Spatial Patterns (2016-2020) and Temporal Trends (1966-2020) in Stream Water Quality across TRCA's Jurisdiction

Prepared by Watershed Planning and Ecosystem Science

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EXECUTIVE SUMMARY

Stream water quality was sampled across the Toronto region between 2016 and 2020 as part of Toronto and Region Conservation Authority's (TRCA) Regional Watershed Monitoring Program (RWMP). The RWMP collects water in streams and measures several contaminants including metals, chloride, and *Escherichia coli (E. coli)* which can be harmful to aquatic life and human health. Phosphorus and nitrogen were also measured because high concentrations can lead to poor water quality conditions (algal blooms, water devoid of oxygen or toxic conditions for fish and other aquatic species). This report contains two major sections: spatial patterns (2016-2020) and temporal trends (~1960-2020).

Spatial patterns

- Water quality was better in the headwaters of each watershed and in watersheds with lower urban development.
- Generally, copper, iron, and zinc concentrations in streams were highest near their output into Lake Ontario although Etobicoke Creek and Mimico Creek generally demonstrated elevated levels throughout the watershed.
- *E. coli* concentrations were highest in the summer months and exceeded water quality objectives at almost every station.
- Nitrogen concentrations were the highest in the Don River watershed but remained below the water quality objective suggesting that levels are not likely to cause toxic effects.
- Phosphorus concentrations were highest at the mouth of the Don River watershed surpassing acceptable levels to protect aquatic life.
- Chloride concentrations were highest in the winter and spring months across the region with Etobicoke Creek, Mimico Creek, and the lower Humber River watershed having the highest concentrations compared to other watersheds. Between 2016 and 2020, 9 of 47 water quality stations had average chloride concentrations above the threshold which protects aquatic life from lethal effects.

Temporal trends

- In general, phosphorus concentrations have been declining across the region since the 1960s.
- The concentration of suspended solids in the water declined at the majority of stations over the past 50 years with the most noticeable declines occurring between 1966-1980 and 2006-2015.
- The continued increase in chloride concentrations over the past 50 years at the majority of water quality stations are a cause for serious concern. The number of stations with median chloride concentrations above the chronic effects guideline has increased over time from 4 out of 12 stations in 1991-1995 to 11 out of 13 stations in 2016-2020.

While many of these substances are naturally occurring in the environment, high concentrations can be toxic to aquatic life and humans. Sources of these contaminants on the landscape vary. Metals generally enter streams through run-off from industry, landfills, car tires, and sewage treatment effluent while chloride generally comes from road salts applied during the winter season. *E. coli*, phosphorus, and nitrogen can be from many sources including sewage effluent, animal wastes, and fertilizers.

Many organizations are using best management practices to mitigate the impacts of contaminants and improve general stream quality (e.g. improvements in sewage treatment capabilities and stormwater management, fertilizing relative to agricultural needs, banning pesticides for personal use, salt management programs, and requiring household detergents to be phosphate-free); however, more efforts are needed to meet stream water quality objectives.

The following recommendations are offered for consideration:

- Continue to partner with the Ministry of the Environment, Conservation and Parks' (MECP) Provincial Water Quality Monitoring Network (PWQMN) to monitor stream water quality and contribute to the broader Ontario stream water quality dataset.
- Communicate the results of this report with partner municipalities to make them aware of several important observations including:
    - The strong spatial pattern in overall water quality (i.e. poor conditions in urban areas and better conditions in rural areas) suggests that past/current standards for urban development are insufficient and unsustainable for protecting aquatic life and freshwater resources. As urban growth continues to occur within the Toronto region, low impact development (LID), green and blue infrastructure, and the most innovative technologies related to stormwater management and wastewater treatment must be included. Where intensification is planned, more effort must be made to retrofit existing/aging water management infrastructure, conduct source-tracking in areas of particular concern, educate home/private business owners on best practices, and develop targets for urban green and blue infrastructure. Watershed planning should be used as a tool to set targets and identify the critical areas where these measures are needed to help direct the most effective locations for these investments as urban growth continues.
    - Chloride concentrations continue to increase in streams and concentrations are rising more in streams with already high concentrations. Retention in soil, groundwater, and stormwater ponds are causing a time lag in release meaning that concentrations will continue to rise even if mitigation measures are implemented immediately. The Sustainable Technologies Evaluation Program (STEP; https://sustainabletechnologies.ca) can provide guidance for designing and implementing salt management programs.
- While grab samples are widely used to represent stream conditions, they only reflect conditions at one particular time (i.e. a "snap shot") and may not reflect the full range of water quality conditions occurring in streams (e.g. minimum and maximum values). Continuous monitoring, with intermittent grab samples, should be considered at least at the outlet of each watershed. Some continuous monitoring of water quality started in January 2021 at the mouth of several watersheds through the Northshore Monitoring Program, an initiative between TRCA, City of Toronto, Peel Region and Durham Region. The Northshore project has had a sonde monitoring conductivity, pH, turbidity, dissolved oxygen along with several other parameters at the outlet of each watershed except for Mimico Creek. We recommend that a sonde should be installed at the mouth of Mimico Creek. The program commenced in January 2021 and is expected to run for 5 years.
- Further research should be conducted to understand why chloride concentrations continue to rise in fully urbanized watersheds, why chloride concentrations are increasing more at stations with already higher concentrations compared to those with already lower concentrations, identify salt vulnerable areas of the jurisdiction, and develop novel/innovative solutions to manage chloride.
- Determine the percent cover of various land use types (e.g. impervious surfaces, industrial, natural) in catchments upstream of water quality monitoring stations and examine relationships between land use types and water quality conditions.
- Where possible, further analyses should be conducted to account for stream flow and seasonality.

For support implementing recommendations related to sustainable technologies, green infrastructure (GI), and LIDs, or further information on water quality in TRCA's jurisdiction, please see the following resources:

- LID Treatment Train Tool – Helps evaluate water quantity/quality impacts that GI can have at the site scale: https://sustainabletechnologies.ca/lid-ttt
- LID stormwater management planning and design guide – Provides information on design, installation, and operation/maintenance of LIDs: https://wiki.sustainabletechnologies.ca/
- The STEP website – Provides resources, tools, and case studies related to sustainable technologies. Within the website there is a resource library to help navigate:
    - https://sustainabletechnologies.ca/
    - https://sustainabletechnologies.ca/resource-library/water/
- LID Life Cycle Costing Tool – Provides an estimate of capital and ongoing maintenance costs for implementing LIDs: https://sustainabletechnologies.ca/lid-lcct/
- TRCA's Watershed and Ecosystems Reporting Hub allows the user to interactively explore information about watersheds and the waterfront in the Toronto region: https://trca.ca/watershed-planning-reporting/. Information on the Hub (including reporting on water quality indicators) will be updated on a regular basis.

ACKNOWLEDGEMENTS

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BC MOE	British Columbia Ministry of the Environment
CCME	Canadian Council of Ministers of the Environment
CDC	Centers for Disease Control and Prevention
CFU	Colony Forming Units
CWQG	Canadian Water Quality Guidelines
EC	Environment Canada
EC & HC	Environment Canada and Health Canada
GI	Green Infrastructure
LID	Low Impact Development
MECP	Ministry of the Environment, Conservation and Parks
OMOE	Ontario Ministry of the Environment
OMOEE	Ontario Ministry of the Environment and Energy
PMCMR	Pairwise Multiple Comparison of Mean Ranks Package
PWQMN	Provincial Water Quality Monitoring Network
PWQO	Provincial Water Quality Objective
QA/QC	Quality Assurance/Quality Control
RWMP	Regional Watershed Monitoring Program
TP	Total Phosphorus
TRCA	Toronto and Region Conservation Authority
TSS	Total Suspended Solids
US EPA	United States Environmental Protection Agency
WQI	Water Quality Index
YSI	Yellow Springs Instrument

1. INTRODUCTION

Every living thing on earth needs water to survive. Water is used for personal, recreational, and work-related purposes. Water quality sustains ecological processes that support fish populations, vegetation, wetlands, and bird life. Protecting water quality requires monitoring to identify problems and implement corrective actions.

Agriculture and urbanization are the two main land use activities that negatively affect stream water quality (Paul and Meyer 2001, TRCA 2011). Stream water quality is impaired by these land uses through the application of fertilizers to agricultural land, salting roads in the winter, discharging wastewater from industries and sewage treatment plants, and non-point source urban runoff. Monitoring helps water resource managers understand the impacts of various activities on water quality so that informed decisions can be made to manage and protect this valuable resource.

Since 2002, Toronto and Region Conservation Authority (TRCA) has partnered with the province's Provincial Water Quality Monitoring Network (PWQMN) to monitor surface water quality throughout TRCA's jurisdiction. Surface water quality samples are collected monthly at 47 sites across the jurisdiction plus several other sites on an as-needed basis. Samples are analyzed for a routine set of analytes including metals, nutrients, and bacteria. In addition to routine monitoring, two sentinel sites at the mouths of the Don and Humber Rivers are also analyzed for mercury and pesticides. These data enable TRCA and other agencies to identify general locations of water quality impairment and determine the effectiveness of broad pollution control and watershed management programs.

This report contains two major sections: spatial patterns (2016-2020) and temporal trends (~1960-2020). The spatial pattern results summarize current (2016-2020) stream water chemistry within TRCA's jurisdiction and complements the annual surface water quality report published each year. This 5-year report should be used as the most recent characterization of stream water quality across the region since it contains a larger sample size than the annual report and includes inter-annual weather differences, which may not be as broadly captured in the annual report. The temporal trend results summarize changes in stream water chemistry using a long-term dataset at stations with sufficient data. Stream water chemistry for TRCA's jurisdiction has been summarized previously for longer periods of time including 1990-1996 (TRCA 1998), 1996-2002 (TRCA 2003), 2003-2007 (TRCA 2009), 2006-2010 (TRCA 2011), and 2011-2015 (TRCA 2017a, 2017b).

1.1 Background

TRCA monitors 13 water quality stations that are a part of the Ministry of the Environment, Conservation and Parks' (MECP) PWQMN. In addition to the PWQMN stations, TRCA collects samples as part of the Regional Watershed Monitoring Program (RWMP) at 34 additional stations. This includes two water quality stations added to the RWMP in the Petticoat Creek and Frenchman's Bay watersheds in 2009, five stations added to the Etobicoke Creek watershed in August 2013, and one new station added to Carruthers Creek in June 2015 for a total of 47 stations (13 PWQMN + 34 RWMP) in TRCA's region (Table 1, Figure 1). Station location information is provided in Appendix A. Between 2009 and May 2015 and when not sent to the MECP, water quality samples were sent to the York-Durham Regional Environmental Laboratory. Starting in June 2015, water quality samples were sent to the City of Toronto Dee Avenue Laboratory. There was a brief disruption in sampling in March and April 2020 due to the COVID-19 pandemic. Also in 2020, samples usually sent to the MECP during summer months were sent to York-Durham Regional Environmental Laboratory due to limited lab capacity at the MECP.

RWMP water quality monitoring is year round and this includes sampling the PWQMN stations during the four months not covered under the agreement with the MECP (December to March). An auger is used for ice-covered streams ensuring at least one water quality sample is collected per month. In June 2009, TRCA began sampling stations at the Don River (station 85014) and Humber River (station 83019) mouths on behalf of the MECP. In exchange, the MECP laboratory began to analyze the water quality at six sites (stations: 85014, 104001, 80006, 83019, 82003, 97011) year round. In addition, the RWMP also collects *Escherichia coli (E. coli)* samples from all sites (both RWMP and PWQMN) year round.

Table 1. Number of water quality sampling locations per watershed and station names.

Watershed	# Stations	Stations
Etobicoke Creek	8	Mayfield, 80007*, Spring Creek, Tributary 3, Lower Etob US, Tributary 4, Little Etob CK, 80006*^{M}
Mimico Creek	2	MM003WM, 82003*^{M}
Humber River	11	83104*, 83018*, 83009*, 83020, 83004, 83103*, HU1RWMP, HU010WM, 83002, 83012, 83019*^{M}
Don River	5	85004, 85003, DN008WM, DM 6.0, 85014*^{M}
Highland Creek	1	94002*^{M}
Rouge River	7	97999, 97018*, 97777, 97003, 97007, 97013, 97011*
Petticoat Creek	1	PT001WM^{M}
Frenchman's Bay (Pine Creek)	1	FB003WM
Duffins Creek	9	104008*, 104037, 104029, 104028, 104023, 104026, 104027, 104025, 104001*^{M}
Carruthers Creek	2	107002^{M}, CC005

Notes:
* denotes a PWQMN station
^{M} denotes a station at the mouth of the watershed or on the main tributary
Many station names have been shortened from the original 11-digit PWQMN code (e.g. 06008501402 ⇒ 85014)

1.2 Quality Assurance/Quality Control

Inter-laboratory Quality Assurance/Quality Control (QA/QC) programs have been run every other year since 2012 to ensure the results of various laboratories were comparable. Samples are collected from three stations (of varying water quality) and are split and sent to five laboratories for comparison. In the most recent analysis from 2018, 78% of parameters analyzed at the City of Toronto lab were similar to the MECP lab and varied based on parameter and station quality. Results of these analyses are available upon request. No inter-laboratory QA/QC was completed in 2020 due to COVID-19 restrictions.

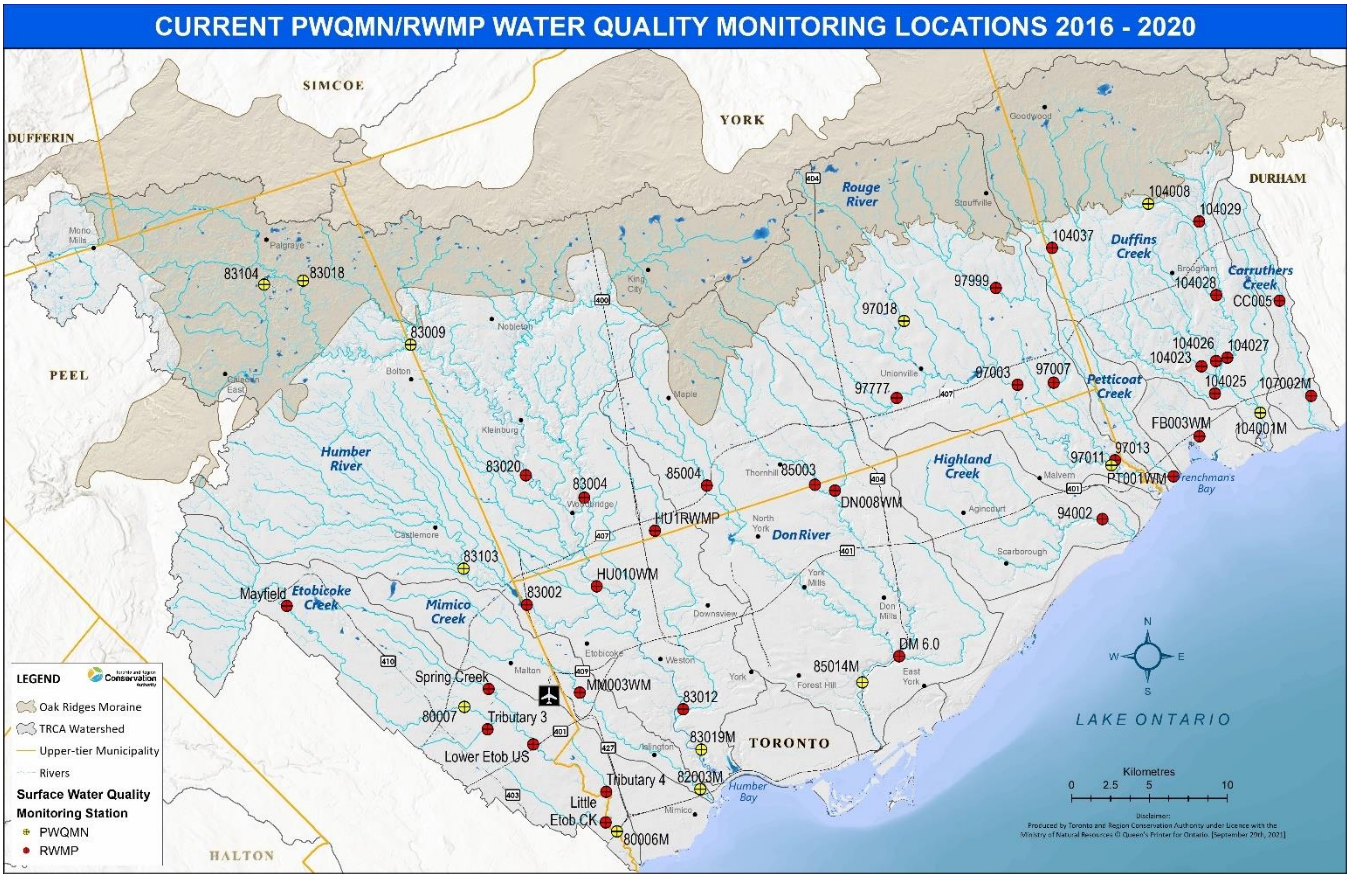

Figure 1. Current PWQMN/RWMP water quality monitoring locations (2016-2020).

1.3 Indicator analytes

Over 36 water quality analytes are monitored at each station. A subset of these parameters was selected for analysis for this report based on their relevance to common water-use concerns. Table 2 outlines the indicator analytes, their common sources as well as their effects on the aquatic environment, and the applicable water quality guidelines for comparison.

Water quality results were compared to the Provincial Water Quality Objective (PWQO) (OMOEE 1994). The PWQO are a set of numerical and narrative criteria that serve as chemical and physical indicators representing a satisfactory level for surface waters which is protective of all forms of aquatic life and/or the protection of recreational water uses based on public health and aesthetic considerations. When PWQO were not available, we used other objectives such as the Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life (CCME 2007).

An objective of 2.93 mg N/L was used for nitrates (nitrates meaning both nitrate and nitrite combined since nitrite is only a minor component of nitrates). The *E. coli* PWQO (100 CFU/100mL) is based on a recreational water quality guideline published by the Ontario Ministry of Health in 1992. The Ministry of Health guideline was changed to 200 CFU/100mL in 2018; however, the MECP has maintained the 100 CFU/100 mL guideline. The PWQO for *E. coli* is a recreational water quality guideline for swimming. The PWQO for *E. coli* is based on a geometric mean of at least five samples per site taken within a one month period. Only one sample was collected monthly for this program so a geometric mean was not calculated. The United States Environmental Protection Agency (US EPA) has established a criterion for beach areas based on a single sample maximum of

235 CFU/100 mL (US EPA 1986). For the purpose of this report, *E. coli* is used as an additional analyte in determining overall aquatic health and will be compared to the PWQO of 100 CFU/100 mL. *E. coli* values in this report should not be used to assess water quality suitability for swimming. A background concentration for TSS was determined to be 5 mg/L. This was based on historical regional monitoring data collected during dry weather conditions from "pristine" watercourses in the jurisdiction (drainage areas that do not include significant urban or agricultural land uses).

Table 2. Significance, sources, and guidelines for key surface water parameters.

Analyte	Significance	Sources (examples)	Guideline
Total Phosphorus (TP)	In excess, phosphorus can have unfavourable effects such as eutrophication (enrichment of a waterbody with nutrients). Phosphorus stimulates plant and algae productivity and biomass. Past a certain point, this can cause reduced biodiversity, changes in the dominant biota, decreases in ecologically sensitive species, increases in tolerant species, anoxia, and increases in toxins (e.g. cyanobacteria).	• Fertilizers • Animal wastes • Sanitary sewage	Interim PWQO[1]: 0.03 mg/L
Nitrates (as N)	Nitrates include both nitrate (NO_3^-) and nitrite (NO_2^-). Nitrogen compounds are nutrients with sources and effects similar to phosphorus. Nitrate serves as the primary source of nitrogen for aquatic plants in well oxygenated systems, and as nitrate levels increase, there is an increasing risk of algal blooms and eutrophication. Nitrite can be toxic to fish and other aquatic organisms at relatively low concentrations.	• Fertilizers • Septic tanks • Animal wastes • Municipal wastewater	CWQG[2]: 2.93 mg N/L
Chloride	Chloride can be toxic to aquatic organisms with acute (short-term) effects at high concentrations and chronic (long-term) effects at lower concentrations.	• Road salt application • Fertilizers • Industrial discharge	CWQG: chronic 120 mg/L; acute 640 mg/L
Escherichia coli (E. coli)	*E. coli* are a large and diverse group of bacteria that are commonly found in the intestines of warm-blooded animals. *E. coli* are used to indicate the presence of fecal waste in water. Some strains of *E. coli* can cause human illness (e.g. diarrhea, urinary tract infections).	• Combined sewer overflows (CSOs: collect rainwater, domestic sewage, and industrial wastewater in the same pipe) • Inputs from wildlife, livestock and domestic animals • Organic fertilizers	PWQO: 100 CFU/100 mL
Total Suspended Solids (TSS)	TSS represents the amount of particulate matter (e.g. silt, clay, organic and inorganic matter, etc.) suspended in water. TSS can act as a transport vector for contaminants (e.g. metals) and nutrients (e.g. phosphorus). Elevated TSS concentrations can affect aquatic organisms such as fish by reducing water clarity and inhibiting the ability to find food, clogging of fish gills, and habitat changes such as smothering fish spawning and nursery areas.	• Construction sites • Farm fields • Lawns and gardens • Eroding stream channels • Road grit accumulation	CWQG: 30 mg/L (background (assumed at <5 mg/L)+ 25 mg/L for short term (<24 hour) exposure)
Metals	Several heavy metals are toxic to fish and other aquatic organisms at varying concentrations. Most metals enter waterways though surface runoff. Metals bind to sediment and can affect fish (e.g. clogging of gills) and benthic invertebrates (e.g. habitat changes, smothering food sources).	• Urban runoff • Industrial discharge • Sewage treatment • Fertilizers/Pesticides • Atmospheric deposition • Soils	PWQO: • Copper – 5 µg/L • Iron – 300 µg/L • Zinc – 20 µg/L

[1]PWQO = Provincial Water Quality Objective
[2]CWQG = Canadian Water Quality Guideline

2. METHODS

2.1 Sample collection and laboratory analysis

Monthly grab samples were collected year-round in accordance with the PWQMN sampling protocols (MECP 2020). To maintain consistency with previous 5-year surface water quality reports, statistical analysis procedures did not include an adjustment for flow. Consideration of flow can aid the analysis of water-quality trends because, on a day-to-day basis, most water-quality characteristics vary in response to changes in flow. Samples were collected on set dates, independent of weather conditions. Thus, changes in flow appear as a source of random variation over the period of analysis.

Samples were stored in a cooler with ice and delivered to a laboratory for analysis usually within 24 hours of sampling. Samples were analyzed at various laboratories for a standard set of water quality indicators (Table 3). Where applicable, results are for total (i.e. particulate) samples rather than the dissolved (i.e. bioavailable) forms. Supporting measurements of water temperature, conductivity, dissolved oxygen, and pH were taken in the field using a handheld water quality probe (e.g. YSI).

Table 3. Standard suite of water quality parameters analyzed for stream samples. Indicator variables analyzed for spatial patterns are shown in bold and those analyzed for temporal trends shown as underlined.

General	Metals		Nutrients	Microbiological
• **<u>TSS</u>** • Total dissolved solids (TDS) • Conductivity • Hardness • Dissolved oxygen (DO) • Sodium • Calcium • **<u>Chloride</u>** • Alkalinity • Turbidity • pH	• Aluminium • Barium • Beryllium • Cadmium • Chromium • Cobalt • **Copper** • **Iron** • Lead	• Magnesium • Manganese • Molybdenum • Nickel • Potassium • Strontium • Titanium • Vanadium • **Zinc**	• **Nitrates (Nitrate + Nitrite)** • Total Kjeldahl Nitrogen (TKN) • Ammonia • **<u>TP</u>** • Phosphate	• ***Escherichia coli***

2.2 Data analysis

2.2.1 Spatial patterns

When results were below the laboratory detection limit (i.e. trace amounts), these values were set at half of the laboratory detection limit for analysis purposes. When the MECP was examining changes in analytical methods for phosphorus in 2017, several methods were used on the same sample. For the purpose of this report, we used method E3516A for total phosphorus based on recommendations from the MECP.

Current (2016-2020) water quality results are presented in bar charts within the text for the indicator variables. Only sites with greater than 40 samples were analyzed. The bar charts represent average water quality results from 2016-2020 (i.e. one value representing the mean of all samples per site). Water quality samples are typically skewed whereby most samples are similar in concentration (base/low flow) with a few samples being significantly higher than the others (storm flow). Median values are often used for skewed distributions. The median value is the numerical value separating the higher half of a sample from the lower half (i.e. 50^{th} percentile). The median is often used because the value is less influenced by extreme results compared to average values, therefore depicting what a stream experiences on a typical day. Average values are influenced by extreme results, often with values much larger than their median counterpart. Average values are depicted in the charts and figures in this report because aquatic organisms are exposed to the high concentrations during storm flow. Median values were used for trend analysis. Descriptive statistics (average, median, minimum, maximum) are presented in Appendix B.

Data were subdivided into four groups to discern if there was any seasonal variation among parameters. Seasons were defined as follows: winter = December, January, February; spring = March, April, May; summer = June, July, August; and autumn = September, October, November. Again, data are presented as bar charts within the text for indicator variables by season (Figures 11-18).

The Water Quality Index (WQI) is a tool that summarizes water quality conditions from multiple analytes into a single measure of water quality per site. The WQI is a representation of the number of parameters that exceed their guidelines, as well as the frequency and magnitude of those exceedances. Values range between 0 and 100, with higher values indicating water that tends to meet the guidelines more frequently and is considered to be of higher quality (Painter and Waltho 2004). Table 4 describes the rating system associated with the WQI. The eight indicator parameters (Table 3) were used to calculate the WQI. More information on the WQI can be found at: https://ccme.ca/en/resources# or in CCME (2017).

Table 4. Description of the Water Quality Index rating system.

Rating	WQI Score	WQI Score Description
Excellent	95-100	Water quality is protected with a virtual absence of threat or impairment; conditions very close to natural or pristine levels
Good	80-94	Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels
Fair	65-79	Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels
Marginal	45-64	Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels
Poor	0-44	Water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels

2.2.2 Temporal trends

Trends were analyzed using the Mann-Kendall test: a non-parametric test for identifying trends in time series data and describes monotonic trends. Monotonic trends occur when a population of observations shifts over time. The detection of a monotonic trend does not imply that the trend is linear, occurs in one or more discrete steps, or in any pattern (Hirsch *et al.* 1991). The test is well-suited to data with missing values and to data that are truncated at upper and lower detection limits (Gilbert 1987). The data values are evaluated as an ordered time series. The initial value of the Mann-Kendall statistic, S, is assumed to be zero (*e.g.*, no trend). A very high positive value of S is an indicator of an increasing trend, and a very low negative value indicates a decreasing trend. Mann-Kendall uses the z statistic to test for significance. Because of the wide range of water quality values (i.e. includes baseflow, low flow and storm events), a significance level of $p<0.05$ was used to determine if temporal trends were significant.

If there were large gaps in the chronological sequence of data (e.g. chloride data for station 83018 was missing multiple time periods in the 1980s and 1990s), the Mann-Kendall can become less appropriate and data were grouped for analysis instead of analyzing data as continuous (Step-trend analysis; Helsel and Hirsch 2002). Data were analyzed using the non-parametric Kruskal-Wallis test with the Nemenyi test as a post-hoc test using the functions kruskal.test and posthoc.kruskal.nemenyi.test provided in the Pairwise Multiple Comparison of Mean Ranks (PMCMR) package in R. The test statistic for the Kruskal-Wallis test is the chi-square (X^2) statistic and significant differences among time periods are represented using letters (A, B, C, D, etc) where different letters denote a significant difference between time periods while time periods sharing the same letter are not significantly different. This test does not detect a trend as a continuous change over time but instead allows you to detect whether different time periods have significantly higher or lower concentrations. For chloride, only station 83018 was analyzed this way while for TSS, a Kruskal-Wallis test was used for multiple stations (83002, 83004, 85004, 85003, 94002, 97003, 97011 and 104001).

3. RESULTS AND DISCUSSION

Results are presented using RWMP station names, which are often a derivative of the (current/historic) 11-digit PWQMN name. For example, PWQMN station 06008000602 is presented as station 80006. Stations which do not have corresponding PWQMN names have text names rather than numeric codes. Stations are presented by watershed from west to east and from headwaters to mouth. This is the first 5 year report where data were included from the new Etobicoke Creek watershed sites: Spring Creek, Tributary 3, Lower Etob US, Tributary 4 and Little Etob CK.

It is important to note that samples were collected on varying field dates, under a variety of weather conditions and analyzed at several laboratories. Water quality samples collected as part of the PWQMN/RWMP are collected independent of weather conditions. Water quality data should represent the range of water quality conditions that affect the aquatic system (e.g. streamflow conditions, including snowmelt, runoff from rain events of varying magnitude, and baseflow conditions during varying seasons). Because specific wet-weather events are not targeted, nutrient and contaminant concentrations presented in this report may be significantly lower than what would be measured during a storm event. The majority of wet weather flow originates from surface runoff, either from agriculture or urban areas. Urban runoff can contain high concentrations of nutrients and contaminants (e.g. sediments, road salts), which are washed off impervious surfaces, such as roads and parking lots. Agricultural runoff is surface water leaving farm fields because of excessive precipitation, irrigation, or snowmelt. It can also contain high levels of pesticides, sediments, nutrients, and bacteria.

3.1 Spatial patterns

Current (2016-2020) average water quality results are summarized in Figure 2 for the indicator variables. This graphic presents the average water quality concentration per site for the 2016-2020 period in relation to their respective water quality objective. Individual maps for each analyte visually display the data in Figures 3 to 10. The data were broken down to show seasonal changes in Figures 11 to 18. Discussion of the current spatial trends follows the entire set of figures. Descriptive statistics for the entire dataset are presented in Appendix B.

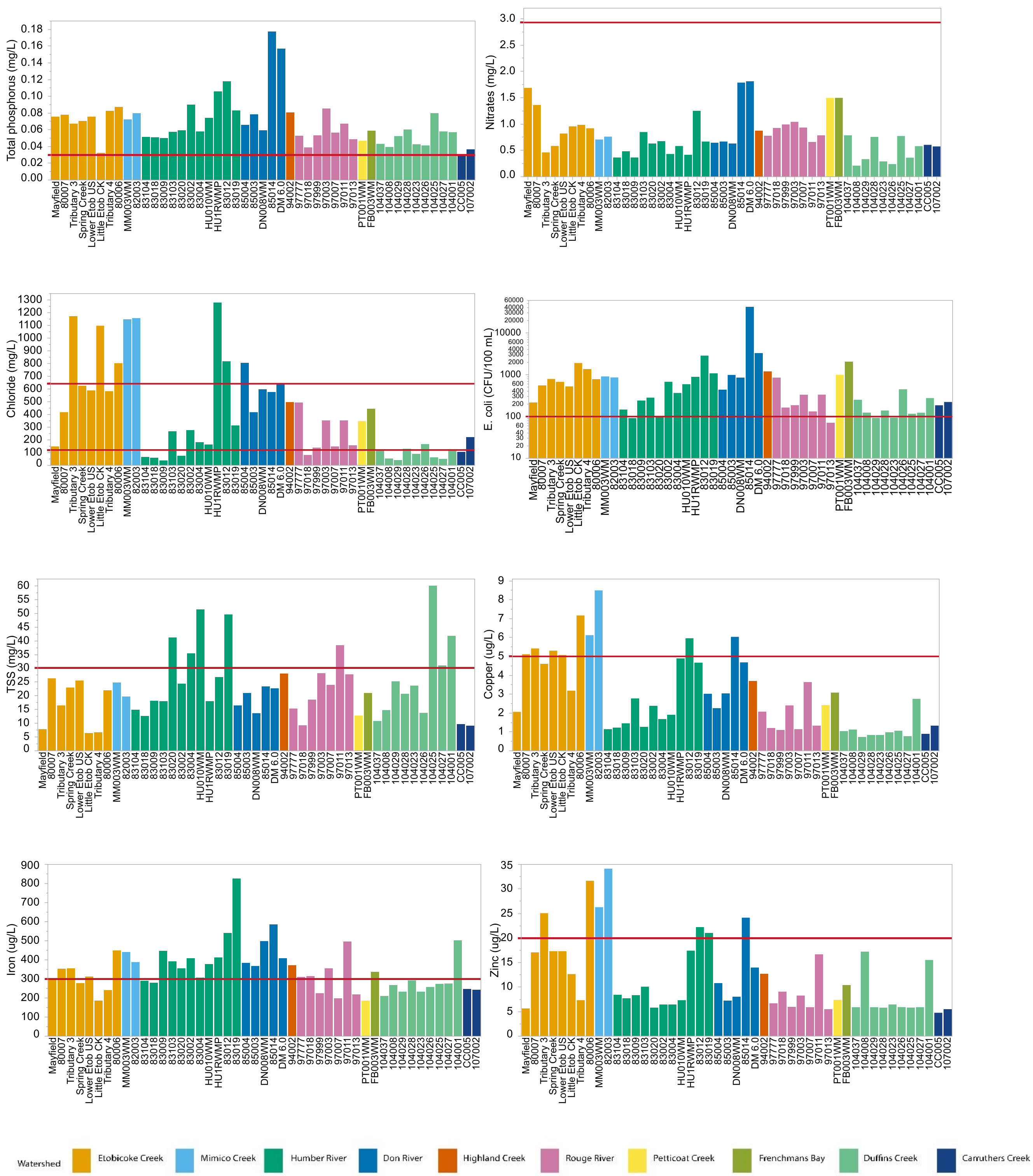

Figure 2. Summary of average water quality data for TRCA's jurisdiction 2016-2020. Horizontal red lines indicate water quality objectives as described in Table 2.

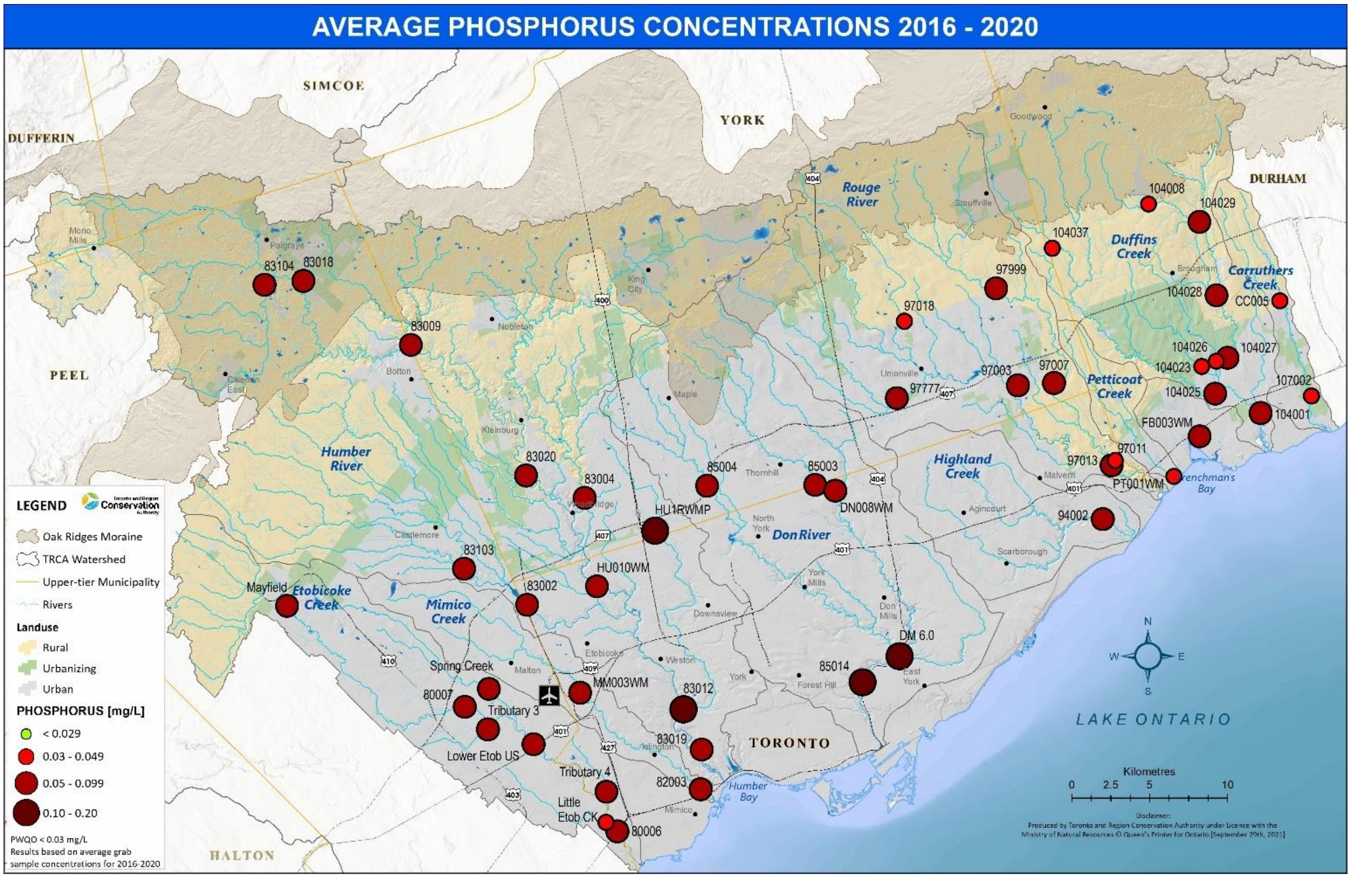

Figure 3. Average phosphorus concentrations 2016-2020.

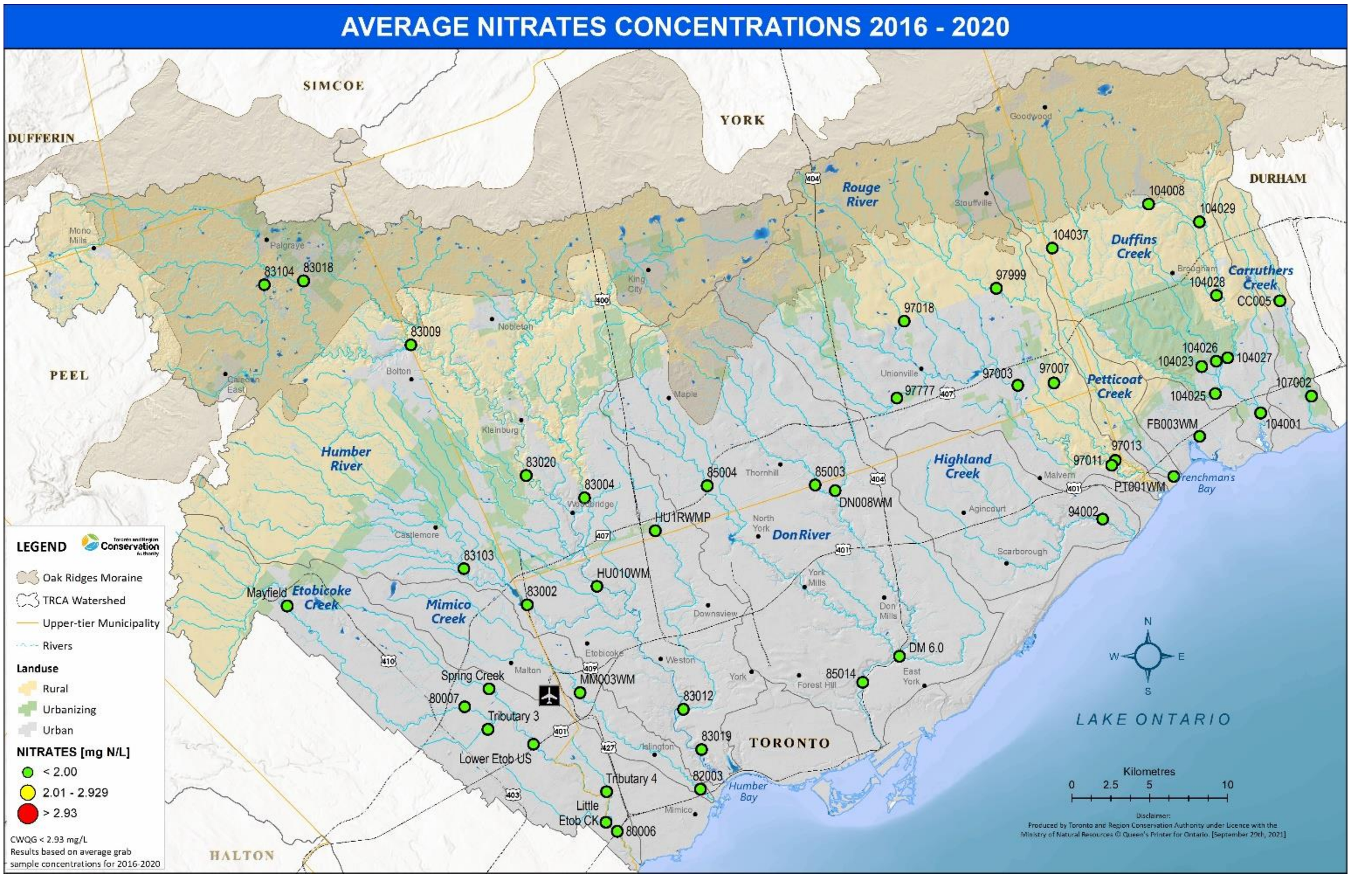

Figure 4. Average nitrates concentrations 2016-2020.

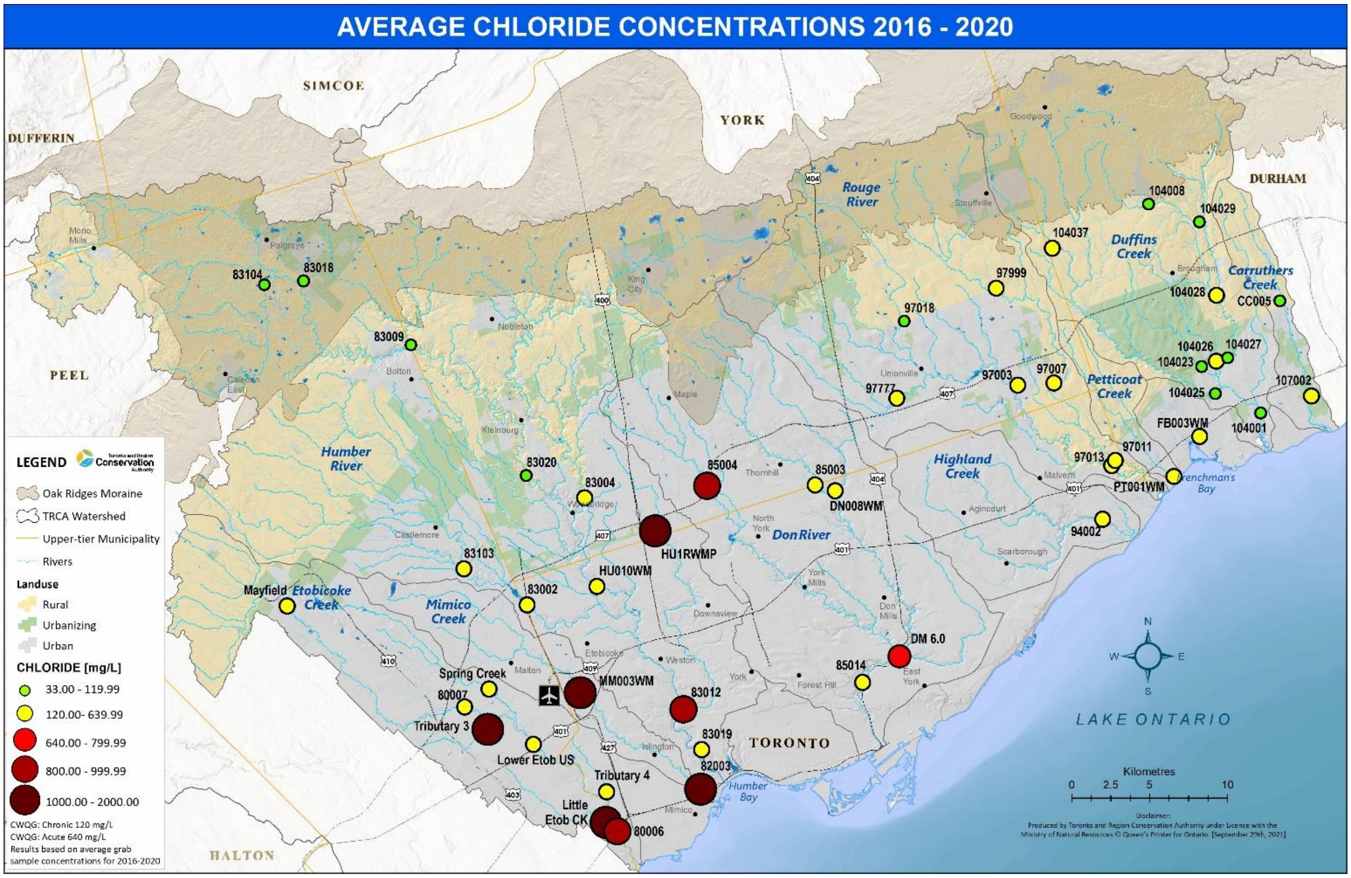

Figure 5. Average chloride concentrations 2016-2020.

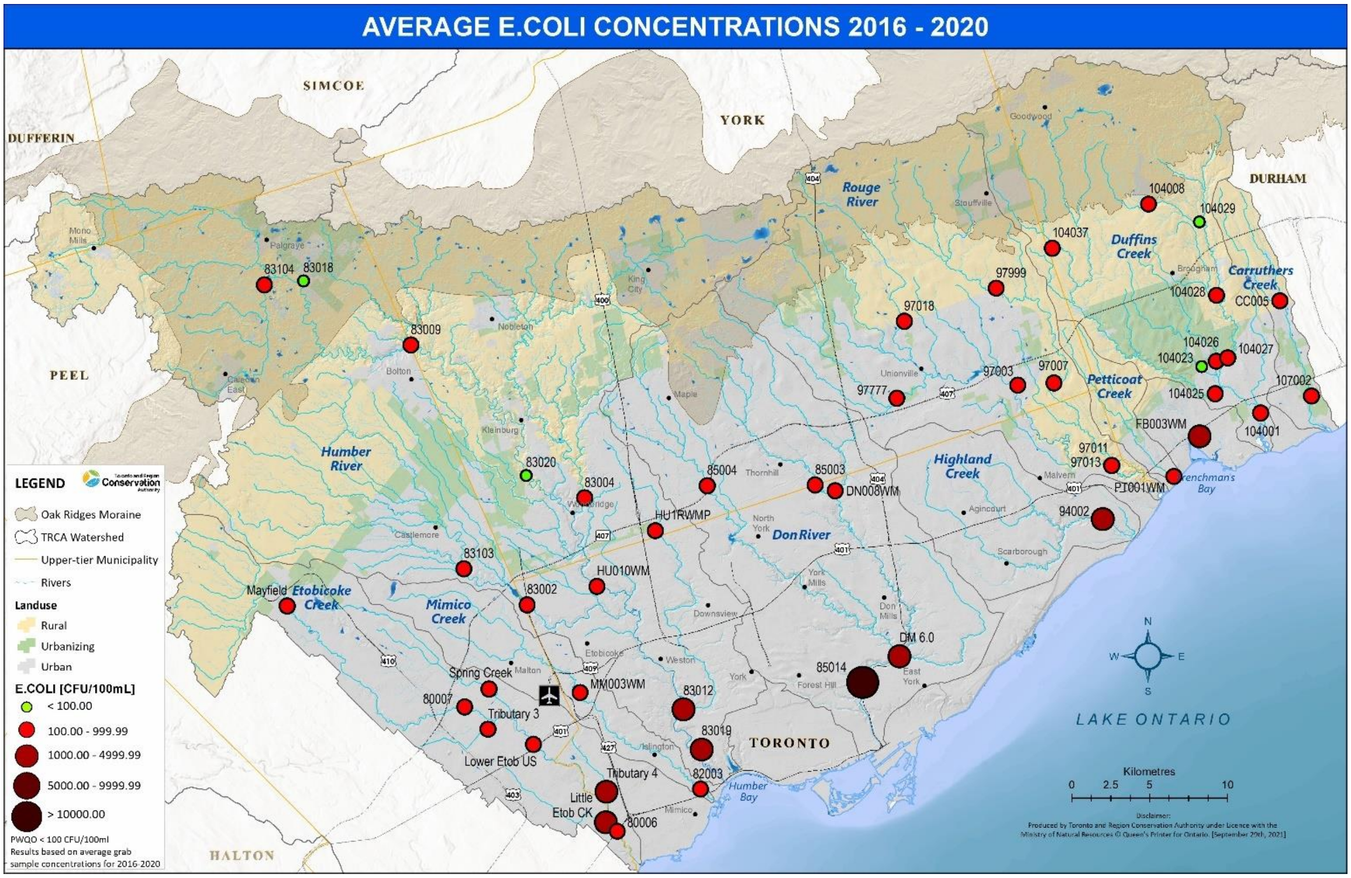

Figure 6. Average *Escherichia coli* concentrations 2016-2020.

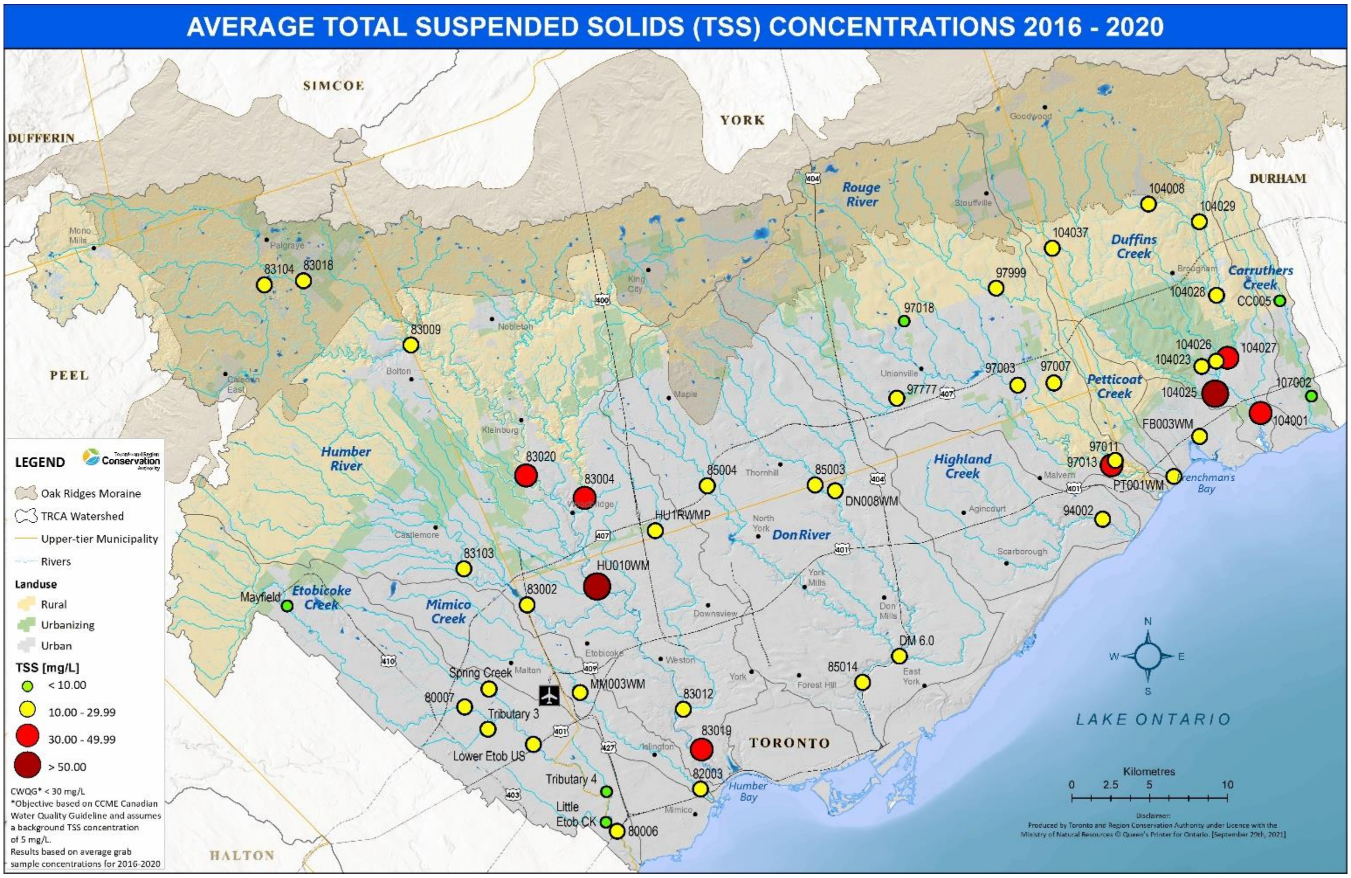

Figure 7. Average total suspended solids concentrations 2016-2020.

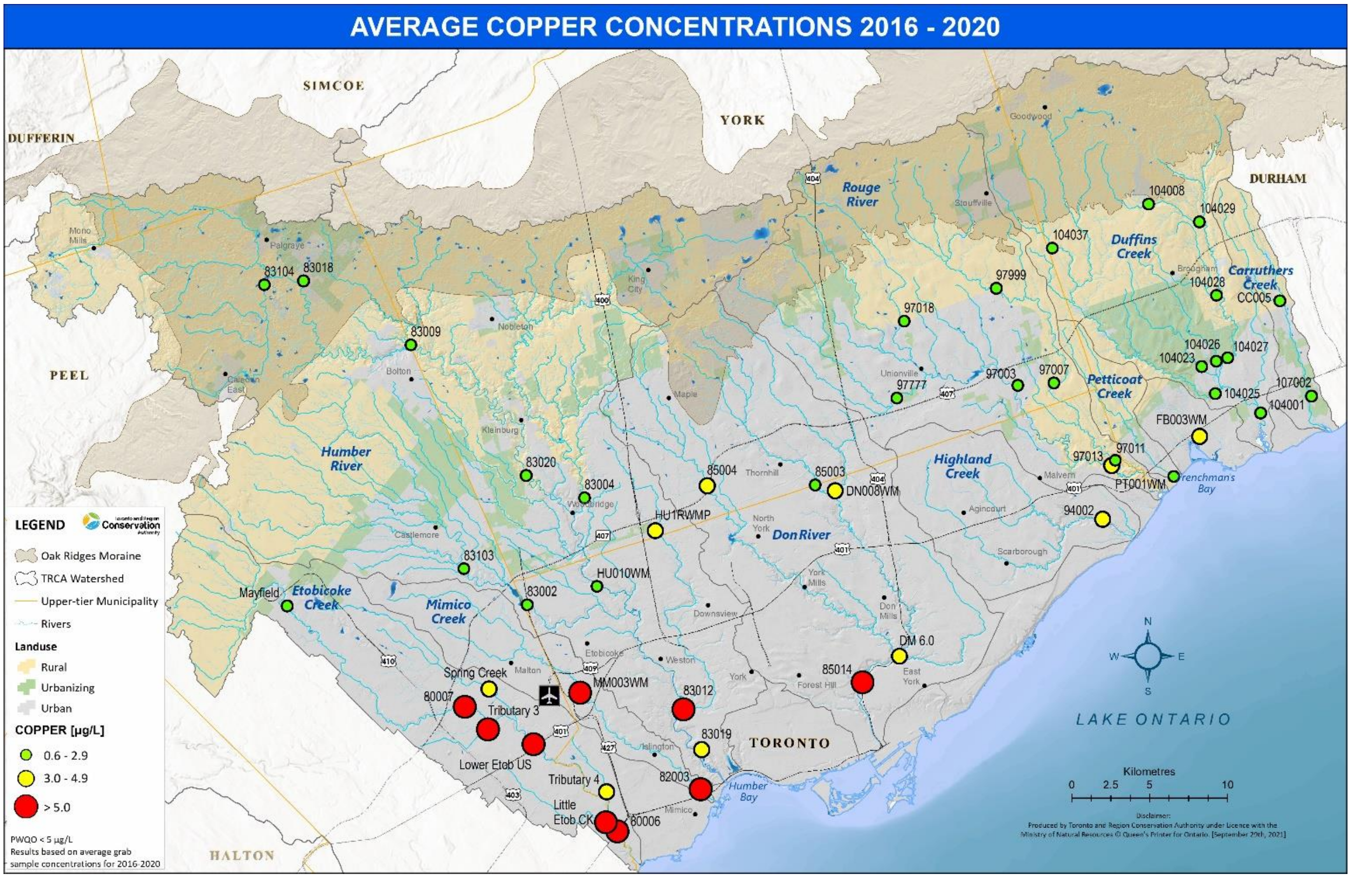

Figure 8. Average copper concentrations 2016-2020.

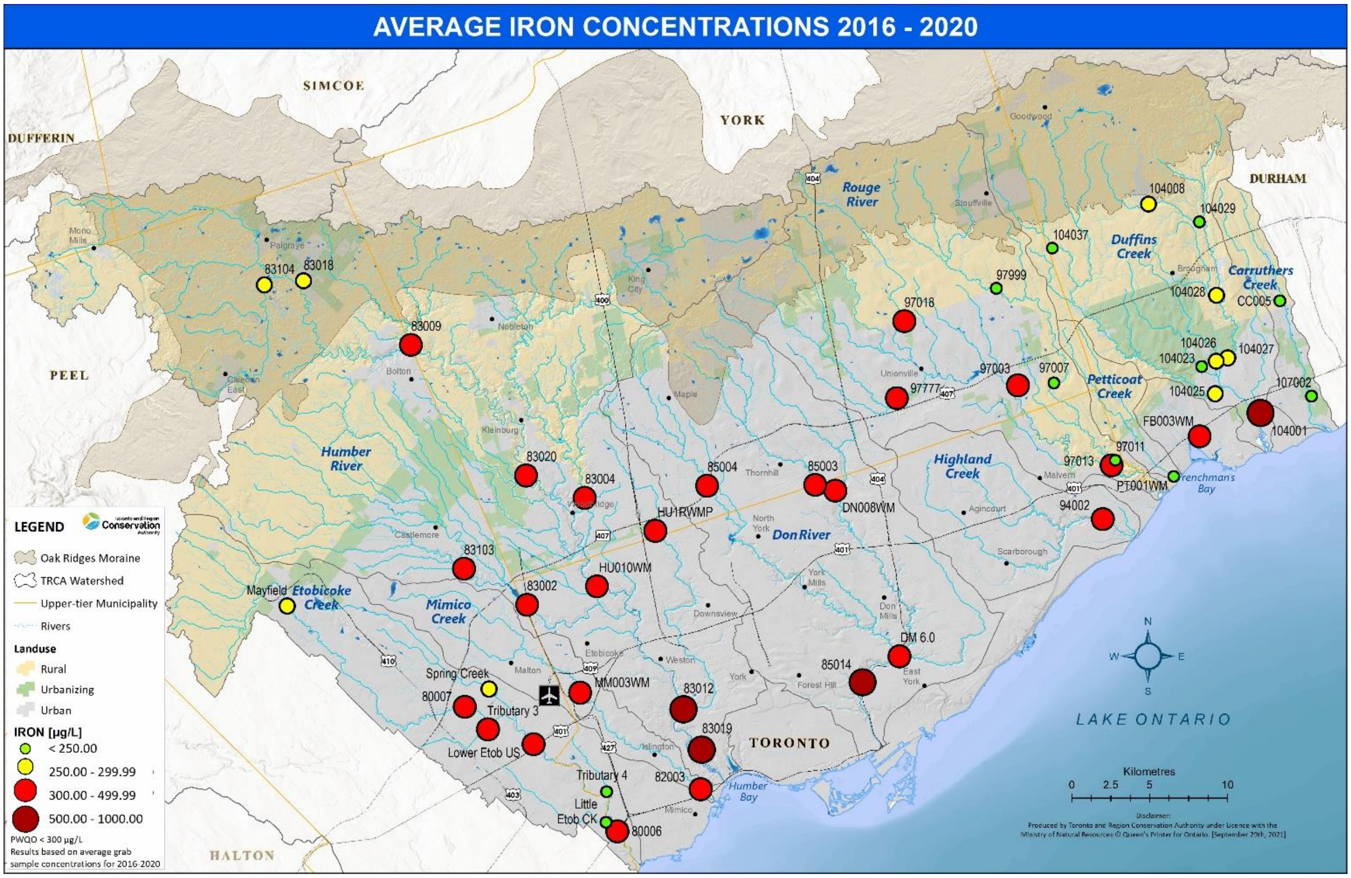

Figure 9. Average iron concentrations 2016-2020.

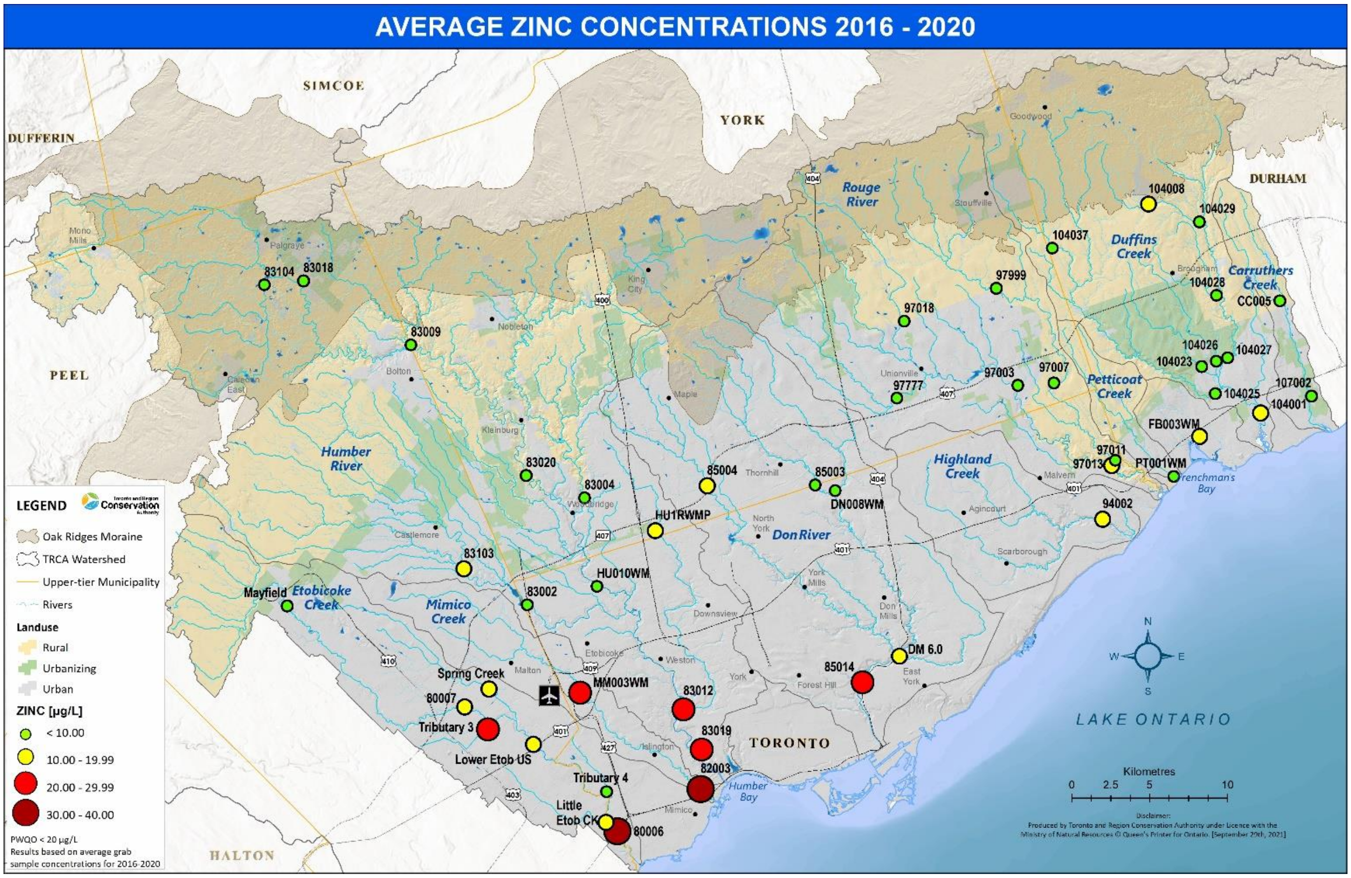

Figure 10. Average zinc concentrations 2016-2020.

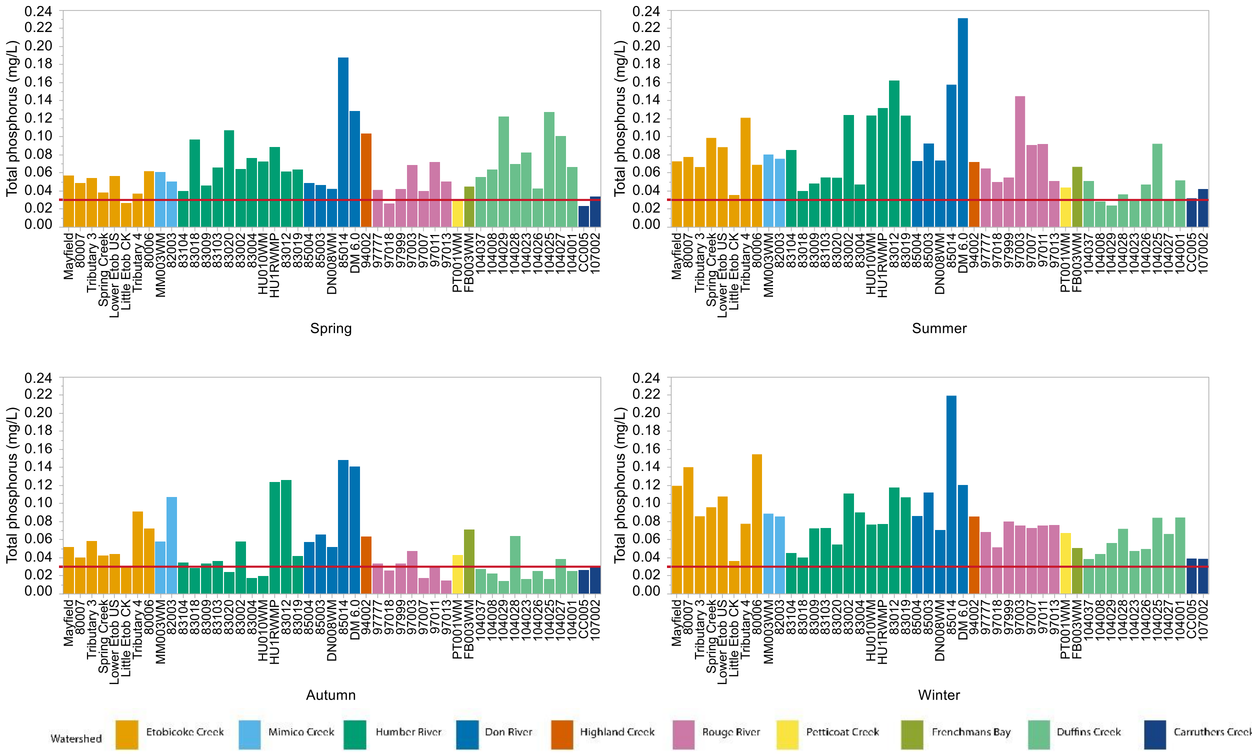

Figure 11. Seasonal average (2016-2020) total phosphorus concentrations in the Toronto region. Horizontal red lines indicate the interim Provincial Water Quality Objective (0.03 mg/L).

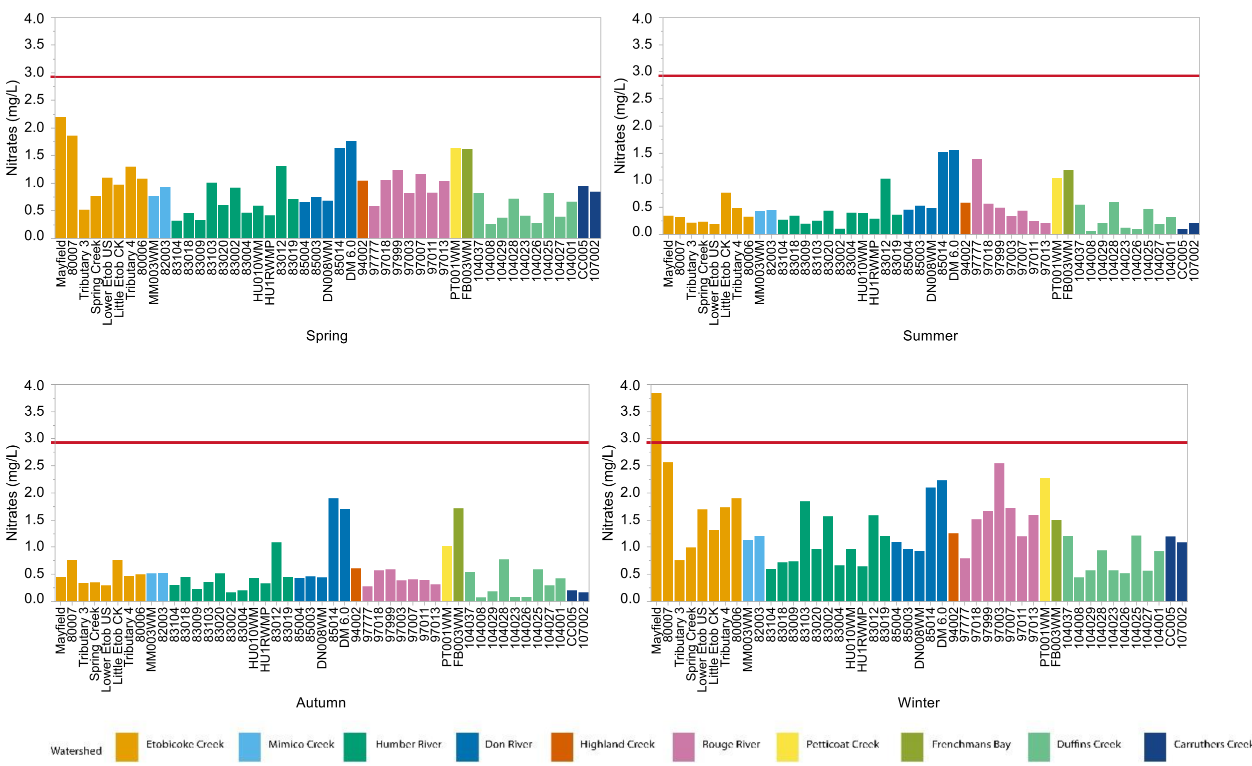

Figure 12. Seasonal average (2016-2020) nitrates concentrations in the Toronto region. Horizontal red lines indicate the Canadian Water Quality Guideline (2.93 mg N/L).

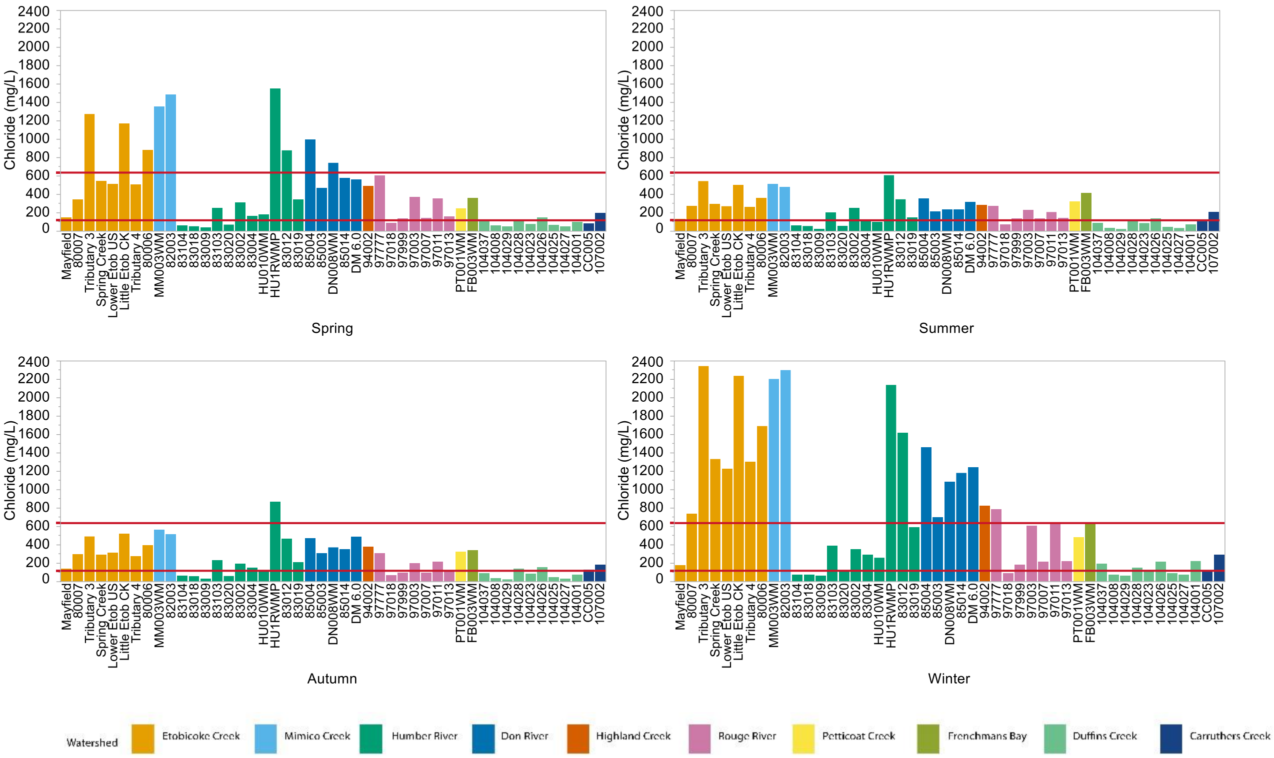

Figure 13. Seasonal average (2016-2020) chloride concentrations in the Toronto region. Horizontal red lines indicate the Canadian Water Quality Guidelines (chronic 120 mg/L; acute 640 mg/L).

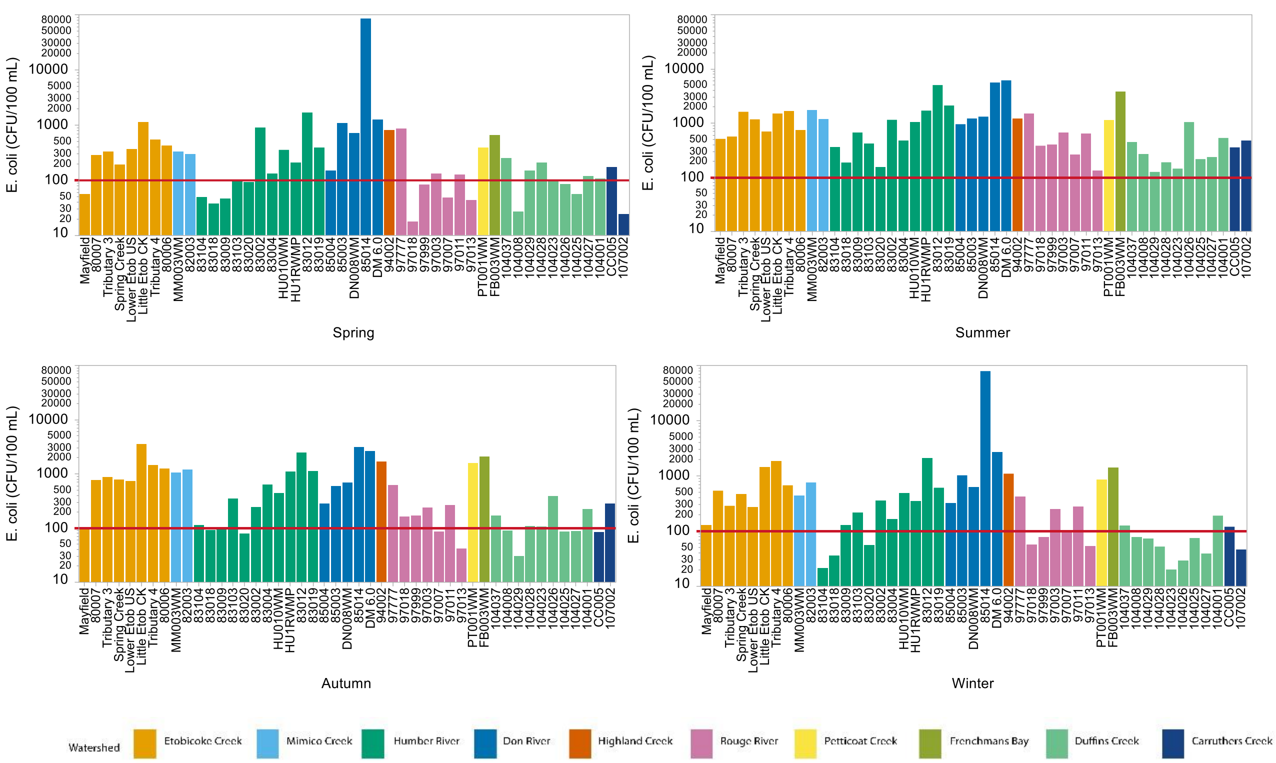

Figure 14. Seasonal average (2016-2020) *Escherichia coli* concentrations in the Toronto region. Horizontal red lines indicate the Provincial Water Quality Objective (100 CFU/100mL).

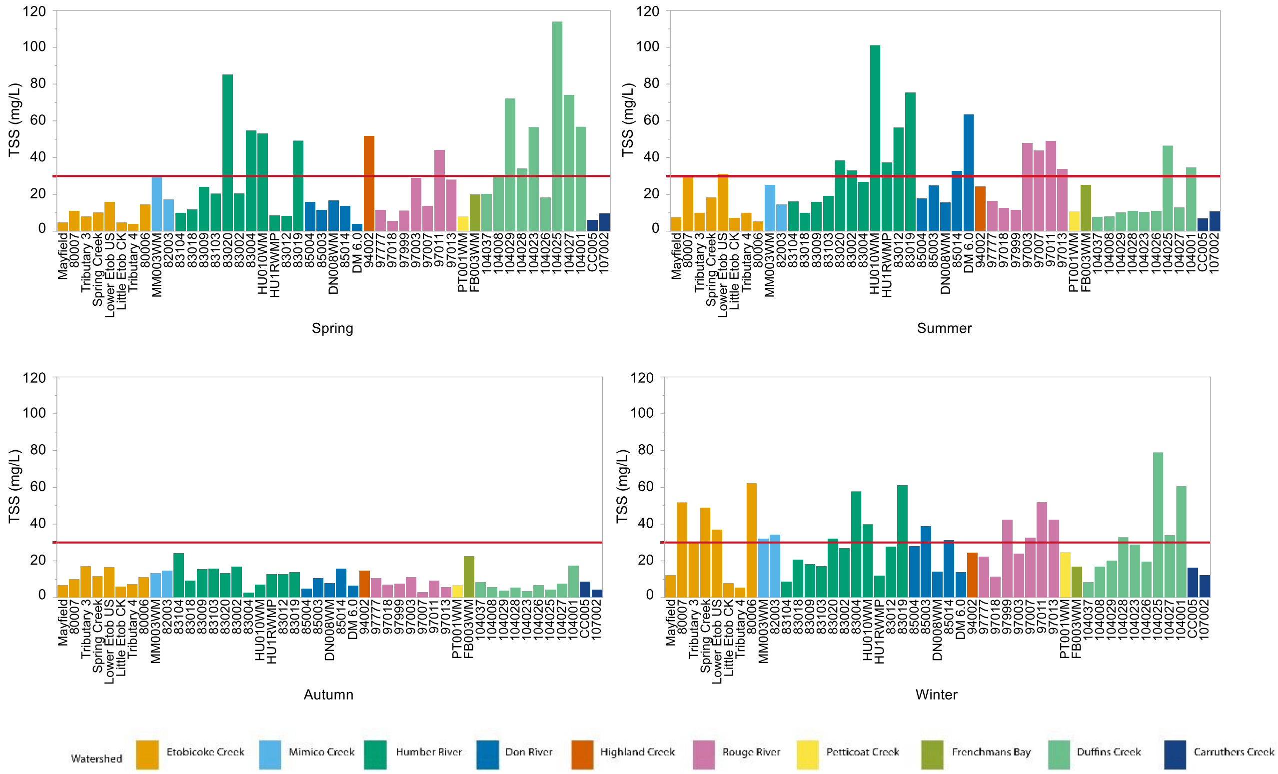

Figure 15. Seasonal average (2016-2020) TSS concentrations in the Toronto region. Horizontal red lines indicate the Canadian Water Quality Guideline (30 mg/L).

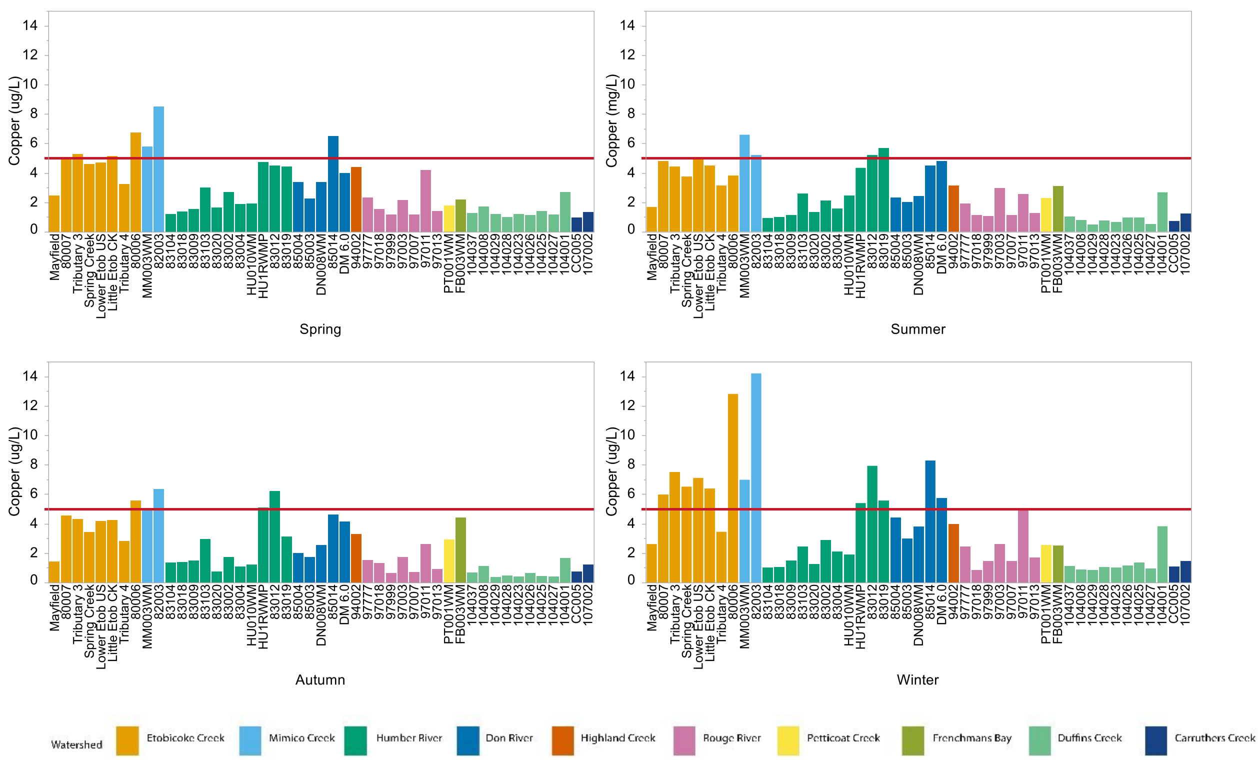

Figure 16. Seasonal average (2016-2020) copper concentrations in the Toronto region. Horizontal red lines indicate the Provincial Water Quality Objective (5 μg/L).

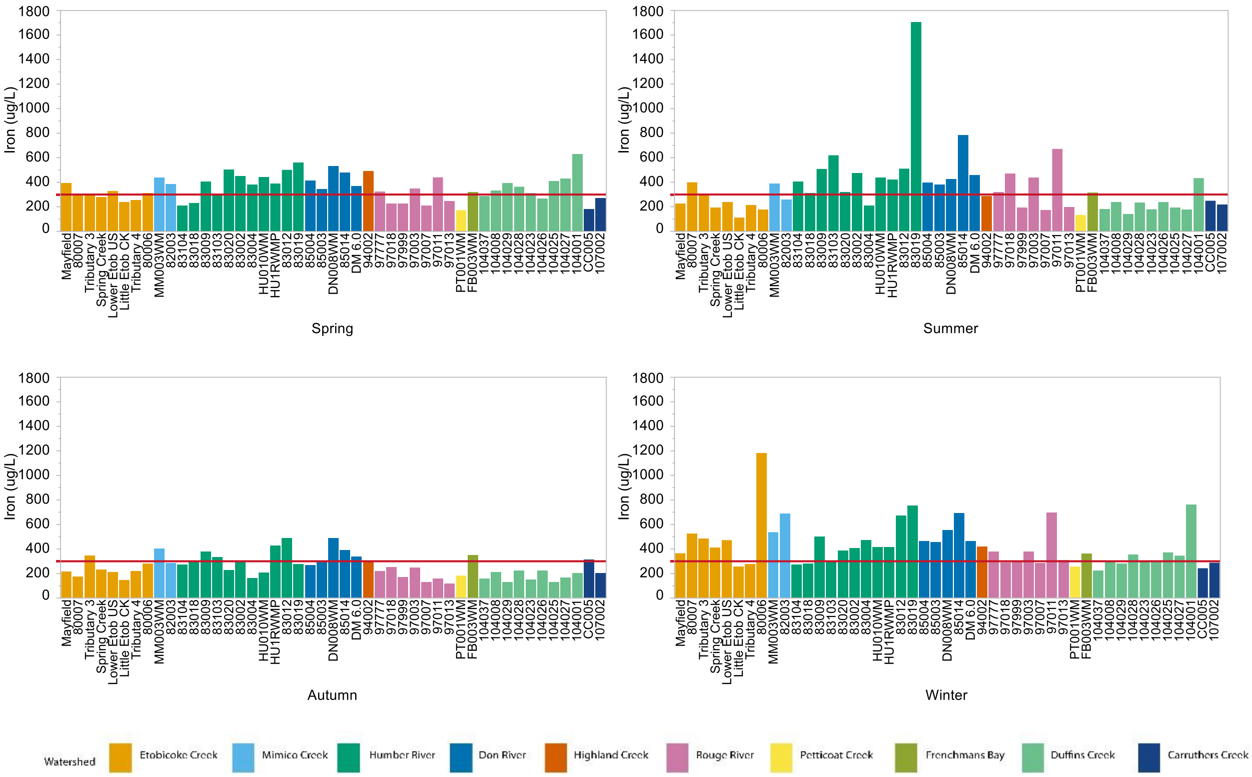

Figure 17. Seasonal average (2016-2020) iron concentrations in the Toronto region. Horizontal red lines indicate the Provincial Water Quality Objective (300 µg/L).

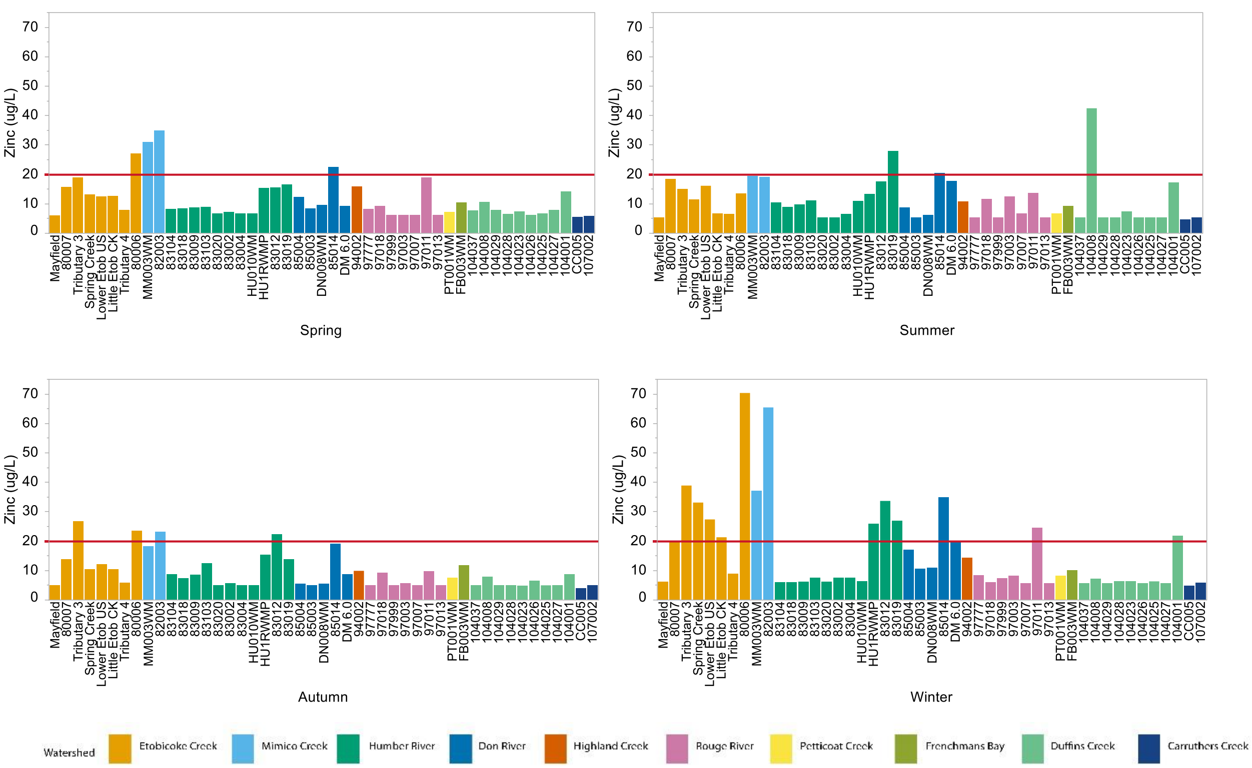

Figure 18. Seasonal average (2016-2020) zinc concentrations in the Toronto region. Horizontal red lines indicate the Provincial Water Quality Objective (20 µg/L).

3.1.1 Total phosphorus

Phosphorus is an essential nutrient for all living organisms but it can have unfavorable effects in high concentrations. Phosphorus is associated with eutrophication – the enrichment of a waterbody with nutrients. Elevated phosphorus concentrations can adversely affect aquatic ecosystems by increasing plant and algal productivity and biomass (CCME 2004). Further phosphorus additions may cause undesirable effects such as decreased biodiversity and changes in dominant biota, decline in ecologically sensitive species, increase in tolerant species, increase in plant and animal biomass, and anoxic conditions (EC 2004). When the excessive plant growth includes certain species of cyanobacteria, toxins may be produced, causing increased risk to aquatic life, livestock, and human health (CCME 2004). The interim PWQO for total phosphorus is 0.03 mg/L. This concentration is intended to prevent excessive plant growth in rivers and streams.

Average phosphorus results for 2016-2020 are presented in Figures 2 and 3. No stations had an average phosphorus concentration less than the PWQO, although 17 stations had median values that were less than the PWQO. Four stations had average phosphorus concentrations greater than 0.1 mg/L. Station 85014 had the highest average phosphorus concentration of 0.18 mg/L, which is six times the PWQO. This station is located in the Don River watershed downstream of the North Toronto Wastewater Treatment Plant. Station DM 6.0, on the lower Taylor-Massey Creek in the lower Don watershed, had the second highest average phosphorus concentration at 0.16 mg/L. This is over five times higher than the PWQO. Two other stations had considerably high average total phosphorus concentrations including 83012 and HU1RWMP both on Black Creek in the Humber watershed (0.12 and 0.11 mg/L, respectively). Compared to the 2011-2015 summary report (TRCA 2017a), average phosphorus concentrations appeared to have increased at 30 stations and decreased at 8 stations. Stations with large increases (increased by >0.03 mg/L) included DM 6.0, HU1RWMP, 83012, 85014, 80007 on the west branch of Etobicoke Creek, and 94002 at the mouth of Highland Creek.

Seasonal changes in phosphorus concentrations are shown in Figure 11. Average phosphorus concentrations appeared to be highest in both the summer and winter months. In the summer, phosphorus concentrations can increase due to the application of fertilizers. In winter, higher concentrations could be related to rain-based precipitation events or thaw events causing run-off (OMOE 2012). Stations 85014 and DM 6.0 in the Don River watershed had the highest average phosphorus concentrations in all seasons while stations in the upper reaches of the Etobicoke, Humber, Rouge, and Duffins watersheds showed the general pattern of higher concentrations in summer and winter.

3.1.2 Nitrates

Nitrates include both nitrate (NO_3^-) and nitrite (NO_2^-). Nitrogen compounds are nutrients with sources and effects similar to phosphorus. Because nitrite is easily oxidized to nitrate, nitrate is the compound predominantly found in groundwater and surface waters. In most water bodies, phosphorus is normally the limiting nutrient for algal growth but nitrogen compounds can play a role in the eutrophication process. Anthropogenic discharges of nitrogen can include municipal and industrial wastewaters, septic tanks, agricultural runoff, feedlot discharges, urban runoff, lawn fertilizers, landfill leachate, nitric oxide and nitrogen dioxide from vehicular exhaust, and storm sewer overflow (CCME 2003). Nitrate serves as the primary source of nitrogen for aquatic plants in well oxygenated systems, and as nitrate levels increase, there is an increasing risk of eutrophication and algal blooms in surface waters. Nitrite and unionized ammonia can be toxic to fish and other aquatic organisms at relatively low concentrations.

Current average concentrations for nitrates are presented in Figures 2 and 4. Environment Canada's Canadian Environmental Sustainability Indicators interpreted the interim CWQG for nitrate as 2.93 mg N/L (EC 2008). All stations had average water quality concentrations below the 2.93 mg/L objective. Stations with the highest average concentration of nitrates were DM 6.0 (Taylor-Massey Creek in the Don), 85014 (mouth of the Don River), Mayfield (west branch of Etobicoke Creek), FB003WM (Pine Creek in Frenchman's Bay) and PT001WM

(Petticoat Creek). These stations all had average concentrations greater than 1.5 mg N/L for the 2016-2020 time period. DM 6.0 had the highest average concentration of 1.81 mg N/L. High concentrations at these stations are likely a result of agricultural run-off (e.g. Petticoat Creek, Mayfield) or urban-related sources (lower Don River watershed). Compared to the 2011-2015 summary report (TRCA 2017a), the average concentration of nitrates appeared to have increased at 16 stations and decreased at 22 stations. While average concentrations remain below the CWQG, stations with the greatest increases included 85014, PT001WM, 97003 (Lower Rouge River), 97777 (Rouge River), and 80007 (West branch of Etobicoke Creek).

Seasonal changes in average nitrate concentrations are shown in Figure 12. Nitrate concentrations appeared to be the highest in the spring and winter months although several stations had consistently high concentrations such as those in the lower Don, Frenchmen's Bay, and Petticoat Creek watersheds. Stations with consistently high concentrations may have more urban-related inputs including wastewater, while those in more rural landscapes may be more affected by run-off from agriculture. During the winter months, nitrates often increase due to decomposition of leaves and other dead material. Only the Mayfield station in the upper Etobicoke Creek watershed exceeded of the water quality objective with a winter concentration of 3.85 mg N/L. Additional monitoring for the Etobicoke Creek Watershed Plan Water Quality Characterization suggested that the source of nitrates in the upper Etobicoke Creek watershed are primarily from the most western catchment (TRCA 2021).

3.1.3 Chloride

Chloride can be toxic to aquatic organisms with acute effects at high concentrations and chronic effects (e.g. growth, reproduction) at lower concentrations (OMOE 2003). Chloride in our waterways is mainly due to the use of road salts which are used as de-icing and anti-icing agents during winter road maintenance. The predominant chloride road salt is sodium chloride, which is composed of about 40% sodium and 60% chloride by weight. There are other sources of chloride some of which include wastewater treatment, industry discharge, water softeners, and fertilizers (OMOE 2003). Natural background concentrations of chloride in water are generally no more than a few milligrams per litre, with some local or regional instances of higher natural salinity (EC & HC 2001). Chloride is a highly soluble and mobile ion.

There are no major natural removal mechanisms (e.g. volatilization, degradation) and therefore, all chloride ions from road salts can be expected to be ultimately found in surface water. Chloride can enter streams through various pathways including overland flow, piped flow, export from stormwater management ponds, and from soils or groundwater (Oswald *et al.* 2019). Based on these pathways, chloride can be either quickly flushed into streams (e.g. overland flow) or retained and released either slowly or quickly (e.g. from soils, stormwater management ponds). Elevated concentrations of chloride can also affect the concentrations of certain metals (e.g. cadmium, copper, lead, zinc) in our waterways. Road salt can facilitate the mobilization and transport of these contaminants into the aquatic ecosystem (Maltby *et al*., 1995, Reinosdotter and Viklander 2007). Increased concentrations of chloride in surface water can lead to the release of metals from sediments and suspended particulate matter (Warren and Zimmerman 1994). The CWQG for chloride is 120 mg/L for chronic (long-term) effects and 640 mg/L for acute (short-term) effects (CCME 2011).

Average chloride results are presented in Figures 2 and 5. The average chloride concentration was highest at station HU1RWMP in the upper Black Creek in the Humber watershed at 1280 mg/L. This is almost 11 times greater than the 120 mg/L guideline for chronic effects and twice the acute guideline of 640 mg/L. Station HU1RWMP is located less than 1 km south of Highway 407 and a similar distance east of Highway 400. Eight other stations had average chloride concentrations greater than the acute guideline of 640 mg/L: 80006 (at the mouth of Etobicoke Creek), 82003 (at the mouth of Mimico Creek), MM003WM (middle Mimico Creek), 83012 (lower Black Creek), 85004 (west Don River), DM 6.0 (lower Taylor-Massey Creek), Little Etob CK (lower Etobicoke), and Tributary 3 (lower Etobicoke Creek). Average chloride concentrations were less than the chronic guideline of 120 mg/L at 26% of stations (12 sites). These stations were located in the Humber River, Rouge

River, Duffins Creek, and Carruthers Creek watersheds. Compared to the 2011-2015 summary report (TRCA 2017a), average chloride concentrations appeared to have increased at 30 stations and decreased at eight stations. Stations with the largest increases (increased by >60 mg/L) included HU1RWMP, 80006, 83103 on the west Humber River, and 85014.

Seasonal changes in average chloride concentrations are shown in Figure 13. As expected, the winter season (December, January, and February) had the highest average chloride concentrations. The highest average winter concentration of chloride was at Tributary 3 in the Etobicoke Creek watershed at 2345 mg/L which was almost 4 times greater than the acute guideline and almost 20 times greater than the chronic guideline. The number of sites with average concentrations below the chronic guideline of 120 mg/L during the winter months was 10 sites or 21%. These sites were located in the upper reaches of Humber River, Rouge River, Duffins Creek, and Carruthers Creek watersheds. Average chloride concentrations remained relatively high during the spring months and were the lowest during the summer and autumn. Despite average chloride concentrations being the lowest during the summer and autumn, 32 of 47 sites (68%) continued to exceed the chronic effects guideline of 120 mg/L.

3.1.4 *Escherichia coli*

E. coli are a large and diverse group of bacteria that are commonly found in the intestines of warm blooded animals. Although most strains of *E. coli* are harmless, others can cause human illness (e.g. diarrhea, urinary tract infections, respiratory illness, pneumonia) (CDC 2008). *E. coli* are often used to indicate the presence of fecal wastes and other harmful bacteria in lakes and streams. The presence of *E. coli* in a water sample suggests there is a greater risk that pathogens are present. Bacteria enters waterways via a variety of sources including sewer systems (e.g. combined sewer overflows), septic systems, wildlife, livestock, pets, waterfowl and organic fertilizers.

Average *E. coli* results are presented in Figures 2 and 6. Average *E. coli* concentrations surpassed the PWQO of 100 CFU/100 mL at 42 of 47 sites (89%). The five sites with an average *E. coli* concentration below the PWQO were 83018 and 83020 in the upper and middle Humber River watershed, 104023 and 104029 in the Duffins Creek watershed, and 97013 in the lower Rouge. The highest average *E. coli* concentration was at station 85014 in the Don River with an average of 42 371 CFU/100 mL (median = 1600 CFU/100 mL). Compared to the 2011-2015 summary report (TRCA 2017a), average *E. coli* counts appeared to have increased at 6 stations and decreased at 32 stations. Station 85014 had the most substantial increase in *E. coli* count increasing from 11 384 CFU/100 mL in 2011-2015 to 42 371 CFU/100 mL in 2016-2020.

Average seasonal *E. coli* results are presented in Figure 14. Average *E. coli* concentrations were generally lowest in the winter and spring. Fourteen sites had average values below the PWQO of 100 CFU/100 mL during the winter, but no sites had average values below the PWQO in summer. Higher than average *E. coli* counts during the summer months is consistent with other urban areas (e.g. Whitman *et al*. 2006, Crabill *et al*. 1999). Summer storms typically produce heavy, sporadic rainfall which flushes bacteria into the streams from animal/waterfowl feces and soil. Crabill *et al*. (1999) found that sediment fecal bacteria was much greater than that found in water suggesting that soil serves as a potential reservoir for fecal bacteria. Re-suspension of bacteria into the water column from both adjacent soil and from bottom sediments due to increased flow velocities are likely contributing to the high *E. coli* counts in Toronto streams during the summer months.

3.1.5 Total suspended solids

A total suspended solids (TSS) value represents the amount of particulate matter (e.g. silt, clay, organic and inorganic matter, soluble organic compounds, plankton, other microscopic organisms) suspended in water. Suspended sediments can act as transport vectors for contaminants and nutrients (e.g. metals and phosphorus can bind to sediments) and can affect aquatic organisms. Direct negative effects on fish include clogging and abrasion of gills, behavioural effects (e.g. movement and migration), blanketing of spawning gravels and other habitat changes, the formation of physical constraints disabling proper egg and fry development, and reduced feeding (CCME 2002). Effects on benthic invertebrates include physical habitat changes, smothering of benthic communities, clogging of interstices between gravel, cobbles, and boulders affecting invertebrate microhabitat, abrasion of respiratory surfaces, and interference of food intake for filter-feeding invertebrates (CCME 2002). The CWQG contain a narrative guideline for TSS which the maximum increase of TSS should be no more than 25 mg/L above the background concentration (defined as 5 mg/L for this report).

Average TSS concentrations are presented in Figures 2 and 7. In general, average TSS concentrations were higher near the mouths of the rivers or in urbanizing areas (e.g. areas with development construction) and lowest in the upper reaches. Eight stations had average TSS concentrations above the objective of 30 mg/L: 83020 (middle Humber River), 83004 (main Humber River), HU010WM (lower main Humber River), 83019 (mouth of the Humber River), 97011 (Rouge River), 104027 (lower in Duffins Creek), 104025 (lower in the West Duffins Creek), 104001 (mouth of Duffins Creek). Median TSS values were all below 30 mg/L. Six stations had average TSS values of 10 mg/L or less: Mayfield (upper Etobicoke Creek), CC005 (middle Carruthers Creek), 97018 (Bruce Creek in the upper Rouge), 107002 (lower Carruthers Creek), Tributary 4 (lower Etobicoke Creek), and Little Etob CK (Little Etobicoke Creek in lower Etobicoke). Compared to the 2011-2015 summary report (TRCA 2017a), average TSS concentrations appeared to have increased at 20 stations and decreased at 18 stations. Stations with the largest increases were HU010WM, 80007 (West branch of Etobicoke Creek), and 97003 (Lower Rouge River).

Seasonal average TSS values are presented in Figure 15. Average TSS values were highest in the spring which is most likely due to snowmelt providing sediment to the stream which was applied to the roads for traction during the winter months. Higher average values could also be due to higher flows causing erosion within the stream. The maximum TSS concentration was 972 mg/L at station 104025 (lower West Duffins Creek) on March 14, 2016. This value was more than 30 times the objective of 30 mg/L. The expansion of Highway 407 to the east began in 2015 and this construction could have contributed to the observed increased TSS concentrations.

3.1.6 Copper

Copper is an essential trace element that can be toxic to aquatic biota at elevated concentrations. It enters aquatic systems through aerial deposition or surface runoff. Sources of copper include the weathering of copper minerals and numerous sources from human activities (e.g. copper pipe, metal alloys, wiring, fungicides and insecticides). Copper strongly adheres to particulate matter (e.g. soil particles) and tends to accumulate in sediments. Because a variety of organisms live in, or are in contact with, the stream bed, sediments act as an important route of exposure to aquatic organisms (CCME 1999a). High levels of copper in the aquatic environment are usually found in more urbanized and industrial areas (OMOE 2003). The PWQO for copper is 5 µg/L.

Average copper results are presented in Figures 2 and 8. Nine stations had average copper results greater than the PWQO: 80006 (mouth of Etobicoke Creek), 82003 (mouth of Mimico Creek), MM003WM (middle Mimico Creek), 83012 (lower Black Creek), 85014 (mouth of the Don River), Tributary 3 (lower Etobicoke Creek), Lower Etob US (lower Etobicoke Creek), 80007 (west branch of Etobicoke Creek), and Little Etob CK (Little Etobicoke Creek in lower Etobicoke Creek). These sites are in highly urbanized and industrialized areas. Some stations may also be influenced by point sources such as the airport, industry, and highways. Station 82003, at the mouth of the Mimico Creek watershed, had the highest average copper concentration at 8.5 µg/L (median = 7.1 µg/L). Compared to the 2011-2015 summary report (TRCA 2017a), average copper concentrations appeared to have increased at 29 stations and decreased at 9 stations. Stations with the largest increases (increased by >1 µg/L) included MM003WM, 82003, and 80007.

Seasonal average copper concentrations are presented in Figure 16. Average copper concentrations were highest in the spring and winter and lowest in the summer and autumn. The increased concentrations of copper during the winter and spring may be due to increased concentrations of chloride in surface water which can lead to the release of metals from sediments and suspended particulate matter (Warren and Zimmerman 1994).

3.1.7 Iron

Iron is required for all forms of life but, it can be toxic to aquatic organisms at high concentrations. The relationship between the insoluble and soluble forms (bioavailable) depends on several factors including pH, dissolved oxygen, dissolved and total organic carbon, humic and other organic substances, exposure to light and chloride concentrations (BC MOE 2008). Anthropogenic sources of iron include landfills, water purification, sewage treatment, pesticides, and fertilizers. Iron bound to other substances (e.g. sediment) can affect aquatic organisms. In fish, iron can clog gills and reduce respiratory potential and therefore overall survival can be affected. It can also decrease the number of benthic invertebrates (which serve as the food supply for fish) directly or through changes to aquatic habitat. The PWQO for iron is 300 µg/L. Relatively high concentrations of metals can occur naturally in some Canadian soils and stream sediments making it difficult to determine the distinction between anthropogenic pollution versus naturally occurring sources.

Average iron results for 2016-2020 are presented in Figures 2 and 9. Twenty sites (43%) had average iron concentrations that were less than the PWQO. Station 83019, located at the mouth of the Humber River, had the highest average concentration of iron at 826 µg/L. Average iron values tended to reflect accumulation as the water flows from the headwaters to the outlet of the watershed with the stations closest to the lake showing the highest iron concentrations in several watersheds (Etobicoke Creek, Humber River, Don River, Duffins Creek). Compared to the 2011-2015 summary report (TRCA 2017a), average iron concentrations appeared to have increased at 16 stations and decreased at 22 stations. Station 104001 had the largest increase of 139 µg/L while stations DM 6.0 (lower Taylor-Massey Creek), 80007 (West branch of Etobicoke Creek), 83018 (upper Humber River), and 83019 (mouth of the Humber River) increased by between 65-75 µg/L.

Seasonal average iron concentrations are presented in Figure 17. Average iron concentrations appeared to vary only slightly among seasons. Concentrations usually rise in the spring due to sediment re-suspension from increased stream flow, increased iron-rich runoff, and flushing of dissolved organic matter (e.g. decaying leaves) into the water (Vuori 1995, Wetzel 2001). The highest average iron concentrations were in the summer (1707 µg/L at 83019 at the mouth of the Humber River) and winter (1180 µg/L at 80006 at the mouth of Etobicoke Creek).

3.1.8 Zinc

Zinc is an essential trace element that is toxic to aquatic organisms at elevated levels causing behavioural changes and mortality as well as decreased benthic invertebrate diversity and abundance (OMOE 2003). Zinc can enter aquatic systems through aerial deposition or surface runoff. The primary use of zinc is for galvanized products for the automotive and construction industry. Sources of anthropogenic zinc include electroplaters, smelting and ore processing, domestic and industrial sewage, combustion of solid wastes and fossil fuels, corrosion of zinc alloy and galvanized surfaces, wear from brake pads and tires, and soil erosion (OMOE 2003, Hwang et al. 2016). Zinc has a strong affinity for aquatic particles (especially organic matter) and tends to accumulate in bed sediments. A wide variety of organisms live in contact with the sediments of aquatic systems. Sediments therefore act as an important route of exposure to zinc for aquatic organisms (CCME 1999b). The PWQO for zinc is 20 µg/L.

Average zinc concentrations are presented in Figures 2 and 10. Seven sites (15%) had average concentrations which exceeded the PWQO. These sites were: 80006 (mouth of Etobicoke Creek), MM003WM (middle Mimico Creek), 82003 (mouth of Mimico Creek), Tributary 3 (lower Etobicoke Creek), 85014 (mouth of the Don River), 83012 (lower Black Creek), and 83019 (mouth of the Humber River). These sites are in urbanized or industrialized areas. The lowest average zinc concentration (4.8 µg/L) was at station CC005 in the middle Carruthers Creek watershed with little urban influence. Three stations had median zinc concentrations above the PWQO: 80006 (20.4 µg/L), 85014 (20.6 µg/L), and 82003 (25.4 µg/L). Compared to the 2011-2015 summary report (TRCA 2017a), average zinc concentrations appeared to have increased at 33 stations and decreased at 5 stations. Stations with the largest increase were 104008 (lower Mitchell Creek in East Duffins), 104001 (lower portion of Duffins Creek), 80007 (West branch of Etobicoke Creek), 80006, and MM003WM.

Seasonal average zinc concentrations are presented in Figure 18. Average zinc concentrations were the highest in the Etobicoke and Mimico Creek watersheds during spring and winter. Numerous stations had the highest average concentrations in the winter surpassing the PWQO. These stations also had the highest chloride concentrations and similar to copper, zinc concentrations are likely related to increased chloride concentrations from road salts.

3.1.9 Water Quality Index

Results for the WQI are presented in Table 5 and Figure 19. According to the WQI, the 47 sites within TRCA's jurisdiction were characterized into 3 categories: fair, marginal, and poor. There were no sites with excellent or good ratings. Only 5 stations (11%) were categorized as fair: 83018 (upper Humber), 104008 (lower Mitchell Creek in the east Duffins), 83104 (upper Humber), 97018 (Bruce Creek in the upper Rouge), and 104029 (Mitchell Creek in the east Duffins). These sites are located in the upper reaches of their respective watersheds. The remaining stations were categorized as marginal (38%) or poor (51%). The 5 stations which received the lowest WQI scores were: 85014 (mouth of the Don River), 83012 (lower Black Creek), DM 6.0 (lower Taylor-Massey Creek), 80006 (mouth of Etobicoke Creek), and MM003WM (middle Mimico Creek).

Table 5. Water Quality Index scores and ratings for TRCA's jurisdiction.

Station	Watershed	WQI	Rating
83018	Humber	69.5	Fair
104008	Duffins	68.8	Fair
83104	Humber	67.8	Fair
97018	Rouge	67.7	Fair
104029	Duffins	64.9	Fair
104027	Duffins	63.7	Marginal
CC005	Carruthers	63.4	Marginal
83009	Humber	63.3	Marginal
104037	Duffins	61.9	Marginal
83020	Humber	61.7	Marginal
107002	Carruthers	60.4	Marginal
104028	Duffins	60.3	Marginal
104023	Duffins	60.1	Marginal
97013	Rouge	59.9	Marginal
97999	Rouge	59.6	Marginal
104025	Duffins	58.6	Marginal
97007	Rouge	58.0	Marginal
104026	Duffins	57.1	Marginal
Mayfield	Etobicoke	53.0	Marginal
83004	Humber	52.4	Marginal
HU010WM	Humber	49.4	Marginal
104001	Duffins	44.3	Marginal
83103	Humber	44.2	Marginal
97003	Rouge	43.5	Poor
97777	Rouge	42.8	Poor
83002	Humber	42.2	Poor
97011	Rouge	40.5	Poor
DN008WM	Don	39.7	Poor
Tributary 4	Etobicoke	39.4	Poor
PT001WM	Petticoat	39.1	Poor
85003	Don	38.8	Poor
85004	Don	38.0	Poor
94002	Highland	34.3	Poor
Spring Creek	Etobicoke	34.1	Poor
Lower Etob US	Etobicoke	33.7	Poor
80007	Etobicoke	33.5	Poor
Little Etob CK	Etobicoke	32.7	Poor
FB003WM	Frenchmans	31.6	Poor
83019	Humber	30.1	Poor
Tributary 3	Etobicoke	29.9	Poor
HU1RWMP	Humber	29.1	Poor
82003	Mimico	28.4	Poor
MM003WM	Mimico	28.3	Poor
80006	Etobicoke	28.2	Poor
DM 6.0	Don	26.5	Poor
83012	Humber	22.6	Poor
85014	Don	17.7	Poor

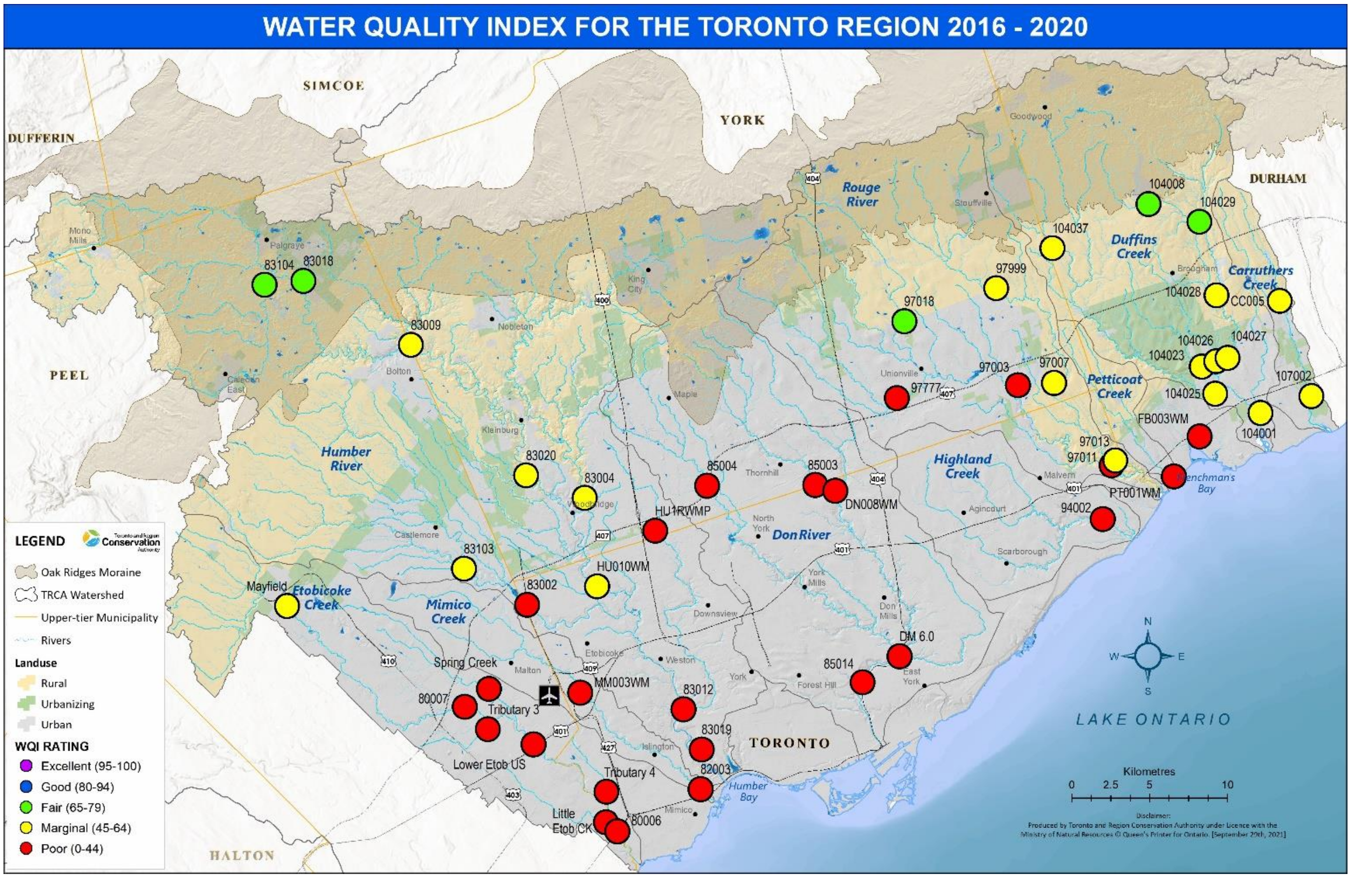

Figure 19. Water Quality Index scores for the Toronto region 2016-2020.

3.2 Temporal trends

3.2.1 Total phosphorus

Trend analysis results for total phosphorus are presented in Table 6 and Figure 20. A decrease in total phosphorus over time (z<0) was found at all 13 stations and no stations had increasing trends (z>0). Of these stations, 6 of 13 showed statistically significant decreasing trends (*p*<0.05).

Currently, 9 of 13 stations have median phosphorus values above the PWQO of 0.03 mg/L. Station 85014, near the mouth of the Don River, had the highest median phosphorus value of 0.133 mg/L (over four times the PWQO). Station 85014 is located downstream of the North Toronto Wastewater Treatment Plant. Despite being elevated, a concentration of 0.133 mg/L is 3.5 times lower than the median concentration of 0.462 mg/L for the 1976-1980 time period. The current median value (0.133 mg/L) at this station is similar to the 2001-2005 time period (0.139 mg/L) and about 1.5 times higher than the value of the previous 2011-2015 time period of 0.084 mg/L.

Table 6. Total phosphorus trend analyses over time (bold indicates value > PWQO of 0.03 mg/L and numbers in brackets represent the number of samples over the 5-year period).

Watershed	Station	Median Total Phosphorus Concentrations in mg/L (N)											Mann-Kendall			Regression
		66-70	71-75	76-80	81-85	86-90	91-95	96-00	01-05	06-10	11-15	16-20	z	S	*p*	R^2
Humber	83018			0.030 (54)	**0.035** (56)		0.024 (41)		0.024 (66)	0.020 (57)	0.020 (60)	0.026 (58)	-1.23	-ve	0.219	0.534
	83002	**0.160** (52)	**0.120** (42)	**0.069** (52)	**0.090** (51)		**0.113** (41)		**0.078** (53)	**0.080** (60)	**0.068** (57)	**0.069** (57)	-2.10	-ve	0.036	0.509
	83004	**0.032** (52)	0.027 (40)	0.025 (53)	0.029 (52)		**0.034** (32)		0.030 (50)	0.030 (58)	0.023 (57)	0.023 (57)	-0.949	-ve	0.343	0.148
	83012			**0.240** (54)	**0.121** (52)		**0.058** (31)		**0.060** (50)	**0.050** (60)	**0.047** (57)	**0.099** (57)	-1.50	-ve	0.133	0.485
	83019[M]			**0.069** (69)	**0.080** (117)	**0.054** (176)	**0.047** (346)	**0.052** (109)	**0.041** (149)	**0.032** (73)	**0.031** (58)	**0.037** (58)	-2.82	-ve	0.005	0.793
Don	85004	**0.510** (54)	**1.600** (42)	**0.280** (50)	**0.099** (51)		**0.064** (39)		**0.065** (40)	**0.050** (60)	**0.033** (59)	**0.050** (57)	-2.94	-ve	0.003	0.387
	85003	**0.250** (57)	**0.480** (42)	**0.277** (54)	**0.078** (51)		**0.056** (41)		**0.065** (42)	**0.060** (60)	**0.044** (59)	**0.052** (57)	-2.61	-ve	0.009	0.582
	85014[M]			**0.462** (65)	**0.275** (135)	**0.178** (145)	**0.190** (372)	**0.168** (99)	**0.139** (140)	**0.186** (64)	**0.084** (60)	**0.133** (58)	-2.61	-ve	0.009	0.631
Highland	94002			**0.054** (87)	**0.032** (52)	0.028 (59)			**0.040** (36)	0.030 (60)	0.027 (59)	**0.042** (57)	-0.601	-ve	0.548	0.090
Rouge	97003		**0.600** (41)	**0.145** (53)	**0.053** (60)	**0.056** (56)	**0.050** (36)			**0.060** (48)	**0.048** (59)	**0.052** (57)	-1.86	-ve	0.064	0.339
	97013		**0.032** (39)	0.020 (51)	0.024 (60)	0.029 (58)	0.018 (41)		**0.035** (41)	0.020 (48)	0.020 (59)	0.023 (57)	-0.426	-ve	0.670	0.061
	97011		**0.415** (42)	**0.099** (52)	**0.031** (60)	**0.034** (58)	0.025 (44)		**0.031** (65)	**0.032** (44)	0.026 (59)	**0.032** (58)	-1.37	-ve	0.171	0.357
Duffins	104001[M]	**0.072** (103)	**0.086** (53)	**0.088** (70)	**0.035** (59)	0.030 (58)	0.022 (48)		0.022 (37)	0.020 (43)	0.020 (60)	0.026 (58)	-2.53	-ve	0.012	0.649

Notes: [M] = mouth of watercourse; bolded values indicate exceedance of 0.03 mg/L objective

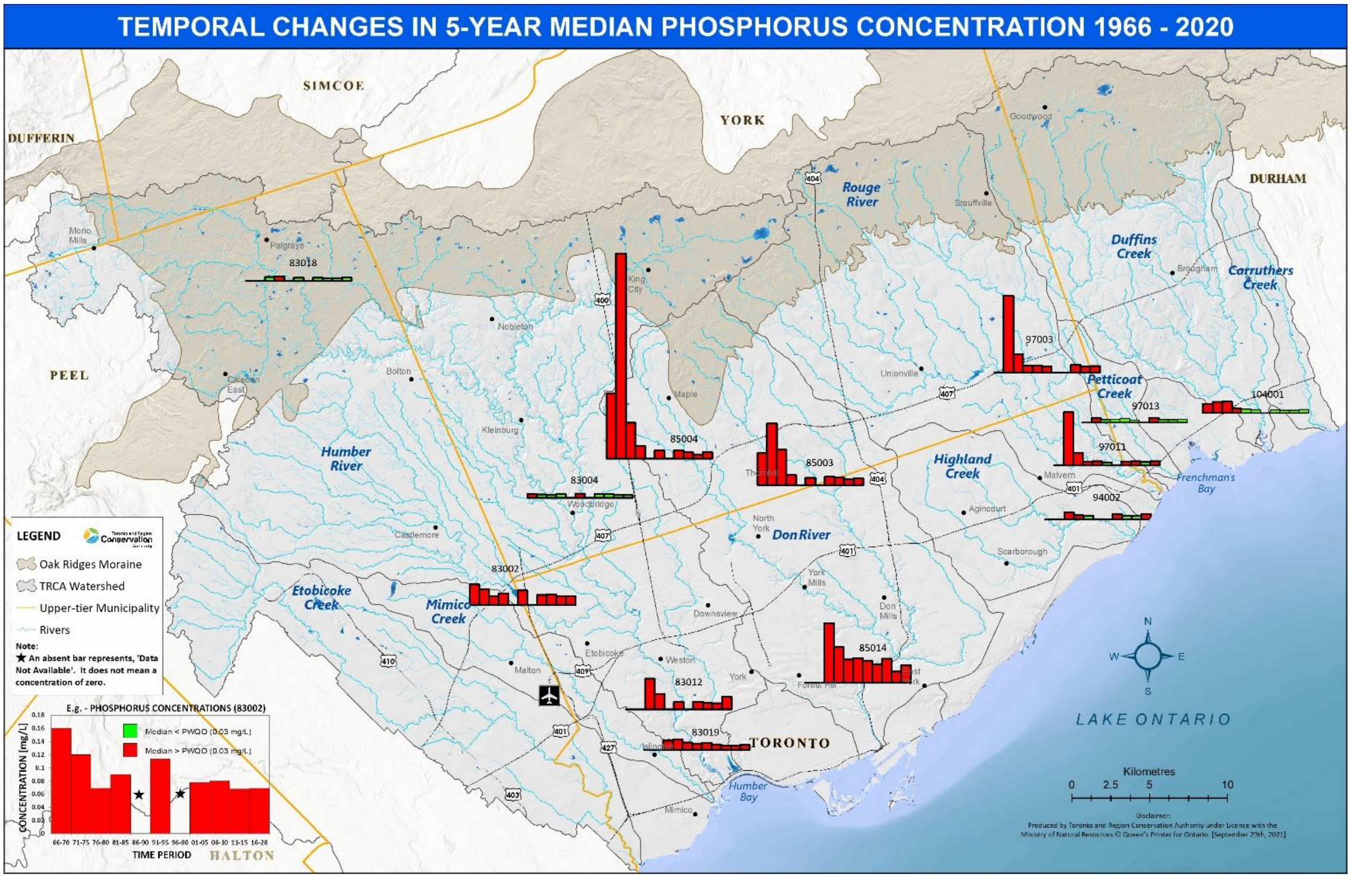

Figure 20. Temporal changes in 5-year median phosphorus concentration (1966-2020).

Total phosphorus concentrations for the mouth of the Humber River (83019), Don River (85014), Highland Creek (94002), Rouge River (97011) and Duffins Creek (104001) are presented in Figure 21. All five watersheds have had decreasing phosphorus concentrations over the last several decades (Figure 22) but only the Humber River, Don River and Duffins Creek watersheds had statistically significant decreasing trends ($p<0.05$). The declining trend in phosphorus is likely associated with a general reduction in phosphorus use in the 1970s and specifically due to the decommissioning of several sewage treatment plants within TRCA's jurisdiction.

Even though phosphorus levels have declined both in Ontario's streams and in offshore Lake Ontario, the potential for current levels to cause harmful algal blooms and eutrophic conditions continues to be monitored (Stammler *et al.* 2017, ECCC 2020). Phosphorus concentrations vary across the Toronto area waterfront and tend to be higher in Toronto Inner Harbour, near wastewater and CSO outfalls, and rivermouths causing these areas to be susceptible to algal blooms (Howell and Benoit 2021). Any increased development or changes in agricultural practices (e.g. fertilization rates) may increase phosphorus loading and further exacerbate the growth of algae.

To help combat eutrophication issues such as algal blooms and anoxia, the federal government introduced a ban which almost eliminates phosphorus from household laundry, dishwasher, and dish washing detergents as well as some household cleaners (Canada Gazette 2009). The ban came into effect in July 2010 and reduces the allowable amount of phosphorus to 0.5% by weight (previously 2.2%). This will help to reduce some of the phosphorus released to watercourses but even the most advanced wastewater treatment technologies available cannot totally eliminate phosphorus releases to the environment. Although this is a step in the right direction, municipal wastewater sewers and septic systems only contribute about 14% to the national phosphorus load (Canada Gazette 2009).

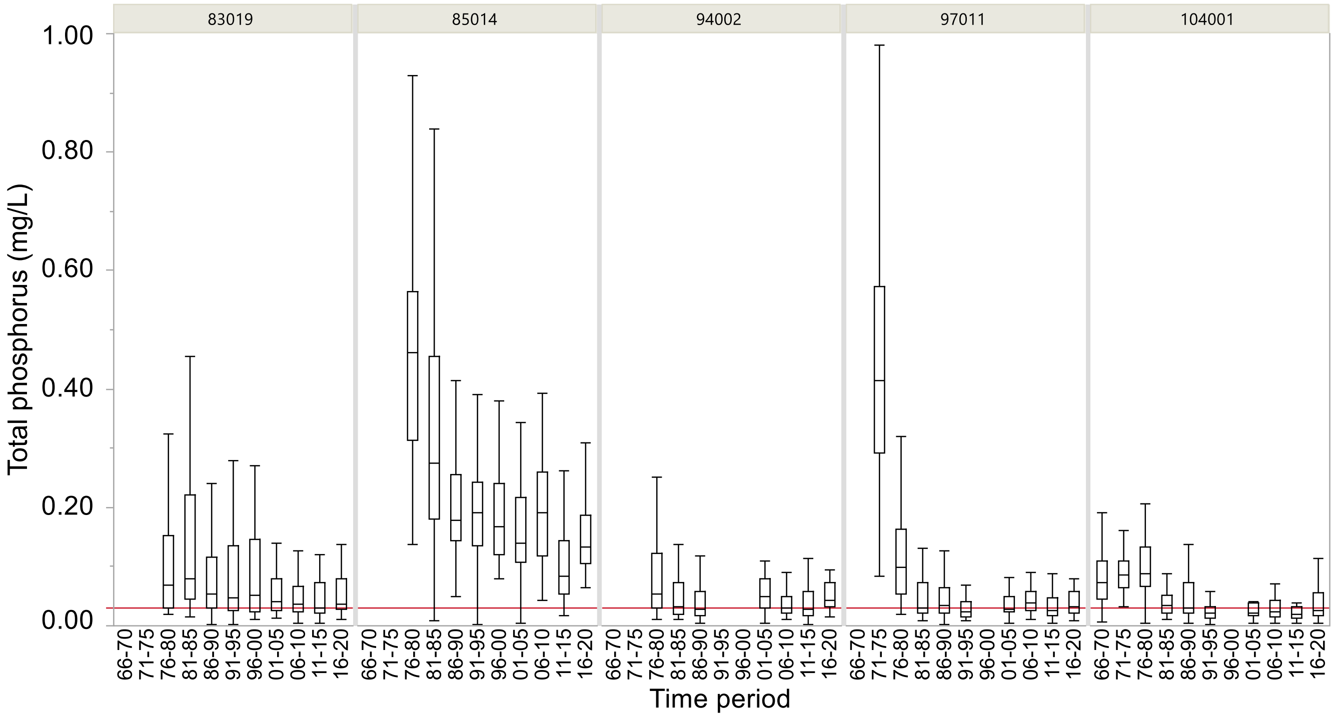

Figure 21. Total phosphorus concentrations for the mouth of the Humber River (83019), Don River (85014), Highland Creek (94002), Rouge River (97011) and Duffins Creek (104001) over time.

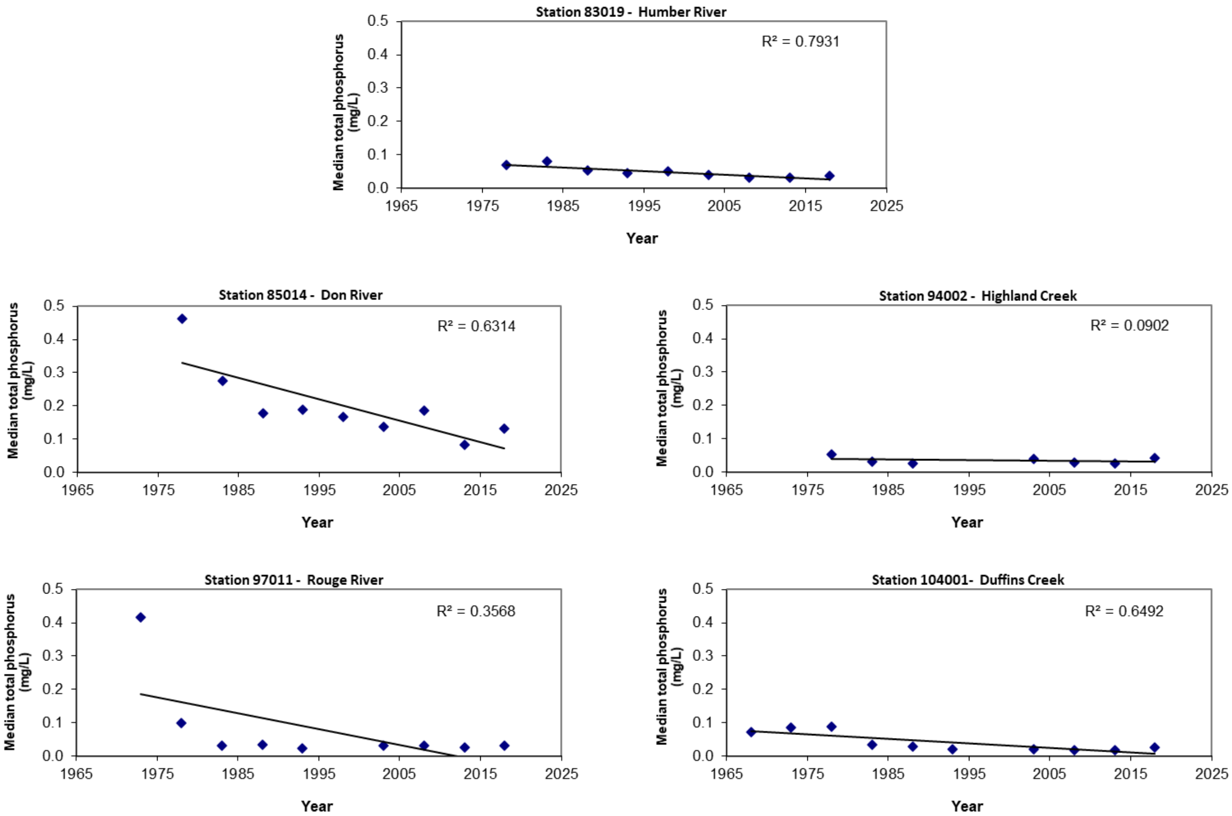

Figure 22. 5-year median total phosphorus concentrations over time at the mouths of the Humber River (83019), Don River (85014), Highland Creek (94002), Rouge River (97011), and Duffins Creek (104001).

3.2.2 Chloride

Trend analysis data for chloride are presented in Tables 7 and 8 and Figure 23. All stations (13 of 13) showed an increasing trend for chloride concentrations with 12 of the 13 stations having a statistically significant increasing trend ($p<0.05$). All stations had higher median chloride concentrations in 2016-2020 compared to 2011-2015 and the difference in concentration between time periods appeared to be greater for stations with higher chloride concentrations. The reasons behind this pattern are unknown and warrant further investigation.

It is important to note that winter samples (when chloride concentrations are expected to be the highest due to road salting activities) were not collected during every time period. At the Duffins Creek site, winter sampling began in 1965. Winter samples were collected at the Rouge River and Highland Creek stations beginning in the mid-1970s and winter sampling did not start at the Humber River and Don River station until 1990. This suggests that median chloride concentrations may have been higher than what is presented during periods when winter sampling did not occur. We also examined temporal trends in chloride concentration only during the ice-free season (April to November) and found similarly significant results (Table 8).

There were five stations in the Humber River watershed with sufficient data to determine temporal trends. All five stations showed an increasing trend for chloride with the trends at four sites being significant (83018 in the upper Humber, 83004 on the main Humber River, 83002 on the west Humber Creek just south of the Claireville Reservoir, 83019 at the mouth of the Humber). Station 83012, located close to the mouth of the Black Creek, had the highest chloride concentration of all stations during each time period monitored (medians: 269-586 mg/L from 1976-2020). Chloride concentrations for this station in the current time period are 3 to 10 times higher than other stations in the Humber River watershed. Station 83018, in the upper reaches of the Humber

River watershed, was the only station in the watershed that did not exceed the 120 mg/L objective during the current time period (58 mg/L). Regardless, this station did have statistically significant increases in chloride between 1976-1980 and 2006-2010 and again from 2011-2015 to 2016-2020.

Three stations in the Don River watershed had sufficient data for trend analysis. Two stations (85003 and 85004) are located in the upper-middle portions of the watershed and one station (85014) is located at the mouth of the Don River. Chloride concentrations increased significantly over time at all three stations (all $p<0.046$). Chloride concentrations at these stations have increased substantially since they were first sampled with 85004 more than three times higher, 85003 more than four times higher, and 85014 more than doubling. These sites are in areas which have undergone considerable urbanization over the past few decades.

All three stations in the Rouge River watershed with adequate chloride data for trend analyses showed statistically significant increases in median chloride concentrations over time. Chloride concentrations on the Little Rouge River remain at about half of the concentration on the Rouge River although both continue to increase. Station 97013, in the lower portion of the Little Rouge River, has now surpassed the threshold for chronic effects for the first time (based on a median).

The Highland Creek and Duffins Creek watersheds each had one station with sufficient chloride data for trend analysis. Station 94002 at the mouth of Highland Creek and station 104001 at the mouth of Duffins Creek both showed a significant increasing trend in median chloride concentrations over time. Station 94002 in the Highland Creek watershed has had concentrations above the chronic effects guideline since sampling began while the Duffins Creek station has continually had the lowest median chloride concentrations of all sites (but continues to move closer to surpassing the chronic effects guideline). This watershed was, and continues to be, mainly rural although pressures such as the 407 east expansion and urbanization remain.

Table 7. Chloride trend analyses over time (bold indicates value > CWQG of 120 mg/L and numbers in brackets represent the number of samples over the 5-year period).

Watershed	Station	Median Chloride Concentrations in mg/L (N)											Test Statistic			Regression
		66-70	71-75	76-80	81-85	86-90	91-95	96-00	01-05	06-10	11-15	16-20	z or X^2	S	*p*	R^2
Humber	83018			16^{A} (42)					48^{B} (37)	52^{C} (57)	53^{C} (60)	58^{D} (58)	X^2=149	n/a	<0.001	n/a
	83004	28 (52)	37 (42)	42 (45)	46 (49)		39 (41)			106 (60)	**124** (57)	**150** (57)	z=2.85	+ve	0.004	0.884
	83002	33 (53)	41 (40)	46 (46)	59 (50)		83 (31)			**154** (60)	**166** (57)	**228** (57)	z=3.34	+ve	<0.001	0.939
	83012			**315** (53)	**269** (51)		**304** (31)			**459** (60)	**419** (57)	**586** (57)	z=1.50	+ve	0.133	0.785
	83019^{M}					102 (112)	111 (344)	104 (111)	**146** (126)	**164** (72)	**178** (60)	**199** (58)	z=2.70	+ve	0.007	0.930
Don	85004	**147** (54)	**158** (42)	**130** (50)	107 (51)		**158** (39)			**362** (60)	**364** (59)	**501** (57)	z=2.00	+ve	0.046	0.814
	85003	60 (57)	90 (41)	110 (54)	66 (51)		87 (41)			**188** (60)	**198** (59)	**290** (57)	z=2.35	+ve	0.018	0.802
	85014^{M}					**148** (113)	**169** (369)	**173** (105)	**199** (122)	**218** (72)	**283** (60)	**381** (58)	z=3.00	+ve	0.003	0.840
Highland	94002^{M}			**158** (87)	**178** (53)	**203** (59)	**218** (43)			**326** (59)	**356** (59)	**399** (57)	z=3.00	+ve	0.003	0.988
Rouge	97003		62 (41)	60 (53)	53 (60)	82 (56)	80 (36)			**180** (48)	**210** (59)	**279** (57)	z=2.35	+ve	0.019	0.894
	97013			41 (51)	39 (58)	51 (58)	50 (41)			84 (48)	119 (59)	**140** (57)	z=2.40	+ve	0.016	0.907
	97011			65 (51)	63 (60)	72 (58)	89 (44)		**162** (44)	**170** (44)	**223** (60)	**262** (58)	z=3.09	+ve	0.002	0.939
Duffins	104001^{M}	15 (103)	18 (53)	21 (70)	21 (59)	32 (58)	38 (47)		52 (33)	53 (43)	71 (60)	87 (58)	z=3.86	+ve	<0.001	0.932

Notes: ^{M} = mouth of watercourse; bolded values indicate exceedance of 120 mg/L objective; difference letters denote a significant difference (e.g. if twotime periods have a similar letter, they are statistically similar)

Table 8. Chloride trend analyses over time for only April to November (bold indicates value > CWQG of 120 mg/L and numbers in brackets represent the number of samples over the 5-year period).

Watershed	Station	Median Chloride Concentrations in mg/L (N) April-November only											Test Statistic			Regression
		66-70	71-75	76-80	81-85	86-90	91-95	96-00	01-05	06-10	11-15	16-20	z or X^2	S	*p*	R^2
Humber	83018			17^{A} (30)					48^{B} (32)	52^{C} (40)	52^{C} (40)	58^{D} (39)	X^2=111	n/a	<0.001	n/a
	83004	27 (36)	30 (29)	40 (29)	45 (32)		36 (29)			98 (40)	110 (37)	**134** (38)	z=2.85	+ve	0.004	0.890
	83002	34 (36)	41 (28)	45 (29)	61 (33)		70 (22)			**130** (38)	**132** (37)	**203** (38)	z=3.34	+ve	<0.001	0.900
	83012			**265** (34)	**237** (32)		**241** (21)			**355** (40)	**349** (37)	**353** (38)	z=1.13	+ve	0.260	0.792
	83019^{M}					97 (80)	97 (236)	95 (89)	**133** (99)	**145** (58)	**152** (40)	**163** (39)	z=2.28	+ve	0.023	0.898
Don	85004	**137** (36)	**157** (29)	**120** (35)	99 (32)		**141** (28)			**252** (40)	**331** (39)	**427** (38)	z=1.86	+ve	0.064	0.760
	85003	57 (37)	86 (28)	104 (35)	56 (32)		80 (28)			**147** (40)	**185** (39)	**228** (38)	z=2.10	+ve	0.036	0.790
	85014^{M}					**126** (81)	**142** (248)	**150** (81)	**183** (94)	**207** (58)	**241** (40)	**282** (39)	z=3.00	+ve	0.003	0.962
Highland	94002^{M}			**138** (59)	**156** (37)	**175** (39)	**202** (30)			**280** (40)	**218** (39)	**292** (38)	z=2.70	+ve	0.007	0.837
Rouge	97003		61 (30)	58 (38)	49 (40)	68 (37)	78 (29)			**142** (40)	**166** (39)	**219** (38)	z=2.60	+ve	0.009	0.886
	97013			39 (36)	38 (39)	50 (38)	49 (32)			81 (40)	101 (39)	119 (38)	z=2.40	+ve	0.016	0.942
	97011			63 (35)	56 (40)	71 (38)	87 (32)		**139** (31)	**156** (40)	**187** (40)	**220** (39)	z=3.09	+ve	0.002	0.956
Duffins	104001^{M}	12 (71)	17 (44)	20 (49)	19 (40)	27 (38)	37 (34)		51 (29)	50 (39)	59 (40)	68 (39)	z=3.58	+ve	<0.001	0.969

Notes: ^{M} = mouth of watercourse; bolded values indicate exceedance of 120 mg/L objective; different letters denote a significant difference (e.g. if two time periods have a similar letter, they are statistically similar)

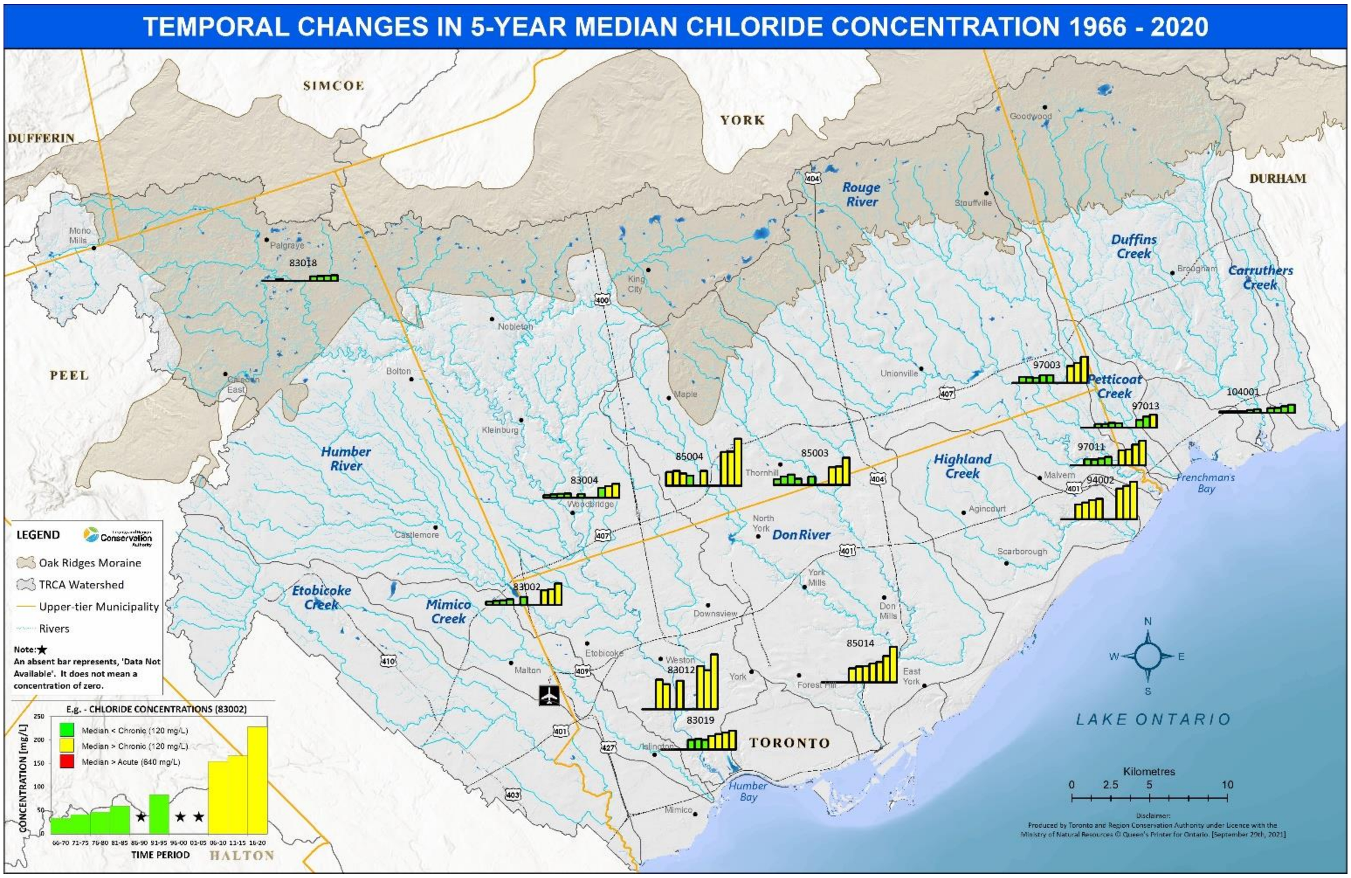

Figure 23. Temporal changes in 5-year median chloride concentration (1966-2020).

Chloride results are presented in Figures 24 and 25 for the mouths of the Humber River (83019), Don River (85014), Highland Creek (94002), Rouge River (97011), and Duffins Creek (104001). All five stations showed increasing trends in chloride concentrations. Stations at the mouth of the Humber River, Don River, Highland Creek, and Rouge River had median chloride concentrations that exceeded the CWQG of 120 mg/L for chronic effects for at least four time periods. While the median value for Duffins Creek remains below the chronic threshold, the 75th percentile for the 2016-2020 data has now surpassed the threshold for the first time in the past 50 years.

The number of stations with median chloride concentrations above the chronic effects guideline has increased over time. During the 1991-1995 time period, only 4 of 12 stations monitored had median concentrations >120 mg/L; however, in the 2016-2020 time period, 11 of 13 stations had median concentrations >120 mg/L. Station 83012 in Black Creek has a median concentration of 586 mg/L which is approaching the acute effects guideline of 640 mg/L (Table 7). If this is reached, it means that half of the samples were collected in conditions that are potentially lethal to aquatic life.

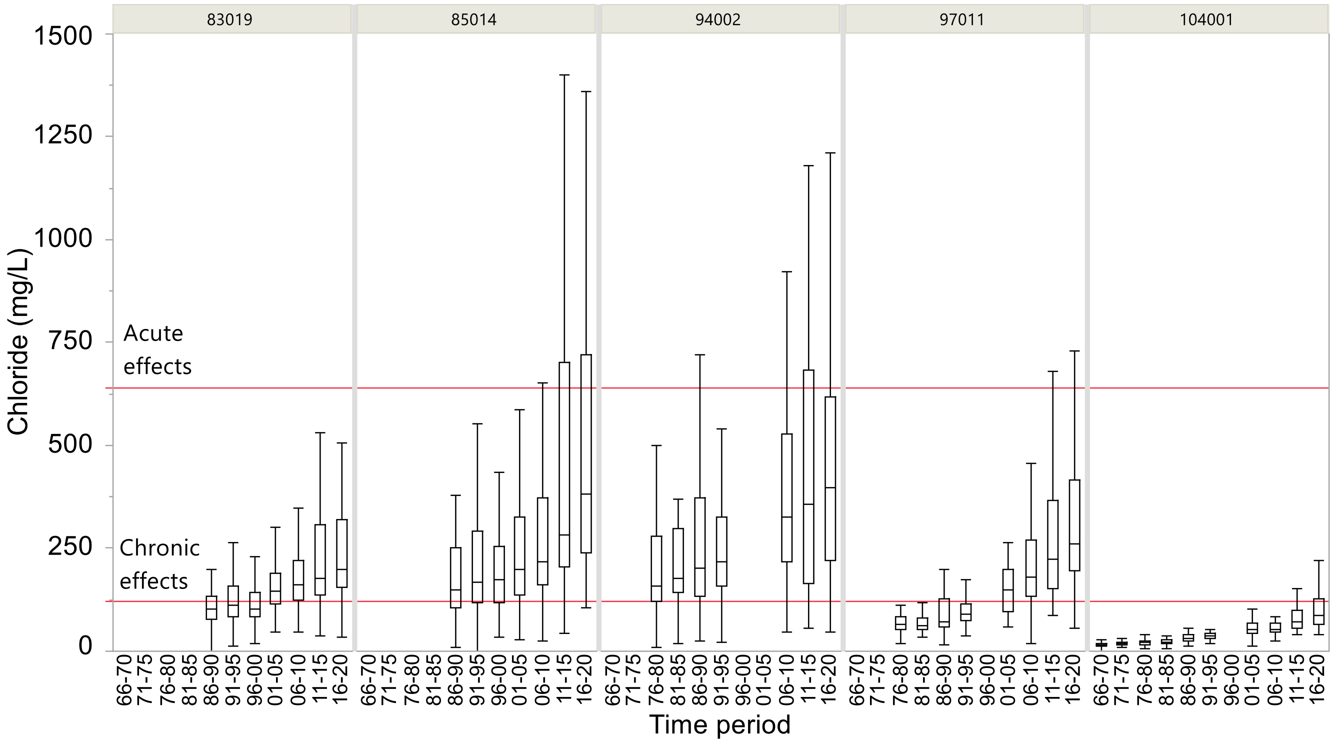

Figure 24. Chloride concentrations for the mouth of the Humber River, Don River, Highland Creek, Rouge River and Duffins Creek over time.

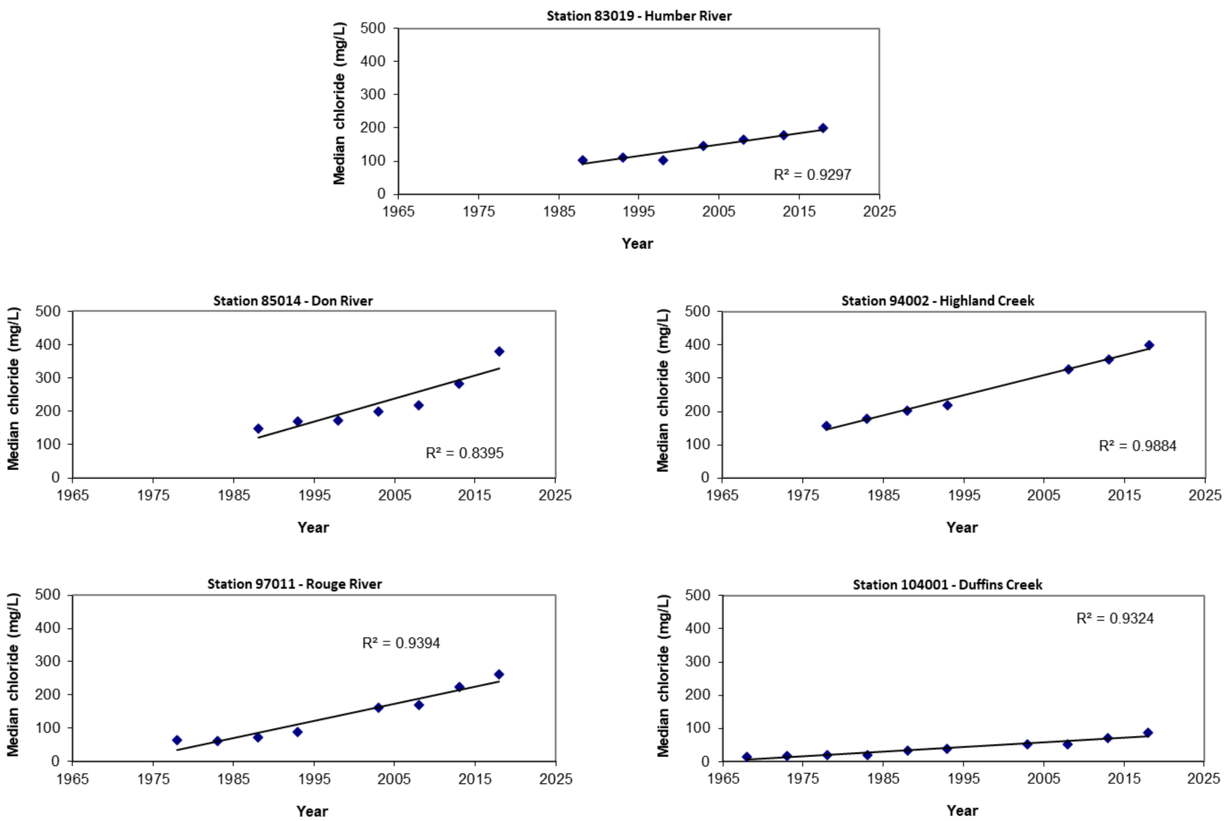

Figure 25. 5-year median chloride concentrations over time at the mouths of the Humber River (83019), Don River (85014), Highland Creek (94002), Rouge River (97011), and Duffins Creek (104001).

3.2.3 Total suspended solids

Trend analyses for TSS concentrations are presented in Table 9 and Figure 26. Station 85014 at the mouth of the Don River had statistically significant decreasing trends in TSS concentrations. During the 1976-1980 time period, the median TSS concentration at this station was 21 mg/L while during the current time period, the median concentration was 13.5 mg/L which is up slightly from 11.1 mg/L in both 2006-2010 and 2011-2015. Since untreated stormwater is the main contributor of TSS to streams in urban areas, the continued installation and improvement of stormwater infrastructure will further improve the health of the streams in the Toronto region. In rural areas, the erosion of tablelands and stream channels contribute to the TSS load. Efforts to improve riparian vegetation and reforestation may help to reduce runoff.

Stations tested for trends using the step-trend test showed variable results. Median TSS concentrations appear to have decreased at both station 83002 (west Humber River just south of the Claireville Reservoir) and 83004 (main Humber River) between 1966-1970 and 2016-2020. Stations 85004 (west Don River) and 85003 (east Don River) had significantly lower TSS concentrations in more recent time periods (2011-2015, 2016-2020) compared to earlier time periods (1966-1970, 1971-1975, 1976-1980). Station 94002 had a significantly lower median TSS concentration in 2016-2020 than in most other time periods. Stations 97003 (Little Rouge River), 97011 (Rouge River) and 104001 (mouth of Duffins Creek) have generally seen declines since earlier time periods compared to more recent periods.

TSS results for the mouths of the Humber River, Don Diver, Highland Creek and Duffins Creek are presented in Figures 27 and 28. Station 94002 on Highland Creek was the only creek mouth station with a median concentration greater than the CWQG derived guideline of 30 mg/L (1976-1980, 31 mg/L). The remaining stations had median values below 30 mg/L for all time periods.

Table 9. Total suspended solids trend analyses over time (bold indicates value > CWQG of 30 mg/L and numbers in brackets represent the number of samples over the 5-year period).

Watershed	Station	Median TSS Concentrations in mg/L (N)											Test Statistic			Regression
		66-70	71-75	76-80	81-85	86-90	91-95	96-00	01-05	06-10	11-15	16-20	z or X^2	S	*p*	R^2
Humber	83018			6.1 (52)	6.0 (50)		5.8 (41)		5.3 (43)	4.6 (55)	4.9 (59)	7.1 (58)	z=-0.901	-ve	0.368	0.017
	83002	28 (53)	23 (39)	20 (39)						20 (58)	15.4 (57)	18 (57)	X^2=13.2 (post-hoc NS)	n/a	0.022* (post-hoc NS)	n/a
	83004	15 (52)	10 (38)	12 (37)						7.2 (60)	7 (57)	6 (57)	X^2=12.9 (post-hoc NS)	n/a	0.025* (post-hoc NS)	n/a
	83019^{M}			14.0 (67)	25.0 (116)	16.0 (179)	18.0 (345)	17.8 (110)	9.0 (126)	9.9 (69)	10.5 (60)	10.9 (58)	z=-1.15	-ve	0.252	0.458
Don	85004	**33.5**^{A} (54)	**40.0**^{A} (41)	21.0^{AB} (43)						8.0^{BC} (60)	7.4^{C} (59)	6^{C} (57)	X^2=101.2	n/a	<0.01*	n/a
	85003	15.0^{AB} (56)	**40.0**^{A} (41)	25.0^{A} (47)						10.0^{BC} (60)	7.3^{C} (59)	6^{C} (57)	X^2=62.1	n/a	<0.01*	n/a
	85014^{M}			21.0 (65)	20.0 (133)	18.7 (144)	13.3 (359)	15.5 (103)	11.5 (121)	11.1 (68)	11.1 (60)	13.5 (58)	z=-2.52	-ve	0.012	0.738
Highland	94002^{M}			**31.0**^{A} (80)	6.8^{BC} (50)	8.3^{B} (54)				4.5^{BC} (60)	4.5^{BC} (59)	3^{C} (57)	X^2=94.4	n/a	<0.01*	n/a
Rouge	97003		15^{AB} (37)	19.5^{A} (52)						13.5^{AB} (60)	9.8^{B} (59)	10^{AB} (57)	X^2=20.1	n/a	<0.01*	n/a
	97011			21^{A} (51)					8^{BC} (37)	12^{AC} (56)	11.6^{AC} (59)	7.1^{BC} (58)	X^2=15.8	n/a	<0.01*	n/a
Duffins	104001^{M}	19.5^{AB} (102)	15.0^{ABCD} (50)	26.0^{A} (69)					9.1^{BD} (32)	9.0^{CD} (55)	$9.3B^{D}$ (59)	11.5^{AD} (58)	X^2=42.0	n/a	<0.01*	n/a

Notes: ^{M} = mouth of watercourse; bolded values indicate exceedance of 30 mg/L objective; different letters denote a significant difference (e.g. if two time periods have a similar letter, they are statistically similar)

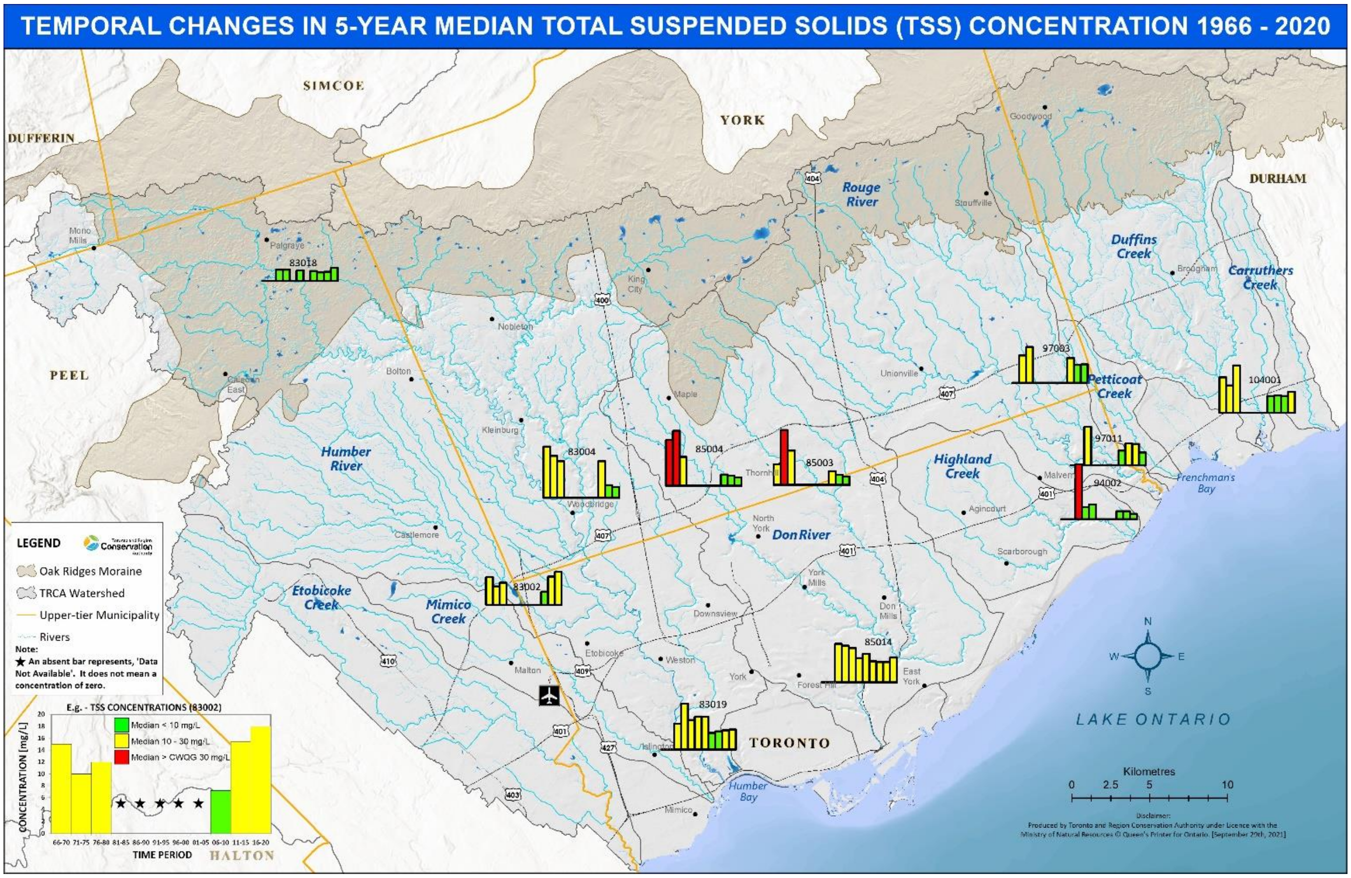

Figure 26. Temporal changes in 5-year median total suspended solids concentration (1966-2020).

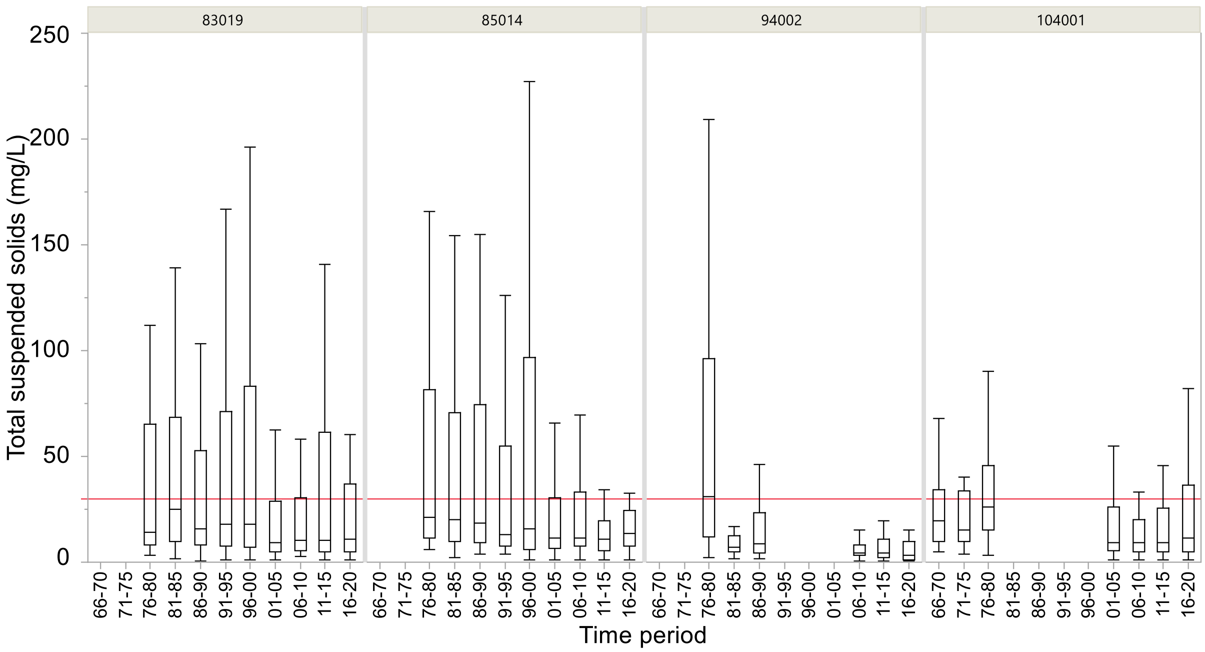

Figure 27. Total suspended solids concentrations for the mouths of the Humber River (83019), Don River (85014), Highland Creek (94002), and Duffins Creek (104001) over time.

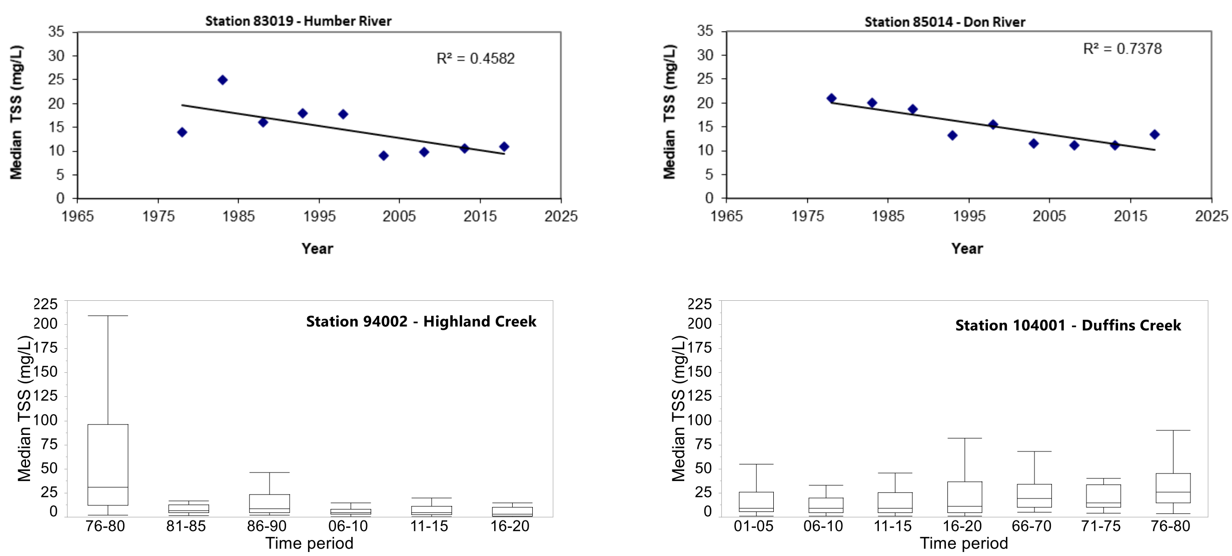

Figure 28. 5-year median total suspended solids concentrations over time at the mouths of the Humber River (83019), Don River (85014), Highland Creek (94002) and Duffins Creek (104001).

4. SUMMARY

4.1 Spatial patterns

Surface water quality for TRCA's jurisdiction has been analyzed several times (TRCA 1998, TRCA 2003, TRCA 2009, TRCA 2011, TRCA 2017a, TRCA 2017b) with the general conclusion that water quality issues are related to the amount of urbanization within a watershed. TRCA (2011) used road density data from 2007 as a surrogate for urbanization and found that higher road densities upstream within the catchment resulted in higher concentrations of several nutrients and contaminants (phosphorus, nitrates, chloride, *E. coli*, copper, and zinc; TRCA 2011). Some specific findings for the 2016-2020 time period include:

Nutrients

- No stations had an average total phosphorus concentration less than the PWQO of 0.03 mg/L; station 85014 in the Don River (downstream of the North Toronto Wastewater Treatment Plant) had the highest average total phosphorus concentration at 0.18 mg/L which is six times higher than the PWQO.
- Total phosphorus concentrations peaked during the summer and winter months. In the summer, fertilizer use is high; however, the reason for higher winter concentrations is less clear.
- All stations had average nitrate values below the CWQG of 2.93 mg N/L; DM 6.0 (Taylor Massey Creek in the Don River watershed) had the highest average nitrate concentration at 1.81 mg N/L.

Chloride

- Average chloride concentrations for 74% of the sites monitored exceeded the guideline for chronic effects (120 mg/L) with 19% of sites exceeding the guideline for acute effects (640 mg/L).
- Station HU1RWMP in the upper Black Creek in the Humber watershed had the highest average chloride concentration of 1280 mg/L while the Duffins Creek watershed and the upper reaches of the Humber River had the lowest concentrations.
- Chloride concentrations were highest during the winter and spring months.

Bacteria

- Average *E. coli* counts surpassed the PWQO of 100 CFU/100 mL at 42 of 47 sites (89%) and were highest at station 85014 in the Don River with an average of over 40 000 CFU/100mL.
- The lowest *E. coli* counts were in the Duffins Creek, upper Humber River, and lower Rouge River watersheds.
- *E. coli* counts tended to be highest during the summer months.

General

- Most stations had average TSS values below the 30 mg/L objective but stations near river mouths tended to have average values exceeding this objective.
- TSS concentrations were highest during the spring when spring melts carry road grit into the streams and stream flow is high causing increased erosion.
- The five stations with the highest (good) WQI values were: 83018 (upper Humber), 104008 (lower Mitchell Creek in east Duffins), 83104 (upper Humber), 97018 (Bruce Creek in the upper Rouge), and 104029 (Mitchell Creek in the east Duffins) while the five stations with the lowest (poor) WQI values

were: 85014 (mouth of the Don River), 83012 (lower Black Creek in the Humber), DM 6.0 (lower Taylor-Massey Creek), 80006 (mouth of Etobicoke Creek), and MM003WM (middle Mimico Creek).

- The Duffins Creek watershed along with the upper Humber River and Rouge River continue to exhibit the best water quality within TRCA's jurisdiction; lower levels of urbanization, larger riparian buffers, and groundwater contributions may play a role in the water quality in these areas.

4.2 Temporal trends

Temporal trends in stream surface water quality over the past 50 years show declines in total phosphorus and TSS concentrations while chloride concentrations have increased over time. These results are similar to the findings of the previous surface water quality summary report which incorporated 2011-2015 data into the long-term data set (TRCA 2017b).

These results are consistent with declines in total phosphorus seen in Lake Ontario between the 1970s and 2014 (Dove and Chapra 2015). This change was in response to limiting the concentration of phosphates in detergent in the early 1970s through Canadian legislation and the signing of the Great Lakes Water Quality Agreement which limited discharges by municipal wastewater treatment plants. Declines in phosphorus have also been found in streams throughout southern Ontario including several within the Toronto region between the 1970s and 2010/2011 (Stammler *et al.* 2017, Raney and Eimers 2014). Several reasons are proposed for declines including declines in agricultural cover, improved urban and rural land use practices, reductions in acid rain, increased nitrogen availability, and forest regeneration (Stammler *et al.* 2017, Raney and Eimers 2014).

The increase in chloride found in this report is consistent with the findings of several other papers examining data from Ontario and elsewhere (Kaushal *et al.* 2005, Kelly *et al.* 2008, Todd and Kaltenecker 2012, Raney and Eimers 2014, Mazumder et al. 2021). Significant increases in chloride were found at 96% of PWQMN stream stations in southern Ontario between 1975 and 2009 based on data collected during the warm season (May to October; Todd and Kaltenecker 2012). Increases in stream chloride concentrations during the warm season are of particular concern since this is the time when many aquatic species reproduce causing a greater impact on population persistence (Lawson and Jackson 2021). While chloride can be flushed into streams quickly with precipitation or snow melt events, retention of chloride in soil, groundwater, and stormwater presents a concern (Kelly *et al.* 2008, Perera *et al.* 2010, Casey *et al.* 2013, Oswald *et al.* 2019). The retention of chloride within these areas are likely leading to a time lag effect on stream concentrations (Kelly *et al.* 2008). Chloride retention is higher in less urbanized watersheds suggesting that chloride concentrations will continue to rise in rural areas long after any mitigation, such as road salt management, has occurred (Kelly *et al.* 2008, Oswald *et al.* 2019).

The assessment of long-term water quality changes across a large area such as the Toronto region is a challenging task. Differences in the number of samples collected, parameters analyzed, analytical capabilities of laboratories completing the analysis, improvements in laboratory analysis techniques (e.g. lower detection levels), and varying stream flow complicate water quality analyses. Several of these factors have confounded water quality analysis within TRCA's jurisdiction but efforts have been made to reduce these issues.

Even though we are seeing declines in total phosphorus and TSS, phosphorus concentrations continue to be greater than the PWQO and chloride concentrations continue to rise with more and more stations surpassing Canadian Water Quality Guidelines. Continued routine efforts such as the treatment of urban runoff via stormwater ponds, innovative actions for wastewater treatment, salt management plans, education, and continued advancement and innovation using new technologies and practices are required to maintain and improve the water quality in streams and rivers within the Toronto region.

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6. APPENDICES

Appendix A. Surface water quality station locations.

Watershed	Station	Alternate Name	Northing	Easting	Subwatershed	Township	Municipality	Location Description	Proprietor
Etobicoke Creek	Mayfield		4843488	595028	Etobicoke Headwaters	Brampton	Peel	Southeast of Mayfield Rd. and Hwy 10	RWMP
	Spring Creek		4838157	607990	Spring Creek	Mississauga	Peel	North of Derry Rd., upstream of Pearson International Airport	RWMP
	80007	06008000702	4836994	606440	Etobicoke West Branch	Mississauga	Peel	Northwest of Dixie Rd. and Derry Rd.	PWQMN
	Tributary 3		4835564	607921	Tributary 3	Mississauga	Peel	North of Courtneypark Dr., west of Dixie Rd.	RWMP
	Lower Etob US	Lower Etobicoke US	4834597	610862	Etobicoke Main Branch	Mississauga	Peel	North of Hwy 401, downstream of Pearson International Airport	RWMP
	Tributary 4		4831543	615546	Tributary 4	Toronto	Toronto	South of Bloor St., east of Markland Dr.	RWMP
	Little Etob CK	Little Etobicoke Creek	4829577	615520	Little Etobicoke Creek	Mississauga	Peel	West of East Mall, north of The Queensway	RWMP
	80006^{M}	06008000602	4829016	616234	Lower Etobicoke Creek	Toronto	Toronto	Southwest of the QEW and Brown's Line	PWQMN
Mimico Creek	MM003WM		4837916	613849	Lower Mimico	Toronto	Toronto	Southwest of Dixon Rd. and Hwy 27, in Royal Woodbine Golf Club	RWMP
	82003^{M}	06008200302	4831713	621585	Lower Mimico	Toronto	Toronto	Southwest of Park Lawn Rd. and The Queensway, Etobicoke	PWQMN
Humber River	83104	06008310402	4864112	593560	Main Humber	Caledon	Peel	Northwest of Old Church Rd. and Hwy 50, in Albion Hills CA, at blue gauge station	PWQMN
	83018	06008301802	4864366	596071	Main Humber	Caledon	Peel	Southwest of Old Church Rd. and Hwy 50, downstream Albion Hills CA	PWQMN
	83009	06008300902	4860243	602980	Main Humber	King	York	Northeast of King Rd. and Caledon-King Townline	PWQMN
	83020	06008302002	4851861	610386	Main Humber	Vaughan	York	Northeast of Rutherford Rd. and Hwy 27 at first bridge	RWMP
	83004	06008300402	4850423	614148	East Humber River	Vaughan	York	At bridge Pine Grove Rd., west of Pine Valley Dr., Woodbridge	RWMP
	83103	06008310302	4845870	606385	West Humber River	Brampton	Peel	Northwest of Hwy 7 and McVean Dr, north (upstream) of Claireville	PWQMN
	HU1RWMP		4848311	618678	Black Creek	Vaughan	York	Northwest of Steeles Ave. and Jane St.	RWMP
	HU010WM		4844739	614940	Lower Main Humber	Toronto	Toronto	Northwest of Finch Ave. and Islington Ave. in Rowntree Mills Park	RWMP
	83002	06008300202	4843562	610459	West Humber River	Toronto	Toronto	Northwest of Hwy 427 and Finch Ave. Claireville dam outlet.	RWMP
	83012	06008301202	4836845	620488	Black Creek	Toronto	Toronto	Northeast of Scarlett Rd. and St. Clair Ave.	RWMP
	83019^{M}	06008301902	4834265	621663	Lower Main Humber	Toronto	Toronto	Old Mill Rd., Etobicoke	PWQMN
Don River	85004	06008500402	4851207	622014	Upper West Don	Vaughan	York	Northwest of Hwy 7 and Centre St.	RWMP
	85003	06008500302	4851256	628954	Upper East Don	Markham	York	Northwest of Steeles Ave. and Bayview Ave.	RWMP
	DN008WM		4850878	630252	German Mills Creek	Toronto	Toronto	Northeast of Cummer Ave. and Bayview Ave.	RWMP
	DM 6.0		4840251	634378	Taylor/Massey Creek	Toronto	Toronto	West of the DVP and east of Don Mills Rd.	RWMP
	85014^{M}	06008501402	4838576	632000	Lower Don	Toronto	Toronto	Pottery Rd., Toronto	PWQMN
Highland Creek	94002	06009400202	4849056	647429	Main Highland Creek	Toronto	Toronto	South of Kingston Rd. and Colonel Danforth Trail	RWMP

^{M} = watercourse outlet/mouth.

Watershed	Station	Alternate Name	Northing	Easting	Subwatershed	Township	Municipality	Location Description	Proprietor
Rouge River	97999	97999	4863887	640589	Little Rouge Creek	Markham	York	Northwest of Major Mackenzie Rd. and 9th Line	RWMP
	97018	06009701802	4861770	634680	Bruce Creek	Markham	York	Northwest of Major Mackenzie Dr. and Kennedy Rd.	PWQMN
	97777	97777	4856823	634214	Middle Rouge/Beaver	Markham	York	Northwest of Hwy 407 and Warden Ave.	RWMP
	97003	RG008WM/06009700302	4857669	641985	Lower Rouge Creek	Markham	York	14 Ave, W of 9 Line, Markham	RWMP
	97007	RG007WM/06009700702	4857816	644300	Little Rouge Creek	Markham	York	Reesor Rd., N of Steeles Ave., E of Markham	RWMP
	97013	06009701302	4852830	648243	Little Rouge Creek	Toronto	Toronto	Northeast of Twyn Rivers Dr.and Sheppard Ave.	RWMP
	97011	06009701102	4852511	648007	Lower Rouge River	Toronto	Toronto	Southeast of Twyn Rivers Dr. anf Sheppard Ave.	PWQMN
Duffins Creek	104008	06010400802/DuE17.5	4869299	650372	East Duffins Creek	Pickering	Durham	Northwest of Brock Rd. and 8th Concession	PWQMN
	104037	8th Concession/06010403702	4866462	644191	West Duffins Creek	Pickering	Durham	Conc 8, W of Sideline 34, W of Atha Road	RWMP
	104029	7th Concession/06010402902	4868158	653641	East Duffins Creek	Pickering	Durham	Sideline 12, N of Conc 7	RWMP
	104028	06010402802	4863432	654742	Brougham Creek	Pickering	Durham	East of 5th Concession and Church St. North	RWMP
	104023	06010402302	4858867	653796	Ganateskiagon Creek	Pickering	Durham	West of 3rd Concession Rd. and Brock Rd.	RWMP
	104026	06010402602	4859199	654730	Urfe Creek	Ajax	Durham	East of 3rd Concession Rd. and Brock Rd.	RWMP
	104027	Paulyn Park/06010402702	4859419	655458	East Duffins Creek	Ajax	Durham	Rossland Rd., W of Church St.	RWMP
	104025	Brock Ridge/06010402502	4857115	654656	West Duffins Creek	Pickering	Durham	Brock Rd., N of Finch Ave.	RWMP
	104001[M]	06010400102/Annadale	4855880	657579	Lower Main Duffins	Ajax	Durham	Southwest of Bayly St. and Westney Rd.	PWQMN
Carruthers Creek	CC005		4863072	658808	Carruthers Creek	Ajax	Durham	Northeast of Tauton Rd. East and Salem Rd. North	RWMP
	107002[M]	Shoal Point/06010700202	4856972	660850	Carruthers Creek	Ajax	Durham	Northwest of Bayly St. and Shoal Point Rd.	RWMP
Petticoat Creek	PT001WM		4851804	652005	Lower Petticoat Creek	Pickering	Durham	Petticoat Creek Conservation Area, 1100 Whites Road, Whites Rd. south of Highway 401	RWMP
Frenchman's Bay (Pine Creek)	FB003WM		4854372	653673	Pine Creek	Pickering	Durham	Liverpool Rd., south of Bayly St.	RWMP

[M] = watercourse outlet/mouth.

Appendix B. Summaries of 2016-2020 water quality data.

		AVERAGE (2016-2020)							
Watershed	**Station**	**Chloride (mg/L)**	**Copper (µg/L)**	***E. coli*** **(CFU/100 mL)**	**Iron (µg/L)**	**Nitrates (mg/L)**	**Total phosphorus (mg/L)**	**TSS (mg/L)**	**Zinc (µg/L)**
Etobicoke	Mayfield	150	2.1	215	299	1.69	0.075	7.8	5.7
	80007	416	5.1	553	354	1.36	0.078	26.4	17.1
	Tributary 3	1172	5.4	792	356	0.46	0.067	16.5	25.1
	Spring Creek	624	4.6	671	278	0.58	0.070	22.9	17.3
	Lower Etob US	589	5.3	526	313	0.82	0.075	25.6	17.3
	Little Etob CK	1097	5.1	1906	187	0.95	0.032	6.4	12.7
	Tributary 4	582	3.2	1377	241	0.98	0.082	6.7	7.3
	80006	802	7.2	789	450	0.92	0.087	22.0	31.7
Mimico	MM003WM	1148	6.1	916	441	0.71	0.072	24.9	26.3
	82003	1157	8.5	862	389	0.76	0.080	19.7	34.1
Humber	83104	65	1.1	147	291	0.37	0.052	15.0	8.4
	83018	61	1.2	92	281	0.49	0.051	12.7	7.7
	83009	38	1.4	239	448	0.37	0.050	18.2	8.4
	83103	266	2.8	283	393	0.85	0.057	18.0	10.1
	83020	76	1.3	96	357	0.63	0.059	41.2	5.8
	83002	277	2.4	678	409	0.68	0.090	24.4	6.5
	83004	183	1.7	366	307	0.43	0.058	35.4	6.4
	HU010WM	164	1.9	598	377	0.58	0.074	51.4	7.3
	HU1RWMP	1280	4.9	882	414	0.42	0.106	18.0	17.4
	83012	818	6.0	2864	542	1.25	0.118	26.8	22.2
	83019	313	4.7	1075	826	0.67	0.083	49.5	21.1
Don	85004	806	3.0	439	385	0.65	0.066	16.4	10.8
	85003	416	2.2	988	368	0.67	0.078	21.0	7.3
	DN008WM	597	3.0	848	498	0.63	0.059	13.7	8.1
	85014	578	6.0	42371	586	1.79	0.177	23.4	24.2
	DM 6.0	646	4.7	3281	409	1.81	0.157	22.7	14.0
Highland	94002	497	3.7	1208	372	0.87	0.081	28.2	12.7
Rouge	97777	494	2.1	858	311	0.78	0.053	15.4	6.7
	97018	80	1.2	165	314	0.92	0.039	9.2	9.0
	97999	140	1.1	186	225	1.00	0.053	18.6	6.0
	97003	354	2.4	334	355	1.04	0.085	28.2	8.2
	97007	149	1.1	132	199	0.93	0.056	23.9	5.9
	97011	353	3.6	334	495	0.66	0.067	38.4	16.6
	97013	158	1.3	71	219	0.79	0.049	27.7	5.5
Petticoat	PT001WM	348	2.4	999	186	1.50	0.047	12.8	7.4
Frenchman's	FB003WM	444	3.1	2044	336	1.50	0.059	21.1	10.4
Duffins	104037	124	1.0	252	211	0.79	0.043	10.9	5.9
	104008	52	1.1	123	269	0.21	0.039	14.7	17.3
	104029	41	0.7	93	233	0.33	0.052	25.3	5.9
	104028	130	0.8	139	293	0.76	0.060	20.7	5.8
	104023	91	0.8	94	234	0.29	0.043	23.8	6.5
	104026	165	1.0	444	257	0.24	0.041	13.8	5.9
	104025	62	1.1	116	275	0.77	0.080	60.1	5.8
	104027	49	0.8	123	277	0.36	0.058	31.0	5.9
	104001	119	2.8	277	503	0.58	0.057	41.8	15.5
Carruthers	CC005	106	0.9	186	248	0.61	0.031	9.6	4.8
	107002	222	1.3	223	244	0.58	0.036	9.2	5.5

		MEDIAN (2016-2020)							
Watershed	**Station**	**Chloride (mg/L)**	**Copper (µg/L)**	***E. coli* (CFU/100 mL)**	**Iron (µg/L)**	**Nitrates (mg/L)**	**Total phosphorus (mg/L)**	**TSS (mg/L)**	**Zinc (µg/L)**
Etobicoke Creek	Mayfield	141	1.8	70	256	0.60	0.058	4	5
	80007	291	4.4	190	204	0.61	0.050	4.7	11.6
	Tributary 3	692	4.4	380	297	0.46	0.055	6	16.6
	Spring Creek	413	3.1	350	226	0.55	0.033	6	5
	Lower Etob US	346	3.9	140	235	0.43	0.044	5	10
	Little Etob CK	701	4.4	850	150	0.95	0.025	2	5
	Tributary 4	384	2.8	1120	233	0.80	0.064	3	5
	80006	469	5.8	530	198	0.59	0.067	5.35	20.4
Mimico Creek	MM003WM	725	4.9	390	382	0.67	0.050	6	17.7
	82003	628	7.1	545	206	0.70	0.052	5.4	25.4
Humber River	83104	63	1.0	60	245	0.34	0.038	7.15	8
	83018	58	1.1	60	209	0.43	0.026	7.1	6.5
	83009	30	1.1	80	356	0.24	0.035	9.6	5.5
	83103	213	2.4	130	311	0.40	0.039	9.85	8.925
	83020	66	1.1	50	280	0.56	0.034	18	5
	83002	228	2.2	145	397	0.23	0.069	18	5
	83004	150	1.2	130	211	0.29	0.023	6	5
	HU010WM	126	1.4	130	241	0.50	0.029	8	5
	HU1RWMP	876	4.0	290	354	0.34	0.068	8	12.9
	83012	586	4.5	1510	492	1.34	0.099	6	16.1
	83019	199	3.5	410	277	0.53	0.037	10.9	16.3
Don River	85004	501	2.4	200	348	0.53	0.050	6	5
	85003	290	1.9	690	313	0.61	0.052	6	5
	DN008WM	343	2.6	400	469	0.57	0.046	6	5
	85014	381	5.3	1600	387	1.69	0.133	13.45	20.55
	DM 6.0	474	3.8	1320	356	1.84	0.118	4	10
Highland Creek	94002	399	2.8	560	292	0.82	0.042	3	5
Rouge River	97777	387	1.8	370	276	0.43	0.035	9	5
	97018	80	1.1	60	234	0.78	0.028	6.15	10
	97999	125	1.0	90	177	0.82	0.038	6	5
	97003	279	1.8	90	281	0.64	0.052	10	5
	97007	134	1.0	40	145	0.75	0.028	5	5
	97011	262	3.4	135	199	0.57	0.032	7.1	13.55
	97013	140	1.2	40	155	0.61	0.023	8	5
Petticoat Creek	PT001WM	296	2.0	480	137	1.16	0.029	3	5
Frenchmans Bay	FB003WM	410	2.2	960	294	1.21	0.036	5	5
Duffins Creek	104037	100	0.9	78	182	0.66	0.029	3	5
	104008	50	0.9	43	198	0.12	0.021	6	10
	104029	37	0.4	20	135	0.24	0.020	4	5
	104028	129	0.4	40	234	0.73	0.029	5	5
	104023	87	0.4	30	158	0.17	0.019	4	5
	104026	150	0.9	60	223	0.13	0.028	6	5
	104025	56	0.9	50	158	0.68	0.024	7	5
	104027	43	0.4	45	200	0.33	0.030	11	5
	104001	87	2.3	110	241	0.52	0.026	11.45	11.65
Carruthers Creek	CC005	102	1.0	60	231	0.15	0.022	3.4	5
	107002	196	1.3	75	233	0.31	0.032	5	5

		MINIMUM (2016-2020)							
Watershed	**Station**	**Chloride (mg/L)**	**Copper (µg/L)**	***E. coli* (CFU/100 mL)**	**Iron (µg/L)**	**Nitrates (mg/L)**	**Total phosphorus (mg/L)**	**TSS (mg/L)**	**Zinc (µg/L)**
Etobicoke Creek	Mayfield	74	0.9	0	123	0.012	0.024	1	5
	80007	44	1.4	10	48	0.01	0.005	0.025	2.76
	Tributary 3	71	2.3	0	152	0.033	0.027	1	5
	Spring Creek	44	2.0	0	5	0.033	0.005	1	5
	Lower Etob US	53	2.3	0	5	0.033	0.011	1	5
	Little Etob CK	98	2.4	10	28	0.3775	0.010	1	5
	Tributary 4	41	1.5	10	86	0.033	0.015	1	5
	80006	138	0.5	10	81	0.02	0.018	0.025	2
Mimico Creek	MM003WM	61	2.4	10	226	0.095	0.018	1	5
	82003	165	1.6	10	43	0.142	0.022	0.025	2
Humber River	83104	44	0.0	0	101	0.01	0.008	0.025	0.657
	83018	33	0.0	0	113	0.21	0.000	0.025	0.499
	83009	9	0.1	0	205	0.01	0.009	0.025	0.432
	83103	26	1.4	10	112	0.0075	0.010	0.025	0.937
	83020	46	0.4	0	140	0.2755	0.012	1	5
	83002	90	1.2	10	169	0.033	0.025	1	5
	83004	70	0.8	10	78	0.033	0.005	1	5
	HU010WM	27	0.4	10	131	0.2155	0.011	1	5
	HU1RWMP	33	2.0	30	151	0.033	0.033	1	5
	83012	38	3.2	210	278	0.248	0.041	1	5
	83019	35	1.0	20	82	0.01	0.011	0.025	2
Don River	85004	139	1.3	20	120	0.033	0.017	1	5
	85003	128	1.1	70	188	0.268	0.022	1	5
	DN008WM	131	1.3	0	227	0.1555	0.021	1	5
	85014	105	0.5	32	3	0.735	0.065	0.025	6
	DM 6.0	37	2.4	60	170	0.255	0.042	1	5
Highland Creek	94002	48	1.1	50	49	0.195	0.016	1	5
Rouge River	97777	1	0.9	10	43	0.066	0.013	1	5
	97018	44	0.2	0	128	0.155	0.005	0.025	0.718
	97999	0	0.4	0	69	0.1655	0.005	1	5
	97003	40	1.2	0	125	0.0755	0.023	1	5
	97007	59	0.4	0	67	0.033	0.005	1	5
	97011	57	0.4	10	56	0.01	0.008	0.025	1.54
	97013	0	0.4	0	40	0.012	0.005	1	5
Petticoat Creek	PT001WM	44	1.1	70	62	0.0615	0.012	1	5
Frenchmans Bay	FB003WM	47	1.1	60	41	0.3355	0.012	1	5
Duffins Creek	104037	57	0.4	10	84	0.326	0.005	1	5
	104008	17	0.0	0	90	0.0075	0.000	0.025	0.285
	104029	14	0.4	0	48	0.111	0.005	1	5
	104028	60	0.4	0	78	0.2855	0.005	1	5
	104023	24	0.4	0	65	0.012	0.005	1	1.9
	104026	42	0.4	0	89	0.005	0.005	1	1.3
	104025	0	0.4	0	43	0.1655	0.005	1	5
	104027	0	0.4	0	73	0.0755	0.005	2	5
	104001	39	0.3	0	108	0.01	0.005	0.025	1.69
Carruthers Creek	CC005	57	0.3	0	98	0.007	0.005	1	0.1
	107002	61	0.4	0	5	0.033	0.005	1	1

		MAXIMUM (2016-2020)							
Watershed	**Station**	**Chloride (mg/L)**	**Copper (µg/L)**	***E. coli* (CFU/100 mL)**	**Iron (µg/L)**	**Nitrates (mg/L)**	**Total phosphorus (mg/L)**	**TSS (mg/L)**	**Zinc (µg/L)**
Etobicoke Creek	Mayfield	412	4.4	2300	919	8.66	0.419	100	12.3
	80007	2770	18.7	5120	2310	6.92	0.549	312	93
	Tributary 3	6470	29.1	8500	1010	1.61	0.236	116	152
	Spring Creek	3850	21.4	4900	1400	1.44	0.752	428	125
	Lower Etob US	3390	19.4	5500	1300	5.19	0.541	244	103
	Little Etob CK	6160	15.4	30000	698	1.75	0.139	58	55.8
	Tributary 4	3730	6.4	7550	469	2.52	0.226	36	27.4
	80006	4780	47.2	5300	3320	4.67	0.592	377	387
Mimico Creek	MM003WM	5470	16.3	11000	1230	1.96	0.386	238	117
	82003	7090	42.3	5120	2920	1.69	0.705	233	216
Humber River	83104	110	4.0	1930	1430	0.88	0.459	185	29.7
	83018	264	4.0	600	895	1.07	0.944	66	17.4
	83009	106	4.4	3340	1330	2.28	0.276	229	22.8
	83103	1090	6.3	1730	2710	3.89	0.361	138	45.4
	83020	245	3.6	380	1220	1.53	0.276	224	13.1
	83002	966	4.7	10750	943	3.70	0.456	172	20.5
	83004	423	7.7	5500	1680	3.58	0.531	316	26
	HU010WM	662	9.4	7280	1540	1.44	0.542	502	68.5
	HU1RWMP	5610	12.8	5650	1170	1.09	0.695	273	62.6
	83012	2980	19.5	34000	1320	2.02	0.587	367	95.5
	83019	1810	37.3	11000	16400	1.97	0.882	686	221
Don River	85004	3380	10.0	6600	1060	1.52	0.422	264	50.1
	85003	1530	8.0	7500	1560	1.79	0.477	252	36.4
	DN008WM	2920	12.1	7300	931	1.45	0.368	184	43.8
	85014	3520	20.6	680000	4350	3.74	0.897	162	105
	DM 6.0	4570	20.5	51000	2560	2.86	1.22	843	155
Highland Creek	94002	1970	15.2	9100	1810	2.08	0.503	304	80.9
Rouge River	97777	1310	6.5	9600	1030	16.61	0.281	142	27.1
	97018	172	2.8	950	2080	4.51	0.237	60.8	25.1
	97999	443	4.8	910	1150	3.49	0.395	467	19.9
	97003	1060	12.3	4260	2090	21.01	0.735	254	81.8
	97007	418	3.7	1400	663	3.70	0.846	468	16.3
	97011	1100	9.3	4840	4510	2.37	0.367	354	63.3
	97013	452	3.6	450	869	3.48	0.444	362	10
Petticoat Creek	PT001WM	1540	8.0	6100	590	4.67	0.371	156	30.1
Frenchmans Bay	FB003WM	2360	11.6	27000	975	6.08	0.391	277	48.6
Duffins Creek	104037	388	3.8	1750	1200	2.01	0.357	196	16.3
	104008	138	4.3	1300	1860	1.49	0.627	328	487
	104029	128	6.8	1480	2050	1.45	1.02	696	22.1
	104028	331	4.5	1870	1260	1.45	0.565	360	16.5
	104023	162	5.3	1020	1370	1.73	0.621	404	36.6
	104026	451	3.1	11750	853	1.04	0.261	175	32.6
	104025	174	6.3	630	2130	2.17	0.903	972	15.2
	104027	241	3.9	1010	1490	1.07	0.564	470	16.4
	104001	778	15.9	3360	4490	1.70	0.395	497	104
Carruthers Creek	CC005	249	2.2	1900	705	2.62	0.142	151	10
	107002	558	3.6	1240	555	2.48	0.116	39	13.4

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