2021 – 2022 Water Quality Sampling Program for the Sturgeon River Watershed, Alberta



PRESENTED TO

North Saskatchewan Watershed Alliance (NSWA)

FEBRUARY 6, 2023
ISSUED FOR USE
FILE: ENW.EENW03601-01

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EXECUTIVE SUMMARY

Tetra Tech Canada Inc., (Tetra Tech) was retained by the North Saskatchewan Watershed Alliance (NSWA) to design and implement a repeatable two-year water quality sampling program for the Sturgeon River (SR) Watershed (SRW). Four sampling events were conducted, one in spring (April/May) 2021 and another in summer (August/September) of each of 2021 and 2022. The purpose of the program is to extend the baseline database and identify issues and detect trends in water quality over time using existing data and initiatives in the SRW and compiling analytical data from 12 sampling locations throughout the watershed along the main stem and primary tributaries.

Based on the review of the analytical results from 2021 and 2022 and the historical comparisons, the following discussion is provided:

- Various parameters were observed to exceed the *Environmental Quality Guidelines for Alberta Surface Waters*, including but not limited to: pH, electrical conductivity (EC), chloride, sulphate, ammonia as nitrogen, total arsenic, total chromium, total cobalt, dissolved iron, total manganese, *Escherichia coli*, and MCPA (a herbicide).
- The exceedances identified during this study do not appear to be consistently reoccurring at any given sampling location.
- Visual trend analysis identified some upwards and some downwards trending parameters during each of the April and August sampling events. Statistical trend analysis cannot be completed until additional data has been collected.
- Overall, water quality within the SRW generally appears acceptable although some parameters of interest should be further investigated.

Based on the findings of the 2021 and 2022 annual sampling programs, the following recommendations are provided:

- Continue with the annual water quality monitoring program beyond 2022. The sampling program should include a minimum of two sampling events to represent spring and summer runoff events at the same 12 stations.
- Incorporate data from other stakeholder monitoring programs, i.e. City of St. Albert, into the SRW data set and trend charts where possible.
- Consider additional analysis at locations up- and downstream of locations where parameters of interest have been identified, including tributary locations which may allow tracing of source inputs.
- Maintain a photographic inventory at all water sampling stations during sampling events to compare apparent algal and other biotic diversity at each location in order to evaluate whether substantial changes to the local biotic communities are occurring for comparison to nutrient data trends.
- Continue graphical trend charts and begin Mann Kendall analysis of parameters after at least four data points have been collected for each of the April and August sampling periods, including historical data where available.

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1.0 INTRODUCTION

Tetra Tech Canada Inc., (Tetra Tech) was retained by the North Saskatchewan Watershed Alliance (NSWA) to design and implement a repeatable two-year water quality sampling program for the Sturgeon River (SR) Watershed (SRW). Four sampling events were conducted, one in spring (April) and the other in summer (August) in each of 2021 and 2022 and data from these sampling events are summarized in this report, along with other relevant historical data.

The purpose of the program was to identify issues and detect trends in water quality over time using existing data and initiatives in the SRW through compiling analytical data from 12 sampling locations throughout the watershed. The 12 sampling locations were sampled and are identified below (Table A). Figure 1 provides a watershed plan which shows all sample locations. Eight (8) stations are located on the main stem of the river and four (4) on significant tributaries. Photographs of each monitoring station are provided in Appendix A.

Table A: Locations Sampled in 2021 and 2022

Sample Location ID	Location Description	Mainstem/Tributary
M2	SR upstream of Isle Lake. Close to Highway 16	Mainstem
M3	SR downstream of Isle Lake and upstream of Lac Ste Anne. North of Highway 16	Mainstem
M4	SR downstream of Lac Ste Anne. North of Highway 43 and east of Highway 33	Mainstem
M7	SR upstream of Rivière Qui Barre. South of Highway 37 and west of Highway 44	Mainstem
M8	SR downstream of Rivière Qui Barre and upstream of Big Lake East of Highway 44 and south of Highway 37	Mainstem
M10	SR upstream of Little Egg Creek. South of Highway 37, west of Highway 28	Mainstem
M11	SR downstream of Little Egg Creek and upstream of Gibbons South of Highway 28	Mainstem
M12	Near the mouth of SR. East of Highway 28A	Mainstem
T1	Kilini Creek near its confluence with Matchayaw Lake East of Highway 43 and south of Highway 37	Tributary
T3	Rivière Qui Barre near its confluence with the SR West of Highway 44 and north of Highway 37	Tributary
T4	Atim Creek upstream of Big Lake at Range Road (RR) 27. North of Highway 16 and Spruce Grove. West of Highway 44	Tributary
T6	Little Egg Creek near its confluence with the SR North of Highway 37 and west of Highway 28	Tributary

1.1 Background and Objectives

The SRW is a primary tributary of the North Saskatchewan River (NSR) in central Alberta (City of St. Albert, 2020). It flows from west to east with the river headwaters at Hoople Lake south of Entwistle and ending at the North Saskatchewan River (NSR) confluence at Fort Saskatchewan (City of St. Albert, 2012). The watershed covers an area of 3,301 km^2, with about 4% of that area made up by urban centres while 74.5% of the people within the watershed live within these urban centres (City of St. Albert, 2012). Approximately 71% of the basin area is under agricultural use and 20% of the watershed is considered undeveloped natural area (City of St. Albert, 2012).

The remaining 5% of the watershed is covered in utilities, roadways, and oil and gas development (City of St. Albert, 2012). Like other rivers in central Alberta, the SR is fed from precipitation/snowmelt, local and regional groundwater discharge and local runoff (CPP Environmental, 2019). The SR flows are not supplemented by mountain snowmelt or glaciers in summer/fall, but instead are influenced by larger lakes west of St. Albert, including Lake Isle, Lac St. Anne and Big Lake which moderate peak flows (City of St. Albert, 2021). The riverbed slope is very low as evidenced by many meanders and oxbow lakes, particularly in the lower reaches of the basin.

Development within the watershed is continually expanding. With constant development in urban areas, agricultural land expansion, utilities and industrial activity, there is potential that the runoff from these areas could be having a negative impact on the river water quality (City of St. Albert, 2012). The purpose of this report is to build on existing data in the watershed to determine changes/trends in water quality, determine where these changes are taking place within the watershed and what could be the possible source.

In 2017, an Aquatic Ecosystem Assessment was initiated by the NSWA at 18 sample locations throughout the watershed, all of which are located in the Sturgeon River basin. This program analyzed both the water quality and physical habitat of the river in conjunction with the health of the macroinvertebrate and fish communities to assess overall aquatic ecosystem health. Twelve of these 18 sampling locations were utilized by Tetra Tech in 2021 and 2022 for the purpose of extended water quality sampling.

To assess water quality sampling over 2021 and 2022, two sampling events were set up for each year. Each year was sampled in the spring (April) to capture the snowmelt and spring runoff, and then again during the summer (August) to capture low flows for pesticides, herbicides, and total coliform concentrations. The main testing parameters include nutrients, pesticides, and salinity, and these were compared to Alberta Surface Water Guidelines (2018) for agricultural use, recreation and aesthetics, and suitability for aquatic life.

The objectives of the program are to:

- Build on the existing database and support initiatives in the Sturgeon River Watershed.
- Identify issues and identify trends in water quality over time.
- Help to better understand if water quality guidelines are being met, where they exist.
- Identify where contaminants may be coming from, if possible.
- Establish the relative impact of various land uses in the basin.
- The relationship, if any, between water quality and quantity.

2.0 SCOPE OF WORK

Tetra Tech conducted the following scope of work in 2021 and 2022:

- Reviewed technical reports (which included the Sturgeon River 2019 Aquatic Ecosystem Assessment) and existing monitoring programs relevant to the Sturgeon River watershed.
- Designed a sampling program that over the long-term will help answer key questions regarding water quality in the basin such as the following:
  - Is water quality getting better or worse and where within the basin? Is it acceptable for the protection of aquatic life? For agriculture/irrigation? For recreation? What is normal or baseline water quality for the watershed? Can clear objectives be set for stakeholders?

  - Are nutrient levels in the mainstem, tributaries and lakes getting better or worse, i.e. improving or declining over time? If worse (declining), why? What is their primary source (urban, agricultural uses or both)? What can be done to target improvements?
  - Are pesticides in the mainstem above guidelines? What are the possible source(s)? From where in the basin? Is compliance/enforcement an issue?
  - Is salinity increasing and if so, is road salt and snow storage and management a contributing factor? What role does climate change play?
- Conducted two sampling events in 2021 and 2022: one in spring (April) and one in the summer (August).
- The following parameters were analyzed for each sampling event:
  - Routine Parameters (temperature, dissolved oxygen, pH, total suspended solids [TSS], plus the additional ALS Labs suite of parameters).
  - Nutrients (P, N): Assess nutrient concentrations and loadings from surrounding land use during the spring and summer sample events.
  - Salinity (chloride): To see if levels are elevated as documented in 2018 and if they are natural or related to road de-icing and maintenance. Sampling during the spring is specifically directed to this issue.
  - Pesticides/Herbicides (similar to the 2018 parameters): Assess if there's a repeat of 2018 of elevated levels in the headwaters. Sampled and tested only during the summer event.
  - E.coli and total coliforms were added to the summer sampling events to determine human health and overall quality of the river.
- Sampled at 12 locations from previous studies, allowing for the utilization of previous data for the purpose of examining long-term trends. The 12 locations are:
  - Three sites upstream of Lake Isle where 2018 sampling showed poor water quality.
  - One mid-river sample where 2018 results showed relatively good water quality.
  - Three sites downstream of St. Albert with issues related to chloride and urbanized runoff (this avoids overlap data collected on the Sturgeon River by the City of St. Albert within city limits).
  - One site at the confluence of the North Saskatchewan River; a site of important fish habitat and with an existing flow gauge station.
  - Four priority tributary sites include: Kilini Creek, Riviere Que Barre, Atim Creek; and Little Egg Creek. Carrot Creek was not sampled since it is already monitored in the City of St. Albert program along with the main stem through the City.

The following additional tasks were completed as recommended by Tetra Tech after confirmation from NSWA:

- A Safety Plan for the program and event-specific Safe Work Forms were prepared for each field event.
- Field measurements were taken for pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), and water temperature at each sample location.
- One field duplicate QA/QC sample was collected and analyzed for the same parameters as the parent sample lab analysis completed by ALS Laboratory in Edmonton, AB. ALS is CALA certified for the parameters and testing methods proposed in this program.

3.0 FIELD ACTIVITIES

3.1 Field Program and Laboratory Analysis

Two water quality sampling events were conducted in 2021 and 2022 at twelve (12) locations: on April 8, 2021, August 30, 2021, April 29, 2022, and August 18, 2022 by a team of two Tetra Tech environment staff during each sampling event. Sampling locations are shown on Figure 1.

During each event, each location was visited to collect field measurements and to obtain water quality grab samples for subsequent laboratory analysis. Field measurements were collected and recorded for pH, EC, DO, turbidity, total dissolved solids (TDS), and water temperature at the time of sampling. New nitrile gloves were worn at each sampling point and grab samples were collected in laboratory-provided bottles at a depth 0.20 cm below surface to avoid floating material or disturbing the riverbed. The samples were kept in a cooler at approximately four degrees Celsius (˚C) and submitted to ALS Canada Ltd. (ALS) laboratory in Edmonton on the same day that the samples were obtained. Note that lab pH, EC, DO and TDS results are also reported by ALS for the samples submitted for laboratory analysis.

All water samples for each event were tested by ALS for the following parameters as requested by the NSWA (RFP):

Spring (April) Sampling Events

- Field Parameters
- Routine Parameters
- Nutrient Parameters
- One duplicate (For routine and nutrient parameters)

Summer (August) Storm Sampling Events

- Field Parameters
- Routine Parameters
- Nutrient Parameters
- Total Metals (Only done at locations M2, M7, M10 and T6)
- *E. coli* and Total Coliforms
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Phenols (Only done at locations M2, M7, M10 and T6)
- Herbicides (Only done at locations M2, M7, M10 and T6)
- Pesticides (Only done at locations M2, M7, M10 and T6)
- One duplicate (for routine and nutrient parameters, and coliforms)

Summaries of the field and lab results for each event are presented in Tables 1 to 3 of the Tables Section. Copies of the original laboratory results reported by ALS are presented under separate cover.

Total nitrogen and dissolved Kjeldahl nitrogen (DKN) were not analyzed in the August 2022 samples due to laboratory error. No regulatory guidelines exist for these specific parameters.

3.2 Field Observations

During the 2021 and 2022 sampling events, Tetra Tech recorded the conditions of the sample locations along with observations on the water turbidity, visible sheen, algal blooms, debris and other observations, as described in the following:

- For the April 2021 sampling event, most sample stations were found to be in a safe and accessible condition. Most locations had ice at the water's edge but were still possible to sample. Water was clear or slightly turbid in most of the sample locations.
- For the August 2021 sampling event, most sample locations were found to be in good sampling condition except for M3. At M3, there was a very low water level with low flow and duck weed present. It was noted at M3 that there was a plume of sediment during sample collection, the cause of which is unknown. Therefore, it was noted that if results at M3 are atypical, it may be due to the substrate being disturbed, allowing for an increase of sediment in the sample. Water at most of the sample locations was clear or slightly yellowish or brownish in colour, except for sample location T3, which had an apparent sheen. It was noted in the field that sample location T3 is downstream from a road crossing with creosote-preserved supports which may leach contaminants. Aquatic vegetation was found in numerous sample locations, including algae, duckweed, arrowheads, and milfoil. Aquatic fauna was also found in several sample locations, including shrimp, backswimmers, and minnows.
- For the April 2022 sampling event, most sample locations were accessible and no ice along the water's edge was apparent. Water was clear to moderately brown/turbid at most sample locations. Floating grass, debris, and duck weed were noted at M8.
- For the August 2022 sampling event, most sample locations were found to be in good condition. Road construction was noted in the vicinity of M11, low water levels or limited flow were noted at M2, M3, M4, and T6, and M4, M10, and T4 were noted as being highly vegetated.

4.0 RESULTS

4.1 Evaluation Criteria

Water quality is generally assessed in accordance with standards or objectives in guidelines that have been developed for the protection of specific surface water uses in Alberta. Evaluation of the water quality samples collected under the present program were evaluated in relation to the *Environmental Quality Guidelines for Alberta Surface Waters* (ASW guidelines) (Government of Alberta, 2018). Data is evaluated against the surface water quality for protection of freshwater aquatic life (PAL guidelines), water quality guidelines for protection of agriculture (agriculture guidelines), and surface water quality guidelines for recreation and aesthetics (recreation and aesthetics guidelines), with the most conservative exposure values (long-term chronic or short term acute) applied.

Table 1 presents the water quality data and targets for each of the referenced guidelines for the 2021-2022 spring and summer events. Table 2 presents the water quality duplicate samples against the parent samples for quality control for both years (details in Section 4.2).

4.2 Quality Assurance/Quality Control (QA/QC)

For an evaluation of field sampling and laboratory testing reproducibility, a single blind duplicate water sample was collected during each of the two sampling events in 2021 and 2022. The duplicates corresponded to M7 for the April 2021 event, M11 for the August 2021 event, M12 for the April 2022 event, and M8 for the August 2022 event. The duplicates were submitted for laboratory analysis for the same suite of parameters that were ordered for the corresponding original samples. Table 2 presents the QA/QC Analytical Results.

To assess the field sampling and laboratory testing reproducibility, each sample-duplicate pair was evaluated using the relative percentage difference (RPD) method. This involved calculating the RPD when both sample-duplicate concentrations were greater than, or equal to, five times the laboratory reporting detection limit (RDL), as shown in Equation 1.

$$\%RPD = \left(\frac{|Sample - Duplicate|}{\overline{X}} \right) * 100 \qquad \text{Equation 1}$$

Where $\overline{X}$ is the average concentration of a sample and its duplicate.

Water quality parameters were considered as having passed the Quality Assurance and Quality Control (QA/QC) reproducibility procedure if the RPD was less than or equal to 20%, indicating a close correlation between the sample-duplicate pair. The 20% RPD value originates from the Alberta Environment Guidelines for Quality Assurance and Quality Control in Surface Water Quality Programs in Alberta (Alberta Environment, 2006). RPD is usually used for flagging data for further review, rather than for taking corrective action.

RPD values were not calculated if one or both of the sample-duplicate concentrations were less than five times the RDL. In these cases, water quality parameters were still considered as having passed the QA/QC reproducibility procedure if the difference between the original sample and duplicate concentration was less than two times the RDL. This practice derives from guidance provided in the 2016 Canadian Council of Ministers of the Environment (CCME) Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 1 Guidance Manual (CCME, 2016).

The results of the RPD calculations are summarized in Table 2. In 2021 spring and summer sampling events, all parameters were considered to pass the RPD test except for *E. coli* in August 2021 with concentrations of 1,200 colony forming units (CFU)/mL and <1.0 CFU/mL in the sample and duplicate, respectively. The TSS RPD in April 2022 was 22%. The TSS result for M12 in April 2022 was substantially greater than in the April 2021 sampling or either August sampling (128 mg/L versus the next highest result of 31.7 mg/L). It may be that such relatively high TSS concentrations are the result of variations in stream flow which in turn caused the relative sample-duplicate RPD to be greater than the 20% reproducibility test criterion. E. coli RPD was 44% in August 2022, however, the actual sample and duplicate concentrations (21 CFU/100 mL and 33 CFU/100 mL, respectively) were well below the agriculture guideline limit of 100 CFU/100 mL. Distribution of *E. coli.* within the stream flow may be uneven, and even the minor disruption of duplicate sampling may cause variability in *E. coli* results as evidenced by both the August 2021 and August 2022 RPD test failures.

Overall, the QA/QC results are generally within acceptable variability, and the duplicate analysis confirms that the analytical results are generally valid and reproducible.

4.3 Local Hydrometric Records

4.3.1 Meteorological Data

Area precipitation and air temperature records from the five days preceding each sampling event were obtained for the Villeneuve A Meteorological Station (Villeneuve Station), located centrally in the watershed and therefore considered representative of typical watershed conditions (Government of Canada, 2022a) and are summarized in Table B. Annual precipitation records for Villeneuve Station (January through October for 2022 records) and climate normal and average data from the Stony Plain Meteorological Station from 1981 to 2010 (Government of Canada, 2022b) were obtained for comparison as climate normal data is not available for Villeneuve Station. In general, annual precipitation in 2021 and in January 2022 through October 2022 at Villeneuve Station (248.0 mm and 335.5 mm, respectively) was well below the climate normal of 487.8 mm for the region. The 2021 monthly precipitation records for Villeneuve Station were well below the climate normal values for April, June, July and August (less than 50% of normal precipitation), with overall annual precipitation in 2021 indicating a substantially reduced input of precipitation events into local surface water volumes. The 2022 monthly precipitation data was substantially less than climate normal in May, July, and August, also indicating a reduced precipitation component of surface water volumes, although not as severe as in 2021.

Table B: Villeneuve A Met Station Precipitation and Air Temperature

Sampling Date	Precipitation (Total)	Daily Air Temperature (Average)
5 days prior to April 8, 2021	0.0 mm	0.1 ˚C
5 days prior to August 30, 2021	0.2 mm	15.1 ˚C
5 days prior to April 29, 2022	16.3 mm	6.4 ˚C
5 days prior to August 18, 2022	0.0 mm	19.3 ˚C

4.3.2 Hydrological Data

Six Alberta Government water monitoring stations are present within the SRW: Lac Ste. Anne at Alberta Beach (05EA006), Atim Creek at Century Road (05EA012), Sturgeon River near Villeneuve (05EA005), Carrot Creek near the Mouth (05EA011), Sturgeon River at St. Albert (05EA002), and Sturgeon River near Fort Saskatchewan (05EA001). Tables C and D summarize the daily average water levels and flow rates observed at each station (where applicable) for each of the April and August sampling events, respectively (Government of Alberta, 2022).

Table C: April 2021 and 2022 Water Monitoring Station Water Levels and Flow Rates

Water Monitoring Station	Water Level (Average Geodetic Elevation at Gauge)		Water Flow Rate (Average Daily)	
	April 8, 2021	April 29, 2022	April 8, 2021	April 29, 2022
Lac Ste. Anne at Alberta Beach (05EA006)	No Data	722.62 m asl	-	-
Atim Creek at Century Road (05EA012)	No Data	8.68 m	No Data	No Data
Sturgeon River near Villeneuve (05EA005)	0.902 m	No Data	No Data	No Data

Table C: April 2021 and 2022 Water Monitoring Station Water Levels and Flow Rates

Water Monitoring Station	Water Level (Average Geodetic Elevation at Gauge)		Water Flow Rate (Average Daily)	
	April 8, 2021	April 29, 2022	April 8, 2021	April 29, 2022
Carrot Creek near the Mouth (05EA011)	7.17 m	No Data	No Data	No Data
Sturgeon River at St. Albert (05EA002)	0.79 m	1.31 m	2.04 m^3/s	7.13 m^3/s
Sturgeon River near Fort Saskatchewan (05EA001)	4.23 m	4.24 m	-	-

'-' denotes data not collected at the indicated location
'No Data' denotes data was not available for the date(s) in question

Table D: August 2021 and 2022 Water Monitoring Station Water Levels and Flow Rates

Water Monitoring Station	Water Level (Average Geodetic Elevation at Gauge)		Water Flow Rate (Average Daily)	
	August 30, 2021	August 18, 2022	August 30, 2021	August 18, 2022
Lac Ste. Anne at Alberta Beach (05EA006)	722.64 m asl	722.62 m asl	-	-
Atim Creek at Century Road (05EA012)	8.51 m	8.57 m	0.00880 m^3/s	0.0365 m^3/s
Sturgeon River near Villeneuve (05EA005)	0.381 m	No Data	0.0 m^3/s	0.0 m^3/s
Carrot Creek near the Mouth (05EA011)	6.87 m	No Data	0.53 m^3/s	No Data
Sturgeon River at St. Albert (05EA002)	0.36 m	1.46 m	0.00957 m^3/s	5.88 m^3/s
Sturgeon River near Fort Saskatchewan (05EA001)	3.54 m	3.68 m	-	-

'-' denotes data not collected at the indicated location
'No Data' denotes data was not available for the date(s) in question

Overall, the August 30, 2021 and August 18, 2022 events can be considered low flow/dry events given the relatively low precipitation in the previous three months compared to climate normals. Lower than normal precipitation combined with higher than normal daytime temperatures could also have resulted in higher surface water evaporation rates. This could have the effect of concentrating metals and other parameters in water samples during the August sampling events.

The water levels and associated flow rates at the water monitoring stations were typical of April flows and slightly lower for August flows in 2021. This is related to normal spring snowmelt rates but lower rainfall in summer months in 2021. Water levels and flow rates in April and August 2022 were typically the same or greater than in 2021, likely due to the improved net moisture regime in 2022 relative to 2021.

4.3.3 Influence of Regional Lakes

The Sturgeon River basin has several large lakes along the upper half of the main stem that moderate peak flows and influence water chemistry. This is somewhat unique of the main tributaries of the North Saskatchewan River watershed. These lakes include, from upstream to downstream; Isle Lake, Lac Ste Anne and Big Lake (among others). The lakes moderate peak flows in spring and after heavy rain storms and augment and prolong main stem flows during the dryer summer and fall period. From a water quality perspective, while tributary flows drain to the main stem in hours or days with few exceptions, these lakes have a large storage capacity which significantly delays outflows. For example, Lac Ste Anne is the largest lake in the basin and has a storage capacity of 263 x 10^6 m^3 (Mitchell and Prepas 1990). Given that the upstream catchment area of 619 km^2 (excluding lake area) only produces an average runoff volume of 26.4 x 10^6 m^3 in a given year, the residency time for runoff through the lake is over ten years. In other words, a proportion of the flow at main stem stations downstream of Lac Ste Anne may be more than ten years old. Isle Lake operates in a similar way with a storage volume of 94.8 x 10^6 m^3, 246 km^2 drainage area and annual runoff yield of 12.3 x 10^6 m^3, the residency time is over 8 years (Mitchell and Prepas 1990). Similar data is not available for Big Lake but it too, will have significant storage capacity that will affect the timing of discharged runoff. The main consequence from this is that best management practices and other strategies may be more effective on the primary tributary streams and can be better evaluated given a more direct response compared to lengthy delays in outflows from lakes. Using the main stem water quality data as a measure of success in water quality improvement will be difficult to evaluate given the age of some of the flow. If the individual tributaries are yielding acceptable water quality, it can be expected that the main stem will be as well since the key tributaries make up a large percentage of the basin area. Finally, because of these lakes, it will be harder to directly improve water quality outside of local sewage system upgrades or other known point sources. This is because these lakes are deep enough to have a temperature gradient that results in periodic turnover and the resuspension of sediments at/near the lake bottom (depending on the specific thermal regime of each water body) that will result in potential changes in phosphorus and other nutrients in outflows during turnover events. This phenomenon occurs naturally and can be best managed/reduced by minimizing use of nutrients and fertilizers, maintaining or improving riparian areas that naturally mitigate nutrient translation into lakes, and other proven management strategies on basin lands before entering the lakes in the first place.

4.4 2021 and 2022 Analytical Results

The analytical results for surface water from one or more of the sample locations were greater than the PAL guidelines (or outside the recommended PAL range, where appropriate) for the following parameters during the 2021 or 2022 sampling events:

- Field DO, Field TDS, Field Turbidity, Field pH, pH (Routine), Chloride (Routine), Sulphate (Routine), TSS (Routine), Ammonia as Nitrogen (Nutrients), and Arsenic (Total).

The following parameters exceeded the agriculture guidelines at one or more sample locations:

- Field TDS, EC (Routine), Sodium Absorption Ratio (SAR) (Routine), TDS (Routine), Chloride (Routine), Iron (Dissolved), Manganese (Total), *E. coli* (Coliforms) and MCPA (Herbicide).

The following parameters exceeded the recreation and aesthetics guidelines at one or more sample locations:

- Field pH, pH (Routine), and *E. coli* (Coliforms).

The following parameters were reported with reportable laboratory detection limits (RDLs) greater than their respective ASW guideline values:

- Benzo(a)pyrene (PAH), Bromoxynil (Herbicide), Dicamba (Herbicide), Dinoseb (Herbicide), MCPA (Herbicide), Azinphos-methyl (Pesticide), Carbaryl (Pesticide), Chlorpyrifos (Pesticide), Diazinon (Pesticide), Metribuzin (Pesticide), Malathion (Pesticide), and Parathion (Pesticide).

Table 1 lists both current and historical analyzed parameters as well as parameters greater than referenced guidelines at each of the 12 sampling locations.

4.5 Historical Comparison

Historical analyses of the sample locations included field, routine, nutrient, limited metals, limited phenols, and limited herbicides parameters. These data were also collected between 2016 and 2017.

The analytical results for surface water from one or more of the sample locations were greater than the PAL guidelines for the following parameters:

- Field pH, Field DO, TSS (Routine), Ammonia as Nitrogen (Nutrients), Arsenic (Total), Chromium (Total), Cobalt (Total), and Iron (Dissolved).

The following parameters were greater than the agriculture guidelines at one or more sample locations:

- EC (Routine), TDS (Routine), Dicamba (Herbicide), MCPA (Herbicide).

There were no parameters greater than the recreation and aesthetics guidelines for any sampling locations in the historical results.

4.6 Graphical Analysis

Based on the results stated in Sections 4.4 and 4.5 above, the following parameters show recent or historical concentrations greater than one or more ASW guideline. Analysis of data trends for these parameters is warranted to observe whether they could potentially be trending upwards (increasing) or downwards (decreasing) over time.

- Field DO
- Field TDS
- Field Turbidity
- Field pH
- pH (Routine)
- EC (Routine)
- SAR (Routine)
- Chloride (Routine)
- Sulphate (Routine)
- TSS (Routine)
- TDS (Routine)
- Ammonia as Nitrogen (Nutrients)
- Arsenic (Total)
- Chromium (Total)
- Cobalt (Total)
- Iron (Dissolved)
- Manganese (Total)
- *E. coli* (Coliforms)
- Dicamba (Herbicides)
- MCPA (Herbicides

The following additional parameters of interest were also analyzed for apparent data trends:

- TKN (Nutrients)
- DKN (Nutrients)
- Total Phosphorus (Nutrients)
- Dissolved Phosphorus (Nutrients)

4.6.1 Visual Graphical Analysis

The Table E summarizes those sampling locations which show apparent visual graphical trends (up or down, as indicated) for a given parameter based on the seasonal (April and August) data collected. No trend analysis was conducted where fewer than three data points were available. Only data collected in April or August, respectively, was used to conduct the visual trend analysis. Other sample dates were not included in the visual trend analysis.

Table E: Visual Graphical Analysis Summary

Parameter	Apparent Up-Trending Locations		Apparent Down-Trending Locations	
	April	August	April	August
Field DO	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Field TDS	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Field Turbidity	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Field pH	M2, M3, M4, M7, M8, M10, M11, M12, T1, T2, T3, T4	T6	-	M7
pH (Routine)	M4, M7, M8, M10, M11, M12, T3	-	-	M7
EC (Routine)	M2, M4, M8, M10, M11, M12, T1, T3, T4	M4, M7	M3	M3
SAR (Routine)	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Chloride (Routine)	M10, M11, M12, T4	M4, M10, M12	M3, T1, T6	M2
Sulphate (Routine)	M2, M3, M4, M8, T3, T4	-	-	-
TSS (Routine)	M3, M4, M7, M8, M10, M11, M12, T6	M4	-	M7, M10, M11, M12
TDS (Routine)	M2, M4, M8, M10, M11, M12, T4	M4, M7, M8, M10, T4	M3	-
Ammonia as Nitrogen (Nutrients)	T6	Insufficient Data	M7, M8, M10, M11, M12, T1, T3, T4	Insufficient Data
TKN (Nutrients)	M7	M4, T6	M2, M10, M11, M12, T1, T3	M3
DKN (Nutrients)	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Total Phosphorus (Nutrients)	M3, T6	M4, M7, M8	M4, M7, M8, M10, M11	-
Dissolved Phosphorus (Nutrients)	M3, M12	Insufficient Data	M4, M8, M10, M11, T1, T3	Insufficient Data
Arsenic (Total)	Insufficient Data	M2	Insufficient Data	-
Chromium (Total)	Insufficient Data	M2	Insufficient Data	-
Cobalt (Total)	Insufficient Data	M7, M10	Insufficient Data	M2, T6
Iron (Dissolved)	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Manganese (Total)	Insufficient Data	-	Insufficient Data	M10, T6
E. coli (Coliforms)	No Data Collected	Insufficient Data	No Data Collected	Insufficient Data
Dicamba (Herbicides)*	No Data Collected	Insufficient Data	No Data Collected	Insufficient Data
MCPA (Herbicides)*	No Data Collected	Insufficient Data	No Data Collected	Insufficient Data

***Note:** Historical dicamba and MCPA analysis was only conducted in July 2017, therefore insufficient April or August trend data exists for these parameters

Trend charts for those parameters with apparent trends are presented on Figures 2a through 2e.

4.6.2 Mann Kendall Statistical Trend Analysis

The Mann Kendall test for monotonic (increasing or decreasing) trends typically requires a minimum of four data points to be able to evaluate potential trends in a data series, with increasing probability of identifying an existing trend as the number of data points increases (Statistics How To, 2023). Because this study is interested in evaluating trends inclusive of the time of sampling, i.e. reflective of the local seasonality within the SRW, separate analyses for the April and August data should be completed. At present, only up to three data points exist for each time period (2017, 2021, 2022), and therefore, Mann Kendall analysis cannot currently be used to provide meaningful analysis or conclusions.

5.0 DISCUSSION/CONCLUSIONS

Based on the review of the analytical results from 2021 and 2022 and the historical comparisons, the following discussion and conclusions are provided:

5.1 Parameters of Interest

5.1.1 Field Parameters

Of the field parameters noted as exceeding the ASW guidelines between 2017 and 2022 (field DO, field TDS, field turbidity, and field pH), only field pH has sufficient data points to assess potential visual trends. Several sampling locations appear to have increasing field pH trends; however, it should be noted that potential field meter issues were reported during the April 2022 field activity, potentially biasing the trend analysis. Excluding the potentially erroneous April 2022 data, relatively few field pH exceedances occurred and were isolated to August measurements and could be due to reduced seasonal flows affecting the concentrations of pH constituent parameters.

Field DO is typically above the minimum PAL guideline threshold, with very occasional outliers in the historical and recent data. Occasional field TDS and field turbidity exceedances are likely related to site-specific solute loads and do not appear consistent at any given location.

5.1.2 Routine Parameters

pH, EC, SAR, chloride, sulphate, TSS, and TDS concentrations greater than one or more ASW guidelines were identified at one or more sampling locations throughout the study. Most of these routine parameter exceedances are periodic and inconsistent and may reflect either seasonal site-specific conditions (such as recurring TSS due to surface sediment loading) or limited influence of local land use interacting with other environmental factors (such as the drier conditions experienced in 2021).

Most of these parameters visually appear to be trending upwards in most sampling locations, and continued monitoring may confirm if these are legitimate trends or part of the normal perturbations that can be expected in the SRW.

5.1.3 Nutrient Parameters

Ammonia as N, TKN, DKN, total phosphorus, and dissolved phosphorus were reviewed for apparent trends. Most of these nutrient parameters appear to be visually down-trending at most sampling locations. The limited amount of data available does not appear sufficient to suggest an upset threshold for nitrogen and phosphorus, and further assessment may provide the means to derive statistical thresholds for monitoring purposes. Depending on the results of future monitoring, thresholds for each sub-basin within the SRW may also be warranted.

5.1.4 Metals Parameters

Trend analysis of most metals parameters of interest (total arsenic, total chromium, total cobalt, dissolved iron, and total manganese) is not currently possible due to the limited number of observations available. Relatively few sampling locations appear to have upward or downward trends in the August data set, however, total arsenic concentrations at the upper mainstem location M2 have been consistently greater than the PAL guideline in both August 2021 and 2022. Some downstream mainstem locations (M7 and M10) also experienced one or more August exceedances. It is not clear whether the total arsenic concentrations are the result of surficial inputs into the streamflow at these locations or other contributing factors (such as localized groundwater connections, which can be high in arsenic from soil parent materials under anoxic groundwater conditions).

The periodic dissolved iron exceedances observed among the sampling locations may likewise represent local groundwater contributions, particularly at the tributary sampling locations where groundwater contributions may make up a larger proportion of tributary stream flow, especially during low flows. Annual lake thermal turnover patterns may also influence the presence of dissolved iron in the stream flows.

5.1.5 Biological Parameters

Agriculture and recreation guideline exceedances of *E. coli* occurred at sampling locations M11 (August 2021) and T4 (August 2021 and August 2022). The limited amount of data available precludes drawing specific conclusions about potential causes of the observed *E. coli* levels, and further study may elaborate on potential trends or causes. *E. coli* levels can be highly variable, localized and are difficult to compare over time.

5.1.6 Pesticides and Herbicides Parameters

Historical and recent exceedances of dicamba and MCPA were noted at several sampling locations, with observable concentrations of 2,4-D and mecoprop also apparent in the data. Trend analysis is not possible as insufficient sampling points have been collected to date, however, the August 2022 MCPA exceedance at sampling location M10 (downstream of St Albert and the Sturgeon Golf and Country Club) could indicate that phenoxy-acid herbicides are present in the SRW as a result of local land management activities. Further analysis of up- and downstream locations during future sampling events may confirm if this was an isolated instance or if MCPA is present on a more frequent basis in this part of the SRA.

5.2 Key Questions

The following sections address the key questions posed in Section 2.0, above.

5.2.1 General Water Quality within the SRW

In general, water quality within the SRW appears to be consistent between the 2017, 2021, and 2022 data sets when variations in annual hydrometric conditions are taken into account. Overall, those parameters of interest exceeding one or more guidelines are not consistently exceeding the ASW guidelines and may be due to limited local or seasonal influences. The residency time of water in Isle Lake, Lac Ste. Anne, and Big Lake likely allows isolated inputs to dilute and be gradually released through the SRW over time (many years). Spot exceedances of some water quality parameters do occur; however, these do not appear to indicate chronic land management issues based on the data currently available.

Tributary water quality also seems generally acceptable, with no substantial local point sources of parameters of interest in the tributaries monitored. Expanded monitoring of tributary locations may provide better refinement of data and isolate reaches of concern.

5.2.2 Mainstem Nutrients

Ammonia (as N), nitrate, and nitrite are generally within the ASW guidelines at mainstem location. Very limited exceedances of ammonia (as N) are apparent in the recent and historical data, however, as the ammonia (as N) guideline varies with both pH and temperature, these appear to be isolated and inconsistent within the sampling locations.

Nitrogen and phosphorus have a narrative guideline under the PAL exposure pathway, indicating that: "total nitrogen and phosphorus concentrations should be maintained so as to prevent detrimental changes to algal and aquatic plant communities, aquatic biodiversity, oxygen levels, and recreational quality." Further guidance in the ASW guidelines notes that site-specific nutrient objectives and management plans should be established, where warranted.

No site-specific nutrient thresholds have been established for the SRW at present, and the limited number of observations to date under this study are not sufficient to derive objective levels at this time. Nutrient cycling within the lakes along the SRW likely also influence sampling locations downstream from those water bodies. Further monitoring and trend analysis may suggest warning thresholds that could be monitored in conjunction with visual observations of the biotic communities at each sampling location to determine if detrimental changes are occurring in conjunction with elevated nutrient concentrations.

5.2.3 Mainstem Pesticides

The presence of historically observable phenoxy-acid herbicides at the mainstem sampling locations indicates that herbicide residues have previously been present in the SRW, likely resulting from adjacent land usage. Periodic exceedance of the ASW guidelines may be related to cumulative impacts from multiple application sources or from larger-scale land uses where herbicides are applied across a large area.

Other pesticides do not appear to have detectable residues at the mainstem sampling locations.

5.2.4 Salinity

Based on the visual trend analysis, some salinity-related parameters (EC, chloride, sulphate) appear to have upward April trends at several locations, however, exceedances of the ASW guidelines for these parameters are limited, typically not greater than the PAL exposure pathway guideline, and not consistently reoccurring at any given sampling location. While local inputs of salts from road and snow management into tributaries or mainstem locations may create elevated concentrations during spring thaw, these perturbations appear to be mitigated by higher overall stream flows, with potential further dilution in the lakes in the upper- to mid-watershed.

The impact of climate change on salinity in the SRW is a complex question with multiple tiers of interacting components based on changing or more variable seasonal and annual precipitation (as both rain and snow) and corresponding changing management needs for roadways and other human endeavors. The limited data collected thus far is unlikely to have captured the full variability of salinity within the SRW, and without an historical baseline for comparison with historical climate data it is difficult to correlate changes in trends with climatic events.

6.0 RECOMMENDATIONS

Based on the findings of the 2021 and 2022 annual sampling program, the following recommendations are provided:

- Continue with the annual water quality monitoring program beyond 2022. The sampling program should include a minimum of two sampling events to represent spring and summer runoff events at the same 12 stations.

- Incorporate data from other stakeholder monitoring programs, i.e. City of St. Albert, Alberta Lake Management Society, into the SRW data set and trend charts where possible. Sampling periods should be coordinated with these other programs, where possible.
- Consider additional analysis at locations up- and downstream of locations where parameters of interest have been identified, including tributary locations which may allow better tracing of source inputs. Table F outlines the additional parameters recommended for analysis at each sampling location. Additional parameters may be considered (such as total cyanobacteria or microcystin) depending on overall program direction and stakeholder input.

Table F: Recommended Additional Analysis

Parameter or Parameter Set	Sampling Location(s) and Frequency	Rationale
Dissolved Aluminum	All locations: April and August	Parameter under PAL guideline
Dissolved Iron	All locations: April and August	Parameter under PAL guideline, recent and historical exceedances
Total Metals	M2, M7, M10, M11, M12: April M3, M4, M8, T1, T3: August	Recent exceedances
E. coli (possibly replaced or augmented by *Enterococcus spp*)	M11, T4: April	Recent exceedances
Phenoxy-acid herbicides	M3, M8, M11, T3, T4: August M2, M10: April	Historical and recent exceedances

- Maintain a photographic inventory at all water sampling stations during sampling events to compare apparent algal and other biotic diversity at each location in order to evaluate whether substantial changes to the local biotic communities are occurring for comparison to nutrient data trends.
- Continue graphical trend charts and begin Mann Kendall analysis of parameters after at least four data points have been collected for each of the April and August sampling periods, including historical data where available.

7.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Respectfully submitted,
Tetra Tech Canada Inc.

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TABLES

Table 1: Surface Water Analytical Results (Including Historical Results) 2017 - 2022

Parameter	Unit	Alberta Surface Waters[1] Agricultural	PAL	Recreation / Aesthetics	M2	M2	M2	M2	M2	M2	M2	M2	M2	M2
Field ID					M2	M2	M2	M2	M2	M2	M2	M2	M2	M2
Sample Date					13-Apr-2017	17-May-2017	21-Jun-2017	27-Jul-2017	29-Aug-2017	19-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-10	L2633873-5	EO2202900-005	EO2206724-011
Field														
Field Electric Conductivity	µS/cm	1000	-	-	362	211	338	388	532.48	302.81	463.5	450.24	80	388.74
Field Dissolved Oxygen	mg/L	-	Minimum 5	-	-	-	-	-	-	-	11.33	13.87	10.76	6.40
Field Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	-	-	-	-	-	-	245.1	296.17	500	250
Field Temperature	°C	-	-	-	2.45	8.75	16.66	18.87	18.39	8.97	4.1	18.95	9.3	24.8
Field Turbidity	NTU	-	See note[7]	50	-	-	-	-	-	-	5.74	8.21	1.18	3.06
Field pH	pH Units	-	6.5-9.0	5.0-9.0	7.54	7.71	7.45	7.78	7.9	7.98	8.03	9.58	8.4	7.74
Routine														
pH	pH Units	-	6.5-9.0	5.0-9.0	7.68	-	7.76	-	7.88	-	8.27	9.19	7.85	7.96
Electrical Conductivity (EC)	µS/cm	1000	-	-	230	-	320	-	580	-	409	447	320	386
Sodium Adsorption Ratio (SAR)	N/A	5	-	-	-	-	-	-	-	-	-	2.57	0.9	0.8
Total Suspended Solids (TSS)	mg/L	-	See note [2]	-	19	11	21	7.3	4	16	9.1	8.4	15.8	<3.0
Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	130	-	200	-	320	-	254	303	203	290
Hardness as $CaCO_3$	mg/L	-	-	-	88	-	150	-	240	-	161	138	123	174
Alkalinity (total as $CaCO_3$)	mg/L	-	Minimum 20	-	79	-	120	-	210	-	216	240	115	177
Bicarbonate	mg/L	-	-	-	97	-	150	-	260	-	264	226	140	216
Carbonate	mg/L	-	-	-	<0.5	-	<0.5	-	<0.5	-	<5.0	32.6	<1.0	<1.0
Hydroxide	mg/L	-	-	-	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	mg/L	-	-	-	24	-	43	-	65	-	42.4	26.3	33.4	47.9
Magnesium	mg/L	-	-	-	6.6	-	11	-	18	-	13.4	17.6	9.56	13.3
Potassium	mg/L	-	-	-	10	-	7.6	-	6.6	-	6.73	6.01	7.78	5.65
Sodium	mg/L	-	-	-	13	-	26	-	41	-	34.7	70.4	22.6	24.3
Chloride	mg/L	100-700 [3]	120	-	10	-	20	-	46	-	3.31	7.45	7.09	11.8
Fluoride	mg/L	1	-	-	-	-	-	-	-	-	0.094	0.185	0.091	0.115
Sulphate	mg/L	-	309-429 [4]	-	17	-	15	-	18	-	23.3	30.7	42.9	11.9
Ionic Balance	N/A	-	-	-	7.9	-	14	-	6.9	-	99.8	106	107	115
Nutrients														
Ammonia as N	mg/L	-	0.03-53.4 [5]	-	0.3	0.03	0.061	0.046	-	0.042	<0.050	0.024	0.0247	0.0198
Nitrate (as NO_3-N)	mg/L	-	3	-	0.17	-	0.12	-	<0.01	-	<0.020	<0.020	0.054	<0.020
Nitrite (as NO_2-N)	mg/L	-	0.04-0.20 [6]	-	0.012	-	0.014	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrite (as N)	mg/L	100	-	-	0.18	-	0.13	-	<0.014	-	<0.022	<0.022	0.054	<0.050
Total Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	-	2.42	1.52	2.23
Dissolved Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	0.55	1.88	1.55	2.43
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	-	2.4	1.9	3.1	2.7	2.2	2	0.74	2.42	1.47	2.23
Phosphorus - Total	mg/L	-	-	-	0.24	0.21	0.48	0.47	0.29	0.24	0.109	0.242	0.157	0.349
Phosphorus - Total Dissolved	mg/L	-	-	-	0.18	0.16	0.34	0.38	-	0.15	0.042	0.189	0.0987	0.286
Total Metals														
Aluminum	mg/L	5	-	-	0.35	-	0.57	-	0.31	-	-	0.0852	-	0.14
Antimony	mg/L	-	-	-	<0.00060	-	<0.00060	-	<0.00060	-	-	0.00019	-	0.00023
Arsenic	mg/L	0.16	0.005	-	0.0015	-	0.0038	-	0.0041	-	-	0.00743	-	0.00646
Barium	mg/L	-	-	-	0.049	-	0.062	-	0.075	-	-	0.0191	-	0.0565
Boron	mg/L	0.5-6.0 [3]	1.5	-	0.034	-	0.038	-	0.046	-	-	0.085	-	0.053
Cadmium	mg/L	0.0082	0.00014-0.00037 [4]	-	<0.000020	-	0.000033	-	<0.000020	-	-	0.0000164	-	0.0000116
Chromium	mg/L	0.008 [8]	0.001 [8]	-	0.0018	-	0.0013	-	<0.0010	-	-	0.00023	-	0.0005
Cobalt	mg/L	0.05	0.001-0.0018 [4]	-	0.00091	-	0.0014	-	0.00078	-	-	-	-	0.00059
Copper	mg/L	0.2-1.0 [3]	0.007 [4]	-	0.0024	-	0.0046	-	0.003	-	-	0.00201	-	0.0016
Iron	mg/L	5	-	-	1.5	-	3	-	2.5	-	-	0.295	-	1.79
Lead	mg/L	0.2	0.0027-0.0070 [4]	-	0.00052	-	0.00097	-	0.00071	-	-	0.000105	-	0.000777
Manganese	mg/L	0.2	-	-	0.16	-	0.18	-	0.2	-	-	0.0469	-	0.101
Mercury	mg/L	-	0.000005	-	-	-	-	-	-	-	-	<0.0000050	-	<0.0000050
Nickel	mg/L	0.2	0.047-0.21 [4]	-	0.0037	-	0.0067	-	0.0053	-	-	0.00318	-	0.00548
Selenium	mg/L	0.02	0.002	-	<0.00020	-	0.00035	-	0.00039	-	-	0.000282	-	0.000313
Silver	mg/L	-	0.00025	-	<0.00010	-	<0.00010	-	<0.00010	-	-	<0.000010	-	<0.000010
Thallium	mg/L	-	0.0008	-	<0.00020	-	<0.00020	-	<0.00020					
Uranium	mg/L	0.01	0.015	-	0.00052	-	0.00068	-	0.0011	-	-	0.00122	-	0.000675
Zinc	mg/L	5 [9]	0.03	-	0.006	-	0.01	-	0.0052	-	-	<0.0030	-	<0.0030
Dissolved Metals														
Iron	mg/L	-	0.3	-	0.79	-	2.1	-	1.7	-	-	-	0.282	1.3
Coliforms														
Total Coliforms	CFU/100mL	-	-	-	-	-	-	-	-	-	-	5500	-	32,600
E.Coli	CFU/100mL	100	-	100	-	-	-	-	-	-	-	<1	-	1
Polycyclic Aromatic Hydrocarbons (PAHs)														
Benzo(a) pyrene	mg/L	-	0.000015	-	-	-	-	-	-	-	-	*<0.000025*	-	-
Phenols														
Pentachlorophenol	mg/L	-	0.0005	-	-	-	-	<0.000080	-	-	-	<0.00050	-	<0.00010
Herbicides														
2,4,5-T	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	<0.00010	-	<0.000050
2,4,5-TP	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-D	mg/L	-	0.004	-	-	-	-	0.0013	-	-	-	<0.00010	-	0.000057
2,4-DB	mg/L	-	0.025	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-DP	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Bromoxynil	mg/L	0.00044	0.005	-	-	-	-	<0.00002	-	-	-	*<0.0010*	-	<0.000050
Clopyralid	mg/L	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.00027
Dicamba	mg/L	0.000008	0.01	-	-	-	-	**0.00018**	-	-	-	*<0.00010*	-	*<0.00010*
Dinoseb	mg/L	0.021	0.00005	-	-	-	-	<0.000020	-	-	-	*<0.0010*	-	<0.000050
MCPA	mg/L	0.00004	0.0026	-	-	-	-	<0.000020	-	-	-	*<0.00010*	-	*<0.000050*
MCPB	mg/L	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.000050
Mecoprop	mg/L	-	0.013	-	-	-	-	0.0007	-	-	-	<0.0010	-	<0.000050
Picloram	mg/L	-	0.029	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.00086
Triclopyr	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Pesticides														
Alachlor	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Ametryn	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Atrazine	mg/L	0.01	0.0018	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Atrazine-desethyl	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Azinphos-methyl	mg/L	-	0.00001	-	-	-	-	-	-	-	-	*<0.00010*	-	*<0.00010*
Bendiocarb	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00050	-	<0.00050
Carbaryl	mg/L	-	0.0002	-	-	-	-	-	-	-	-	*<0.00050*	-	<0.000050
Carbofuran	mg/L	-	0.0018	-	-	-	-	-	-	-	-	<0.00050	-	<0.00020
Chlorpyrifos	mg/L	-	0.000002	-	-	-	-	-	-	-	-	*<0.00010*	-	*<0.00010*
Cyanazine	mg/L	0.0005	0.002	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Diazinon	mg/L	-	0.00017	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Diclofop-methyl	mg/L	0.00024	0.0061	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Dimethoate	mg/L	-	0.0062	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Malathion	mg/L	-	0.0001	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Metolachlor	mg/L	0.028	0.0078	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Metribuzin	mg/L	0.0005	0.001	-	-	-	-	-	-	-	-	*<0.0010*	-	<0.00010
Parathion	mg/L	-	0.000013	-	-	-	-	-	-	-	-	*<0.00010*	-	*<0.00010*
Parathion-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Phorate	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Prometon	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Prometryn	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Propazine	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Simazine	mg/L	0.0005	0.01	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Temephos	mg/L	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.0010
Terbufos	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Terbutryn	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Triallate	mg/L	-	0.00024	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Trifluralin	mg/L	-	0.0002	-	-	-	-	-	-	-	-	<0.00010	-	<0.00010

Parameter	Unit	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3
Field ID		M3	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3	M3
Sample Date		22-Dec-2016	18-Jan-2017	15-Feb-2017	13-Apr-2017	17-May-2017	21-Jun-2017	27-Jul-2017	29-Aug-2017	19-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number		3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID		3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-9	L2633873-6	EO2202900-006	EO2206724-010
Field														
Field Electric Conductivity	µS/cm	453	457	503	602	245	385	365	372.8	339.87	383.6	650.35	**1040**	290.78
Field Dissolved Oxygen	mg/L	-	-	3	-	-	-	-	-	-	5.97	13.55	10.61	4.86
Field Total Dissolved Solids (TDS)	mg/L	-	-	-	-	-	-	-	-	-	201	421.46	**650**	180
Field Temperature	°C	0.025	0.9	0.05	3.4	8.28	17.1	19.34	19.08	9.31	1.5	20.58	10.49	19.50
Field Turbidity	NTU	-	-	-	-	-	-	-	-	-	5.89	15.19	2.62	0.14
Field pH	pH Units	7.255	7.4	7.3	7.82	7.61	7.53	7.48	7.59	8.24	7.77	8.84	8.76	7.35
Routine														
pH	pH Units	-	-	7.81	7.98	-	7.91	-	7.71	-	7.59	8.55	8.22	7.7
Electrical Conductivity (EC)	µS/cm	-	-	480	390	-	370	-	400	-	325	654	283	299
Sodium Adsorption Ratio (SAR)	N/A	-	-	-	-	-	-	-	-	-	-	1.60	0.31	0.17
Total Suspended Solids (TSS)	mg/L	-	-	-	10	27	6	8.7	15	63	15.5	180	20.6	3
Total Dissolved Solids (TDS)	mg/L	-	-	270	230	-	220	-	220	-	194	386	171	231
Hardness as $CaCO_3$	mg/L	-	-	150	130	-	140	-	140	-	149	250	127	169
Alkalinity (total as $CaCO_3$)	mg/L	-	-	220	180	-	170	-	180	-	145	188	113	153
Bicarbonate	mg/L	-	-	270	220	-	200	-	220	-	176	210	138	187
Carbonate	mg/L	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	9.0	<1.0	<1.0
Hydroxide	mg/L	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	mg/L	-	-	36	33	-	36	-	35	-	42.5	63.3	36.7	49.7
Magnesium	mg/L	-	-	14	12	-	12	-	12	-	10.4	22.4	8.68	11
Potassium	mg/L	-	-	13	12	-	11	-	13	-	14.5	7.45	11.2	6.14
Sodium	mg/L	-	-	42	35	-	33	-	34	-	6.80	58.0	8.18	5.12
Chloride	mg/L	-	-	15	14	-	12	-	12	-	11.3	**103**	8.20	2.48
Fluoride	mg/L	-	-	-	-	-	-	-	-	-	0.096	0.165	0.125	0.12
Sulphate	mg/L	-	-	16	14	-	11	-	6.9	-	21.0	18.7	25.2	4.06
Ionic Balance	N/A	-	-	1	2.4	-	7.4	-	5	-	102	110	106	117
Nutrients														
Ammonia as N	mg/L	-	-	0.53	0.069	0.26	0.23	0.35	-	0.79	1.05	0.052	0.0150	0.0293
Nitrate (as NO_3-N)	mg/L	-	-	0.25	0.23	-	0.088	-	<0.01	-	0.146	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	mg/L	-	-	0.041	<0.01	-	0.052	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrite (as N)	mg/L	-	-	0.29	0.23	-	0.14	-	<0.014	-	0.146	<0.022	<0.0500	<0.050
Total Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	-	4.22	2.47	-
Dissolved Kjeldahl Nitrogen	mg/L	-	-	2.5	-	-	-	-	-	-	2.81	3.35	1.75	-
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	2.1	2	2.6	2	2.2	4.2	3.9	3.49	4.22	2.47	2.61
Phosphorus - Total	mg/L	-	-	0.049	0.11	0.26	<0.1	0.24	0.46	0.55	0.604	0.398	0.293	0.348
Phosphorus - Total Dissolved	mg/L	-	-	0.041	0.026	0.072	0.1	0.18	-	0.13	0.241	0.215	0.099	0.282
Total Metals														
Aluminum	mg/L	-	-	-	0.024	-	0.021	-	0.022	-	-	-	-	-
Antimony	mg/L	-	-	-	<0.00060	-	<0.00060	-	<0.00060	-	-	-	-	-
Arsenic	mg/L	-	-	-	0.001	-	0.0015	-	0.0016	-	-	-	-	-
Barium	mg/L	-	-	-	0.081	-	0.077	-	0.09	-	-	-	-	-
Boron	mg/L	-	-	-	0.061	-	0.055	-	0.057	-	-	-	-	-
Cadmium	mg/L	-	-	-	<0.000020	-	<0.000020	-	<0.000020	-	-	-	-	-
Chromium	mg/L	-	-	-	<0.0010	-	<0.0010	-	<0.0010	-	-	-	-	-
Cobalt	mg/L	-	-	-	<0.00030	-	<0.00030	-	<0.00030	-	-	-	-	-
Copper	mg/L	-	-	-	0.00047	-	0.002	-	0.00029	-	-	-	-	-
Iron	mg/L	-	-	-	0.21	-	0.14	-	0.2	-	-	-	-	-
Lead	mg/L	-	-	-	<0.00020	-	<0.00020	-	<0.00020	-	-	-	-	-
Manganese	mg/L	-	-	-	0.064	-	0.13	-	**0.25**	-	-	-	-	-
Mercury	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	mg/L	-	-	-	0.00065	-	0.0011	-	<0.00050	-	-	-	-	-
Selenium	mg/L	-	-	-	<0.00020	-	<0.00020	-	<0.00020	-	-	-	-	-
Silver	mg/L	-	-	-	<0.00010	-	<0.00010	-	<0.00010	-	-	-	-	-
Thallium	mg/L				<0.00020	-	<0.00020	-	<0.00020	-				
Uranium	mg/L	-	-	-	0.00044	-	0.00033	-	0.00019	-	-	-	-	-
Zinc	mg/L	-	-	-	<0.0030	-	<0.0030	-	<0.0030	-	-	-	-	-
Dissolved Metals														
Iron	mg/L	-	-	<0.060	0.13	-	0.076	-	0.071	-	-	-	0.454	0.299
Coliforms														
Total Coliforms	CFU/100mL	-	-	-	-	-	-	-	-	-	-	500	-	2420
E.Coli	CFU/100mL	-	-	-	-	-	-	-	-	-	-	<1	-	99
Polycyclic Aromatic Hydrocarbons (PAHs)														
Benzo(a) pyrene	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenols														
Pentachlorophenol	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Herbicides														
2,4,5-T	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4,5-TP	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4-D	mg/L	-	-	-	-	-	-	<0.000050	-	-	-	-	-	-
2,4-DB	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4-DP	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromoxynil	mg/L	-	-	-	-	-	-	<0.00002	-	-	-	-	-	-
Clopyralid	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Dicamba	mg/L	-	-	-	-	-	-	<0.0000050	-	-	-	-	-	-
Dinoseb	mg/L	-	-	-	-	-	-	<0.000020	-	-	-	-	-	-
MCPA	mg/L	-	-	-	-	-	-	<0.000020	-	-	-	-	-	-
MCPB	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Mecoprop	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Picloram	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Triclopyr	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Pesticides														
Alachlor	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Ametryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Bendiocarb	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbaryl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbofuran	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanazine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Diazinon	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethoate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Malathion	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Metolachlor	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Metribuzin	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Parathion	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Phorate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometon	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Propazine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Simazine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Temephos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbufos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbutryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Triallate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifluralin	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-

Parameter	Unit	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4
Field ID		M4	M4	M4	M4	M4	M4	M4	M4	M4	M4
Sample Date		13-Apr-2017	17-May-2017	21-Jun-2017	27-Jul-2017	29-Aug-2017	19-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number		3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID		3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-8	L2633873-7	EO2202900-007	EO2206724-009
Field											
Field Electric Conductivity	µS/cm	824	283	392	390	563.39	416.4	426.4	429.27	**1490**	**1045**
Field Dissolved Oxygen	mg/L	-	-	-	-	-	-	10.51	11.02	10.47	7.56
Field Total Dissolved Solids (TDS)	mg/L	-	-	-	-	-	-	223.9	279.04	**850**	**680**
Field Temperature	°C	2.85	9.15	17.02	20.86	19.56	8.95	7.9	17.45	11.28	19.88
Field Turbidity	NTU	-	-	-	-	-	-	8.71	9.74	2.98	36.45
Field pH	pH Units	7.68	8.16	8.03	7.79	8.13	7.92	8.23	9.15	8.46	8.09
Routine											
pH	pH Units	7.95	-	8.24	-	8.16	-	8.21	8.72	8.31	8.37
Electrical Conductivity (EC)	µS/cm	530	-	380	-	600	-	382	427	807	**1090**
Sodium Adsorption Ratio (SAR)	N/A	-	-	-	-	-	-	-	1.57	1.00	**5.19**
Total Suspended Solids (TSS)	mg/L	6	17	2.7	<1	2	27	9.7	9.8	22.4	13.4
Total Dissolved Solids (TDS)	mg/L	290	-	220	-	340	-	232	271	**512**	**661**
Hardness as $CaCO_3$	mg/L	160	-	140	-	150	-	147	163	355	218
Alkalinity (total as $CaCO_3$)	mg/L	170	-	180	-	230	-	189	207	228	387
Bicarbonate	mg/L	210	-	220	-	280	-	230	225	272	461
Carbonate	mg/L	<0.5	-	<0.5	-	<0.5	-	<5.0	13.1	2.6	5.2
Hydroxide	mg/L	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	mg/L	44	-	34	-	33	-	37.0	39.2	96.1	41.6
Magnesium	mg/L	12	-	14	-	16	-	13.2	15.9	28.0	27.6
Potassium	mg/L	12	-	13	-	14	-	11.5	12.1	13.3	11.9
Sodium	mg/L	50	-	34	-	77	-	28.5	46.1	45.1	176
Chloride	mg/L	50	-	11	-	36	-	12.3	25.3	58.4	**126**
Fluoride	mg/L	-	-	-	-	-	-	0.156	0.179	0.16	0.177
Sulphate	mg/L	19	-	9.3	-	27	-	14.9	7.85	130	11.4
Ionic Balance	N/A	3.3	-	6.4	-	4.3	-	101	112	106	107
Nutrients											
Ammonia as N	mg/L	<0.05	0.26	<0.015	0.039	-	0.3	0.452	0.153	0.0154	0.0528
Nitrate (as NO_3-N)	mg/L	<0.01	-	<0.01	-	<0.01	-	0.291	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	mg/L	<0.01	-	<0.01	-	<0.01	-	0.026	<0.010	<0.010	<0.010
Nitrate and Nitrite (as N)	mg/L	<0.01	-	<0.014	-	<0.014	-	0.318	<0.022	<0.0500	<0.050
Total Nitrogen	mg/L	-	-	-	-	-	-	-	3.38	1.89	-
Dissolved Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	1.82	2.88	1.45	-
Total Kjeldahl Nitrogen (TKN)	mg/L	2	1.1	1.1	1.7	1.3	1.5	1.83	3.38	1.89	2.5
Phosphorus - Total	mg/L	0.31	0.05	0.048	0.076	0.17	0.068	0.090	0.588	0.201	0.624
Phosphorus - Total Dissolved	mg/L	0.16	0.017	0.036	0.065	-	0.029	0.058	0.492	0.0413	0.581
Total Metals											
Aluminum	mg/L	0.024	-	0.013	-	0.024	-	-	-	-	-
Antimony	mg/L	<0.00060	-	<0.00060	-	<0.00060	-	-	-	-	-
Arsenic	mg/L	0.0011	-	0.0012	-	0.0024	-	-	-	-	-
Barium	mg/L	0.058	-	0.074	-	0.064	-	-	-	-	-
Boron	mg/L	0.054	-	0.065	-	0.1	-	-	-	-	-
Cadmium	mg/L	<0.000020	-	<0.000020	-	<0.000020	-	-	-	-	-
Chromium	mg/L	<0.0010	-	<0.0010	-	<0.0010	-	-	-	-	-
Cobalt	mg/L	<0.00030	-	<0.00030	-	<0.00030	-	-	-	-	-
Copper	mg/L	0.00076	-	0.0012	-	0.00039	-	-	-	-	-
Iron	mg/L	0.73	-	0.086	-	0.11	-	-	-	-	-
Lead	mg/L	<0.00020	-	<0.00020	-	<0.00020	-	-	-	-	-
Manganese	mg/L	0.012	-	0.011	-	0.016	-	-	-	-	-
Mercury	mg/L	-	-	-	-	-	-	-	-	-	-
Nickel	mg/L	0.0014	-	<0.0005	-	0.00098	-	-	-	-	-
Selenium	mg/L	<0.00020	-	<0.00020	-	<0.00020	-	-	-	-	-
Silver	mg/L	<0.00010	-	<0.00010	-	<0.00010	-	-	-	-	-
Thallium	mg/L	<0.00020	-	<0.00020	-	<0.00020					
Uranium	mg/L	0.00065	-	0.00022	-	0.00039	-	-	-	-	-
Zinc	mg/L	<0.0030	-	<0.0030	-	<0.0030	-	-	-	-	-
Dissolved Metals											
Iron	mg/L	0.51	-	<0.060	-	0.073	-	-	-	0.228	0.045
Coliforms											
Total Coliforms	CFU/100mL	-	-	-	-	-	-	-	1800	-	1730
E.Coli	CFU/100mL	-	-	-	-	-	-	-	<1	-	57
Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a) pyrene	mg/L	-	-	-	-	-	-	-	-	-	-
Phenols											
Pentachlorophenol	mg/L	-	-	-	<0.000080	-	-	-	-	-	-
Herbicides											
2,4,5-T	mg/L	-	-	-	<0.000080	-	-	-	-	-	-
2,4,5-TP	mg/L	-	-	-	<0.000080	-	-	-	-	-	-
2,4-D	mg/L	-	-	-	<0.000050	-	-	-	-	-	-
2,4-DB	mg/L	-	-	-	<0.000080	-	-	-	-	-	-
2,4-DP	mg/L	-	-	-	-	-	-	-	-	-	-
Bromoxynil	mg/L	-	-	-	<0.00002	-	-	-	-	-	-
Clopyralid	mg/L	-	-	-	-	-	-	-	-	-	-
Dicamba	mg/L	-	-	-	<0.0000050	-	-	-	-	-	-
Dinoseb	mg/L	-	-	-	<0.000020	-	-	-	-	-	-
MCPA	mg/L	-	-	-	<0.000020	-	-	-	-	-	-
MCPB	mg/L	-	-	-	-	-	-	-	-	-	-
Mecoprop	mg/L	-	-	-	<0.000080	-	-	-	-	-	-
Picloram	mg/L	-	-	-	<0.000080	-	-	-	-	-	-
Triclopyr	mg/L	-	-	-	-	-	-	-	-	-	-
Pesticides											
Alachlor	mg/L	-	-	-	-	-	-	-	-	-	-
Ametryn	mg/L	-	-	-	-	-	-	-	-	-	-
Atrazine	mg/L	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	mg/L	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	mg/L	-	-	-	-	-	-	-	-	-	-
Bendiocarb	mg/L	-	-	-	-	-	-	-	-	-	-
Carbaryl	mg/L	-	-	-	-	-	-	-	-	-	-
Carbofuran	mg/L	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	mg/L	-	-	-	-	-	-	-	-	-	-
Cyanazine	mg/L	-	-	-	-	-	-	-	-	-	-
Diazinon	mg/L	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	mg/L	-	-	-	-	-	-	-	-	-	-
Dimethoate	mg/L	-	-	-	-	-	-	-	-	-	-
Malathion	mg/L	-	-	-	-	-	-	-	-	-	-
Metolachlor	mg/L	-	-	-	-	-	-	-	-	-	-
Metribuzin	mg/L	-	-	-	-	-	-	-	-	-	-
Parathion	mg/L	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	mg/L	-	-	-	-	-	-	-	-	-	-
Phorate	mg/L	-	-	-	-	-	-	-	-	-	-
Prometon	mg/L	-	-	-	-	-	-	-	-	-	-
Prometryn	mg/L	-	-	-	-	-	-	-	-	-	-
Propazine	mg/L	-	-	-	-	-	-	-	-	-	-
Simazine	mg/L	-	-	-	-	-	-	-	-	-	-
Temephos	mg/L	-	-	-	-	-	-	-	-	-	-
Terbufos	mg/L	-	-	-	-	-	-	-	-	-	-
Terbutryn	mg/L	-	-	-	-	-	-	-	-	-	-
Triallate	mg/L	-	-	-	-	-	-	-	-	-	-
Trifluralin	mg/L	-	-	-	-	-	-	-	-	-	-

Notes:

[1] Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (PAL). Most conservative values applied (chronic or acute). Table 2 Water quality guidelines for the protection of agricultural water uses, for irrigation and livestock water. Table 3 Surface water quality guidelines for recreation and aesthetics.

[2] Maximum increase of 25 mg/L from background (M2)

[3] Guideline is crop-specific

[4] Guideline varies with hardness. Values shown based on hardness range of 88 mg/L to 515 mg/L.

[5] Guideline varies with pH and temperature. Values shown based on pH range of 6.54 to 11.26 and temperature range of 0.3 °C to 24.8 °C

[6] Guideline varies with chloride. Values shown based on chloride range of 3.31 mg/L to 119 mg/L.

[7] Maximum increase of 8 NTU from background (M2)

[8] Guideline is for Chromium VI

[9] Guideline varies with pH. Values shown based on pH range of 6.54 to 9.58

"-" No applicable guideline or not analyzed

BOLD - Greater than Agricultural guideline.

Shaded - Greater than PAL guideline.

Red - Greater than Recreation / Aesthetics guideline.

Italic - Detection limit greater than applicable Alberta Surface Water Quality Standard

N/A - Not applicable.

Table 1: Surface Water Analytical Results (Including Historical Results) 2017 - 2022

Location					M7									
Field ID					M7	M7	M7	M7	M7	M7	M7	M7	M7	M7
Sample Date					12-Apr-2017	16-May-2017	20-Jun-2017	27-Jul-2017	29-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-6	L2633873-8	EO2202900-008	EO2206724-006
		Alberta Surface Waters[1]												
Parameter	Unit	Agricultural	PAL	Recreation / Aesthetics										
Field														
Field Electric Conductivity	µS/cm	1000	-	-	294	475	536	531	502.48	541.56	476.7	701.89	740	659.11
Field Dissolved Oxygen	mg/L	-	Minimum 5	-	-	-	-	-	-	-	10.67	7.48	11.13	8.63
Field Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	-	-	-	-	-	-	249.1	457.2	340	430
Field Temperature	°C	-	-	-	1.25	11.53	20.79	20.57	20.24	9.24	1.1	18.07	8.52	20.26
Field Turbidity	NTU	-	See note [7]	50	-	-	-	-	-	-	12.09	3.44	1.28	0.00
Field pH	pH Units	-	6.5-9.0	5.0-9.0	7.73	8.06	8.52	8.12	8.19	8.34	8.42	8.37	8.94	7.67
Routine														
pH	pH Units	-	6.5-9.0	5.0-9.0	8.07	-	8.54	-	8.29	-	8.14	8.36	8.45	7.97
Electrical Conductivity (EC)	µS/cm	1000	-	-	520	-	530	-	530	-	400	684	525	665
Sodium Adsorption Ratio (SAR)	N/A	5	-	-	-	-	-	-	-	-	-	2.52	1.42	2.31
Total Suspended Solids (TSS)	mg/L	-	See note [2]	-	12	7.3	3.3	10	4	10	12.5	6.6	39.0	<3.0
Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	300	-	310	-	300	-	253	458	326	433
Hardness as $CaCO_3$	mg/L	-	-	-	150	-	180	-	140	-	150	236	198	207
Alkalinity (total as $CaCO_3$)	mg/L	-	Minimum 20	-	190	-	230	-	220	-	193	367	200	277
Bicarbonate	mg/L	-	-	-	230	-	250	-	270	-	235	435	233	338
Carbonate	mg/L	-	-	-	<0.5	-	11	-	<0.5	-	<5.0	6.5	5.3	<1.0
Hydroxide	mg/L	-	-	-	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	mg/L	-	-	-	39	-	43	-	31	-	39.8	53.3	52.7	45
Magnesium	mg/L	-	-	-	14	-	17	-	16	-	12.4	25.1	16.1	23.1
Potassium	mg/L	-	-	-	10	-	9.6	-	11	-	8.66	7.17	9.87	9.73
Sodium	mg/L	-	-	-	52	-	54	-	59	-	35.1	92.9	44.4	76.4
Chloride	mg/L	100-700 [3]	120	-	18	-	14	-	15	-	10.2	10.2	13.6	19.9
Fluoride	mg/L	1	-	-	-	-	-	-	-	-	0.130	0.144	0.139	0.134
Sulphate	mg/L	-	309-429 [4]	-	58	-	38	-	37	-	29.6	49.4	68.4	63.1
Ionic Balance	N/A	-	-	-	1.8	-	3.7	-	1.2	-	99.4	103	106	104
Nutrients														
Ammonia as N	mg/L	-	0.03-53.4 [5]	-	0.24	0.054	0.022	0.037	-	0.071	0.059	0.026	0.0164	0.0374
Nitrate (as NO_3-N)	mg/L	-	3	-	0.29	-	0.011	-	<0.01	-	0.330	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	mg/L	-	0.04-0.20 [6]	-	0.015	-	<0.01	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrite (as N)	mg/L	100	-	-	0.31	-	0.011	-	<0.014	-	0.330	<0.022	<0.0500	<0.050
Total Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	-	1.46	2.28	1.39
Dissolved Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	1.13	1.20	1.54	1.6
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	-	1.7	1.2	1.3	1.4	1.4	1.3	1.37	1.46	2.28	1.39
Phosphorus - Total	mg/L	-	-	-	0.17	0.1	0.12	0.11	0.066	0.091	0.114	0.248	0.253	0.276
Phosphorus - Total Dissolved	mg/L	-	-	-	0.057	0.045	0.096	0.061	-	0.029	0.056	0.223	0.0495	0.24
Total Metals														
Aluminum	mg/L	5	-	-	0.092	-	0.034	-	0.046	-	-	0.0485	-	0.0327
Antimony	mg/L	-	-	-	<0.00060	-	<0.00060	-	<0.00060	-	-	0.00012	-	0.00015
Arsenic	mg/L	0.16	0.005	-	0.0013	-	0.0022	-	0.002	-	-	0.00549	-	0.0033
Barium	mg/L	-	-	-	0.062	-	0.061	-	0.063	-	-	0.0426	-	0.0509
Boron	mg/L	0.5-6.0 [3]	1.5	-	0.064	-	0.081	-	0.087	-	-	0.125	-	0.092
Cadmium	mg/L	0.0082	0.00014-0.00037 [4]	-	<0.000020	-	<0.000020	-	<0.000020	-	-	<0.0000050	-	<0.0000050
Chromium	mg/L	0.008 [8]	0.001 [8]	-	<0.0010	-	<0.0010	-	<0.0010	-	-	0.00010	-	<0.00050
Cobalt	mg/L	0.05	0.001-0.0018 [4]	-	0.00039	-	<0.00030	-	<0.00030	-	-	-	-	0.00017
Copper	mg/L	0.2-1.0 [3]	0.007 [4]	-	0.001	-	0.0005	-	<0.00020	-	-	0.00051	-	0.00056
Iron	mg/L	5	-	-	0.63	-	0.3	-	0.23	-	-	0.183	-	0.22
Lead	mg/L	0.2	0.0027-0.0070 [4]	-	0.00023	-	<0.00020	-	<0.00020	-	-	0.000093	-	0.000056
Manganese	mg/L	0.2	-	-	0.14	-	0.069	-	**0.24**	-	-	0.0578	-	0.117
Mercury	mg/L	-	0.000005	-	-	-	-	-	-	-	-	<0.0000050	-	<0.0000050
Nickel	mg/L	0.2	0.047-0.21 [4]	-	0.0016	-	0.00091	-	0.001	-	-	0.00154	-	0.00127
Selenium	mg/L	0.02	0.002	-	<0.00020	-	<0.00020	-	<0.00020	-	-	0.000100	-	0.000117
Silver	mg/L	-	0.00025	-	<0.00010	-	<0.00010	-	<0.00010	-	-	<0.000010	-	<0.000010
Thallium	mg/L	-	0.0008	-	<0.00020	-	<0.00020	-	<0.00020					
Uranium	mg/L	0.01	0.015	-	0.0016	-	0.00087	-	0.00071	-	-	0.00128	-	0.000966
Zinc	mg/L	5 [9]	0.03	-	0.0031	-	<0.0030	-	0.0034	-	-	<0.0030	-	<0.0030
Dissolved Metals														
Iron	mg/L	-	0.3	-	0.32	-	0.19	-	<0.060	-	-	-	0.103	0.084
Coliforms														
Total Coliforms	CFU/100mL	-	-	-	-	-	-	-	-	-	-	2900	-	2420
E.Coli	CFU/100mL	100	-	100	-	-	-	-	-	-	-	<1	-	41
Polycyclic Aromatic Hydrocarbons (PAHs)														
Benzo(a) pyrene	mg/L	-	0.000015	-	-	-	-	-	-	-	-	-	-	-
Phenols														
Pentachlorophenol	mg/L	-	0.0005	-	-	-	-	<0.000080	-	-	-	<0.00050	-	<0.00010
Herbicides														
2,4,5-T	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	<0.00010	-	<0.000050
2,4,5-TP	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-D	mg/L	-	0.004	-	-	-	-	<0.000050	-	-	-	<0.00010	-	<0.000050
2,4-DB	mg/L	-	0.025	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-DP	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Bromoxynil	mg/L	0.00044	0.005	-	-	-	-	<0.00002	-	-	-	*<0.0010*	-	<0.000050
Clopyralid	mg/L	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.00024
Dicamba	mg/L	0.000008	0.01	-	-	-	-	<0.0000050	-	-	-	*<0.00010*	-	*<0.00010*
Dinoseb	mg/L	0.021	0.00005	-	-	-	-	<0.000020	-	-	-	*<0.0010*	-	<0.000050
MCPA	mg/L	0.00004	0.0026	-	-	-	-	<0.000020	-	-	-	*<0.00010*	-	*<0.000050*
MCPB	mg/L	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.000050
Mecoprop	mg/L	-	0.013	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
Picloram	mg/L	-	0.029	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.00010
Triclopyr	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Pesticides														
Alachlor	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Ametryn	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Atrazine	mg/L	0.01	0.0018	-	-	-	-	-	-	-	-	<0.00020	-	<0.000050
Atrazine-desethyl	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.000050
Azinphos-methyl	mg/L	-	0.00001	-	-	-	-	-	-	-	-	*<0.00020*	-	*<0.00010*
Bendiocarb	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00050	-	<0.00050
Carbaryl	mg/L	-	0.0002	-	-	-	-	-	-	-	-	*<0.00050*	-	<0.000050
Carbofuran	mg/L	-	0.0018	-	-	-	-	-	-	-	-	<0.00050	-	<0.00020
Chlorpyrifos	mg/L	-	0.000002	-	-	-	-	-	-	-	-	*<0.00020*	-	*<0.00010*
Cyanazine	mg/L	0.0005	0.002	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Diazinon	mg/L	-	0.00017	-	-	-	-	-	-	-	-	*<0.00020*	-	<0.00010
Diclofop-methyl	mg/L	0.00024	0.0061	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Dimethoate	mg/L	-	0.0062	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Malathion	mg/L	-	0.0001	-	-	-	-	-	-	-	-	*<0.00020*	-	<0.00010
Metolachlor	mg/L	0.028	0.0078	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Metribuzin	mg/L	0.0005	0.001	-	-	-	-	-	-	-	-	*<0.0010*	-	<0.00010
Parathion	mg/L	-	0.000013	-	-	-	-	-	-	-	-	*<0.00020*	-	*<0.00010*
Parathion-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Phorate	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Prometon	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Prometryn	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Propazine	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Simazine	mg/L	0.0005	0.01	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Temephos	mg/L	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.0010
Terbufos	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Terbutryn	mg/L	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Triallate	mg/L	-	0.00024	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Trifluralin	mg/L	-	0.0002	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010

Location	M8									
Field ID	M8	M8	M8	M8	M8	M8	M8	M8	M8	M8
Sample Date	12-Apr-2017	16-May-2017	20-Jun-2017	26-Jul-2017	28-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-5	L2633873-9	EO2202900-009	EO2206724-005
Parameter										
Field										
Field Electric Conductivity	261	517	528	531	513.54	535.81	460.9	607.17	260	624.99
Field Dissolved Oxygen	-	-	-	-	-	-	12.53	8.95	11.16	7.53
Field Total Dissolved Solids (TDS)	-	-	-	-	-	-	239.7	394.72	330	410
Field Temperature	5.06	12.26	22.49	22.07	20.51	9.84	1.6	18.33	9.41	20.48
Field Turbidity	-	-	-	-	-	-	13.26	3.12	1.31	0.33
Field pH	7.49	8.22	8.65	8.37	8.1	8.28	8.5	8.47	9.03	8.13
Routine										
pH	7.92	-	8.64	-	8.25	-	8.22	8.29	8.43	8.26
Electrical Conductivity (EC)	410	-	520	-	540	-	395	587	493	627
Sodium Adsorption Ratio (SAR)	-	-	-	-	-	-	-	1.22	1.31	1.93
Total Suspended Solids (TSS)	17	15	4.7	4	8	11	13.9	5.4	26.8	<3.0
Total Dissolved Solids (TDS)	240	-	310	-	310	-	250	393	305	401
Hardness as $CaCO_3$	110	-	180	-	150	-	149	258	181	211
Alkalinity (total as $CaCO_3$)	130	-	230	-	230	-	186	246	178	238
Bicarbonate	160	-	250	-	280	-	227	297	208	290
Carbonate	<0.5	-	14	-	<0.5	-	<5.0	<5.0	4.3	<1.0
Hydroxide	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	29	-	43	-	32	-	39.5	57.4	48.2	45.2
Magnesium	10	-	17	-	17	-	12.3	27.8	14.8	23.8
Potassium	13	-	9.9	-	11	-	8.59	7.18	10.1	8.26
Sodium	39	-	56	-	61	-	33.1	45.2	40.8	64.4
Chloride	20	-	14	-	15	-	11.5	7.22	14.1	15.2
Fluoride	-	-	-	-	-	-	0.128	0.148	0.152	0.129
Sulphate	44	-	36	-	41	-	32.1	100	68.0	81.2
Ionic Balance	2.4	-	4.6	-	0.85	-	98.1	102	105	105
Nutrients										
Ammonia as N	0.5	0.03	0.017	0.026	-	0.033	<0.050	0.026	0.0177	0.0091
Nitrate (as NO_3-N)	0.25	-	<0.01	-	<0.01	-	0.217	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	0.022	-	<0.01	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrite (as N)	0.27	-	<0.01	-	<0.014	-	0.217	<0.022	<0.0500	<0.050
Total Nitrogen	-	-	-	-	-	-	-	0.73	2.38	-
Dissolved Kjeldahl Nitrogen	-	-	-	-	-	-	0.97	0.619	1.53	-
Total Kjeldahl Nitrogen (TKN)	2.6	1.4	1.4	1.3	1.3	1.4	1.52	0.73	2.38	1.11
Phosphorus - Total	0.33	0.17	0.16	0.14	0.094	0.099	0.183	0.095	0.233	0.284
Phosphorus - Total Dissolved	0.15	0.062	0.11	0.093	-	0.037	0.073	0.065	0.0523	0.251
Total Metals										
Aluminum	0.28	-	0.066	-	0.061	-	-	-	-	-
Antimony	<0.00060	-	<0.00060	-	<0.00060	-	-	-	-	-
Arsenic	0.0018	-	0.0025	-	0.0019	-	-	-	-	-
Barium	0.059	-	0.047	-	0.059	-	-	-	-	-
Boron	0.05	-	0.081	-	0.086	-	-	-	-	-
Cadmium	0.000021	-	<0.000020	-	<0.000020	-	-	-	-	-
Chromium	<0.0010	-	<0.0010	-	<0.0010	-	-	-	-	-
Cobalt	0.00078	-	<0.00030	-	<0.00030	-	-	-	-	-
Copper	0.002	-	0.00079	-	0.0002	-	-	-	-	-
Iron	1.5	-	0.46	-	0.22	-	-	-	-	-
Lead	0.00048	-	<0.00020	-	<0.00020	-	-	-	-	-
Manganese	0.16	-	0.071	-	0.064	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-	-	-
Nickel	0.0032	-	0.0012	-	0.0012	-	-	-	-	-
Selenium	<0.00020	-	<0.00020	-	<0.00020	-	-	-	-	-
Silver	<0.00010	-	<0.00010	-	<0.00010	-	-	-	-	-
Thallium	<0.00020	-	<0.00020	-	<0.00020					
Uranium	0.00093	-	0.00091	-	0.0007	-	-	-	-	-
Zinc	0.0054	-	<0.0030	-	<0.003	-	-	-	-	-
Dissolved Metals										
Iron	0.77	-	0.2	-	0.062	-	-	-	0.247	0.037
Coliforms										
Total Coliforms	-	-	-	-	-	-	-	2400	-	2420
E.Coli	-	-	-	-	-	-	-	<1	-	21
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a) pyrene	-	-	-	-	-	-	-	-	-	-
Phenols										
Pentachlorophenol	-	-	-	<0.000080	-	-	-	-	-	-
Herbicides										
2,4,5-T	-	-	-	<0.000080	-	-	-	-	-	-
2,4,5-TP	-	-	-	<0.000080	-	-	-	-	-	-
2,4-D	-	-	-	<0.000050	-	-	-	-	-	-
2,4-DB	-	-	-	<0.000080	-	-	-	-	-	-
2,4-DP	-	-	-	-	-	-	-	-	-	-
Bromoxynil	-	-	-	<0.00002	-	-	-	-	-	-
Clopyralid	-	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	0.0000054	-	-	-	-	-	-
Dinoseb	-	-	-	<0.000020	-	-	-	-	-	-
MCPA	-	-	-	0.000026	-	-	-	-	-	-
MCPB	-	-	-	-	-	-	-	-	-	-
Mecoprop	-	-	-	<0.000080	-	-	-	-	-	-
Picloram	-	-	-	<0.000080	-	-	-	-	-	-
Triclopyr	-	-	-	-	-	-	-	-	-	-
Pesticides										
Alachlor	-	-	-	-	-	-	-	-	-	-
Ametryn	-	-	-	-	-	-	-	-	-	-
Atrazine	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	-	-	-	-	-	-	-	-	-	-
Bendiocarb	-	-	-	-	-	-	-	-	-	-
Carbaryl	-	-	-	-	-	-	-	-	-	-
Carbofuran	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-	-
Diazinon	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	-	-	-	-	-	-	-	-	-	-
Dimethoate	-	-	-	-	-	-	-	-	-	-
Malathion	-	-	-	-	-	-	-	-	-	-
Metolachlor	-	-	-	-	-	-	-	-	-	-
Metribuzin	-	-	-	-	-	-	-	-	-	-
Parathion	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	-	-	-	-	-	-	-	-	-	-
Phorate	-	-	-	-	-	-	-	-	-	-
Prometon	-	-	-	-	-	-	-	-	-	-
Prometryn	-	-	-	-	-	-	-	-	-	-
Propazine	-	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-	-
Temephos	-	-	-	-	-	-	-	-	-	-
Terbufos	-	-	-	-	-	-	-	-	-	-
Terbutryn	-	-	-	-	-	-	-	-	-	-
Triallate	-	-	-	-	-	-	-	-	-	-
Trifluralin	-	-	-	-	-	-	-	-	-	-

Location	M10												
Field ID	M10	M10	M10	M10	M10	M10	M10	M10	M10	M10	M10	M10	M10
Sample Date	21-Dec-2016	19-Jan-2017	16-Feb-2017	12-Apr-2017	16-May-2017	20-Jun-2017	26-Jul-2017	28-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-4	L2633873-10	EO2202900-010	EO2206724-004
Parameter													
Field													
Field Electric Conductivity	**1164**	**1222**	**1390**	394	453	665	565	587.95	594.2	799.5	941.84	80	757.15
Field Dissolved Oxygen	-	-	<0.1	-	-	-	-	-	-	9.58	10.14	11.1	6.94
Field Total Dissolved Solids (TDS)	-	-	-	-	-	-	-	-	-	420.4	**610.54**	50	490
Field Temperature	0.45	0.97	0.06	4.9	11.8	21.75	19.93	18.96	10.26	6.3	18.07	9.00	21.22
Field Turbidity	-	-	-	-	-	-	-	-	-	28.4	6.83	1.22	0.17
Field pH	5.15	7.5	6.9	7.33	7.83	8.11	7.89	7.59	7.68	7.69	8.51	11.26	7.66
Routine													
pH	-	-	7.63	7.78	-	8.25	-	8.01	-	8.11	8.32	8.72	7.85
Electrical Conductivity (EC)	-	-	**1500**	390	-	650	-	610	-	685	908	570	748
Sodium Adsorption Ratio (SAR)	-	-	-	-	-	-	-	-	-	-	1.16	1.21	2.03
Total Suspended Solids (TSS)	-	-	-	30	19	8.7	2.7	8.7	8	38.7	7.4	55.6	<3.0
Total Dissolved Solids (TDS)	-	-	**920**	220	-	400	-	360	-	455	**652**	356	480
Hardness as $CaCO_3$	-	-	500	110	-	220	-	170	-	285	440	220	241
Alkalinity (total as $CaCO_3$)	-	-	460	110	-	200	-	210	-	244	180	136	150
Bicarbonate	-	-	560	140	-	240	-	260	-	298	214	148	182
Carbonate	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	8.6	<1.0
Hydroxide	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1	<1.0
Calcium	-	-	120	27	-	51	-	35	-	73.7	103	61	54.4
Magnesium	-	-	51	9.1	-	22	-	20	-	24.5	44.3	16.5	25.5
Potassium	-	-	13	13	-	8.2	-	11	-	10.5	4.04	9.92	9.42
Sodium	-	-	120	32	-	66	-	67	-	52.2	57.5	40.4	72.5
Chloride	-	-	95	23	-	29	-	28	-	33.8	21.8	34	54.4
Fluoride	-	-	-	-	-	-	-	-	-	0.147	0.134	0.155	0.149
Sulphate	-	-	240	45	-	99	-	67	-	114	313	111	146
Ionic Balance	-	-	0.95	1.1	-	4.3	-	0.95	-	100	107	107	108
Nutrients													
Ammonia as N	-	-	1.4	0.74	0.045	0.11	0.033	-	0.61	<0.050	0.017	0.0192	0.012
Nitrate (as NO_3-N)	-	-	<0.01	0.33	-	0.025	-	<0.01	-	<0.020	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	-	-	<0.01	0.039	-	0.013	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrite (as N)	-	-	<0.01	0.37	-	0.038	-	<0.014	-	<0.022	<0.022	<0.050	<0.050
Total Nitrogen	-	-	-	-	-	-	-	-	-	-	0.906	2.25	1.38
Dissolved Kjeldahl Nitrogen	-	-	3.6	-	-	-	-	-	-	1.41	0.718	1.73	1.5
Total Kjeldahl Nitrogen (TKN)	-	-	3.9	2.8	1.5	1.5	1.3	1.8	2.3	1.98	0.906	2.25	1.38
Phosphorus - Total	-	-	0.5	0.34	0.14	0.19	0.25	0.26	0.11	0.207	0.243	0.223	0.231
Phosphorus - Total Dissolved	-	-	0.53	0.11	0.073	0.11	0.19	-	0.085	0.071	0.184	0.0478	0.181
Total Metals													
Aluminum	-	-	-	0.6	-	0.13	-	0.043	-	-	0.110	-	0.0338
Antimony	-	-	-	<0.00060	-	<0.00060	-	<0.00060	-	-	0.00028	-	0.00014
Arsenic	-	-	-	0.002	-	0.0028	-	0.003	-	-	0.00673	-	0.00372
Barium	-	-	-	0.053	-	0.046	-	0.039	-	-	0.0186	-	0.0235
Boron	-	-	-	0.055	-	0.088	-	0.11	-	-	0.115	-	0.142
Cadmium	-	-	-	0.000031	-	<0.000020	-	<0.000020	-	-	0.0000054	-	<0.0000050
Chromium	-	-	-	0.0016	-	<0.0010	-	<0.0010	-	-	0.00028	-	<0.00050
Cobalt	-	-	-	0.00081	-	0.00043	-	<0.00030	-	-	-	-	0.00016
Copper	-	-	-	0.0028	-	0.001	-	0.00023	-	-	0.00079	-	<0.00050
Iron	-	-	-	1.6	-	0.76	-	0.51	-	-	0.417	-	0.337
Lead	-	-	-	0.00086	-	0.00036	-	<0.00020	-	-	0.000213	-	0.000091
Manganese	-	-	-	0.12	-	0.07	-	0.031	-	-	0.0282	-	0.0165
Mercury	-	-	-	-	-	-	-	-	-	-	<0.0000050	-	<0.0000050
Nickel	-	-	-	0.0038	-	0.0018	-	0.0013	-	-	0.00222	-	0.00151
Selenium	-	-	-	0.00021	-	<0.00020	-	<0.00020	-	-	0.000165	-	0.000143
Silver	-	-	-	<0.00010	-	<0.00010	-	<0.00010	-	-	<0.000010	-	<0.000010
Thallium				<0.00020	-	<0.00020	-	<0.00020					
Uranium	-	-	-	0.00072	-	0.0013	-	0.00048	-	-	0.00114	-	0.000339
Zinc	-	-	-	0.0079	-	<0.0030	-	0.0033	-	-	<0.0030	-	<0.0030
Dissolved Metals													
Iron	-	-	0.083	0.63	-	0.3	-	0.2	-	-	-	0.122	0.077
Coliforms													
Total Coliforms	-	-	-	-	-	-	-	-	-	-	4100	-	1120
E.Coli	-	-	-	-	-	-	-	-	-	-	<1	-	14
Polycyclic Aromatic Hydrocarbons (PAHs)													
Benzo(a) pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenols													
Pentachlorophenol	-	-	-	-	-	-	<0.000080	-	-	-	<0.00050	-	<0.00010
Herbicides													
2,4,5-T	-	-	-	-	-	-	<0.000080	-	-	-	<0.00010	-	<0.000050
2,4,5-TP	-	-	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-D	-	-	-	-	-	-	0.0015	-	-	-	0.00095	-	0.000073
2,4-DB	-	-	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-DP	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Bromoxynil	-	-	-	-	-	-	<0.000020	-	-	-	*<0.0010*	-	<0.000050
Clopyralid	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.00056
Dicamba	-	-	-	-	-	-	**0.00016**	-	-	-	*<0.00010*	-	*<0.00010*
Dinoseb	-	-	-	-	-	-	<0.000020	-	-	-	*<0.0010*	-	<0.000050
MCPA	-	-	-	-	-	-	**0.0001**	-	-	-	*<0.00010*	-	**0.000095**
MCPB	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.000050
Mecoprop	-	-	-	-	-	-	0.00065	-	-	-	0.00057	-	<0.000050
Picloram	-	-	-	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.00039
Triclopyr	-	-	-	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Pesticides													
Alachlor	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Ametryn	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Atrazine	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.000050
Atrazine-desethyl	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.000050
Azinphos-methyl	-	-	-	-	-	-	-	-	-	-	*<0.00020*	-	*<0.00010*
Bendiocarb	-	-	-	-	-	-	-	-	-	-	<0.00050	-	<0.00050
Carbaryl	-	-	-	-	-	-	-	-	-	-	*<0.00050*	-	<0.000050
Carbofuran	-	-	-	-	-	-	-	-	-	-	<0.00050	-	<0.00020
Chlorpyrifos	-	-	-	-	-	-	-	-	-	-	*<0.00020*	-	*<0.00010*
Cyanazine	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Diazinon	-	-	-	-	-	-	-	-	-	-	*<0.00020*	-	<0.00010
Diclofop-methyl	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Dimethoate	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Malathion	-	-	-	-	-	-	-	-	-	-	*<0.00020*	-	<0.00010
Metolachlor	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Metribuzin	-	-	-	-	-	-	-	-	-	-	*<0.0010*	-	<0.00010
Parathion	-	-	-	-	-	-	-	-	-	-	*<0.00020*	-	*<0.00010*
Parathion-methyl	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Phorate	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Prometon	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Prometryn	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Propazine	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Simazine	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Temephos	-	-	-	-	-	-	-	-	-	-	<0.0010	-	<0.0010
Terbufos	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Terbutryn	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Triallate	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010
Trifluralin	-	-	-	-	-	-	-	-	-	-	<0.00020	-	<0.00010

Notes:

[1] Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (PAL). Most conservative values applied (chronic or acute). Table 2 Water quality guidelines for the protection of agricultural water uses, for irrigation and livestock water. Table 3 Surface water quality guidelines for recreation and aesthetics.

[2] Maximum increase of 25 mg/L from background (M2)

[3] Guideline is crop-specific

[4] Guideline varies with hardness. Values shown based on hardness range of 88 mg/L to 515 mg/L.

[5] Guideline varies with pH and temperature. Values shown based on pH range of 6.54 to 11.26 and temperature range of 0.3 °C to 24.8 °C

[6] Guideline varies with chloride. Values shown based on chloride range of 3.31 mg/L to 119 mg/L.

[7] Maximum increase of 8 NTU from background (M2)

[8] Guideline is for Chromium VI

[9] Guideline varies with pH. Values shown based on pH range of 6.54 to 9.58

"-" No applicable guideline or not analyzed

BOLD - Greater than Agricultural guideline.

Shaded - Greater than PAL guideline.

Red - Greater than Recreation / Aesthetics guideline.

Italic - Detection limit greater than applicable Alberta Surface Water Quality Standard

N/A - Not applicable.

TETRA TECH

Table 1: Surface Water Analytical Results (Including Historical Results) 2017 - 2022

Location					M11												
Field ID					M11	M11	M11	M11	M11	M11	M11	M11	M11	M11	M11	M11	M11
Sample Date					21-Dec-2016	19-Jan-2017	16-Feb-2017	13-Apr-2017	16-May-2017	20-Jun-2017	26-Jul-2017	28-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-2	L2633873-11	EO2202900-011	EO2206724-002
Parameter	Unit	Alberta Surface Waters[1] Agricultural	PAL	Recreation / Aesthetics													
Field																	
Field Electric Conductivity	µS/cm	1000	-	-	**1162**	**1149**	**1269**	624	463	725	738	617.14	586.61	868.6	**1102.2**	990	727.00
Field Dissolved Oxygen	mg/L	-	Minimum 5	-	-	6.2	9.2	-	-	-	-	-	-	10.17	8.88	11.52	7.26
Field Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	-	-	-	-	-	-	-	-	-	454.2	**719.5**	**640**	470
Field Temperature	°C	-	-	-	0.9	0.06	0.01	4.66	11.13	19.89	18.84	18	9.57	0.6	18.1	7.92	21.89
Field Turbidity	NTU	-	See note[7]	50	-	-	-	-	-	-	-	-	-	25.7	4.85	384.55	0.82
Field pH	pH Units	-	6.5-9.0	5.0-9.0	5.15	6.9	7	7.69	7.96	7.97	7.93	7.93	8.12	7.23	8.27	10.35	7.89
Routine																	
pH	pH Units	-	6.5-9.0	5.0-9.0	-	7.78	7.6	7.92	-	8.09	-	8.18	-	8.18	8.24	8.44	8.1
Electrical Conductivity (EC)	µS/cm	1000	-	-	-	**1200**	**1400**	400	-	720	-	650	-	742	**1080**	579	714
Sodium Adsorption Ratio (SAR)	N/A	5	-	-	-	-	-	-	-	-	-	-	-	-	1.44	1.15	1.65
Total Suspended Solids (TSS)	mg/L	-	See note [2]	-	-	-	-	52	31	3.3	6.7	12	8.7	32.7	7.2	94.6	4.2
Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	-	**750**	**850**	230	-	440	-	390	-	470	**791**	360	457
Hardness as $CaCO_3$	mg/L	-	-	-	-	410	510	120	-	270	-	200	-	298	515	219	244
Alkalinity (total as $CaCO_3$)	mg/L	-	Minimum 20	-	-	360	420	120	-	200	-	220	-	255	238	131	155
Bicarbonate	mg/L	-	-	-	-	440	520	140	-	250	-	260	-	311	290	152	189
Carbonate	mg/L	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	3.8	<1.0
Hydroxide	mg/L	-	-	-	-	<0.5	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	mg/L	-	-	-	-	97	130	32	-	67	-	46	-	78.8	129	59.7	60
Magnesium	mg/L	-	-	-	-	41	48	9.9	-	24	-	21	-	24.7	46.8	17.0	23
Potassium	mg/L	-	-	-	-	11	11	13	-	8.4	-	9.4	-	10.3	6.43	10.5	7.98
Sodium	mg/L	-	-	-	-	100	94	33	-	66	-	64	-	48.7	75.1	38.4	59.3
Chloride	mg/L	100-700 [3]	120	-	-	58	70	24	-	32	-	28	-	32.3	18.1	34.8	44.1
Fluoride	mg/L	1	-	-	-	-	-	-	-	-	-	-	-	0.145	0.200	0.152	0.147
Sulphate	mg/L	-	309-429 [4]	-	-	230	240	50	-	120	-	89	-	122	373	117	145
Ionic Balance	N/A	-	-	-	-	0.96	0.95	2.6	-	5.2	-	0.59	-	97.6	105	105	104
Nutrients																	
Ammonia as N	mg/L	-	0.03-53.4 [5]	-	-	-	0.97	0.68	0.091	0.021	0.034	-	0.33	0.114	0.011	0.0183	0.0374
Nitrate (as NO_3-N)	mg/L	-	3	-	-	<0.01	<0.01	0.32	-	0.023	-	<0.01	-	0.113	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	mg/L	-	0.04-0.20 [6]	-	-	<0.01	<0.01	0.044	-	<0.01	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrate (as N)	mg/L	100	-	-	-	<0.02	<0.01	0.36	-	0.023	-	<0.014	-	0.113	<0.022	<0.0500	<0.050
Total Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	0.699	2.15	-
Dissolved Kjeldahl Nitrogen	mg/L	-	-	-	-	-	2.7	-	-	-	-	-	-	0.76	0.532	1.52	-
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	-	-	-	3	2.7	1.5	1.4	1.4	1.7	1.9	1.78	0.699	2.15	1.14
Phosphorus - Total	mg/L	-	-	-	-	-	0.48	0.33	0.17	0.14	0.17	0.19	0.15	0.180	0.061	0.241	0.119
Phosphorus - Total Dissolved	mg/L	-	-	-	-	-	0.037	0.15	0.077	0.089	0.08	-	0.1	0.064	0.033	0.0474	0.0827
Total Metals																	
Aluminum	mg/L	5	-	-	-	-	-	0.61	-	0.046	-	0.063	-	-	-	-	-
Antimony	mg/L	-	-	-	-	-	-	<0.00060	-	<0.00060	-	<0.00060	-	-	-	-	-
Arsenic	mg/L	0.16	0.005	-	-	-	-	0.0021	-	0.0027	-	0.003	-	-	-	-	-
Barium	mg/L	-	-	-	-	-	-	0.058	-	0.051	-	0.038	-	-	-	-	-
Boron	mg/L	0.5-6.0 [3]	1.5	-	-	-	-	0.057	-	0.09	-	0.094	-	-	-	-	-
Cadmium	mg/L	0.0082	0.00014-0.00037 [4]	-	-	-	-	0.000035	-	<0.000020	-	<0.000020	-	-	-	-	-
Chromium	mg/L	0.008 [8]	0.001 [8]	-	-	-	-	0.0025	-	<0.0010	-	<0.0010	-	-	-	-	-
Cobalt	mg/L	0.05	0.001-0.0018 [4]	-	-	-	-	0.001	-	0.00038	-	<0.00030	-	-	-	-	-
Copper	mg/L	0.2-1.0 [3]	0.007 [4]	-	-	-	-	0.0035	-	0.00094	-	0.00048	-	-	-	-	-
Iron	mg/L	5	-	-	-	-	-	2.2	-	0.67	-	0.54	-	-	-	-	-
Lead	mg/L	0.2	0.0027-0.0070 [4]	-	-	-	-	0.0012	-	0.00024	-	0.00025	-	-	-	-	-
Manganese	mg/L	0.2	-	-	-	-	-	0.13	-	0.087	-	0.077	-	-	-	-	-
Mercury	mg/L	-	0.000005	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	mg/L	0.2	0.047-0.21 [4]	-	-	-	-	0.0045	-	0.0023	-	0.0019	-	-	-	-	-
Selenium	mg/L	0.02	0.002	-	-	-	-	<0.00020	-	<0.00020	-	<0.00020	-	-	-	-	-
Silver	mg/L	-	0.00025	-	-	-	-	<0.00010	-	<0.00010	-	<0.00010	-	-	-	-	-
Thallium	mg/L	-	0.0008	-				<0.00020	-	<0.00020	-	<0.00020					
Uranium	mg/L	0.01	0.015	-	-	-	-	0.00078	-	0.0014	-	0.00069	-	-	-	-	-
Zinc	mg/L	5 [9]	0.03	-	-	-	-	0.0097	-	<0.0030	-	<0.0030	-	-	-	-	-
Dissolved Metals																	
Iron	mg/L	-	0.3	-	-	0.88	0.57	-	0.71	0.3	-	0.11	-	-	-	0.164	0.094
Coliforms																	
Total Coliforms	CFU/100mL	-	-	-	-	-	-	-	-	-	-	-	-	-	3000	-	649
E.Coli	CFU/100mL	100	-	100	-	-	-	-	-	-	-	-	-	-	**1200**	-	12
Polycyclic Aromatic Hydrocarbons (PAHs)																	
Benzo(a) pyrene	mg/L	-	0.000015	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenols																	
Pentachlorophenol	mg/L	-	0.0005	-	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Herbicides																	
2,4,5-T	mg/L	-	-	-	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4,5-TP	mg/L	-	-	-	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4-D	mg/L	-	0.004	-	-	-	-	-	-	-	0.00007	-	-	-	-	-	-
2,4-DB	mg/L	-	0.025	-	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4-DP	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromoxynil	mg/L	0.00044	0.005	-	-	-	-	-	-	-	<0.00002	-	-	-	-	-	-
Clopyralid	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dicamba	mg/L	0.000008	0.01	-	-	-	-	-	-	-	**0.000015**	-	-	-	-	-	-
Dinoseb	mg/L	0.021	0.00005	-	-	-	-	-	-	-	<0.000020	-	-	-	-	-	-
MCPA	mg/L	0.00004	0.0026	-	-	-	-	-	-	-	0.000038	-	-	-	-	-	-
MCPB	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mecoprop	mg/L	-	0.013	-	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Picloram	mg/L	-	0.029	-	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Triclopyr	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pesticides																	
Alachlor	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ametryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine	mg/L	0.01	0.0018	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	mg/L	-	0.00001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bendiocarb	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbaryl	mg/L	-	0.0002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbofuran	mg/L	-	0.0018	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	mg/L	-	0.000002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanazine	mg/L	0.0005	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diazinon	mg/L	-	0.00017	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	mg/L	0.00024	0.0061	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethoate	mg/L	-	0.0062	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Malathion	mg/L	-	0.0001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metolachlor	mg/L	0.028	0.0078	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metribuzin	mg/L	0.0005	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parathion	mg/L	-	0.000013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phorate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometon	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Propazine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simazine	mg/L	0.0005	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Temephos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbufos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbutryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Triallate	mg/L	-	0.00024	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifluralin	mg/L	-	0.0002	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Location	M12												
Field ID	M12	M12	M12	M12	M12	M12	M12	M12	M12	M12	M12	M12	M12
Sample Date	21-Dec-2016	20-Jan-2017	17-Feb-2017	13-Apr-2017	16-May-2017	20-Jun-2017	26-Jul-2017	28-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-1	L2633873-12	EO2202900-012	EO2206724-001
Field													
Field Electric Conductivity	**1238**	**1438**	**1396**	620	473	729	667	614.84	574.12	848	965.51	**1220**	736.25
Field Dissolved Oxygen	-	-	4.3	-	-	-	-	-	-	11.13	8.21	11.64	8.16
Field Total Dissolved Solids (TDS)	-	-	-	-	-	-	-	-	-	444.1	**628.4**	**820**	480
Field Temperature	0.99	0.18	0.11	4.76	10.76	19.87	19.69	17.86	9.51	0.3	17.7	7.39	19.96
Field Turbidity	-	-	-	-	-	-	-	-	-	25.3	2.09	1.34	0.11
Field pH	5.89	7.5	7	7.94	8.14	8.3	8.41	8.23	8.44	7.81	8.32	10.51	8.24
Routine													
pH	-	-	7.69	8	-	8.51	-	8.2	-	8.24	8.25	8.27	8.27
Electrical Conductivity (EC)	-	-	**1400**	400	-	720	-	640	-	711	957	544	725
Sodium Adsorption Ratio (SAR)	-	-	-	-	-	-	-	-	-	-	1.58	1.14	1.71
Total Suspended Solids (TSS)	-	-	-	94	38	3.3	1.3	23	8.7	31.7	3.0	128	5.4
Total Dissolved Solids (TDS)	-	-	**910**	230	-	450	-	380	-	454	**670**	338	459
Hardness as $CaCO_3$	-	-	570	120	-	260	-	200	-	285	412	202	243
Alkalinity (total as $CaCO_3$)	-	-	420	110	-	210	-	200	-	248	196	125	168
Bicarbonate	-	-	510	140	-	240	-	250	-	303	239	152	204
Carbonate	-	-	<0.5	<0.5	-	9.3	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Hydroxide	-	-	<0.5	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	-	-	140	32	-	66	-	49	-	75.3	95.7	56.2	59.2
Magnesium	-	-	54	9.6	-	24	-	20	-	23.5	41.9	14.9	23.2
Potassium	-	-	14	14	-	8.1	-	8.6	-	10.8	9.33	10.3	8.18
Sodium	-	-	130	33	-	65	-	59	-	49.9	73.6	38.6	61.2
Chloride	-	-	87	24	-	33	-	26	-	29.9	23.3	33.1	47.5
Fluoride	-	-	-	-	-	-	-	-	-	0.144	0.220	0.158	0.145
Sulphate	-	-	240	50	-	130	-	92	-	115	308	106	134
Ionic Balance	-	-	1.1	2.6	-	3.3	-	1.2	-	99	106	106	103
Nutrients													
Ammonia as N	-	-	1.1	0.76	0.095	0.015	0.032	-	0.036	<0.050	0.026	0.0318	0.0094
Nitrate (as NO_3-N)	-	-	0.024	0.33	-	<0.01	-	<0.01	-	0.160	<0.020	<0.020	<0.020
Nitrite (as NO_2-N)	-	-	<0.01	0.038	-	<0.01	-	<0.01	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrate (as N)	-	-	0.024	0.37	-	<0.01	-	<0.014	-	0.160	<0.022	<0.0500	<0.050
Total Nitrogen	-	-	-	-	-	-	-	-	-	-	0.881	2.21	-
Dissolved Kjeldahl Nitrogen	-	-	2.6	-	-	-	-	-	-	1.43	0.709	1.42	-
Total Kjeldahl Nitrogen (TKN)	-	-	2.9	3	1.4	1.2	1.2	1.3	1.6	1.43	0.881	2.21	1.1
Phosphorus - Total	-	-	0.25	0.36	0.18	0.1	0.097	0.15	0.16	0.207	0.046	0.258	0.0797
Phosphorus - Total Dissolved	-	-	0.0087	0.14	0.072	0.049	0.067	-	0.082	0.070	0.031	0.233	0.0626
Total Metals													
Aluminum	-	-	-	0.9	-	0.038	-	0.056	-	-	-	-	-
Antimony	-	-	-	<0.00060	-	<0.00060	-	<0.00060	-	-	-	-	-
Arsenic	-	-	-	0.0025	-	0.0024	-	0.0029	-	-	-	-	-
Barium	-	-	-	0.067	-	0.052	-	0.038	-	-	-	-	-
Boron	-	-	-	0.053	-	0.086	-	0.088	-	-	-	-	-
Cadmium	-	-	-	0.000054	-	<0.000020	-	<0.000020	-	-	-	-	-
Chromium	-	-	-	0.0034	-	<0.0010	-	<0.0010	-	-	-	-	-
Cobalt	-	-	-	0.0015	-	0.00033	-	<0.00030	-	-	-	-	-
Copper	-	-	-	0.0045	-	0.0011	-	0.00068	-	-	-	-	-
Iron	-	-	-	3.2	-	0.55	-	0.42	-	-	-	-	-
Lead	-	-	-	0.0017	-	<0.00020	-	0.00021	-	-	-	-	-
Manganese	-	-	-	0.2	-	0.041	-	0.052	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	-	-	-	0.0057	-	0.0023	-	0.0021	-	-	-	-	-
Selenium	-	-	-	<0.00020	-	0.00025	-	<0.00020	-	-	-	-	-
Silver	-	-	-	<0.00010	-	<0.00010	-	<0.00010	-	-	-	-	-
Thallium				<0.00020	-	<0.00020	-	<0.00020					
Uranium	-	-	-	0.00093	-	0.0014	-	0.00072	-	-	-	-	-
Zinc	-	-	-	0.012	-	0.0041	-	0.0036	-	-	-	-	-
Dissolved Metals													
Iron	-	-	0.26	0.74	-	0.26	-	0.22	-	-	-	0.173	0.062
Coliforms													
Total Coliforms	-	-	-	-	-	-	-	-	-	-	510	-	1990
E.Coli	-	-	-	-	-	-	-	-	-	-	<1	-	15
Polycyclic Aromatic Hydrocarbons (PAHs)													
Benzo(a) pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenols													
Pentachlorophenol	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Herbicides													
2,4,5-T	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4,5-TP	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4-D	-	-	-	-	-	-	0.00018	-	-	-	-	-	-
2,4-DB	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
2,4-DP	-	-	-	-	-	-	-	-	-	-	-	-	-
Bromoxynil	-	-	-	-	-	-	<0.00002	-	-	-	-	-	-
Clopyralid	-	-	-	-	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	-	-	-	**0.000036**	-	-	-	-	-	-
Dinoseb	-	-	-	-	-	-	<0.000020	-	-	-	-	-	-
MCPA	-	-	-	-	-	-	0.00004	-	-	-	-	-	-
MCPB	-	-	-	-	-	-	-	-	-	-	-	-	-
Mecoprop	-	-	-	-	-	-	0.00011	-	-	-	-	-	-
Picloram	-	-	-	-	-	-	<0.000080	-	-	-	-	-	-
Triclopyr	-	-	-	-	-	-	-	-	-	-	-	-	-
Pesticides													
Alachlor	-	-	-	-	-	-	-	-	-	-	-	-	-
Ametryn	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine	-	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	-	-	-	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	-	-	-	-	-	-	-	-	-	-	-	-	-
Bendiocarb	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbaryl	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbofuran	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-	-	-	-	-
Diazinon	-	-	-	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethoate	-	-	-	-	-	-	-	-	-	-	-	-	-
Malathion	-	-	-	-	-	-	-	-	-	-	-	-	-
Metolachlor	-	-	-	-	-	-	-	-	-	-	-	-	-
Metribuzin	-	-	-	-	-	-	-	-	-	-	-	-	-
Parathion	-	-	-	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	-	-	-	-	-	-	-	-	-	-	-	-	-
Phorate	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometon	-	-	-	-	-	-	-	-	-	-	-	-	-
Prometryn	-	-	-	-	-	-	-	-	-	-	-	-	-
Propazine	-	-	-	-	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-	-	-	-	-
Temephos	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbufos	-	-	-	-	-	-	-	-	-	-	-	-	-
Terbutryn	-	-	-	-	-	-	-	-	-	-	-	-	-
Triallate	-	-	-	-	-	-	-	-	-	-	-	-	-
Trifluralin	-	-	-	-	-	-	-	-	-	-	-	-	-

Location	T1								
Field ID	T1	T1	T1	T1	T1	T1	T1	T1	T1
Sample Date	13-Apr-2017	17-May-2017	21-Jun-2017	27-Jul-2017	19-Sep-2017	21-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2579106	L2633873	EO2202900	EO2206724
Laboratory Sample ID	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2579106-1	L2633873-1	EO2202900-001	EO2206724-008
Field									
Field Electric Conductivity	749	543	649	663	665.98	508.9	564.9	930	715.80
Field Dissolved Oxygen	-	-	-	-	-	8.45	9.44	11.19	9.59
Field Total Dissolved Solids (TDS)	-	-	-	-	-	274.4	367.27	**880**	**470**
Field Temperature	2.49	11.97	16.44	19.21	8.98	8.1	17.45	8.61	19.83
Field Turbidity	-	-	-	-	-	6.21	1.66	1.13	0.06
Field pH	7.68	7.73	7.55	7.31	7.94	7.05	8.40	8.9	8.03
Routine									
pH	7.95	-	8.01	-	-	8.14	8.27	8.05	-
Electrical Conductivity (EC)	480	-	620	-	-	457	556	578	721
Sodium Adsorption Ratio (SAR)	-	-	-	-	-	-	1.36	1.07	1.16
Total Suspended Solids (TSS)	11	6	8	6.7	4	7.1	<3.0	7.00	4.2
Total Dissolved Solids (TDS)	280	-	390	-	-	278	353	367	486
Hardness as $CaCO_3$	180	-	290	-	-	224	243	258	320
Alkalinity (total as $CaCO_3$)	170	-	260	-	-	220	301	231	324
Bicarbonate	210	-	310	-	-	269	367	282	395
Carbonate	<0.5	-	<0.5	-	-	<5.0	<5.0	<1.0	<1.0
Hydroxide	<0.5	-	<0.5	-	-	<5.0	<5.0	<1.0	<1.0
Calcium	50	-	82	-	-	63.1	61.3	72.2	88.8
Magnesium	13	-	21	-	-	16.2	21.9	18.8	24
Potassium	11	-	6.8	-	-	5.88	4.13	6.71	4.71
Sodium	34	-	41	-	-	19.8	48.9	38.7	47.7
Chloride	23	-	18	-	-	12.3	12.6	16.7	19.8
Fluoride	-	-	-	-	-	0.136	0.130	0.136	0.15
Sulphate	48	-	61	-	-	28.3	23.1	66.0	51.5
Ionic Balance	3.3	-	5.9	-	-	103	103	108	106
Nutrients									
Ammonia as N	0.28	0.063	0.035	0.037	0.034	<0.050	0.033	0.0479	0.0393
Nitrate (as NO_3-N)	0.18	-	0.51	-	-	0.064	0.034	<0.020	0.064
Nitrite (as NO_2-N)	0.013	-	0.021	-	-	<0.010	<0.010	<0.010	<0.010
Nitrate and Nitrate (as N)	0.2	-	0.53	-	-	0.064	0.034	<0.0500	0.064
Total Nitrogen	-	-	-	-	-	-	0.883	1.09	-
Dissolved Kjeldahl Nitrogen	-	-	-	-	-	1.00	0.663	1.23	-
Total Kjeldahl Nitrogen (TKN)	1.7	1.1	1.5	1.1	0.95	1.20	0.85	1.09	1.28
Phosphorus - Total	0.22	0.11	0.24	0.13	0.082	0.099	0.107	0.145	0.497
Phosphorus - Total Dissolved	0.14	0.039	0.16	0.07	0.048	0.033	0.068	0.0427	0.445
Total Metals									
Aluminum	0.056	-	0.23	-	-	-	-	-	-
Antimony	<0.00060	-	<0.00060	-	-	-	-	-	-
Arsenic	0.0011	-	0.0022	-	-	-	-	-	-
Barium	0.06	-	0.078	-	-	-	-	-	-
Boron	0.051	-	0.055	-	-	-	-	-	-
Cadmium	<0.000020	-	<0.000020	-	-	-	-	-	-
Chromium	<0.0010	-	<0.0010	-	-	-	-	-	-
Cobalt	0.00031	-	0.00034	-	-	-	-	-	-
Copper	0.00085	-	0.002	-	-	-	-	-	-
Iron	1.1	-	0.63	-	-	-	-	-	-
Lead	<0.00020	-	<0.00020	-	-	-	-	-	-
Manganese	**0.23**	-	0.11	-	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-	-
Nickel	0.0013	-	0.0017	-	-	-	-	-	-
Selenium	<0.00020	-	0.00038	-	-	-	-	-	-
Silver	<0.00010	-	<0.00010	-	-	-	-	-	-
Thallium	<0.00020	-	<0.00020						
Uranium	0.0012	-	0.0018	-	-	-	-	-	-
Zinc	<0.0030	-	0.0032	-	-	-	-	-	-
Dissolved Metals									
Iron	0.78	-	0.19	-	-	-	-	0.164	0.086
Coliforms									
Total Coliforms	-	-	-	-	-	-	2400	-	1480
E.Coli	-	-	-	-	-	-	<1	-	31
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a) pyrene	-	-	-	-	-	-	-	-	-
Phenols									
Pentachlorophenol	-	-	-	<0.000080	-	-	-	-	-
Herbicides									
2,4,5-T	-	-	-	<0.000080	-	-	-	-	-
2,4,5-TP	-	-	-	<0.000080	-	-	-	-	-
2,4-D	-	-	-	<0.000050	-	-	-	-	-
2,4-DB	-	-	-	<0.000080	-	-	-	-	-
2,4-DP	-	-	-	-	-	-	-	-	-
Bromoxynil	-	-	-	<0.00002	-	-	-	-	-
Clopyralid	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	<0.0000050	-	-	-	-	-
Dinoseb	-	-	-	<0.000020	-	-	-	-	-
MCPA	-	-	-	<0.000020	-	-	-	-	-
MCPB	-	-	-	-	-	-	-	-	-
Mecoprop	-	-	-	<0.000080	-	-	-	-	-
Picloram	-	-	-	<0.000080	-	-	-	-	-
Triclopyr	-	-	-	-	-	-	-	-	-
Pesticides									
Alachlor	-	-	-	-	-	-	-	-	-
Ametryn	-	-	-	-	-	-	-	-	-
Atrazine	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	-	-	-	-	-	-	-	-	-
Azinphos-methyl	-	-	-	-	-	-	-	-	-
Bendiocarb	-	-	-	-	-	-	-	-	-
Carbaryl	-	-	-	-	-	-	-	-	-
Carbofuran	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-
Diazinon	-	-	-	-	-	-	-	-	-
Diclofop-methyl	-	-	-	-	-	-	-	-	-
Dimethoate	-	-	-	-	-	-	-	-	-
Malathion	-	-	-	-	-	-	-	-	-
Metolachlor	-	-	-	-	-	-	-	-	-
Metribuzin	-	-	-	-	-	-	-	-	-
Parathion	-	-	-	-	-	-	-	-	-
Parathion-methyl	-	-	-	-	-	-	-	-	-
Phorate	-	-	-	-	-	-	-	-	-
Prometon	-	-	-	-	-	-	-	-	-
Prometryn	-	-	-	-	-	-	-	-	-
Propazine	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-
Temephos	-	-	-	-	-	-	-	-	-
Terbufos	-	-	-	-	-	-	-	-	-
Terbutryn	-	-	-	-	-	-	-	-	-
Triallate	-	-	-	-	-	-	-	-	-
Trifluralin	-	-	-	-	-	-	-	-	-

Notes:

[1] Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (PAL). Most conservative values applied (chronic or acute). Table 2 Water quality guidelines for the protection of agricultural water uses, for irrigation and livestock water. Table 3 Surface water quality guidelines for recreation and aesthetics.

[2] Maximum increase of 25 mg/L from background (M2)

[3] Guideline is crop-specific

[4] Guideline varies with hardness. Values shown based on hardness range of 88 mg/L to 515 mg/L.

[5] Guideline varies with pH and temperature. Values shown based on pH range of 6.54 to 11.26 and temperature range of 0.3 °C to 24.8 °C

[6] Guideline varies with chloride. Values shown based on chloride range of 3.31 mg/L to 119 mg/L.

[7] Maximum increase of 8 NTU from background (M2)

[8] Guideline is for Chromium VI

[9] Guideline varies with pH. Values shown based on pH range of 6.54 to 9.58

"-" No applicable guideline or not analyzed

BOLD - Greater than Agricultural guideline.

Shaded - Greater than PAL guideline.

Red - Greater than Recreation / Aesthetics guideline.

Italic - Detection limit greater than applicable Alberta Surface Water Quality Standard

N/A - Not applicable.

Table 1: Surface Water Analytical Results (Including Historical Results) 2017 - 2022

Location					T3								
Field ID					T3	T3	T3	T3	T3	T3	T3	T3	T3
Sample Date					12-Apr-2017	16-May-2017	20-Jun-2017	27-Jul-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID					3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-7	L2633873-2	EO2202900-002	EO2206724-007
Parameter	Unit	Alberta Surface Waters[1]											
		Agricultural	PAL	Recreation / Aesthetics									
Field													
Field Electric Conductivity	µS/cm	1000	-	-	295	291	442	425	411.51	482.7	442.73	150	484.39
Field Dissolved Oxygen	mg/L	-	Minimum 5	-	-	-	-	-	-	5.53	8.22	11.04	8.39
Field Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	-	-	-	-	-	253.5	288.13	100	310
Field Temperature	°C	-	-	-	6.93	12.06	19.44	15.4	8.77	2.1	17.94	9.25	20.06
Field Turbidity	NTU	-	See note[7]	50	-	-	-	-	-	20.4	11.08	1.31	5.13
Field pH	pH Units	-	6.5-9.0	5.0-9.0	7.06	7.64	7.41	7.31	7.91	8.11	8.48	9.82	8.02
Routine													
pH	pH Units	-	6.5-9.0	5.0-9.0	7.46	-	7.82	-	-	7.72	8.17	7.89	8.06
Electrical Conductivity (EC)	µS/cm	1000	-	-	290	-	430	-	-	410	433	358	509
Sodium Adsorption Ratio (SAR)	N/A	5	-	-	-	-	-	-	-	-	1.60	1.19	2.5
Total Suspended Solids (TSS)	mg/L	-	See note [2]	-	15	18	4.7	17	10	14.9	11.4	17.6	5.4
Total Dissolved Solids (TDS)	mg/L	500-3500 [3]	-	-	170	-	250	-	-	253	265	225	345
Hardness as $CaCO_3$	mg/L	-	-	-	70	-	150	-	-	134	151	111	129
Alkalinity (total as $CaCO_3$)	mg/L	-	Minimum 20	-	83	-	170	-	-	160	204	76.2	182
Bicarbonate	mg/L	-	-	-	100	-	210	-	-	195	249	93	222
Carbonate	mg/L	-	-	-	<0.5	-	<0.5	-	-	<5.0	<5.0	<1.0	<1.0
Hydroxide	mg/L	-	-	-	<0.5	-	<0.5	-	-	<5.0	<5.0	<1.0	<1.0
Calcium	mg/L	-	-	-	18	-	40	-	-	36.7	40.0	30.6	33.7
Magnesium	mg/L	-	-	-	5.9	-	12	-	-	10.2	12.4	8.48	10.9
Potassium	mg/L	-	-	-	16	-	14	-	-	12.5	13.1	11.0	10.9
Sodium	mg/L	-	-	-	26	-	38	-	-	35.8	45.2	27.7	65.4
Chloride	mg/L	100-700 [3]	120	-	20	-	21	-	-	21.9	24	15.6	34.1
Fluoride	mg/L	1	-	-	-	-	-	-	-	0.152	0.193	0.142	0.187
Sulphate	mg/L	-	309-429 [4]	-	30	-	24	-	-	38.6	7.44	75.1	25
Ionic Balance	N/A	-	-	-	2.6	-	5.3	-	-	99.6	108	105	112
Nutrients													
Ammonia as N	mg/L	-	0.03-53.4 [5]	-	0.74	0.058	0.031	0.057	0.18	1.12	0.022	0.0385	0.0354
Nitrate (as NO_3-N)	mg/L	-	3	-	0.23	-	0.052	-	-	0.210	<0.020	0.374	<0.020
Nitrite (as NO_2-N)	mg/L	-	0.04-0.20 [6]	-	0.032	-	<0.01	-	-	0.062	<0.010	0.026	<0.010
Nitrate and Nitrate (as N)	mg/L	100	-	-	0.26	-	0.052	-	-	0.273	<0.022	0.400	<0.050
Total Nitrogen	mg/L	-	-	-	-	-	-	-	-	-	2.71	3.00	-
Dissolved Kjeldahl Nitrogen	mg/L	-	-	-	-	-	-	-	-	3.28	2.12	1.79	-
Total Kjeldahl Nitrogen (TKN)	mg/L	-	-	-	3.3	2.5	2.8	3.7	2.5	3.45	2.71	2.60	3.26
Phosphorus - Total	mg/L	-	-	-	0.43	0.46	0.66	0.49	0.5	0.650	0.361	0.259	1.43
Phosphorus - Total Dissolved	mg/L	-	-	-	0.28	0.29	0.44	0.21	0.23	0.316	0.164	0.0884	1.14
Total Metals													
Aluminum	mg/L	5	-	-	0.35	-	0.072	-	-	-	-	-	-
Antimony	mg/L	-	-	-	<0.00060	-	<0.00060	-	-	-	-	-	-
Arsenic	mg/L	0.16	0.005	-	0.0019	-	0.0039	-	-	-	-	-	-
Barium	mg/L	-	-	-	0.054	-	0.054	-	-	-	-	-	-
Boron	mg/L	0.5-6.0 [3]	1.5	-	0.12	-	0.043	-	-	-	-	-	-
Cadmium	mg/L	0.0082	0.00014-0.00037 [4]	-	0.00003	-	<0.000020	-	-	-	-	-	-
Chromium	mg/L	0.008 [8]	0.001 [8]	-	0.001	-	<0.0010	-	-	-	-	-	-
Cobalt	mg/L	0.05	0.001-0.0018 [4]	-	0.0013	-	0.00049	-	-	-	-	-	-
Copper	mg/L	0.2-1.0 [3]	0.007 [4]	-	0.0032	-	0.0014	-	-	-	-	-	-
Iron	mg/L	5	-	-	2.3	-	2.9	-	-	-	-	-	-
Lead	mg/L	0.2	0.0027-0.0070 [4]	-	0.00064	-	0.00032	-	-	-	-	-	-
Manganese	mg/L	0.2	-	-	0.16	-	0.036	-	-	-	-	-	-
Mercury	mg/L	-	0.000005	-	-	-	-	-	-	-	-	-	-
Nickel	mg/L	0.2	0.047-0.21 [4]	-	0.0051	-	0.0055	-	-	-	-	-	-
Selenium	mg/L	0.02	0.002	-	0.00023	-	0.0004	-	-	-	-	-	-
Silver	mg/L	-	0.00025	-	<0.00010	-	<0.00010	-	-	-	-	-	-
Thallium	mg/L	-	0.0008	-	<0.00020	-	<0.00020						
Uranium	mg/L	0.01	0.015	-	0.00037	-	0.00054	-	-	-	-	-	-
Zinc	mg/L	5 [9]	0.03	-	0.0071	-	0.003	-	-	-	-	-	-
Dissolved Metals													
Iron	mg/L	-	0.3	-	1.3	-	2.2	-	-	-	-	0.68	0.539
Coliforms													
Total Coliforms	CFU/100mL	-	-	-	-	-	-	-	-	-	4200	-	613
E.Coli	CFU/100mL	100	-	100	-	-	-	-	-	-	<1	-	13
Polycyclic Aromatic Hydrocarbons (PAHs)													
Benzo(a) pyrene	mg/L	-	0.000015	-	-	-	-	-	-	-	-	-	-
Phenols													
Pentachlorophenol	mg/L	-	0.0005	-	-	-	-	<0.000080	-	-	-	-	-
Herbicides													
2,4,5-T	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-
2,4,5-TP	mg/L	-	-	-	-	-	-	<0.000080	-	-	-	-	-
2,4-D	mg/L	-	0.004	-	-	-	-	<0.000050	-	-	-	-	-
2,4-DB	mg/L	-	0.025	-	-	-	-	<0.000080	-	-	-	-	-
2,4-DP	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Bromoxynil	mg/L	0.00044	0.005	-	-	-	-	<0.00002	-	-	-	-	-
Clopyralid	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Dicamba	mg/L	0.000008	0.01	-	-	-	-	<0.0000050	-	-	-	-	-
Dinoseb	mg/L	0.021	0.00005	-	-	-	-	<0.000020	-	-	-	-	-
MCPA	mg/L	0.00004	0.0026	-	-	-	-	**0.000045**	-	-	-	-	-
MCPB	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Mecoprop	mg/L	-	0.013	-	-	-	-	<0.000080	-	-	-	-	-
Picloram	mg/L	-	0.029	-	-	-	-	<0.000080	-	-	-	-	-
Triclopyr	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Pesticides													
Alachlor	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Ametryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Atrazine	mg/L	0.01	0.0018	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	mg/L	-	0.00001	-	-	-	-	-	-	-	-	-	-
Bendiocarb	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Carbaryl	mg/L	-	0.0002	-	-	-	-	-	-	-	-	-	-
Carbofuran	mg/L	-	0.0018	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	mg/L	-	0.000002	-	-	-	-	-	-	-	-	-	-
Cyanazine	mg/L	0.0005	0.002	-	-	-	-	-	-	-	-	-	-
Diazinon	mg/L	-	0.00017	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	mg/L	0.00024	0.0061	-	-	-	-	-	-	-	-	-	-
Dimethoate	mg/L	-	0.0062	-	-	-	-	-	-	-	-	-	-
Malathion	mg/L	-	0.0001	-	-	-	-	-	-	-	-	-	-
Metolachlor	mg/L	0.028	0.0078	-	-	-	-	-	-	-	-	-	-
Metribuzin	mg/L	0.0005	0.001	-	-	-	-	-	-	-	-	-	-
Parathion	mg/L	-	0.000013	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Phorate	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Prometon	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Prometryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Propazine	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Simazine	mg/L	0.0005	0.01	-	-	-	-	-	-	-	-	-	-
Temephos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Terbufos	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Terbutryn	mg/L	-	-	-	-	-	-	-	-	-	-	-	-
Triallate	mg/L	-	0.00024	-	-	-	-	-	-	-	-	-	-
Trifluralin	mg/L	-	0.0002	-	-	-	-	-	-	-	-	-	-

Location	T4									
Field ID	T4	T4	T4	T4	T4	T4	T4	T4	T4	T4
Sample Date	12-Apr-2017	16-May-2017	21-Jun-2017	27-Jul-2017	28-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-11	L2633873-3	EO2202900-003	EO2206724-012
Field										
Field Electric Conductivity	675	728	826	685	592.66	584.72	759.5	703.17	**1180**	714.75
Field Dissolved Oxygen	-	-	-	-	-	-	11.01	10.13	10.96	10.65
Field Total Dissolved Solids (TDS)	-	-	-	-	-	-	399	458.66	**770**	470
Field Temperature	3.27	8.7	18.2	15.56	20.71	8.99	2.3	18.55	9.59	22.59
Field Turbidity	-	-	-	-	-	-	5.95	4.04	1.11	5.85
Field pH	7.54	7.91	8.16	7.53	7.96	8.09	8.34	8.45	7.99	8.26
Routine										
pH	7.91	-	8.32	-	8.29	-	8.20	8.31	7.97	8.4
Electrical Conductivity (EC)	660	-	800	-	660	-	639	681	890	717
Sodium Adsorption Ratio (SAR)	-	-	-	-	-	-	-	1.31	1.37	1.03
Total Suspended Solids (TSS)	5.3	3.3	8.7	2.7	15	11	8.5	3.8	5.40	8
Total Dissolved Solids (TDS)	390	-	**520**	-	380	-	416	447	**579**	**461**
Hardness as $CaCO_3$	250	-	390	-	270	-	292	303	368	316
Alkalinity (total as $CaCO_3$)	180	-	270	-	290	-	237	259	213	326
Bicarbonate	220	-	330	-	360	-	289	310	260	384
Carbonate	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	6.6
Hydroxide	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	70	-	110	-	73	-	80.9	84.7	106	86.3
Magnesium	18	-	27	-	22	-	21.9	22.3	25.2	24.4
Potassium	11	-	4.8	-	4.1	-	8.11	3.87	6.86	4.36
Sodium	39	-	45	-	41	-	33.3	52.4	60.3	42.2
Chloride	40	-	32	-	18	-	24.4	37.3	69.3	20.9
Fluoride	-	-	-	-	-	-	0.151	0.162	0.149	0.161
Sulphate	95	-	140	-	50	-	104	90.3	170	55.2
Ionic Balance	1.2	-	4.4	-	0.57	-	98.6	105	104	100
Nutrients										
Ammonia as N	0.17	0.038	0.024	0.025	-	0.027	0.098	0.026	0.0488	0.0107
Nitrate (as NO_3-N)	0.43	-	0.085	-	0.014	-	0.147	0.023	0.044	<0.020
Nitrite (as NO_2-N)	0.021	-	<0.010	-	<0.010	-	0.014	<0.010	<0.010	<0.010
Nitrate and Nitrate (as N)	0.45	-	0.085	-	0.014	-	0.161	0.023	<0.050	<0.050
Total Nitrogen	-	-	-	-	-	-	-	0.751	1.13	-
Dissolved Kjeldahl Nitrogen	-	-	-	-	-	-	0.76	0.556	1.07	-
Total Kjeldahl Nitrogen (TKN)	1.5	1.2	1	0.84	0.81	0.64	0.93	0.728	1.09	0.8
Phosphorus - Total	0.092	0.048	0.081	0.073	0.088	0.077	0.117	0.075	0.072	0.0908
Phosphorus - Total Dissolved	0.032	0.021	0.043	0.056	-	0.041	0.053	0.051	0.0326	0.0998
Total Metals										
Aluminum	0.04	-	0.067	-	0.16	-	-	-	-	-
Antimony	<0.00060	-	<0.00060	-	<0.00060	-	-	-	-	-
Arsenic	0.0017	-	0.0036	-	0.0039	-	-	-	-	-
Barium	0.06	-	0.073	-	0.079	-	-	-	-	-
Boron	0.078	-	0.12	-	0.12	-	-	-	-	-
Cadmium	<0.000020	-	<0.000020	-	<0.000020	-	-	-	-	-
Chromium	<0.0010	-	<0.0010	-	<0.0010	-	-	-	-	-
Cobalt	<0.00030	-	<0.00030	-	<0.00030	-	-	-	-	-
Copper	0.00093	-	0.0018	-	0.00032	-	-	-	-	-
Iron	0.39	-	0.48	-	0.68	-	-	-	-	-
Lead	<0.00020	-	<0.00020	-	0.00031	-	-	-	-	-
Manganese	0.1	-	0.089	-	0.15	-	-	-	-	-
Mercury	-	-	-	-	-	-	-	-	-	-
Nickel	0.0013	-	0.0014	-	0.0014	-	-	-	-	-
Selenium	<0.00020	-	0.00041	-	<0.00020	-	-	-	-	-
Silver	<0.00010	-	<0.00010	-	<0.00010	-	-	-	-	-
Thallium	<0.00020	-	<0.00020	-	<0.00020					
Uranium	0.0023	-	0.0016	-	0.0012	-	-	-	-	-
Zinc	<0.0030	-	<0.0030	-	<0.0030	-	-	-	-	-
Dissolved Metals										
Iron	0.18	-	0.15	-	<0.060	-	-	-	0.068	<0.030
Coliforms										
Total Coliforms	-	-	-	-	-	-	-	5100	-	2030
E.Coli	-	-	-	-	-	-	-	**1700**	-	**260**
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a) pyrene	-	-	-	-	-	-	-	-	-	-
Phenols										
Pentachlorophenol	-	-	-	<0.000080	-	-	-	-	-	-
Herbicides										
2,4,5-T	-	-	-	<0.000080	-	-	-	-	-	-
2,4,5-TP	-	-	-	<0.000080	-	-	-	-	-	-
2,4-D	-	-	-	0.0003	-	-	-	-	-	-
2,4-DB	-	-	-	<0.000080	-	-	-	-	-	-
2,4-DP	-	-	-	-	-	-	-	-	-	-
Bromoxynil	-	-	-	<0.00002	-	-	-	-	-	-
Clopyralid	-	-	-	-	-	-	-	-	-	-
Dicamba	-	-	-	**0.000093**	-	-	-	-	-	-
Dinoseb	-	-	-	<0.000020	-	-	-	-	-	-
MCPA	-	-	-	**0.00036**	-	-	-	-	-	-
MCPB	-	-	-	-	-	-	-	-	-	-
Mecoprop	-	-	-	0.00019	-	-	-	-	-	-
Picloram	-	-	-	<0.000080	-	-	-	-	-	-
Triclopyr	-	-	-	-	-	-	-	-	-	-
Pesticides										
Alachlor	-	-	-	-	-	-	-	-	-	-
Ametryn	-	-	-	-	-	-	-	-	-	-
Atrazine	-	-	-	-	-	-	-	-	-	-
Atrazine-desethyl	-	-	-	-	-	-	-	-	-	-
Azinphos-methyl	-	-	-	-	-	-	-	-	-	-
Bendiocarb	-	-	-	-	-	-	-	-	-	-
Carbaryl	-	-	-	-	-	-	-	-	-	-
Carbofuran	-	-	-	-	-	-	-	-	-	-
Chlorpyrifos	-	-	-	-	-	-	-	-	-	-
Cyanazine	-	-	-	-	-	-	-	-	-	-
Diazinon	-	-	-	-	-	-	-	-	-	-
Diclofop-methyl	-	-	-	-	-	-	-	-	-	-
Dimethoate	-	-	-	-	-	-	-	-	-	-
Malathion	-	-	-	-	-	-	-	-	-	-
Metolachlor	-	-	-	-	-	-	-	-	-	-
Metribuzin	-	-	-	-	-	-	-	-	-	-
Parathion	-	-	-	-	-	-	-	-	-	-
Parathion-methyl	-	-	-	-	-	-	-	-	-	-
Phorate	-	-	-	-	-	-	-	-	-	-
Prometon	-	-	-	-	-	-	-	-	-	-
Prometryn	-	-	-	-	-	-	-	-	-	-
Propazine	-	-	-	-	-	-	-	-	-	-
Simazine	-	-	-	-	-	-	-	-	-	-
Temephos	-	-	-	-	-	-	-	-	-	-
Terbufos	-	-	-	-	-	-	-	-	-	-
Terbutryn	-	-	-	-	-	-	-	-	-	-
Triallate	-	-	-	-	-	-	-	-	-	-
Trifluralin	-	-	-	-	-	-	-	-	-	-

Location	T6									
Field ID	T6	T6	T6	T6	T6	T6	T6	T6	T6	T6
Sample Date	12-Apr-2017	16-May-2017	20-Jun-2017	26-Jul-2017	28-Aug-2017	20-Sep-2017	8-Apr-2021	30-Aug-2021	29-Apr-2022	18-Aug-2022
Laboratory Report Number	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086	L2633873	EO2202900	EO2206724
Laboratory Sample ID	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	3rd Party	L2575086-3	L2633873-4	EO2202900-004	EO2206724-003
Field										
Field Electric Conductivity	608	822	**1239**	**1201**	**1063.4**	**1194.9**	763.6	**1586.7**	630	**1261.3**
Field Dissolved Oxygen	-	-	-	-	-	-	11.73	8.77	11.92	8.84
Field Total Dissolved Solids (TDS)	-	-	-	-	-	-	399.3	**1035.3**	340	**820**
Field Temperature	5.74	8.64	19.93	18.6	14.47	8.54	0.8	15.42	6.23	16.75
Field Turbidity	-	-	-	-	-	-	34.0	5.39	1.11	0.03
Field pH	7.8	7.97	7.93	7.95	7.53	7.89	6.54	8.14	9.58	7.95
Routine										
pH	8	-	8.12	-	8.1	-	7.85	8.16	7.93	8.14
Electrical Conductivity (EC)	600	-	**1200**	-	**1300**	-	650	**1560**	561	1250
Sodium Adsorption Ratio (SAR)	-	-	-	-	-	-	-	4.11	0.86	3.53
Total Suspended Solids (TSS)	10	6	4.7	2.7	4.7	6.7	44.3	5	43.2	3.6
Total Dissolved Solids (TDS)	350	-	**780**	-	**800**	-	420	**1110**	364	815
Hardness as $CaCO_3$	170	-	390	-	330	-	242	478	214	347
Alkalinity (total as $CaCO_3$)	110	-	180	-	290	-	87.3	264	110	264
Bicarbonate	140	-	220	-	360	-	107	322	135	322
Carbonate	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Hydroxide	<0.5	-	<0.5	-	<0.5	-	<5.0	<5.0	<1.0	<1.0
Calcium	48	-	96	-	85	-	68.9	120	58.7	88.5
Magnesium	12	-	36	-	29	-	17.1	43.4	16.3	30.6
Potassium	16	-	8.3	-	10	-	13.9	15.0	19.7	15.9
Sodium	49	-	130	-	160	-	34.6	207	28.2	151
Chloride	52	-	91	-	77	-	35.4	**119**	28.1	93.5
Fluoride	-	-	-	-	-	-	0.175	0.229	0.183	0.258
Sulphate	100	-	310	-	270	-	188	447	137	254
Ionic Balance	1.7	-	4.3	-	0.73	-	99.1	106	103	105
Nutrients										
Ammonia as N	0.37	0.057	0.045	0.028	-	0.028	0.858	0.025	0.644	0.0315
Nitrate (as NO_3-N)	0.4	-	0.012	-	<0.010	-	2.10	<0.020	0.317	<0.020
Nitrite (as NO_2-N)	0.026	-	<0.010	-	<0.010	-	0.089	<0.010	0.017	<0.010
Nitrate and Nitrate (as N)	0.42	-	0.012	-	<0.014	-	2.19	<0.022	0.334	<0.050
Total Nitrogen	-	-	-	-	-	-	-	0.985	2.76	-
Dissolved Kjeldahl Nitrogen	-	-	-	-	-	-	2.50	0.773	2.26	-
Total Kjeldahl Nitrogen (TKN)	2.3	1.3	1.1	1	0.66	0.59	2.86	0.985	2.43	1.29
Phosphorus - Total	0.17	0.098	0.17	0.31	0.038	0.03	0.268	0.069	0.311	0.0557
Phosphorus - Total Dissolved	0.1	0.039	0.065	0.23	-	0.0069	0.106	0.021	0.105	0.0296
Total Metals										
Aluminum	0.12	-	0.062	-	0.17	-	-	0.0523	-	0.0286
Antimony	<0.00060	-	<0.00060	-	<0.00060	-	-	0.00015	-	0.00018
Arsenic	0.0018	-	0.0026	-	0.0021	-	-	0.00156	-	0.00193
Barium	0.044	-	0.042	-	0.053	-	-	0.0527	-	0.0483
Boron	0.064	-	0.074	-	0.1	-	-	0.135	-	0.106
Cadmium	0.000025	-	<0.000020	-	0.000035	-	-	0.0000118	-	0.0000128
Chromium	<0.0010	-	<0.0010	-	<0.0010	-	-	0.00013	-	<0.00050
Cobalt	0.00072	-	0.00051	-	0.0012	-	-	-	-	0.0006
Copper	0.0033	-	0.0012	-	0.0014	-	-	0.0015	-	0.00138
Iron	1.1	-	0.82	-	1.3	-	-	0.700	-	0.303
Lead	0.00031	-	<0.00020	-	0.00074	-	-	0.000084	-	<0.000050
Manganese	0.092	-	0.12	-	**0.6**	-	-	**0.38**	-	0.192
Mercury	-	-	-	-	-	-	-	<0.0000050	-	<0.0000050
Nickel	0.0055	-	0.0041	-	0.0053	-	-	0.00516	-	0.00739
Selenium	0.00026	-	0.00031	-	<0.00020	-	-	0.000233	-	0.000259
Silver	<0.00010	-	<0.00010	-	<0.00010	-	-	<0.000010	-	0.000014
Thallium	<0.00020	-	<0.00020	-	<0.00020					
Uranium	0.0015	-	0.0021	-	0.001	-	-	0.00177	-	0.00174
Zinc	0.0054	-	<0.0030	-	0.005	-	-	<0.0030	-	<0.0030
Dissolved Metals										
Iron	0.71	-	0.4	-	<0.060	-	-	-	0.451	0.034
Coliforms										
Total Coliforms	-	-	-	-	-	-	-	2300	-	866
E.Coli	-	-	-	-	-	-	-	<1	-	16
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a) pyrene	-	-	-	-	-	-	-	<0.0000050	-	-
Phenols										
Pentachlorophenol	-	-	-	<0.000080	-	-	-	<0.00050	-	<0.00010
Herbicides										
2,4,5-T	-	-	-	<0.000080	-	-	-	<0.00010	-	<0.000050
2,4,5-TP	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-D	-	-	-	0.0011	-	-	-	<0.00010	-	<0.000050
2,4-DB	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.000050
2,4-DP	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Bromoxynil	-	-	-	<0.00002	-	-	-	*<0.0010*	-	<0.000050
Clopyralid	-	-	-	-	-	-	-	<0.0010	-	<0.00131
Dicamba	-	-	-	**0.00022**	-	-	-	*<0.00010*	-	*<0.00010*
Dinoseb	-	-	-	<0.000020	-	-	-	*<0.0010*	-	<0.000050
MCPA	-	-	-	**0.0001**	-	-	-	*<0.00010*	-	*<0.000050*
MCPB	-	-	-	-	-	-	-	<0.0010	-	<0.000050
Mecoprop	-	-	-	0.00059	-	-	-	<0.0010	-	<0.000050
Picloram	-	-	-	<0.000080	-	-	-	<0.0010	-	<0.00021
Triclopyr	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Pesticides										
Alachlor	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Ametryn	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Atrazine	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Atrazine-desethyl	-	-	-	-	-	-	-	<0.00010	-	<0.000050
Azinphos-methyl	-	-	-	-	-	-	-	*<0.00010*	-	*<0.00010*
Bendiocarb	-	-	-	-	-	-	-	<0.00050	-	<0.00050
Carbaryl	-	-	-	-	-	-	-	*<0.00050*	-	<0.000050
Carbofuran	-	-	-	-	-	-	-	<0.00050	-	<0.00020
Chlorpyrifos	-	-	-	-	-	-	-	*<0.00010*	-	*<0.00010*
Cyanazine	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Diazinon	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Diclofop-methyl	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Dimethoate	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Malathion	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Metolachlor	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Metribuzin	-	-	-	-	-	-	-	*<0.0010*	-	<0.00010
Parathion	-	-	-	-	-	-	-	*<0.00010*	-	*<0.00010*
Parathion-methyl	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Phorate	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Prometon	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Prometryn	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Propazine	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Simazine	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Temephos	-	-	-	-	-	-	-	<0.0010	-	<0.0010
Terbufos	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Terbutryn	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Triallate	-	-	-	-	-	-	-	<0.00010	-	<0.00010
Trifluralin	-	-	-	-	-	-	-	<0.00010	-	<0.00010

Notes:

[1] Government of Alberta. 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Table 1 Surface water quality guidelines for the protection of freshwater aquatic life (PAL). Most conservative values applied (chronic or acute). Table 2 Water quality guidelines for the protection of agricultural water uses, for irrigation and livestock water. Table 3 Surface water quality guidelines for recreation and aesthetics.

[2] Maximum increase of 25 mg/L from background (M2)

[3] Guideline is crop-specific

[4] Guideline varies with hardness. Values shown based on hardness range of 88 mg/L to 515 mg/L.

[5] Guideline varies with pH and temperature. Values shown based on pH range of 6.54 to 11.26 and temperature range of 0.3 °C to 24.8 °C

[6] Guideline varies with chloride. Values shown based on chloride range of 3.31 mg/L to 119 mg/L.

[7] Maximum increase of 8 NTU from background (M2)

[8] Guideline is for Chromium VI

[9] Guideline varies with pH. Values shown based on pH range of 6.54 to 9.58

"-" No applicable guideline or not analyzed

BOLD - Greater than Agricultural guideline.

Shaded - Greater than PAL guideline.

Red - Greater than Recreation / Aesthetics guideline.

Italic - Detection limit greater than applicable Alberta Surface Water Quality Standard

N/A - Not applicable.

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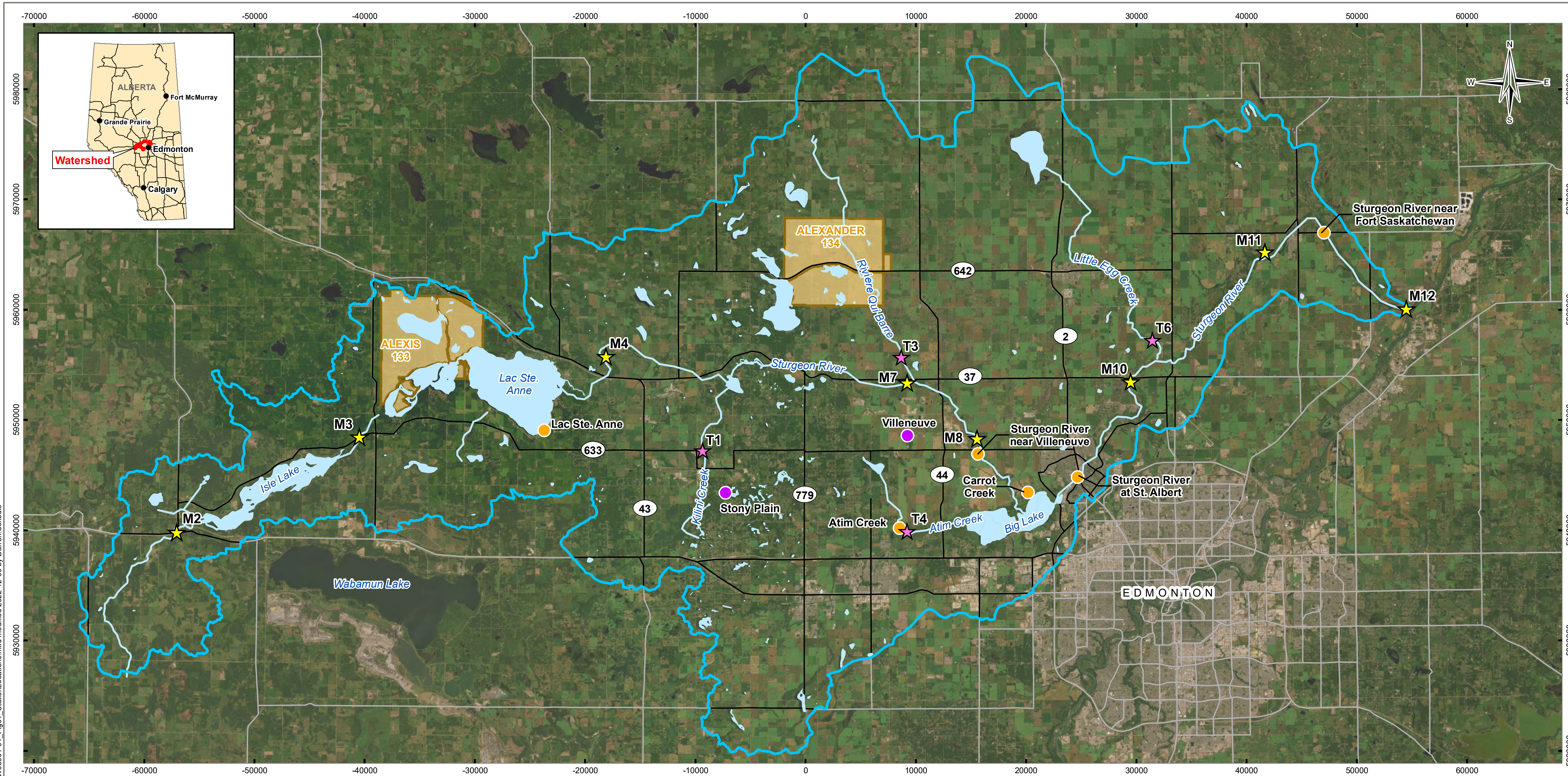
Table 2: Surface Water Quality Assurance/Quality Control Analytical Results

		QAQC Type	Duplicate															
		Field ID	M7	DUP 1	RPD (%)	Pass/Fail	M11	DUPLICATE 1	RPD (%)	Pass/Fail	M12	DUP	RPD (%)	Pass/Fail	M8	DUP	RPD (%)	Pass/Fail
		Sample Date	8-Apr-2021	8-Apr-2021			30-Aug-2021	30-Aug-2021			29-Apr-2022	29-Apr-2022			18-Aug-2022	18-Aug-2022		
		Laboratory Report Number	L2575086	L2575086			L2633873	L2633873			EO2202900	EO2202900			EO2206724	EO2206724		
		Laboratory Sample ID	L2575086-6	L2575086-12			L2633873-11	L2633873-13			EO2202900-012	EO2202900-013			EO2206724-005	EO2206724-013		
Parameter	**Unit**	**RDL**																
Routine																		
pH	pH Units	0.1	8.14	8.18	0.5	Pass	8.24	8.23	0.1	Pass	8.27	8.29	0.2	Pass	8.26	8.29	0	Pass
Electrical Conductivity (EC)	µS/cm	2	400	420	5	Pass	1080	1080	0	Pass	544	542	0.4	Pass	627	627	0	Pass
Sodium Adsorption Ratio (SAR)	N/A	0.1	-	-	-	-	1.44	1.41	2	Pass	1.14	1.18	3	Pass	1.93	1.83	5	Pass
Total Suspended Solids (TSS)	mg/L	3	12.5	11.5	-	Pass	7.2	8.6	18	Pass	128	99.0	**26**	**Fail**	<3.0	3	-	**Fail**
Total Dissolved Solids (TDS)	mg/L	N/A	253	250	1	Pass	791	788	0.4	Pass	338	336	1	Pass	401	395	2	Pass
Hardness as $CaCO_3$	mg/L	N/A	150	151	1	Pass	515	511	1	Pass	202	199	1	Pass	211	203	4	Pass
Alkalinity (total as $CaCO_3$)	mg/L	2	193	190	2	Pass	238	240	1	Pass	125	125	0	Pass	238	238	0	Pass
Bicarbonate	mg/L	5	235	232	1	Pass	290	292	1	Pass	152	152	0	Pass	290	289	0	Pass
Carbonate	mg/L	5	<5.0	<5.0	-	Pass	<5.0	<5.0	-	Pass	<1.0	<1.0	-	Pass	<1.0	<1.0	-	Pass
Hydroxide	mg/L	5	<5.0	<5.0	-	Pass	<5.0	<5.0	-	Pass	<1.0	<1.0	-	Pass	<1.0	<1.0	-	Pass
Calcium	mg/L	0.5	39.8	40.0	1	Pass	129	127	2	Pass	56.2	55.3	2	Pass	45.2	44.1	2	Pass
Magnesium	mg/L	0.1	12.4	12.4	0	Pass	46.8	47.2	1	Pass	14.9	14.7	1	Pass	23.8	22.6	5	Pass
Potassium	mg/L	0.5	8.66	8.53	2	Pass	6.43	6.55	2	Pass	10.3	10.1	2	Pass	8.26	8.29	0	Pass
Sodium	mg/L	1	35.1	33.8	4	Pass	75.1	73.2	3	Pass	38.6	37.8	2	Pass	64.4	60.1	7	Pass
Chloride	mg/L	0.5	10.2	10.2	0	Pass	18.1	18.0	1	Pass	33.1	33.0	0.3	Pass	15.2	15.2	0	Pass
Fluoride	mg/L	0.02	0.130	0.132	2	Pass	0.200	0.21	5	Pass	0.158	0.153	3	Pass	0.129	0.122	6	Pass
Sulphate	mg/L	0.3	29.6	29.8	1	Pass	373	372	0.3	Pass	106	106	0	Pass	81.2	81.5	0	Pass
Nutrients																		
Ammonia as N	mg/L	0.05	0.059	0.057	-	Pass	0.011	<0.010	-	Pass	0.0318	0.0262	-	Pass	0.0091	0.0088	3	Pass
Nitrate (as NO_3-N)	mg/L	0.02	0.330	0.331	0.3	Pass	<0.020	<0.020	-	Pass	<0.020	<0.020	-	Pass	<0.020	<0.020	-	Pass
Nitrite (as NO_2-N)	mg/L	0.01	<0.010	<0.010	-	Pass	<0.010	<0.010	-	Pass	<0.010	<0.010	-	Pass	<0.010	<0.010	-	Pass
Nitrate and Nitrate (as N)	mg/L	0.02	0.330	0.331	0.3	Pass	<0.022	<0.022	-	Pass	<0.0500	<0.0500	-	Pass	<0.050	<0.050	-	Pass
Dissolved Kjeldahl Nitrogen	mg/L	0.2	1.13	0.99	13	Pass	0.699	0.669	-	Pass	1.42	1.37	4	Pass	-	-	-	-
Total Nitrogen	mg/L	0.05	-	-	-	Pass	0.532	0.551	4	Pass	2.21	2.01	9	Pass	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	mg/L	0.2	1.37	1.35	1	Pass	0.699	0.669	-	Pass	2.21	2.01	9	Pass	1.11	1.05	6	Pass
Phosphorus - Total	mg/L	0.02	0.114	0.115	1	Pass	0.061	0.061	-	Pass	0.258	0.258	0	Pass	0.284	0.268	6	Pass
Phosphorus - Total Dissolved	mg/L	0.02	0.056	0.058	-	Pass	0.033	0.030	-	Pass	0.233	0.269	14	Pass	0.251	0.252	0	Pass
Coliforms																		
Total Coliforms	CFU/100mL	1	-	-	-	-	3000	2500	18	Pass	-	-	-	-	2420	2180	10	Pass
E.Coli	CFU/100mL	1	-	-	-	-	1200	<1.0	-	**Fail**	-	-	-	-	21	33	**44**	**Fail**

Notes:
RDL - Reportable detection limit
RPD - Relative Percentage Difference calculated as RPD(%)=(|V1-V2|)/[(V1+V2)/2])*100 where V1,V2 = concentrations of parent and duplicate sample, respectively.
"-" Indicates RPD not calculated or not analyzed. RPDs have only been considered where both concentrations are greater than 5 times the RDL
N/A - Not applicable
BOLD - RPD value greater than 20%

FIGURES



LEGEND

- Sturgeon River Sampling Station
- Tributary Water Quality Station
- Hydrometric Station
- Meteorological Station

Base Data

- First Nation Reserve
- Sub-watershed Boundary
- Waterbody
- Watercourse
- Road

NOTES
Base data source:
CanVec 1:250,000 & 1:1,000,000 (2019)
Government of Alberta (2022)

STATUS
ISSUED FOR USE

WATER SAMPLING PROGRAM STURGEON RIVER WATERSHED

Sturgeon River Sampling Stations

PROJECTION	DATUM	CLIENT
3TM 114	NAD83	North Saskatchewan Watershed Alliance (NSWA)

Scale: 1:350,000
6 3 0 6
Kilometres

FILE NO.
EENW03601-01_Fig01_StationLocations.mxd

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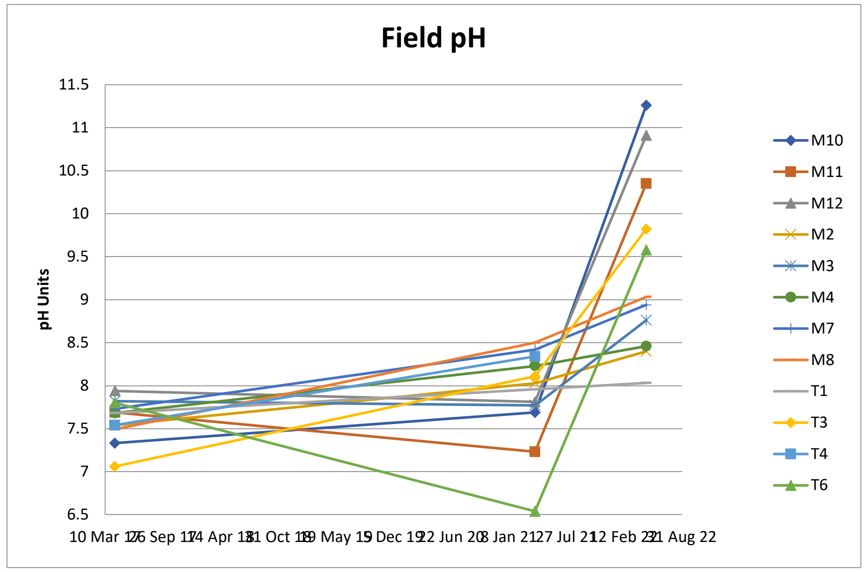
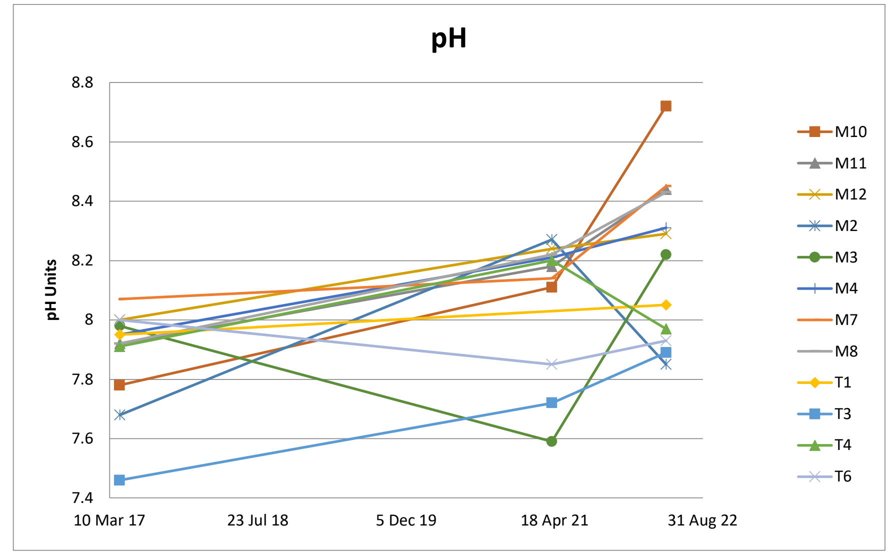
OFFICE	DWN	CKD	APVD	REV
Tt-VANC	DS	SL	SF	0

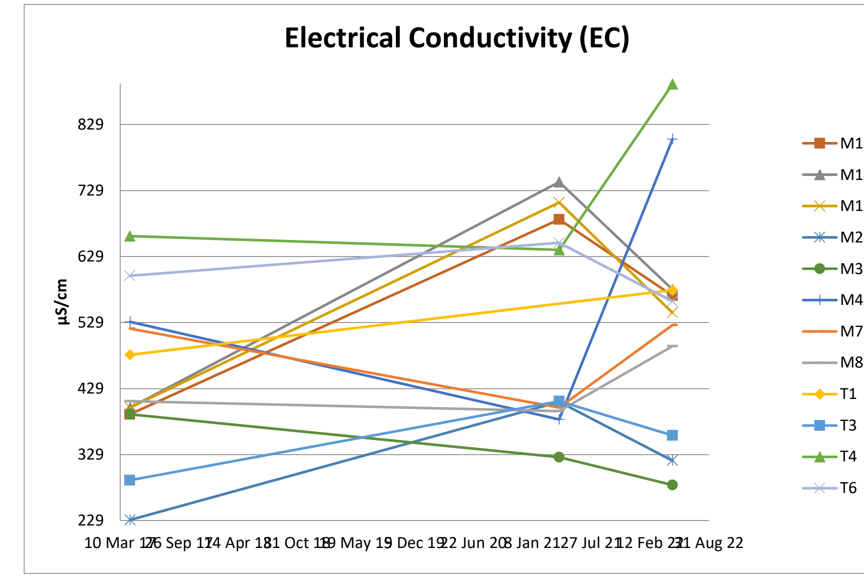
DATE	PROJECT NO.
December 6, 2022	ENW.EENW03601-01

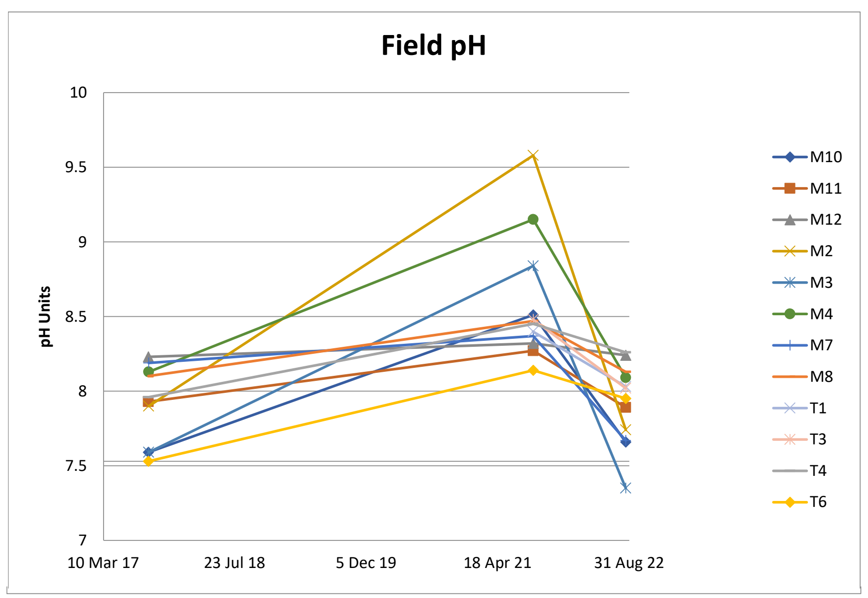
Figure 1

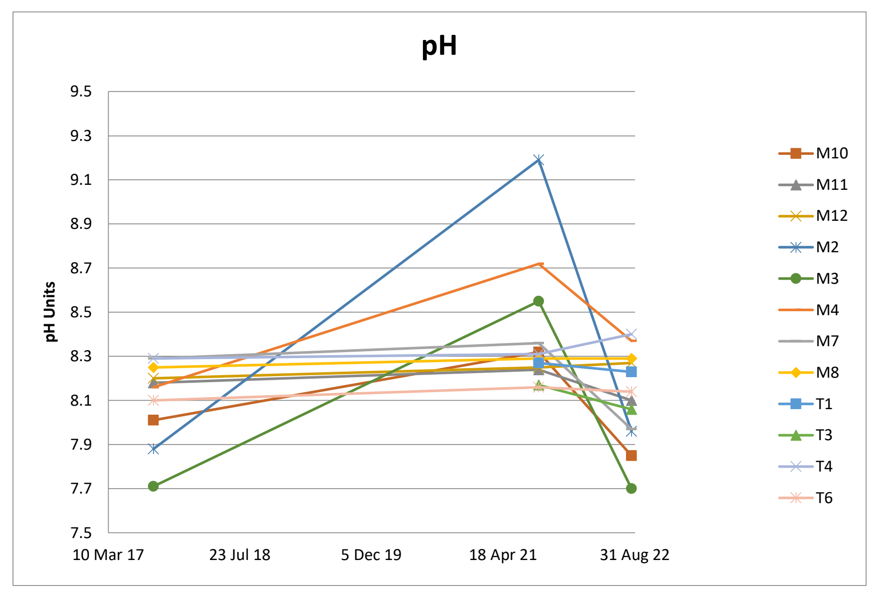
Q:\Vancouver\GIS\ENVIRONMENTAL\EENW\EENW03601-01\Maps\EENW03601-01_Fig01_StationLocations.mxd modified 2022-12-06 by Darren Schouls











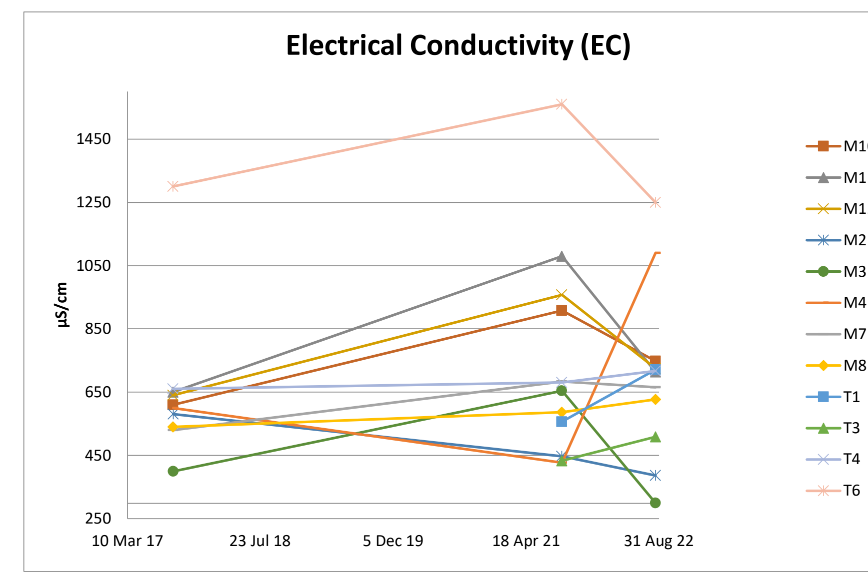


Figure 2a: Field pH, pH, and Electrical Conductivity (EC) Trend Charts

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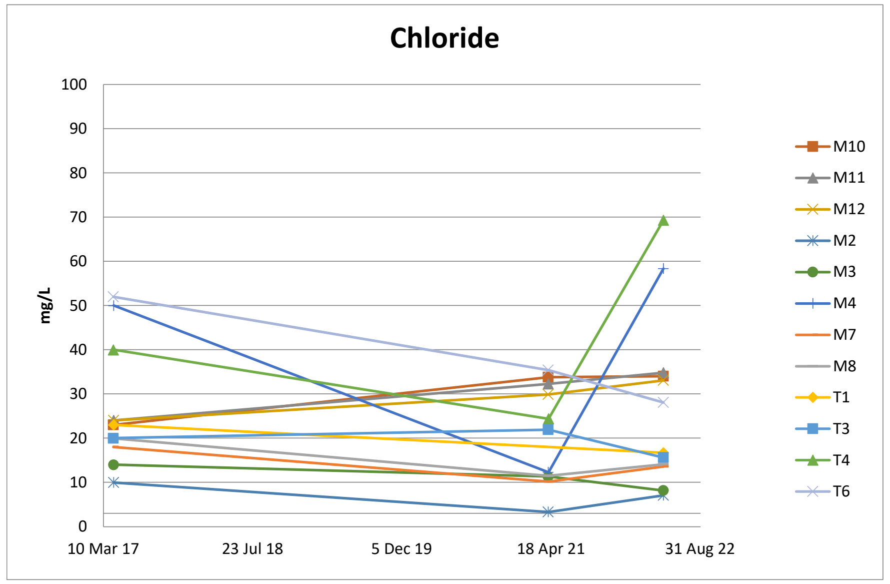
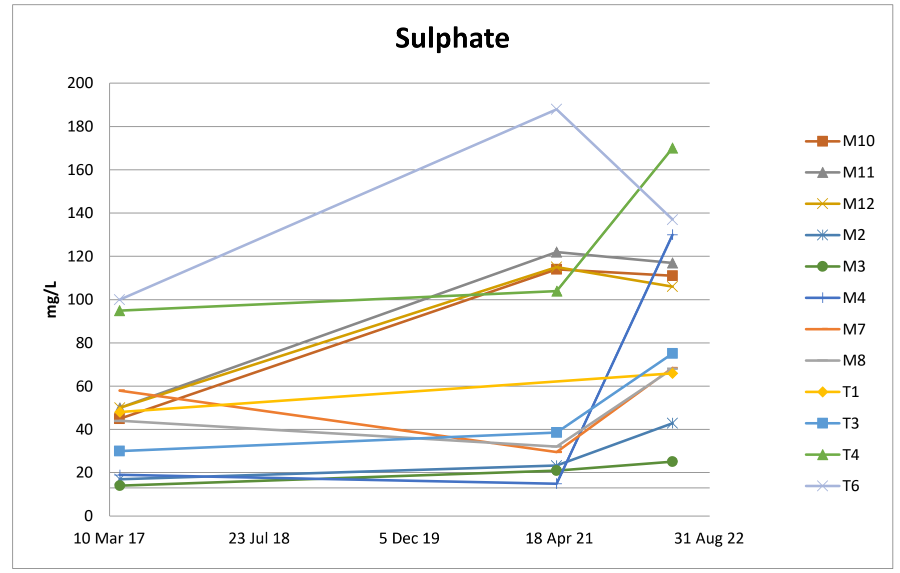
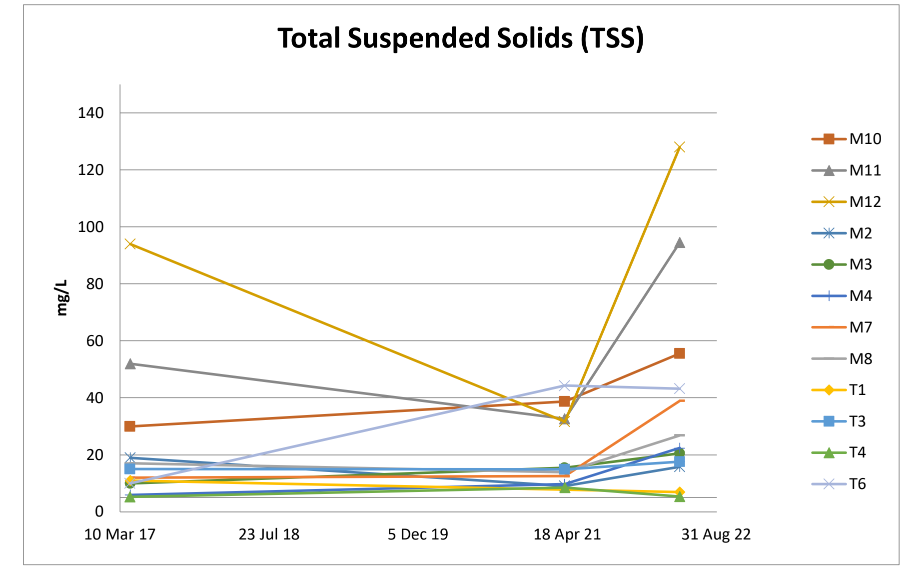
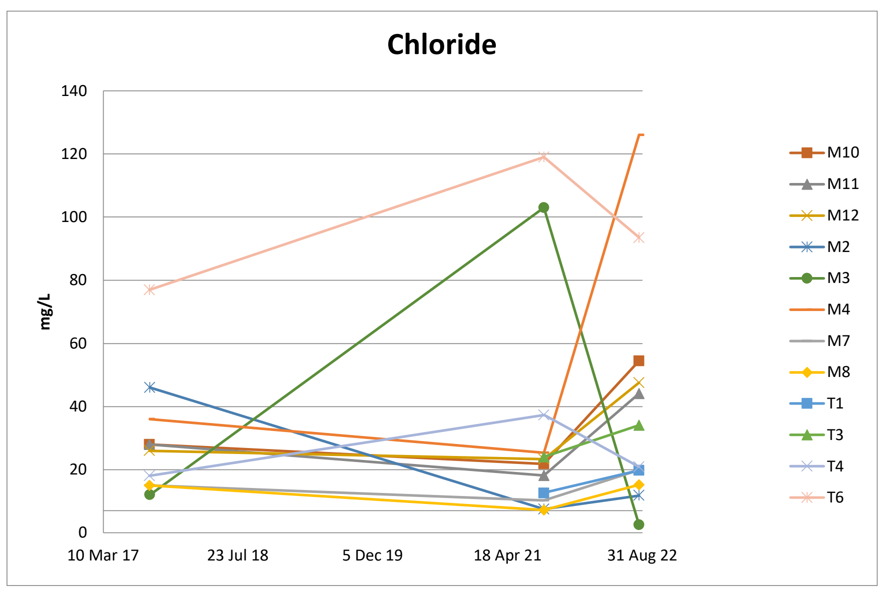
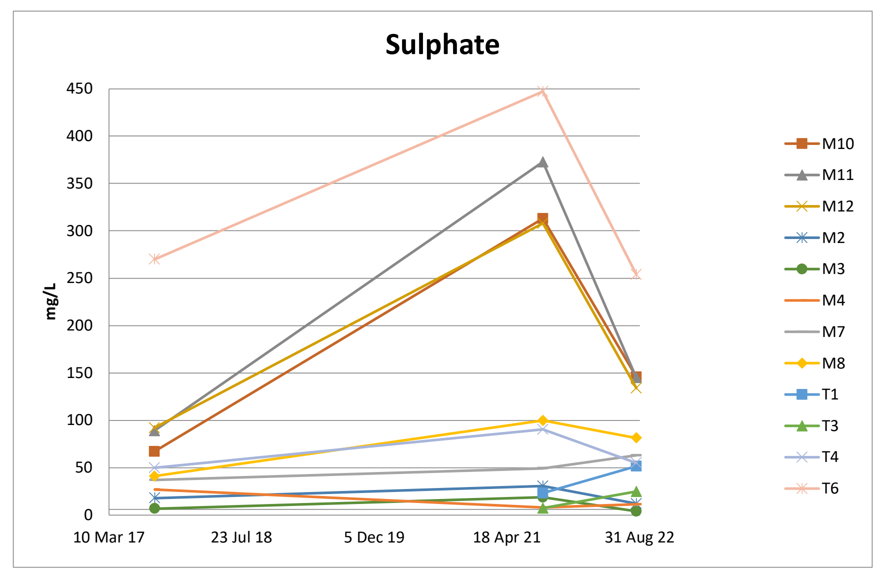










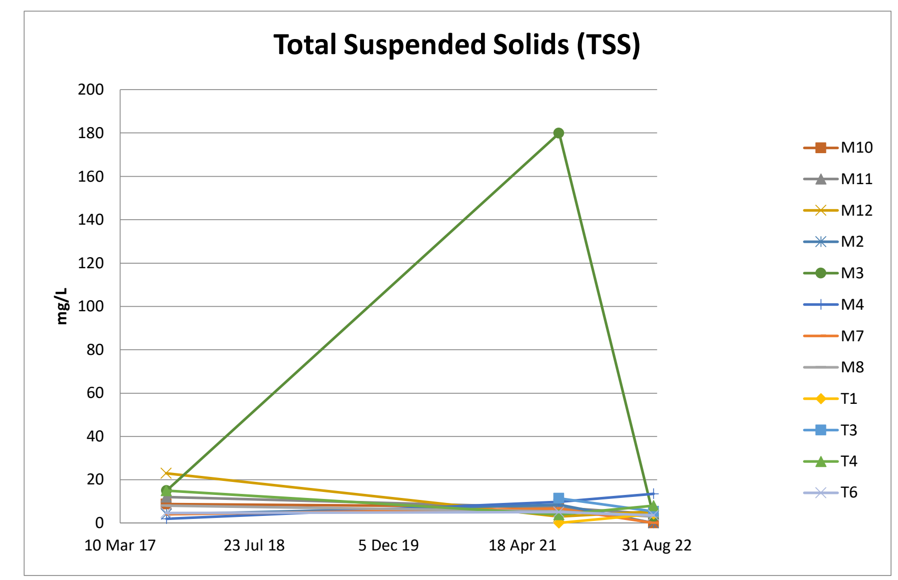
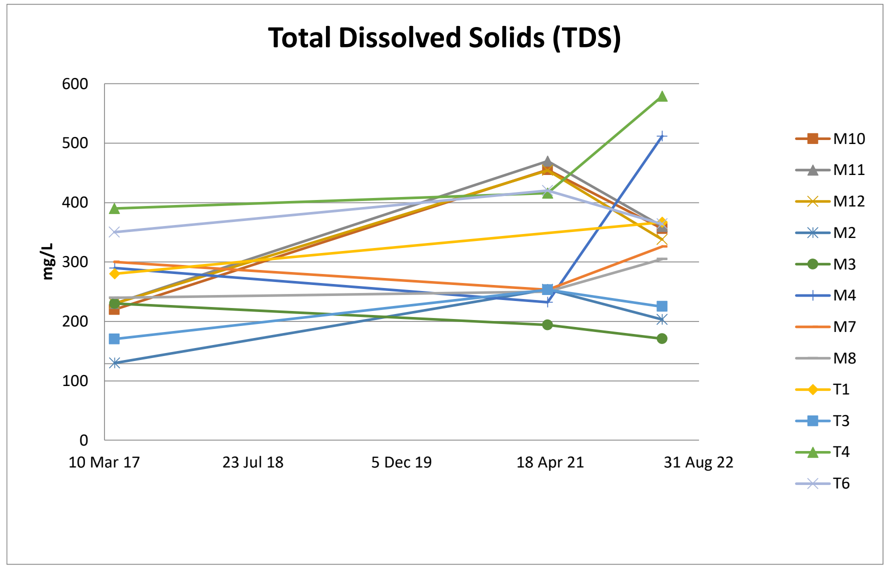
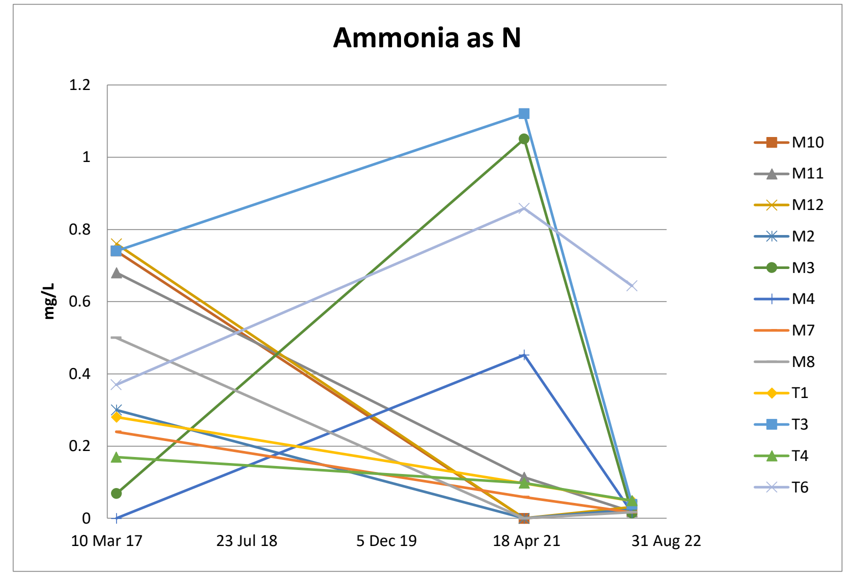
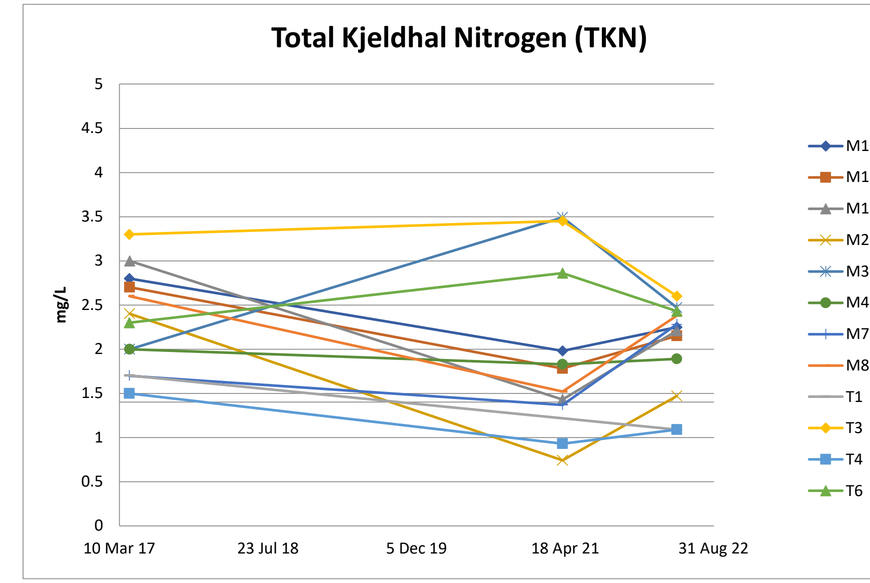
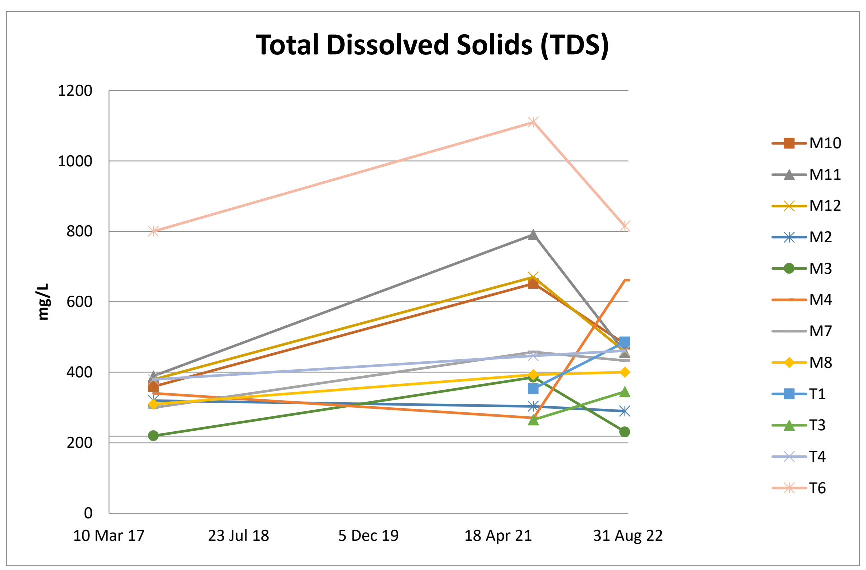


Figure 2b: Chloride, Sulphate, and Total Suspended Solids (TSS) Trend Charts









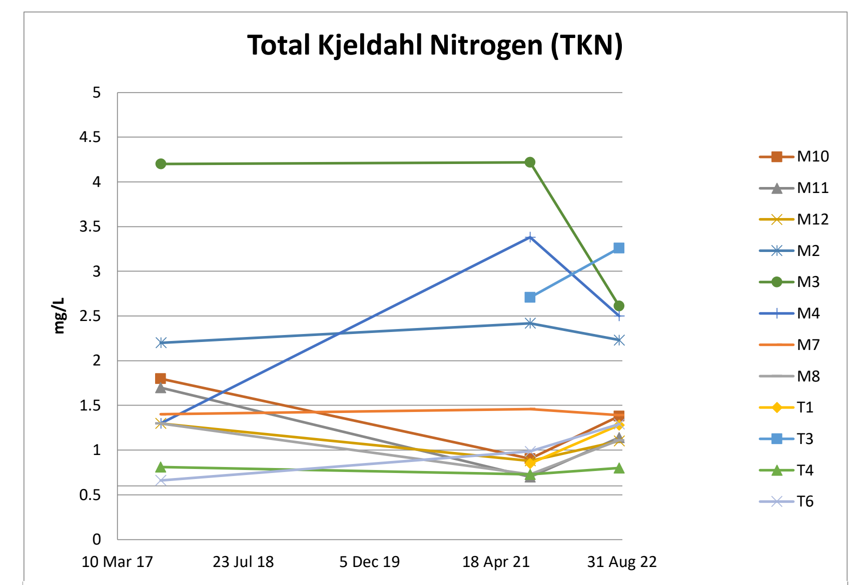
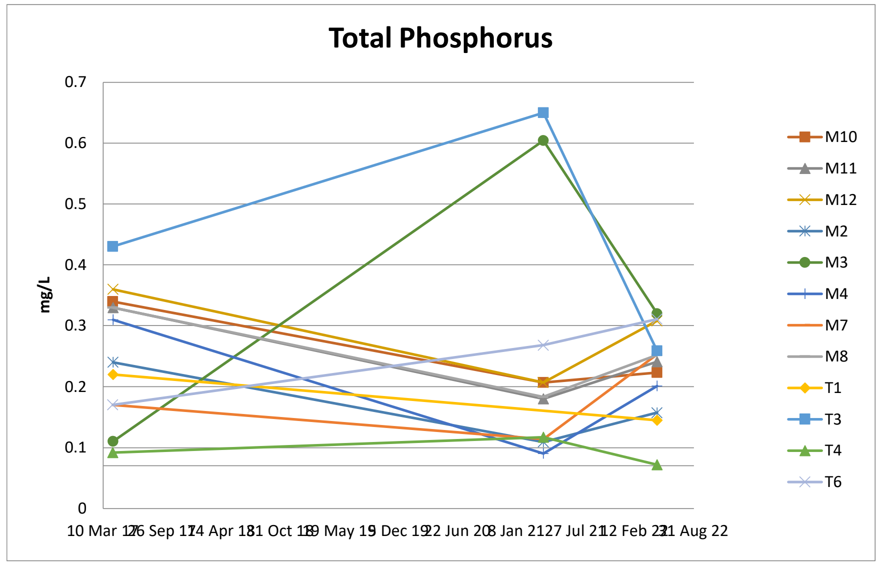
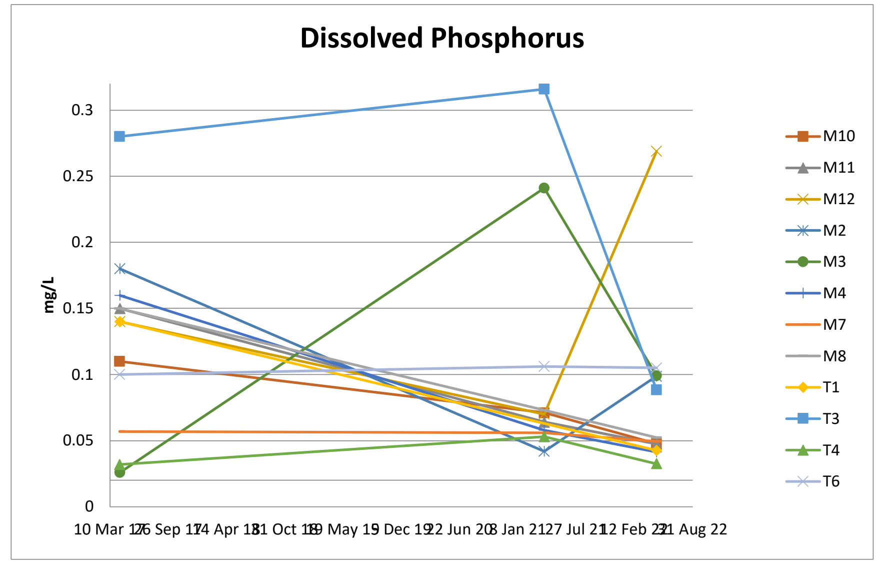


Figure 2c: Total Dissolved Solids, Ammonia as N, and Total Kjeldahl Nitrogen (TKN) Trend Charts

TETRA TECH





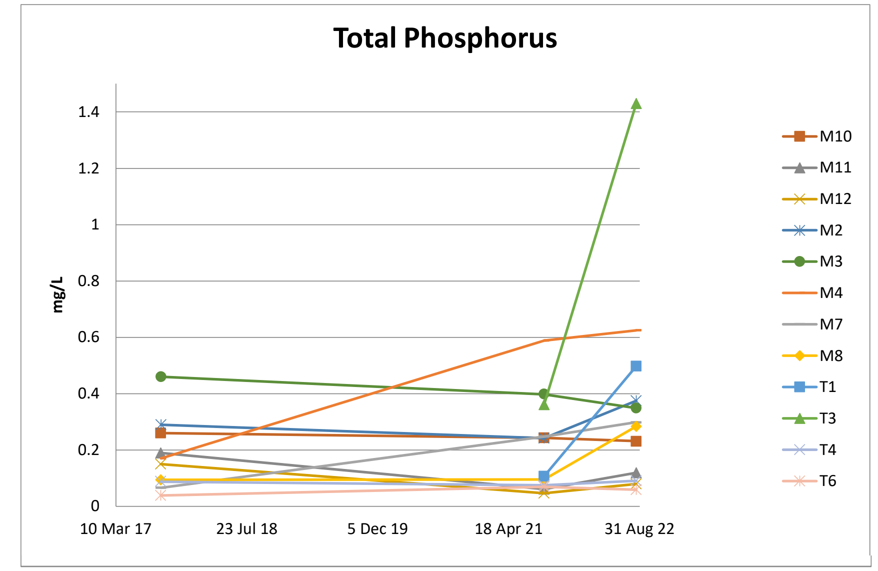


Figure 2d: Total Phosphorus and Dissolved Phosphorus Trend Charts

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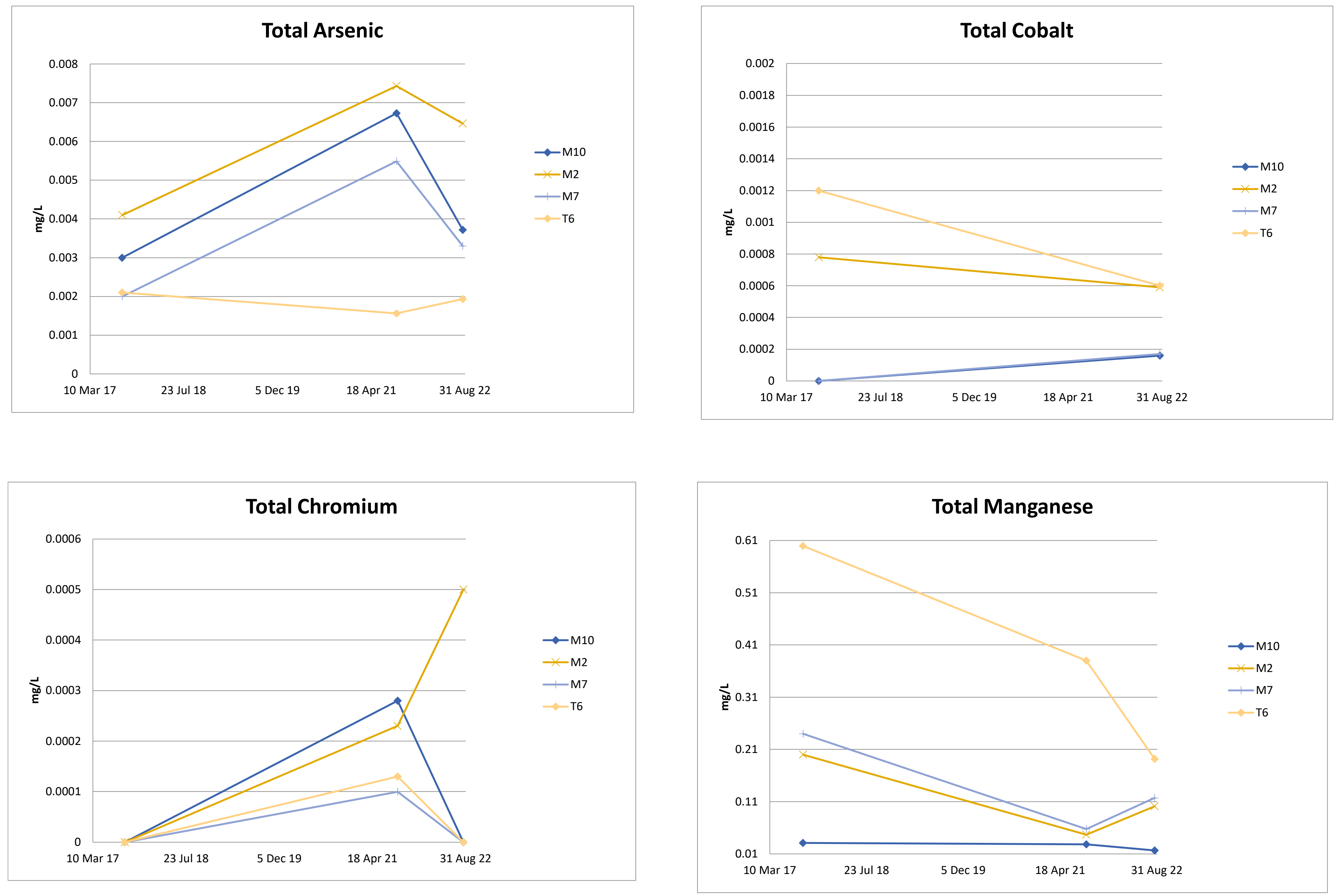

Figure 2e: Total Arsenic, Total Chromium, Total Cobalt, and Total Manganese Trend Charts

APPENDIX A

2022 SAMPLING LOCATION PHOTOGRAPHS

Photo 1: Sampling Location M2. April 29, 2022.

Photo 2: Sampling Location M3. April 29, 2022.

Photo 3: Sampling Location M4. April 29, 2022.

Photo 4: Sampling Location M7. April 29, 2022.

Photo 5: Sampling Location M8. April 29, 2022.

Photo 6: Sampling Location M10. April 29, 2022.

Photo 7: Sampling Location M11. April 29, 2022.

Photo 8: Sampling Location M12. April 29, 2022.

Photo 9: Sampling Location T1 (Kilini Creek). April 29, 2022.

Photo 10: Sampling Location T3 (Riviere Qui Barre). April 29, 2022.

Photo 11: Sampling Location T4.
April 29, 2022
(Atim Creek)

Photo 12: Sampling Location T6 (Little Egg Creek).
April 29, 2022

APPENDIX B

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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