barium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

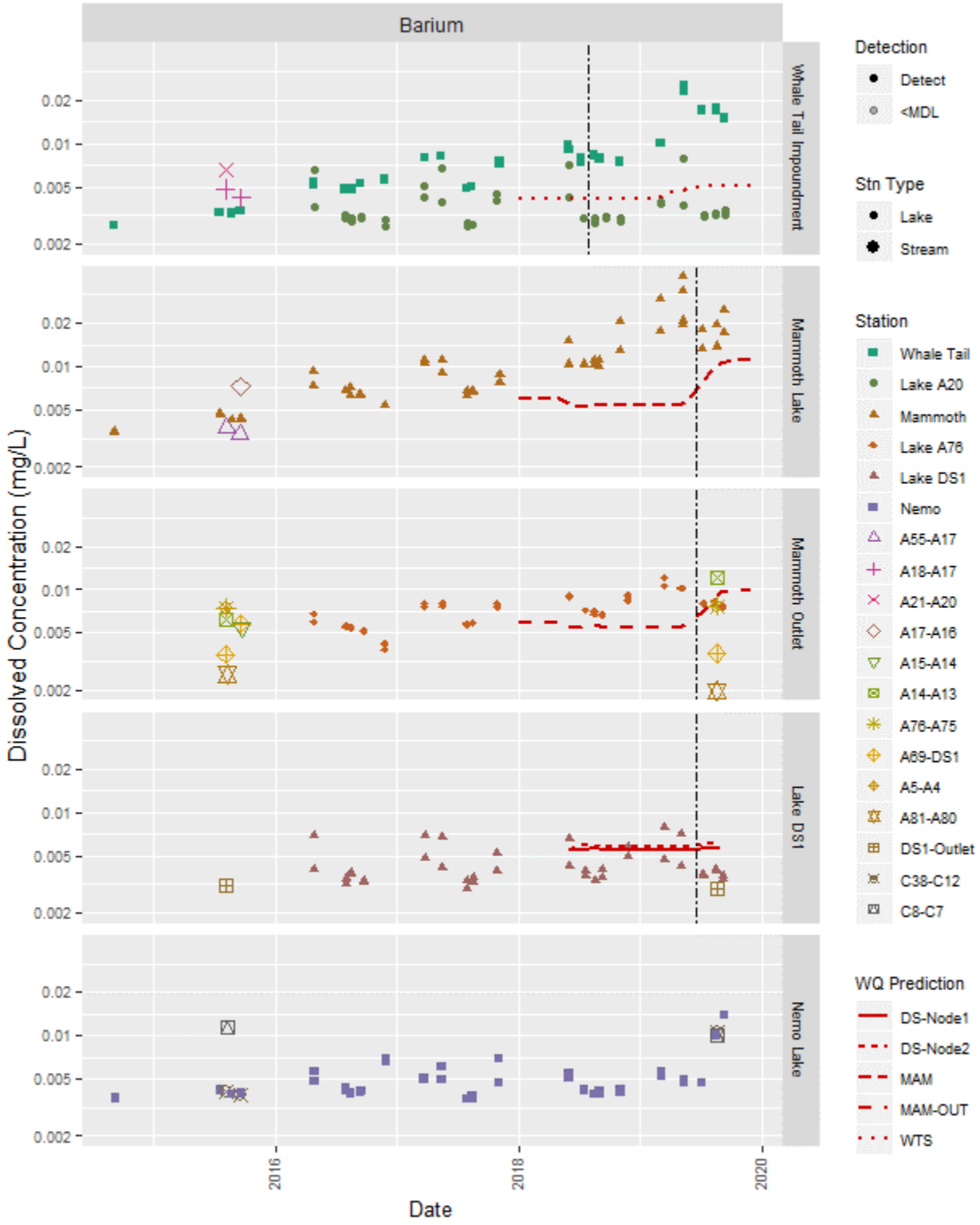


Figure D.13. Dissolved calcium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

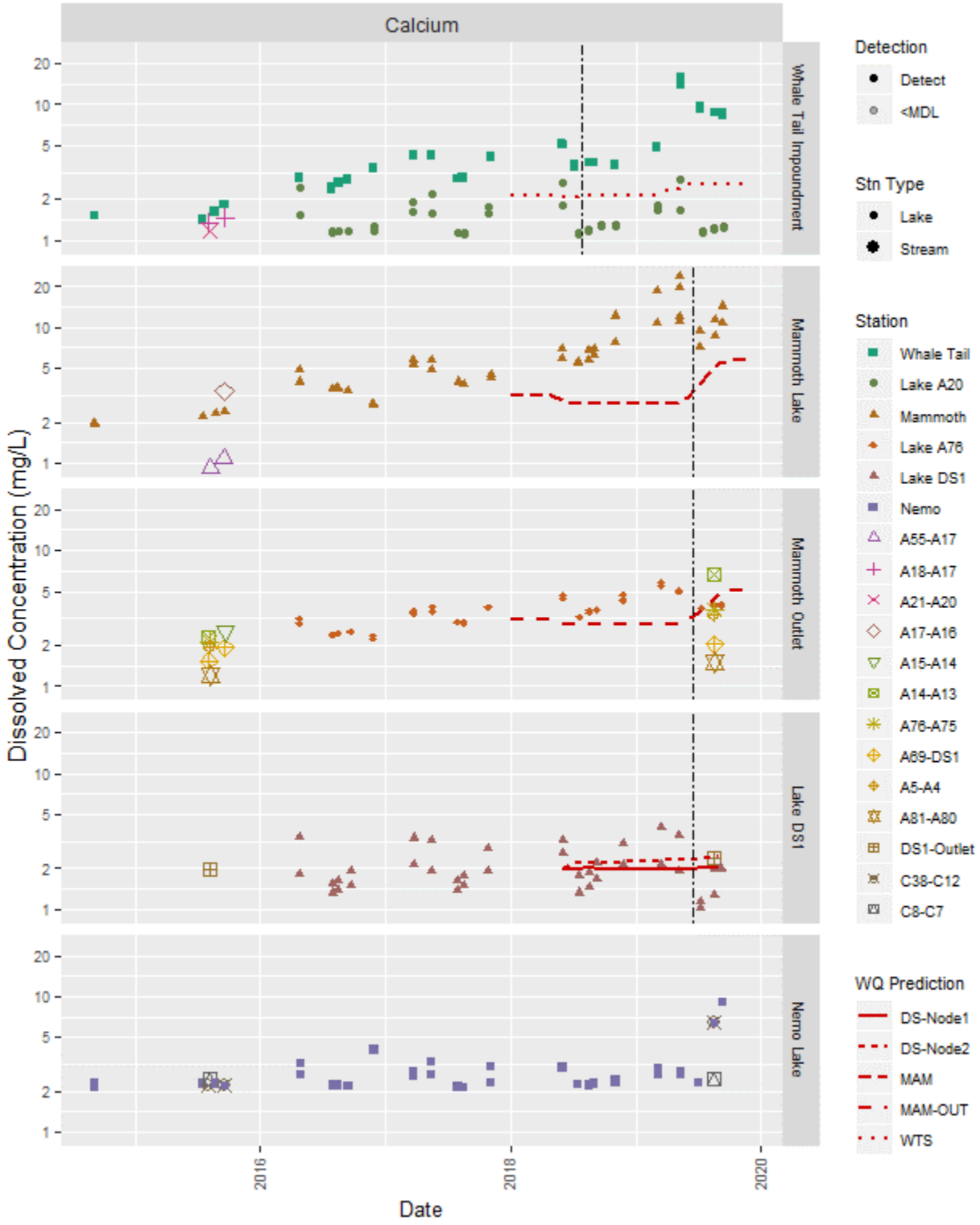


Figure D.14. Dissolved copper concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

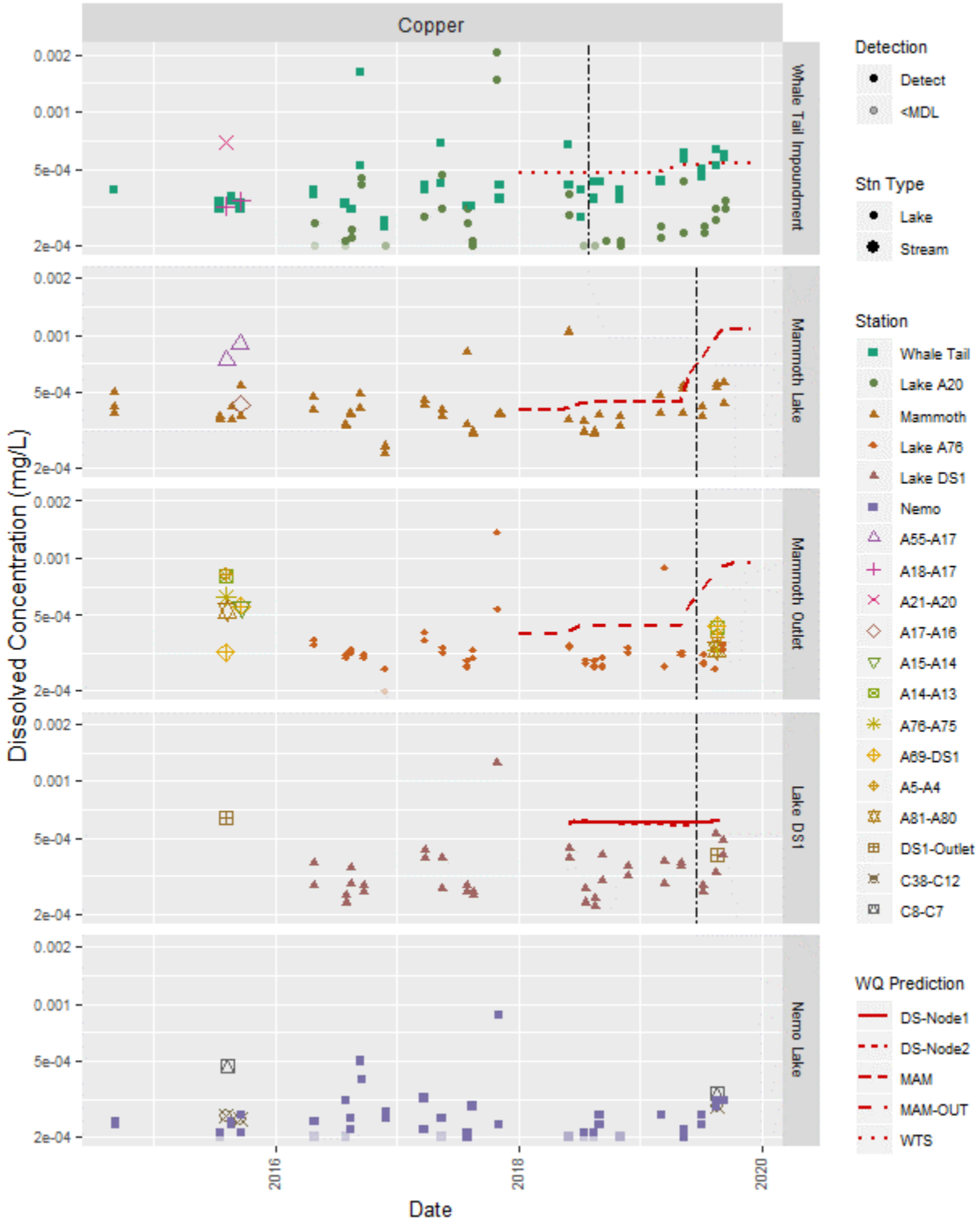


Figure D.15. Dissolved iron concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

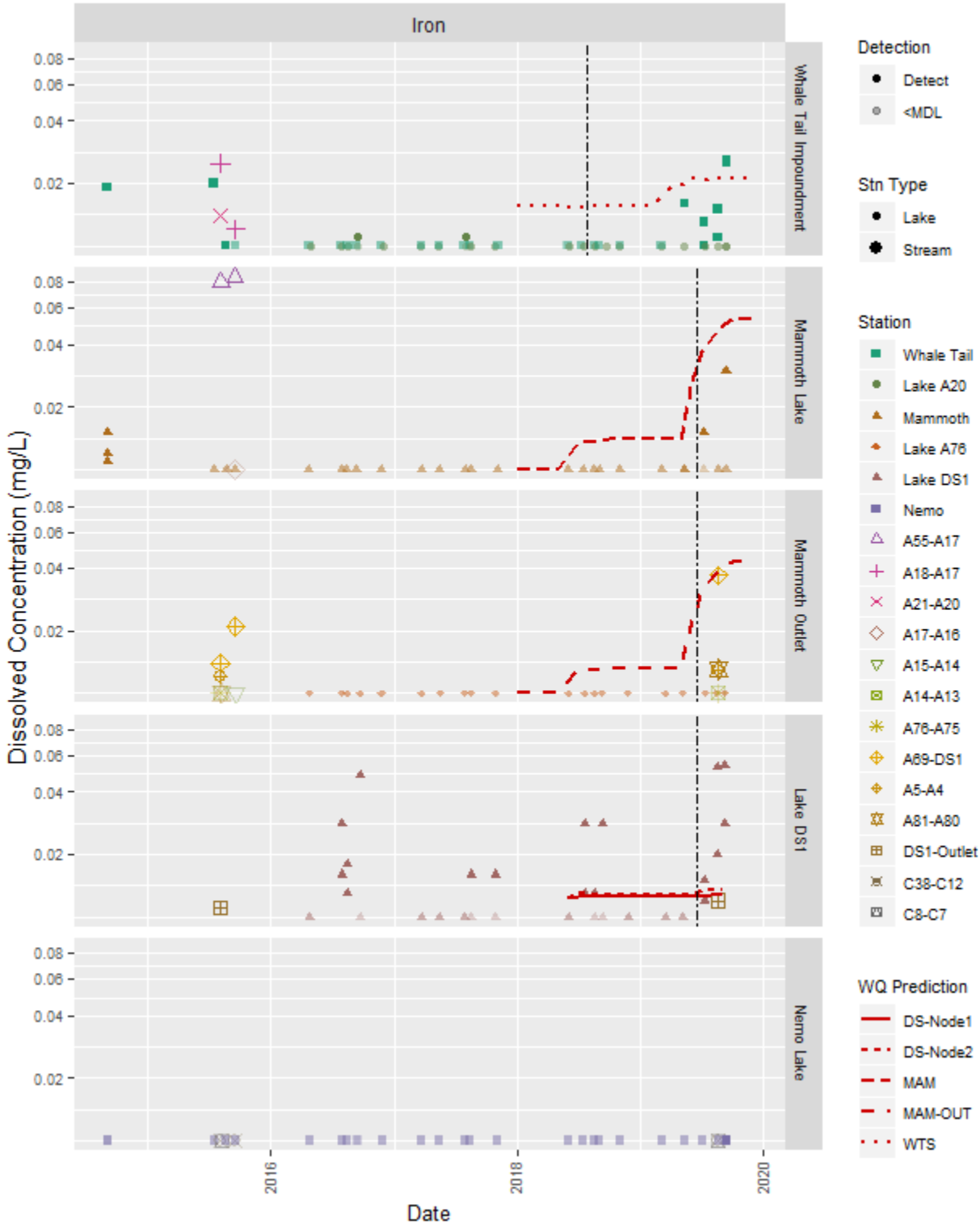


Figure D.16. Dissolved lithium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

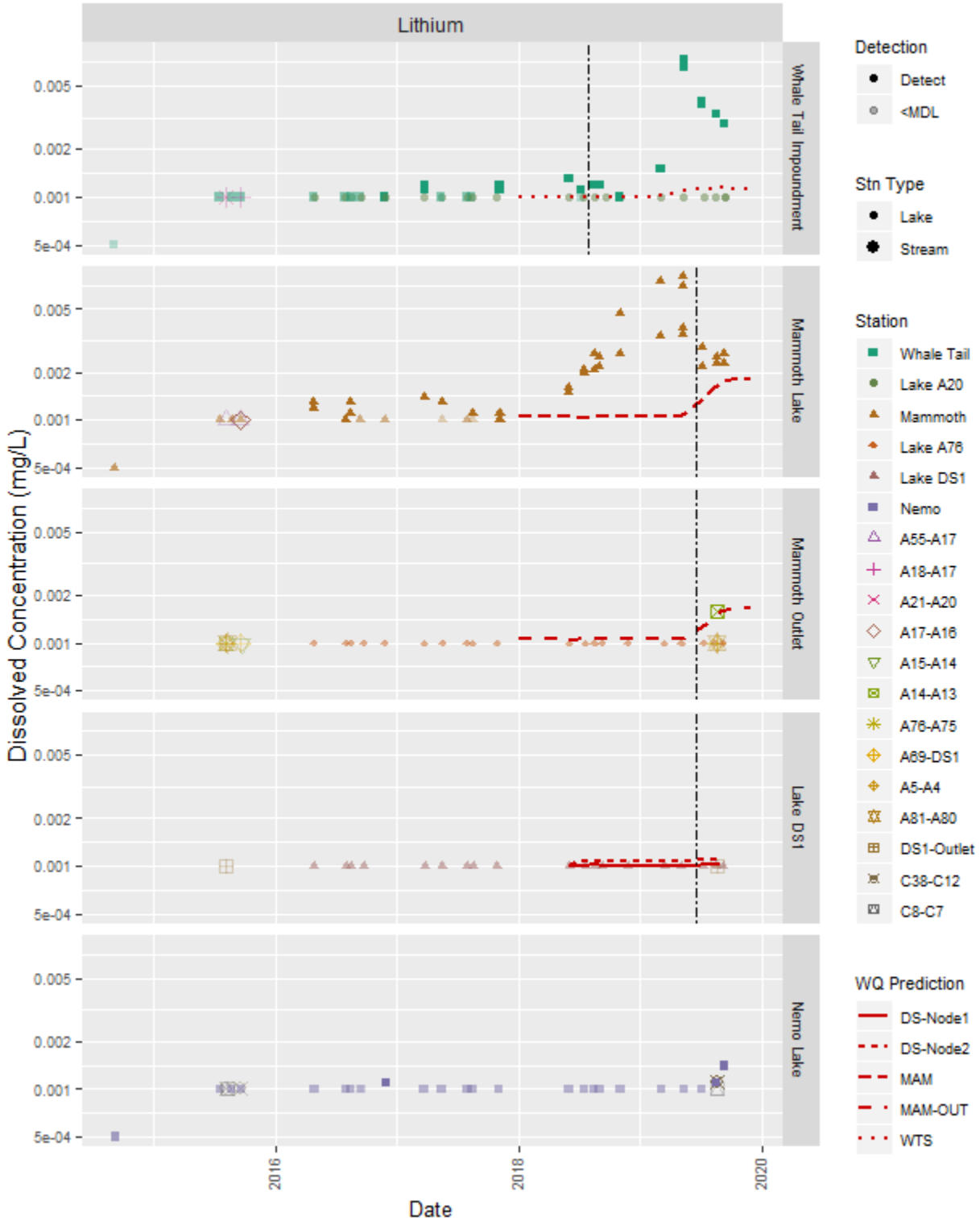


Figure D.17. Dissolved magnesium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

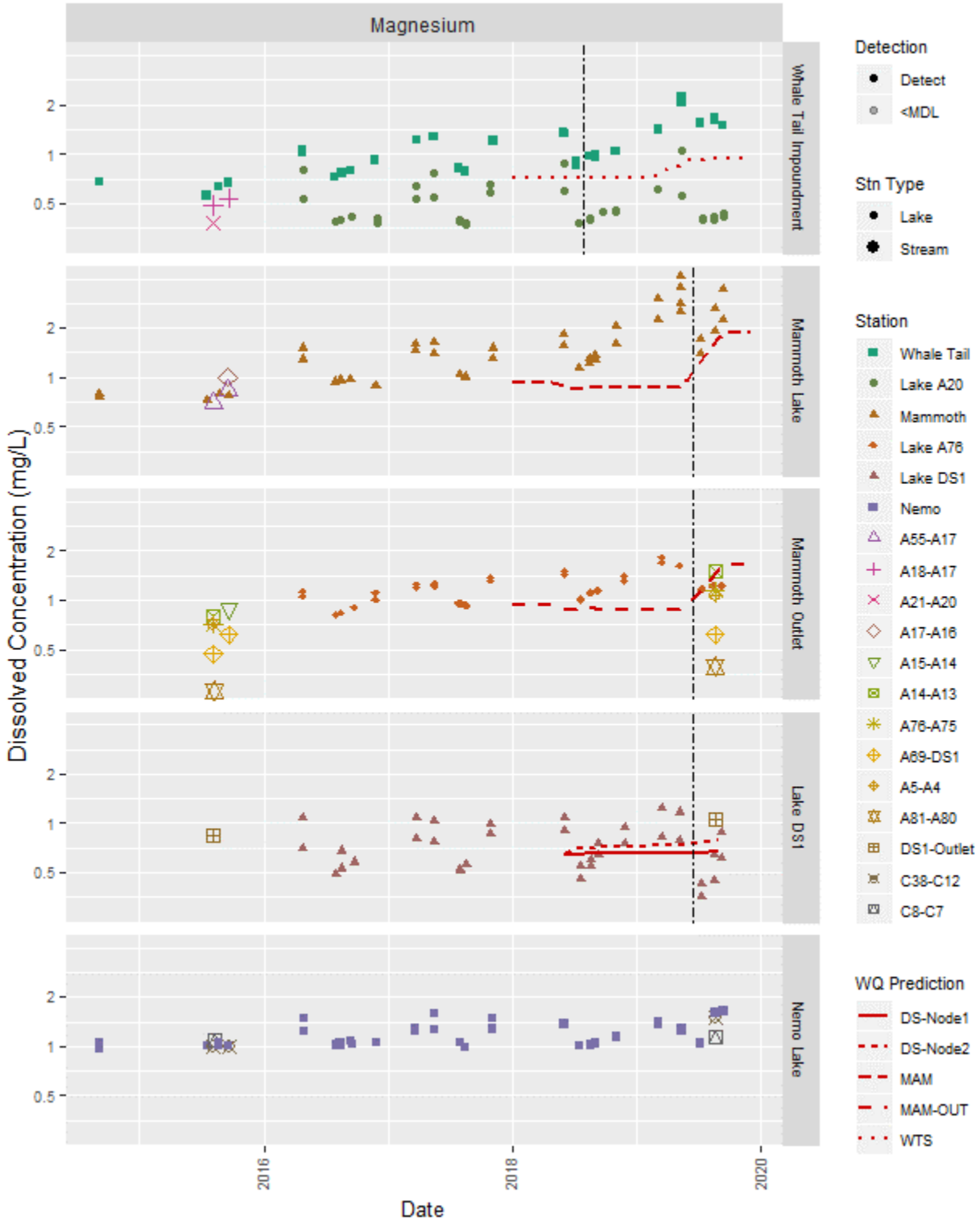


Figure D.18. Dissolved manganese concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

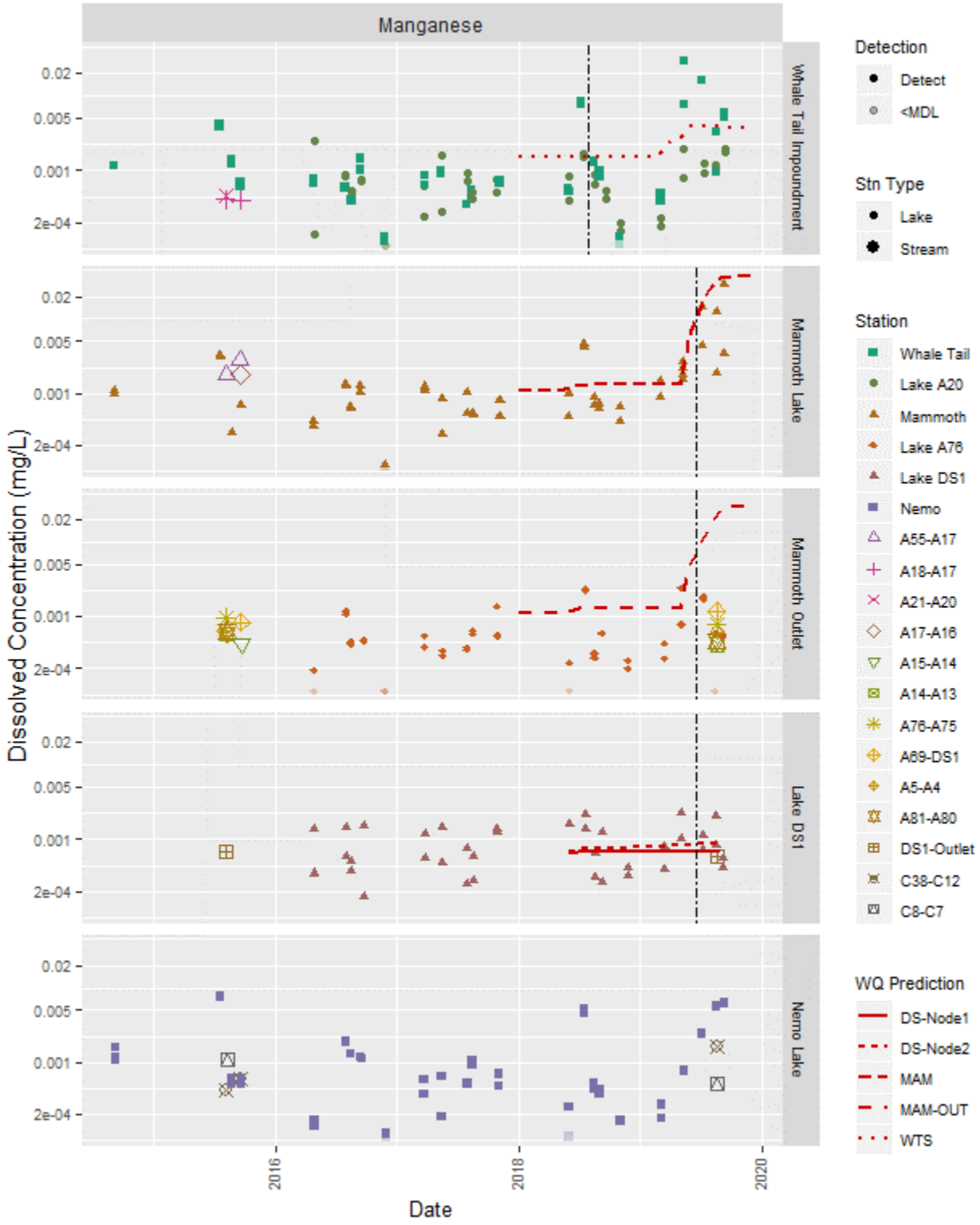


Figure D.19. Dissolved molybdenum concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

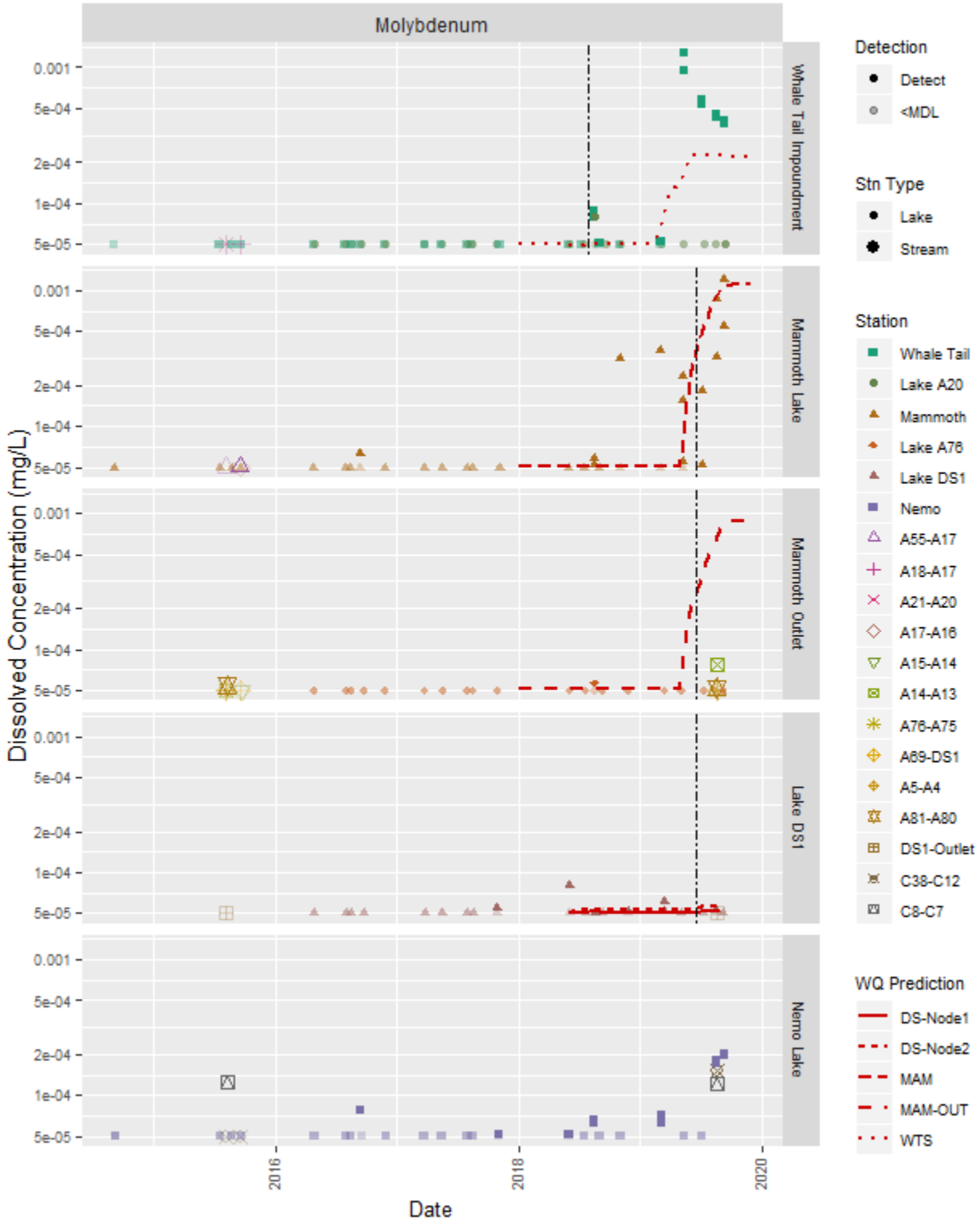


Figure D.20. Dissolved nickel concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

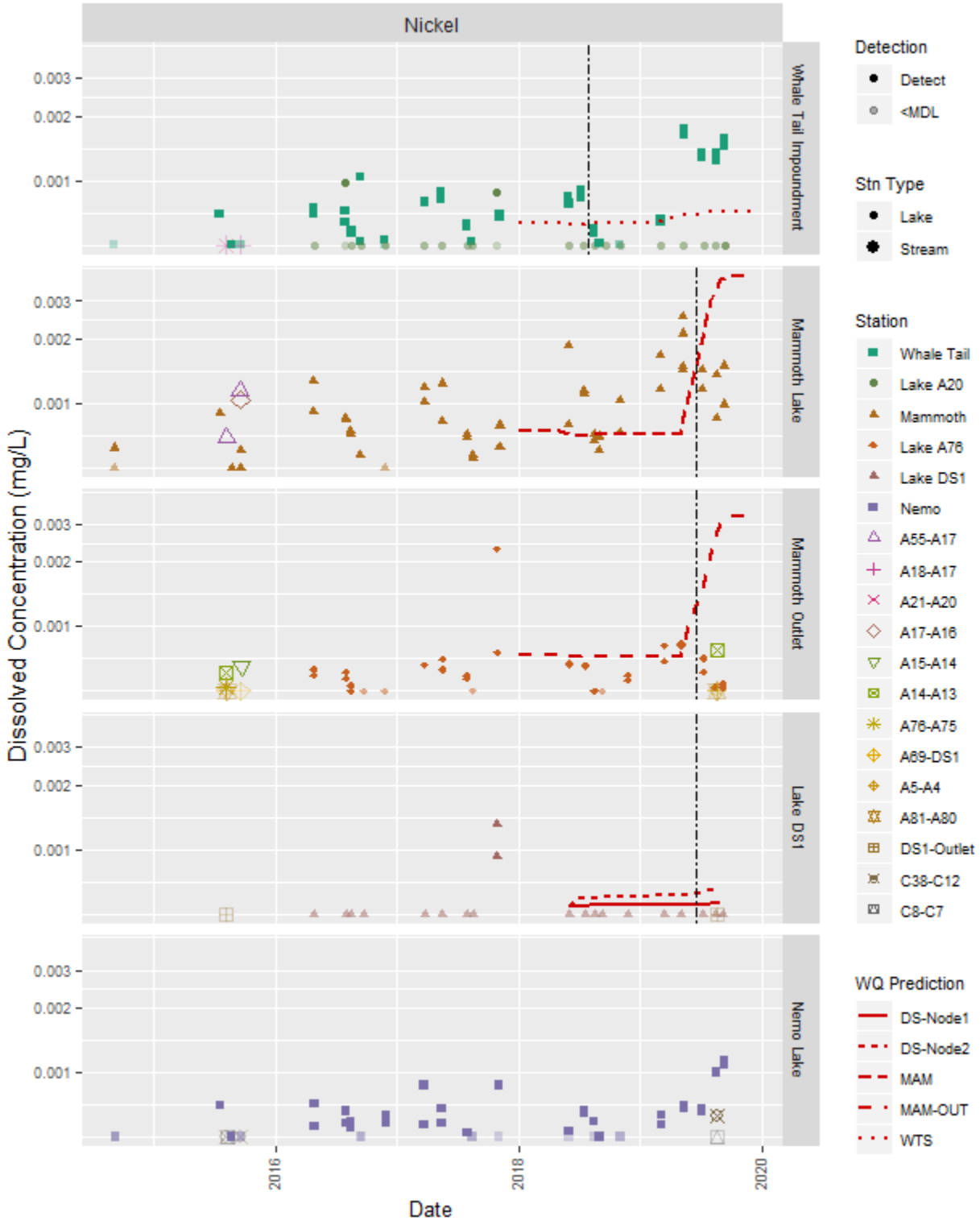


Figure D.21. Dissolved potassium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

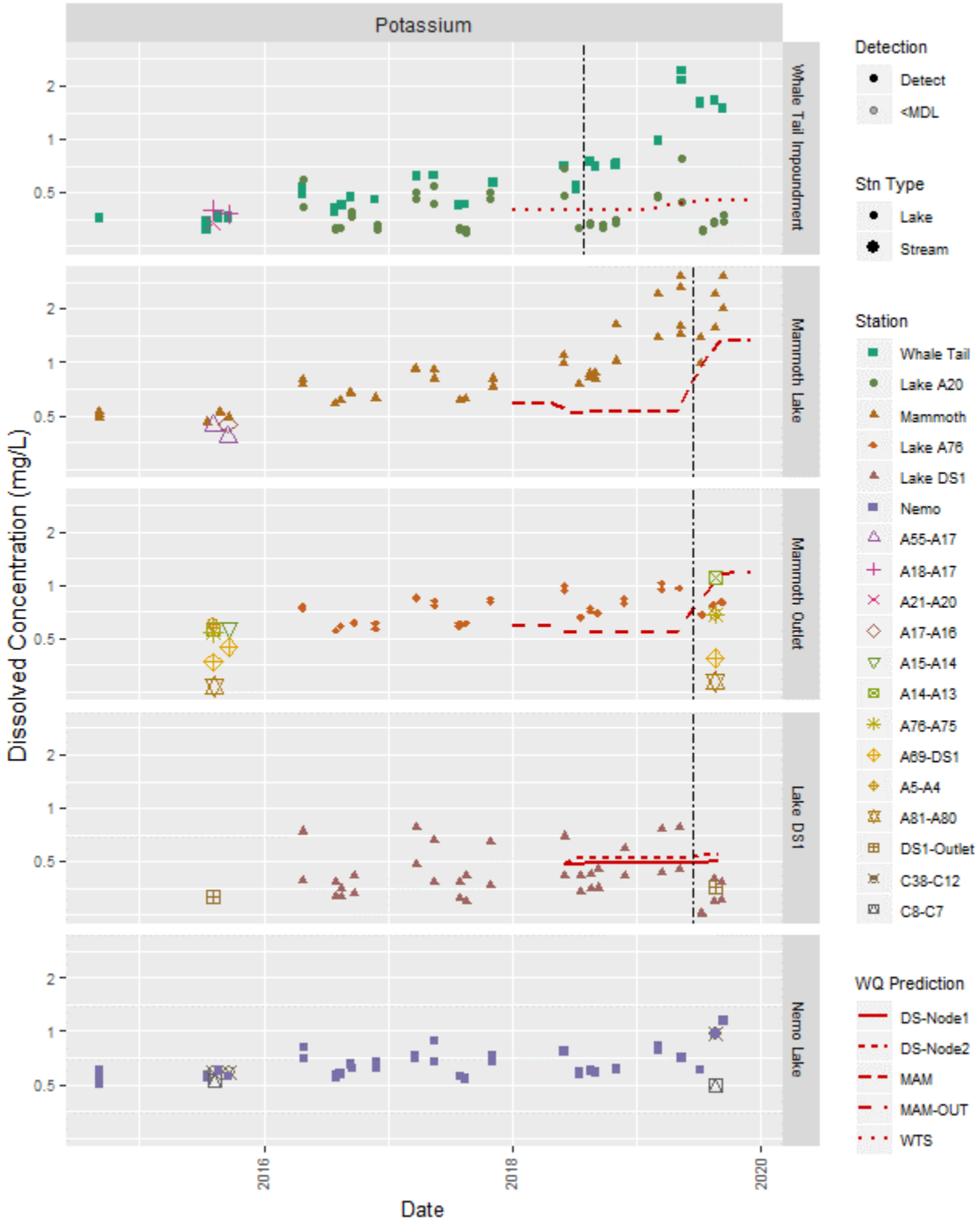


Figure D.22. Dissolved sodium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.

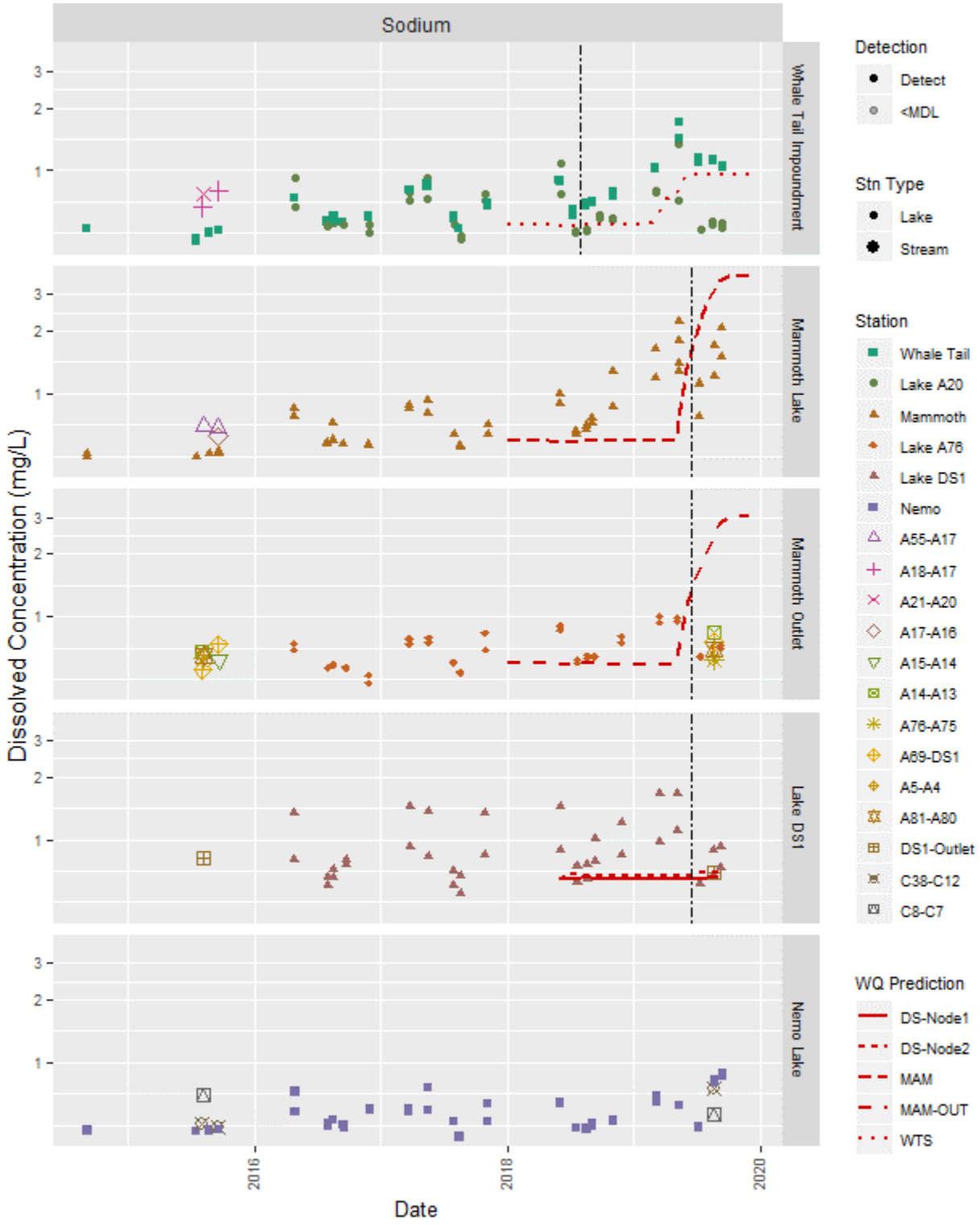
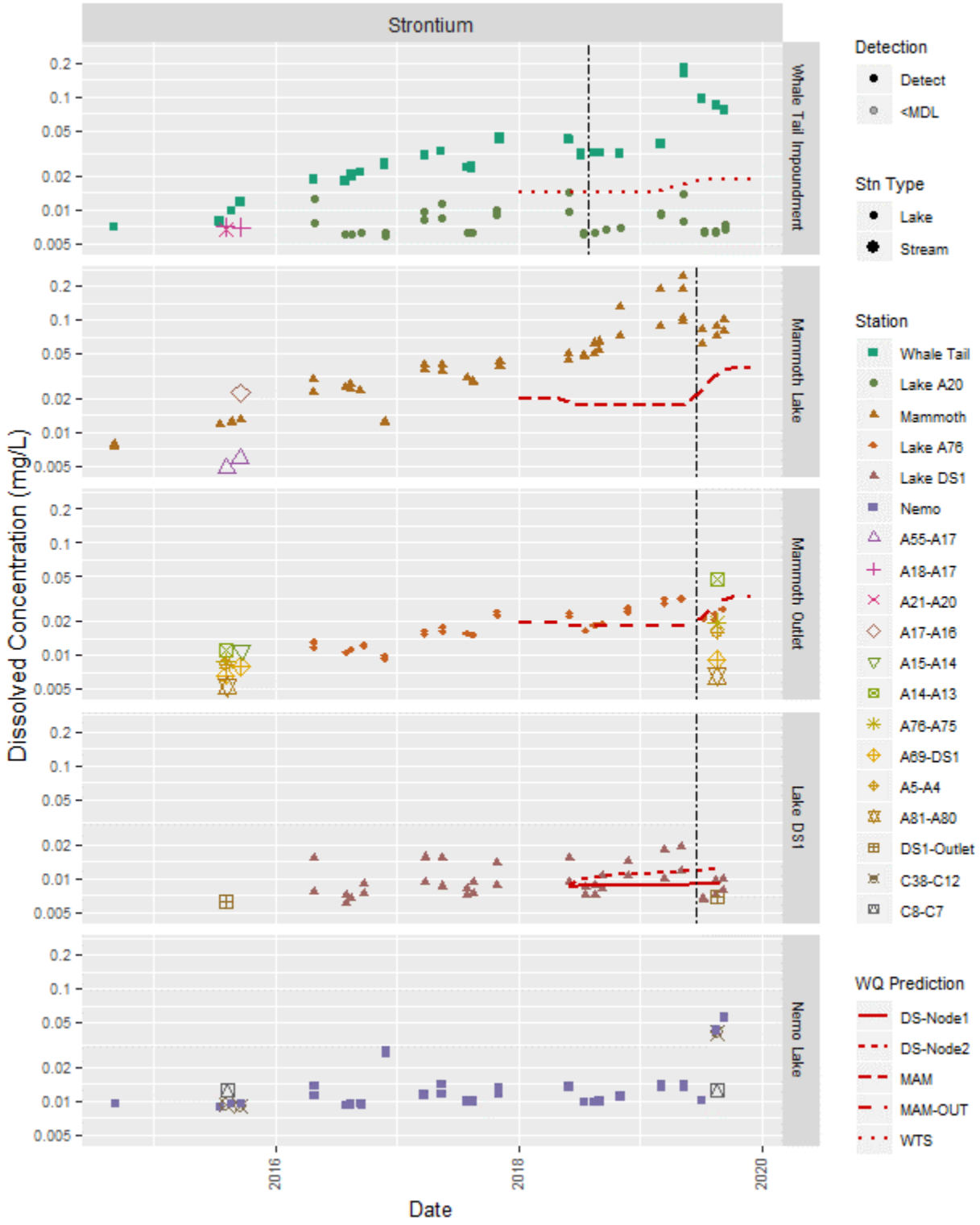


Figure D.23. Dissolved strontium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.



AZIMUTH

Figure D.24. Dissolved uranium concentration in lake and stream samples collected between 2015 and 2019.

Note. The vertical line in the Whale Tail Impoundment plots indicate the start of dike construction. The vertical line in the Mammoth Lake, Mammoth Outlet, and Lake DS1 plots indicate the start of effluent discharge at Mammoth Lake. Water quality predictions were not developed for Nemo Lake and stations downstream. Non-detect results are shaded lighter in the plots.