NPCA Watershed Monitoring Technical Report 2024

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Niagara Peninsula Conservation Authority

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Land Acknowledgement

The Niagara Peninsula watershed is situated within the traditional territory of the Haudenosaunee, Attiwonderonk (Neutral), and the Anishinaabeg, including the Mississaugas of the Credit—many of whom continue to live and work here today. This territory is covered by the Upper Canada Treaties (No. 3, 4, and 381) and is within the land protected by the Dish with One Spoon Wampum agreement. Today, the watershed is home to many First Nations, Métis, and Inuit peoples.

Through the NPCA 2021-2031 Strategic Plan, we re-confirm our commitment to shared stewardship of natural resources and deep appreciation of Indigenous culture and history in the watershed.

Acknowledgements

The Niagara Peninsula Conservation Authority would like to thank the Regional Municipality of Niagara, City of Hamilton, and Haldimand County as well as the Ontario Ministry of Environment, Conservation and Parks for their support of the NPCA Integrated Watershed Monitoring Program.

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Executive Summary

As part of its 2021–2031 Strategic Plan, the Niagara Peninsula Conservation Authority (NPCA) developed an Enhanced Integrated Watershed Monitoring Program to strengthen and focus its monitoring efforts across the watershed. This comprehensive program includes the NPCA's Long-Term Monitoring Program, Corporate Support Services, and Monitoring Services. Portions of the program are delivered in partnership with the Ontario Ministry of Environment, Conservation and Parks (MECP), the Ontario Ministry of Natural Resources (MNR), the Regional Municipality of Niagara (RMN), Haldimand County, and the City of Hamilton.

The NPCA Long-Term Monitoring Program assesses watershed health through the integration of surface water, groundwater, hydrometric, and terrestrial ecosystem monitoring. Surface water quality is assessed using chemical analyses and biological sampling with results indicating that many watersheds show marginal to poor water quality due to both point and non-point source pollution. The best water quality is observed in watersheds influenced by groundwater discharge, that have augmented water flow from the Niagara River/Welland Canal and that are well-forested subwatersheds. Groundwater is monitored through a network of bedrock and overburden wells, with water chemistry results compared to Ontario Drinking Water Standards. Most exceedances are attributed to the natural geology of the region, although one well shows ongoing nitrate exceedances. Elevated levels of sodium and nitrate, which may have public health implications, have been thoroughly investigated by Niagara Public Health and MECP. The NPCA continues to encourage residents with private wells to test regularly and install appropriate water treatment systems if needed. The Hydrometric network continues to play a crucial role in assessing surface water quantity and climate conditions, supporting the NPCA's ability to forecast where and when flooding may occur and to issue timely flood messages. To complement its aquatic monitoring efforts, in 2024 the NPCA also established 35 permanent forest plots within its Conservation Areas as part of its Terrestrial Monitoring Program. These plots support the long-term tracking of forest composition, structure, and stressors such as climate change and development pressure.

In 2024, the NPCA's Corporate Support Services supported a range of specialized monitoring initiatives, including beach and surface water quality monitoring within Conservation Areas, ecological studies to assess the health of these protected lands, and PFAS monitoring at Lake Niapenco. The program also provided monitoring services for external partners, including the City of Hamilton at the Glanbrook Landfill, drain classification work for Fisheries and Oceans Canada (DFO), and environmental monitoring at Hamilton International Airport.

The way the land is managed is often reflected in the health of our watershed resources. The Integrated Watershed Monitoring Program provides valuable information about the health of the NPCA watershed. The NPCA's watershed health has been degraded by decades of environmental degradation; however, watershed improvement programs that refine how nutrients are managed, increase riparian buffers, and expand forest cover can begin to address and reverse these impacts. It will likely take many years of implementing these programs before the watershed health in the NPCA watershed improves to the

point where it is able to meet federal and provincial water quality guidelines and objectives. As such, it is recommended that the NPCA continues its watershed monitoring to ensure there is current watershed information available, be able to quantify watershed trends, and continue to identify sources of impact within the NPCA watershed.

Table of Acronyms

BMI	Benthic Macroinvertebrates
BMPs	Best Management Practices
CCME	Canadian Council of Ministers of the Environment
CWQG	Canadian Water Quality Guidelines
DFO	Department of Oceans and Fisheries
ECCC	Environment and Climate Change Canada
EMAN	Ecological Monitoring and Assessment Network
EMRB	Environmental Monitoring and Reporting Branch
HIA	Hamilton International Airport
HBI	Hilsenhoff Biotic Index
IWMP	Integrated Watershed Monitoring Program
MECP	Ministry of Environment, Conservation and Parks
MNR	Ministry of Natural Resources
NPCA	Niagara Peninsula Conservation Authority
PFC	Perfluorinated Compound
PGMN	Provincial Groundwater Monitoring Network
PWQMN	Provincial Water Quality Monitoring Network
PWQO	Provincial Water Quality Objective
OBBN	Ontario Benthos Biomonitoring Network
ODWS	Ontario Drinking Water Standard
OGS	Ontario Geologic Survey
OPG	Ontario Power Generation
RMN	Regional Municipality of Niagara
WQI	Water Quality Index for Canadian Council of Ministers of the Environment

1.0 INTRODUCTION

In 2024, the Niagara Peninsula Conservation Authority (NPCA) Board of Directors approved an Enhanced Integrated Watershed Monitoring Program (IWMP) to advance the strategic targets and actions outlined in its 2021–2031 Strategic Plan. The primary goal of the IWMP is to comprehensively assess the ecological health and resilience of the NPCA watershed through coordinated monitoring initiatives that support evidence-based conservation and watershed management strategies.

To support this goal, the NPCA developed a conceptual model (**Figure 1**) that outlines three core Watershed Monitoring Program Areas: Long-Term Watershed Monitoring, Corporate Support Services, and Monitoring Service Provider. It also identifies four essential Monitoring Support Systems: Data Management, GIS, Communications and External Partnerships, and External Data. Together, these components form a cohesive framework for delivering effective and integrated watershed monitoring across the NPCA's jurisdiction.

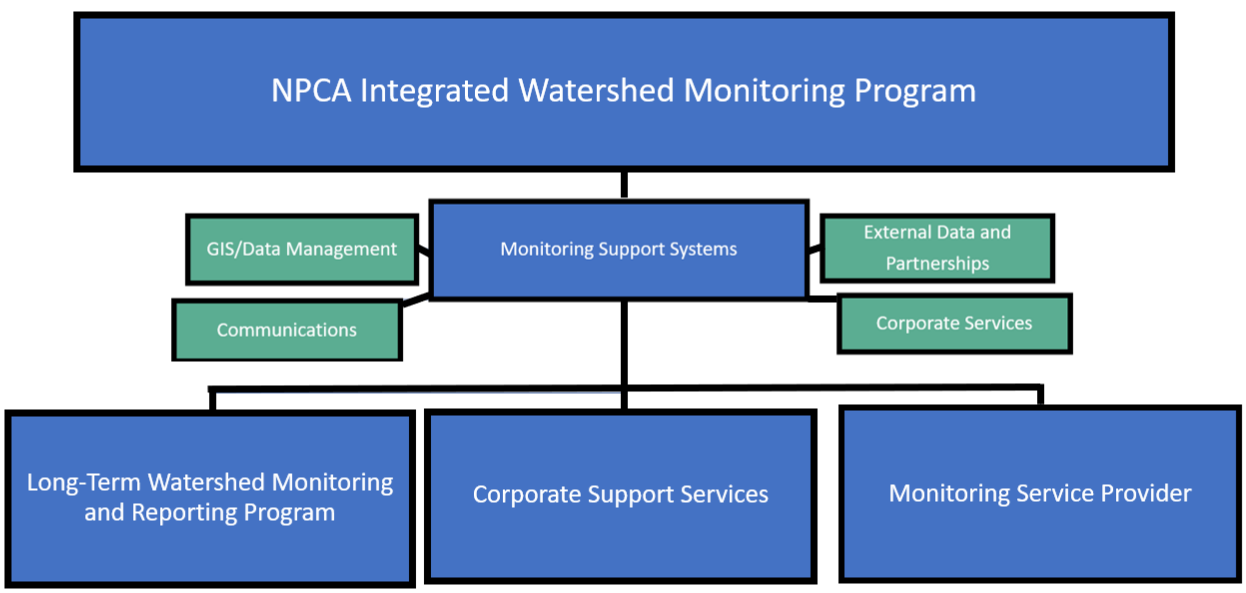

Figure 1. NPCA Integrated Watershed Monitoring Program Model

2.0 LONG-TERM WATERSHED MONITORING PROGRAM

The NPCA's Long-Term Watershed Monitoring Program plays a vital role in enhancing the understanding and management of ecosystems and natural hazards within the NPCA watershed. It serves as the foundation for collecting baseline data, tracking environmental trends, assessing climate change impacts, supporting scientific research, guiding conservation efforts, and enabling evidence-based decision-making. The program includes four key components: Surface Water Monitoring, Groundwater Monitoring, Terrestrial Monitoring, and Hydrometric Monitoring. This 2024 NPCA Watershed Monitoring Summary Report will highlight findings from the surface water, groundwater, and terrestrial monitoring programs.

2.1 Surface Water Monitoring Program

2.1.1 Water Chemistry

The NPCA's water chemistry program monitors ambient surface water conditions at 84 stations across 52 watersheds. Grab samples are collected monthly during the ice-free months and analyzed for various parameters, including nutrients, metals, bacteria, suspended solids, and general chemistry. The NPCA receives additional laboratory support from the RMN and the Ministry of the Environment, Conservation and Parks (MECP). Support from the MECP is provided through the Provincial Water Quality Monitoring Network (PWQMN).

Established in 1964, the PWQMN collects surface water quality data from rivers and streams at strategic locations throughout Ontario. Over time, stations have been added or discontinued in response to evolving MECP and program-specific needs. The NPCA currently operates 13 PWQMN stations, located on Black Creek (Fort Erie), the Welland River (West Lincoln and Welland), Twenty Mile Creek (West Lincoln and Lincoln), Forty Mile Creek (Grimsby), Four Mile Creek (Niagara-on-the-Lake), and Twelve Mile Creek (Pelham and St. Catharines).

Surface Water Quality Indicator Parameters

For this summary report, the NPCA used nine indicator parameters which included eight chemical and one benthic macroinvertebrate (BMI) community indicators. These parameters, and their water quality objectives, are summarized in **Table 1** below.

Table 1: Summary of surface water quality indicator parameters.

Indicator Parameter	Parameter objective/goal	Reference
Chloride	120 mg/L (Chronic)	CWQG (CCME 2011)
Nitrate	2.93 mg/L	CWQG (CCME 2003)
Total Phosphorus	30 µg/L	PWQO (MOE 1994)
Total Suspended Solids	35 mg/L	CWQG (CCME 2002)
Copper	5 µg/L	PWQO (MOE 1994)
Lead	5 µg/L	PWQO (MOE 1994)
Zinc	20 µg/L	PWQO (MOE 1994)
Escherichia coli	100 count/100mL	PWQO (MOE 1994)
Benthic Macroinvertebrates	Fair water quality rating or higher	HBI (Hilsenhoff 1988)

Indicator Parameters

Chloride

Chloride is a naturally occurring substance found in all water. Chloride can be toxic to aquatic organisms with acute toxic effects at higher concentrations and chronic effects on growth and reproduction at lower concentrations. Chloride is not susceptible to degradation in the aquatic environment and tends to remain in solution. Chloride is extensively used in the form of sodium chloride and calcium chloride for salting roadways and ice removal during the winter season. Other anthropogenic or human-derived sources of chloride include sewage, animal waste, storm and irrigation drainage, fertilizers, and industrial effluent. The Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life recommends that long-term or chronic chloride concentrations should not exceed 120mg/L in surface water (CCME 2011).

Nitrate

Nitrate is the most common form of nitrogen that occurs in surface water. In aerobic or oxygen-rich water, bacteria convert ammonium and nitrite to nitrate through a process known as nitrification. In anaerobic or oxygen-depleted water, the process is reversed through denitrification. The nitrate ion is the most stable form of nitrogen in water and does not tend to combine with other ions in solution. Nitrate can be toxic to aquatic organisms, and elevated concentrations contribute to excessive plant and algae growth in surface water. Anthropogenic sources of nitrates include sewage discharges, animal waste, fertilizers, and pesticides. The CWQG for the Protection of Aquatic Life recommends that nitrate-nitrogen concentrations should not exceed 2.93 mg/L in surface water (CCME 2003).

Total Phosphorus

Phosphorus is a natural element found in rocks, soils and organic material and is an essential nutrient for plant growth. Phosphorus clings tightly to soil particles and is often associated with suspended sediment. Excessive phosphorus concentrations stimulate the overgrowth and decomposition of plants and algae. The decomposition of organic matter in turn depletes dissolved oxygen concentrations and stresses aquatic organisms such as fish and benthic invertebrates. Total phosphorus is a measure of all forms of phosphorus in a water sample and includes biologically accessible phosphates. Anthropogenic sources of phosphorus include fertilizers, pesticides, and sewage discharges. The interim Ontario Provincial Water Quality Objective (PWQO) for total phosphorus in streams and rivers is 30 µg/L (MOE 1994).

Total Suspended Solids

Total suspended solids (TSS) are a measure of undissolved solid material in surface water and usually consist of silt, clay, plankton, and fine particles of organic and inorganic matter. Sources of suspended solids include soil erosion, stormwater, wastewater, and industrial effluent. Fine particles are significant carriers of phosphorus, metals and other contaminants. Concentrations of suspended solids vary seasonally and often peak during rain events. Due to natural variability in surface water, there is currently no water quality guideline for suspended solids in Ontario. High concentrations of suspended solids in surface water can negatively impact aquatic organisms. The Canadian Water Quality Guidelines provides a narrative guideline for TSS: the maximum increase of TSS should be no more than 25 mg/L from background concentrations (with NPCA using a background TSS concentration of 10 mg/L, determined using data from the NPCA jurisdiction; CCME 2002). Therefore, a concentration of 35 mg/L was used as the NPCA's guideline.

Copper

Copper is an essential trace element that is toxic to aquatic organisms at elevated concentrations. In surface water, copper tends to bind with organic matter and accumulates in streambed sediment. Natural sources are wind-blown dust, decaying vegetation, and forest fires. Anthropogenic sources of copper include industrial wastewater, sewage discharge and pesticides. The interim PWQO for copper is 5 µg/L based on >20 mg/L hardness as $CaCO_3$ (MOE 1994).

Lead

Lead is a non-essential trace element that is toxic to aquatic organisms at elevated concentrations. Lead tends to bioaccumulate and can affect the central nervous system. Lead occurs naturally in the environment; however, most lead concentrations that are found in the environment are a result of human activities. Anthropogenic sources of lead include industrial wastewater, sewage discharge, municipal waste incineration, fertilizers, and pesticides. The interim PWQO for lead is 5 µg/L based on >80 mg/L hardness as $CaCO_3$ (MOE 1994).

Zinc

Zinc is an essential trace element that is toxic to aquatic organisms at elevated concentrations. In surface water zinc tends to bind with organic matter and accumulate in streambed sediment. Zinc occurs naturally in air, water, and soil. Anthropogenic sources of zinc include industrial wastewater, sewage discharge and stormwater runoff. The interim PWQO for zinc is 20 µg/L (MOE 1994).

Escherichia coli

Escherichia coli (*E. coli*) is a type of fecal coliform bacteria that is commonly found in the intestines of warm-blooded animals including humans. It is used as an indicator for the presence of sewage or animal waste in surface water, and the possible presence of pathogens (Tchobanoglous & Schroeder 1987). The PWQO for *E. coli* is 100 counts per 100 mL (MOE 1994).

The Canadian Water Quality Index

The Canadian Council of Ministers of the Environment (CCME) Water Quality Index (WQI) was used to summarize the indicator parameter data collected from NPCA surface water quality monitoring stations between 2020 and 2024. This approach reduces the overall sample size of water quality monitoring stations, while allowing the partitioning of the water quality dataset to determine if CCME WQI ratings are changing over time. This approach is consistent with Conservation Ontario's recommendation for comparing water quality data in watershed reporting (Conservation Ontario 2011). Using five-year blocks of data minimizes seasonal variation and provides sufficient data (n=40 to 50) for reliable statistics in surface water analyses.

The WQI was developed by a sub-committee established under the Canadian Council for Ministers of the Environment (CCME) Water Quality Guidelines Task Group to provide a convenient means of summarizing complex water quality information and communicating it to the public (CCME 2001). The WQI incorporates the number of parameters where water quality objectives have been exceeded, the frequency of exceedances within each parameter, and the amplitude of each exceedance. The index produces a number between 0 and 100 which represents the worst and best water quality, respectively. These numbers are divided into five descriptive categories that range from *Poor* to *Excellent* (**Table 2**). The CCME WQI has been used extensively by other agencies, including conservation authorities and provincial ministries, as a means of reporting water quality data.

Table 2: CCME Water Quality Index Categories (CCME 2001).		
Category	**Water Quality Index**	**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.

The calculation of the WQI is dependent on the water quality parameters and objectives selected for analysis. The indicator parameters and objectives summarized in **Table 1** were used to determine the WQI for NPCA monitoring stations. BMI data is not included in the WQI and is presented separately. It is important to note that the water quality information presented in this report is limited by the size of the dataset which represents one to five years of data, depending on the station. The reliability of the WQI rating improves over time (greater than three years) as more data is collected and a wider range of water quality conditions are captured in the dataset. In addition, water quality indicator parameters were summarized using boxplots which allow for comparison of the data distributions and basic statistical attributes such as median, percentiles, overall range, and outliers (**Figure 2**).

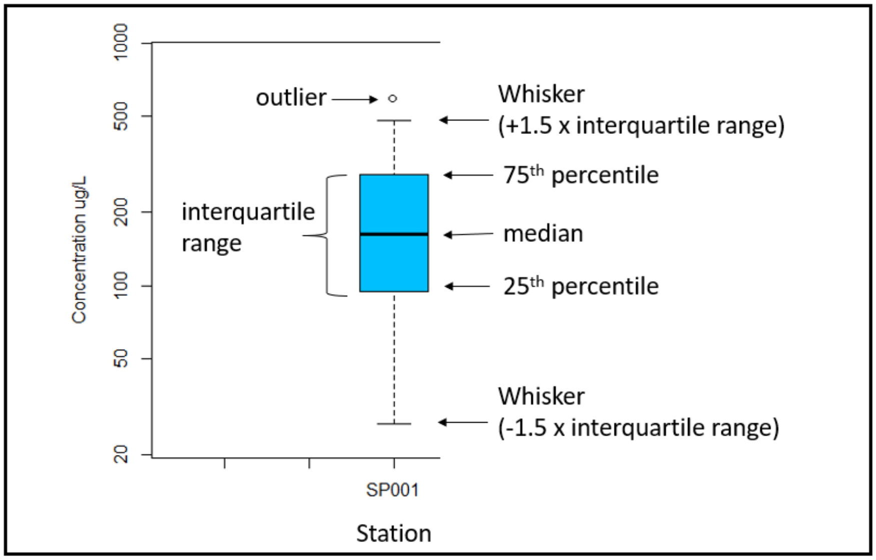

Figure 2: Description of a boxplot.

Trend Analysis

Trend analyses are very useful for determining if water quality parameter concentrations are increasing, decreasing, or remaining unchanged over time. If the concentration of a water quality parameter is found to be increasing or remaining in an impaired status, appropriate corrective action can be taken. Trend analysis is also useful for evaluating the performance of stewardship or remediation efforts.

The data on many water quality parameters for the NPCA are not normally distributed, and it is not appropriate to use parametric statistical methods to test trends. Non-parametric statistical methods can deal effectively with non-normally distributed data and are flexible enough to account for seasonal variability. The Seasonal Mann-Kendall Test is often used to determine trends in water quality data (Helsel and Hirsch 1992). The Seasonal Mann-Kendall Test modified from the Mann-Kendall Test (Helsel and Hirsch 1992), compares relative ranks of data values from the same season. This means the water quality parameter concentrations of May would be compared with concentrations of May in other years. Similarly, June concentrations would be compared with other June concentrations and so forth. The null hypothesis (H_0) is that the concentration of a water quality parameter is independent of time, or, in other words, the datasets show no distinct trend. The alternative hypothesis (HA) means that a significant increasing or decreasing trend is found over time. The Seasonal Mann-Kendall uses alpha (α) to quantify the probability that a trend exists. For this report, the alpha level for statistical significance was set at α =0.05. This alpha level is commonly used in statistical methods to test for statistical significance. It should be noted that a value of $\alpha = 0.05$ means there is a 5 percent possibility of falsely rejecting the null hypothesis that no trend exists. Probability values of less than 0.05 mean there was a statistically significant trend (increasing or decreasing). Trend analysis using the Seasonal Mann-Kendall Test was conducted on chloride, *E. coli*, total phosphorus and total suspended solids concentrations at all stations with 5 or more years of data using software provided by the U.S.

Geological Survey (Helsel *et al*., 2005). Trend analysis for copper, lead, nitrate, and zinc parameters could only be conducted on a small number of stations because many concentrations found were below the laboratory detections limits. These were reported as "non-detect" or a "less than" the laboratory detection limit. Trend analysis with many non-detections or less than values was not favourable for analysis and therefore was excluded from most stations.

2.1.2 Benthic Macroinvertebrates

The NPCA monitors surface water quality using BMI as indicators of stream health. Water quality monitoring has historically relied heavily upon chemical testing as a means of measuring the quality of water, but the advantages of biological monitoring using BMIs as indicators of water quality are well documented (Griffiths 1999, Jones *et al.* 2005). Due to their restricted mobility and habitat preferences, BMIs usually remain in a localized area. As a result, they are continuously subjected to the effects of all pollutants and environmental stream conditions over time, and as such can provide a broad overview of water-quality-related problems. They are abundant in all types of aquatic systems and can be easily collected and identified. The NPCA has been using BMI as indicators of water quality since 1995 and is a leader in the field of biological monitoring in the Niagara Peninsula.

Benthic Macroinvertebrates: Protocol and Analysis

Benthic macroinvertebrates are the larger organisms inhabiting the substrate of watercourses for at least part of their life cycle. As a rule, BMI includes those species whose body width exceeds 500 microns. Examples of benthic invertebrate species that are commonly found in the NPCA watershed include clams, snails, leeches, worms, and the larval stages of dragonflies, stoneflies, caddisflies, mayflies, and beetles. The NPCA uses the Ontario Benthos Biomonitoring Network (OBBN) protocol (Jones *et al.* 2005) for its long-term benthic macroinvertebrate sampling program. The OBBN provides a standardized benthic invertebrate sampling protocol for the province of Ontario and provides a biological complement to the chemistry based PWQMN.

The NPCA collected benthic macroinvertebrate (BMI) samples during the spring and summer at approximately 20 monitoring stations each year, with each station visited once every three to five years. The BMIs were collected, counted, and preserved; they were then identified to the family level, and various statistics were calculated.

For this 2024 report, the Hilsenhoff Biotic Index (HBI) (Hilsenhoff 1987 & 1988) was calculated for each sample station. The HBI estimates the overall tolerance of the benthic community in a sampled area, weighted by the relative abundance of each taxonomic family. Organisms were assigned modified Hilsenhoff tolerance values based on criteria from the New York State Department of Environmental Conservation (Smith et al. 2009).

Water quality was classified along a gradient from Excellent to Very Poor (**Table 3**), reflecting the presence of organisms whose environmental requirements and tolerances align with expected conditions at minimally stressed sites. As environmental conditions deteriorate, more stress-tolerant organisms become dominant. At impaired stations, these tolerant species typically outnumber sensitive ones, resulting in reduced biodiversity.

Table 3: Hilsenhoff Family Biotic Index water quality classifications (Hilsenhoff 1988).

Family Biotic Index	Water Quality Rating
0.00-3.75	*Excellent*
3.76-4.25	*Very Good*
4.26-5.00	*Good*
5.01-5.75	*Fair*
5.76-6.50	*Fairly Poor*
6.51-7.25	*Poor*
7.26-10.00	*Very Poor*

2.1.3 In-situ Stream Monitoring

The NPCA operates two complementary in-situ monitoring programs to assess aquatic ecosystem health across its jurisdiction: a stream temperature monitoring program focused on the Upper Twelve Mile Creek watershed and a watershed-wide in situ water quality sensor program.

Stream Temperature Monitoring

The stream temperature monitoring program is confined to the Upper Twelve Mile Creek watershed, home to the only identified coldwater streams in the Niagara Region. These streams are groundwater-fed and maintain cold water temperatures, typically remaining below 19 °C throughout the year. Because they rely on groundwater rather than precipitation or surface runoff, they continue to flow even during dry periods. Water temperature plays a critical role in shaping aquatic communities, with coldwater-sensitive species such as brook trout, sculpins, and certain mayflies and stoneflies depending on cold, well-oxygenated conditions. As a result, these streams support a unique and sensitive aquatic community. However, coldwater stream ecosystems are increasingly threatened by climate change, land use alterations, and excessive groundwater withdrawal. In response, the NPCA reinitiated temperature monitoring in the Upper Twelve Mile Creek watershed in 2013 with two main objectives: (1) to identify and classify the thermal regimes at various surface water sampling stations, and (2) to detect any long-term changes in the thermal stability of the creek.

Watershed Wide In-situ Stream Monitoring

Complementing this focused effort, the NPCA also conducts a watershed-wide in situ water quality monitoring program. This program utilizes a network of sensors to monitor key water quality parameters continuously during the ice-free months. **Table 4** outlines the suite of sensors deployed in 2024, including those specific to the Upper Twelve Mile Creek temperature monitoring project. This broader sensor network provides vital ambient water quality data, supporting both long-term studies and targeted investigations across the watershed.

Table 4: Water quality sensors deployed in 2024

Location	Parameters
Big Forks Creek, Wainfleet	Water temperature, dissolved oxygen
Wignell Drain, Port Colborne	Water temperature, dissolved oxygen
Beaver Dam Drain, Port Colborne	Water temperature, dissolved oxygen
Welland River, upstream of Binbrook Conservation Area	Water temperature, dissolved oxygen
Welland River, Welland	Water temperature, pH, conductivity, dissolved oxygen, turbidity
Lake Niapenco, Binbrook Conservation Area	Water temperature, pH, conductivity, dissolved oxygen, turbidity, total algae
Twelve Mile Creek downstream of Short Hills Provincial Park	Water temperature, pH, conductivity, dissolved oxygen, turbidity
Welland River, Caistorville	Water temperature, pH, conductivity, dissolved oxygen, turbidity
Twenty Mile Creek, Woodburn	Water temperature, pH, conductivity, dissolved oxygen, turbidity

2.1.4 Surface Water Quality Monitoring Results

Welland River

The Welland River is the largest watershed in the NPCA jurisdiction with a total drainage area of 1,023 km^2. The watershed covers eleven local municipalities, originating in the Town of Ancaster and spanning the center of the Niagara Peninsula to its physical outlet in the City of Niagara Falls at the Niagara River **(Figure 3**). Over 70% of the watershed is classified as rural. The Welland River is part of the Niagara River Area of Concern (AOC). As shown in **Appendix A**, 30 of the 84 surface water quality monitoring stations are in the Welland River watershed, and 14 of these 30 stations are located on the main Welland River channel.

Welland River: Canadian Water Quality Index

The calculated WQI for the Welland River ranges from *Poor* to *Good*. Based on the 2020-2024 data collected, two of fourteen Welland River stations have *Poor* water quality, nine stations were rated as *Marginal*, two stations were rated as *Fair,* and one was rated as *Good* (WR000). WQI results are illustrated in **Appendix A**. Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020-2024 are found in **Appendix B and C**. In 2022, a new station was added (WR003A) on Harrison Road, however, there is insufficient data to include in this report. Highlights of the water quality monitoring in the Welland River are summarized in **Table 5**.

Figure 3: Welland River watershed

Table 5: Summary of NPCA water quality data for the Welland River, 2020-2024.

Station	WQI Rating ↔Stable ↓ Declining ↑ Improving	Hilsenhoff Family Biotic Index Rating	Factors Affecting Water Quality (% percentage reported if >50)	Indicator Parameter Trends (2020-2024)
WR00A Welland River	***Marginal*** ↔	***Fairly Poor***	• Exceedances of total phosphorus in 95% of samples taken. • Agricultural and roadway runoff. • Groundwater discharge sustains baseflow.	• Decreasing total phosphorus and total suspended solids. • Stable *E. coli*. • Increasing chloride.
WR000 Welland River	***Good*** ↔	***Fairly Poor***	• Exceedances of total phosphorus in 70% of samples taken. • Agricultural and roadway runoff. • Groundwater discharge provides intermittent baseflow	• Decrease in all indicator parameters.
WR001 Welland River	***Marginal*** ↔	***Very Poor***	• Exceedances of total phosphorus in 87% and *E. coli* in 54% of samples taken. • Agricultural and airport runoff.	• Indicator parameters remain stable.
WR002 Welland River	***Poor*** ↔	***Fairly Poor***	• Exceedances of chloride (85%), *E. coli* (51%), total phosphorus (54%), and zinc (95%). • Agricultural and airport runoff.	• Indicator parameters remain stable.
WR020 Welland River	***Marginal*** ↔	***Insufficient Data***	• Exceedances in chloride (51%) and total phosphorus (95%). • Agricultural and roadway runoff.	• Decrease in total suspended solids • Phosphorus, *E. coli*, and chloride remain stable.
WR003 Welland River	***Marginal*** ↔	***Poor***	• Exceedances of total phosphorus (100%). • Agricultural runoff	• Decrease in *E. coli* and total suspended solids • Phosphorus and chloride stable

WR004 Welland River	***Fair ↔***	***Fairly Poor***	• Exceedances in total phosphorus (76%). • Agricultural and road runoff. • Lake Niapenco improves the water quality.	• Decrease in all indicator parameters.
WR003A Welland River	***Insufficient Data***	***Fairly Poor***	• Agricultural and roadway runoff.	• Insufficient data.
WR005 Welland River	***Poor ↔***	***Fairly Poor***	• Exceedances in *E. coli* (56%) and total phosphorus (100%). • Agricultural and roadway runoff.	• Indicator parameters remain stable.
WR006 Welland River	***Marginal ↔***	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural and roadway runoff. • Excessive algae and duckweed in summer months.	• Decrease in phosphorus • *E. coli*, total suspended solids, and chloride remain stable.
WR007 Welland River	***Marginal ↑***	***Very Poor***	• Exceedances in total phosphorus (100%). • Agricultural and roadway runoff. • Non-native Zebra Mussels present.	• Increase in phosphorus, *E. coli*, and total suspended solids. • Chloride remains stable.
WR009B Welland River	***Marginal ↔***	***Insufficient Data***	• Exceedances in total phosphorus (92%). • Potential sewage treatment plant effluent, agricultural runoff, and urban runoff. • Station strongly influenced by Niagara River back flow which may improve water quality.	• Decrease in chloride. • *E. coli*, total suspended solids, and phosphorus remain stable.
WR010 Welland River	***Marginal ↔***	***Insufficient Data***	• Exceedances in total phosphorus (85%). • Potential sewage treatment plant effluent, agricultural, and urban runoff. • Station strong influenced by Niagara River back flow which may improve water quality.	• Indicator parameters remain stable.
WR011 Welland River	***Marginal ↓***	***Insufficient Data***	• Exceedances in total phosphorus (64%). • Potential sewage treatment plant effluent, agricultural, and urban runoff.	• Decrease in *E. coli*. • Phosphorus, total suspended solids, and chloride remain stable.

			• Station strong influenced by Niagara River back flow which may improve water quality.	
WR012 Welland River	***Fair*** ↔	***Insufficient Data***	• Urban runoff. • Station strongly influenced by Niagara River back flow which may improve water quality.	• Indicator parameters remain stable.

Welland River: Hilsenhoff Biotic Index Results

Hilsenhoff Biotic Index (HBI) results indicate that water quality at most stations in the Welland River ranged from *Very Poor* to *Fairly Poor* (**Table 5**). Results from Hilsenhoff Biotic Index assessments completed between 2020 and 2024 are illustrated in **Appendix B**.

Low HBI scores observed in the Welland River mainly are due to road salts and metals in stormwater, sediment loading, lack of in-stream habitat, and nutrient enrichment. Biological assessments were not completed for WR009B, WR010, WR011 and WR012 due to high water depth and channel morphology. These stations are located at the siphon where the Welland River flows beneath the Welland Canal and would require boat access for sample collection.

Welland River: In-situ Monitoring

The in-situ water quality sensors deployed in the Welland River at Caistorville, and O'Reilly's Bridge indicate typical large river conditions impacted by agricultural land uses which include dissolved oxygen fluctuations and warm water temperatures.

In 2024, the Welland River at Caistorville had large fluctuations in dissolved oxygen which is typical of high nutrient driven plant and algae growth. High nutrient input promotes vegetation and algae growth which produce and consume oxygen throughout their lifespan, driving these fluctuations. This was also found in the Welland River at E.C. Brown in 2024. At E.C. Brown, the dissolved oxygen is below 4 mg/L for extended periods of time, which is stressful conditions for biotic life including fish. Warm summer temperatures can also contribute to low oxygen concentrations as warmer water cannot hold as much oxygen as cooler water.

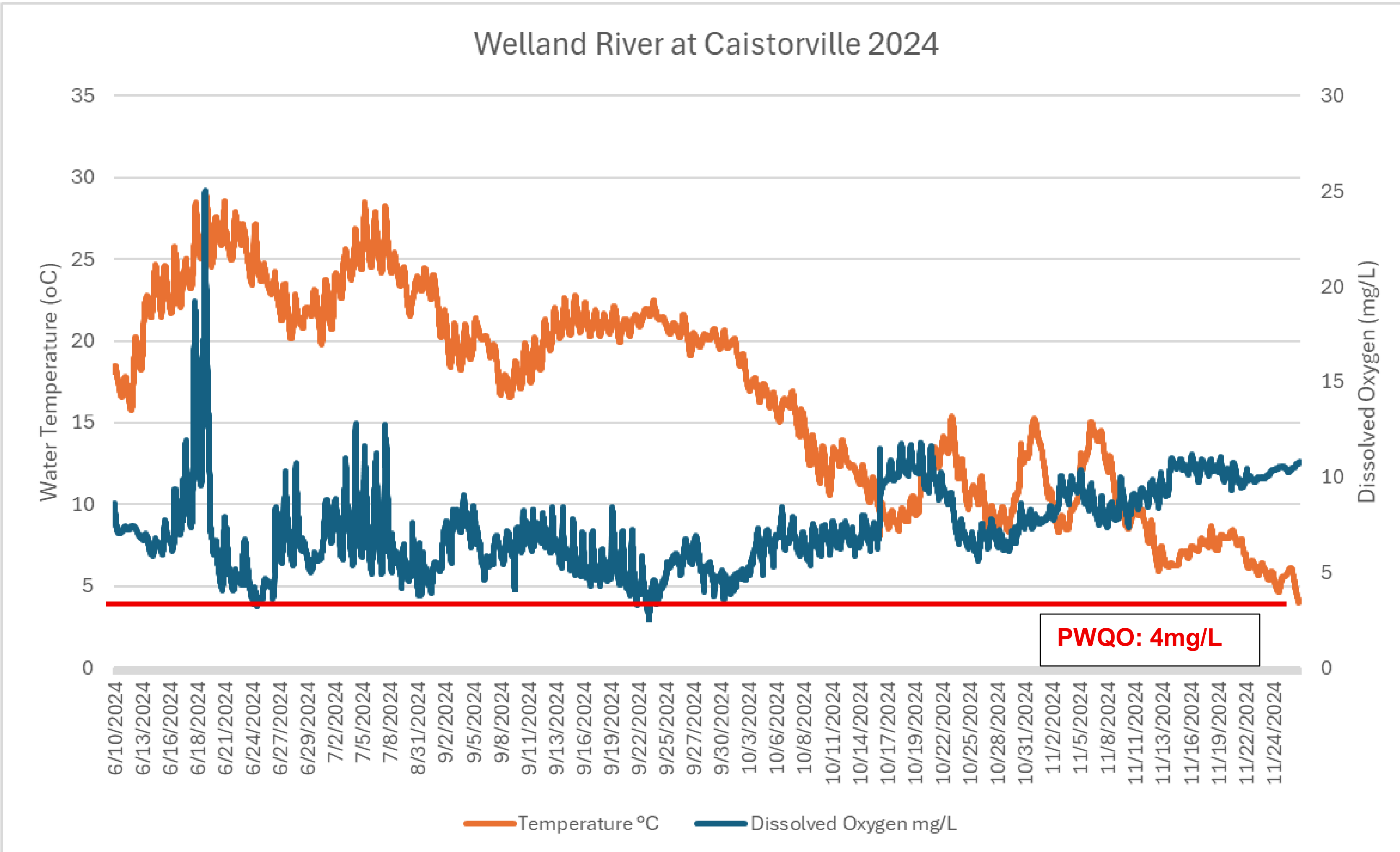

Figure 4: 2024 Water Temperature and Dissolved Oxygen of Welland River at Caistorville (West Lincoln).

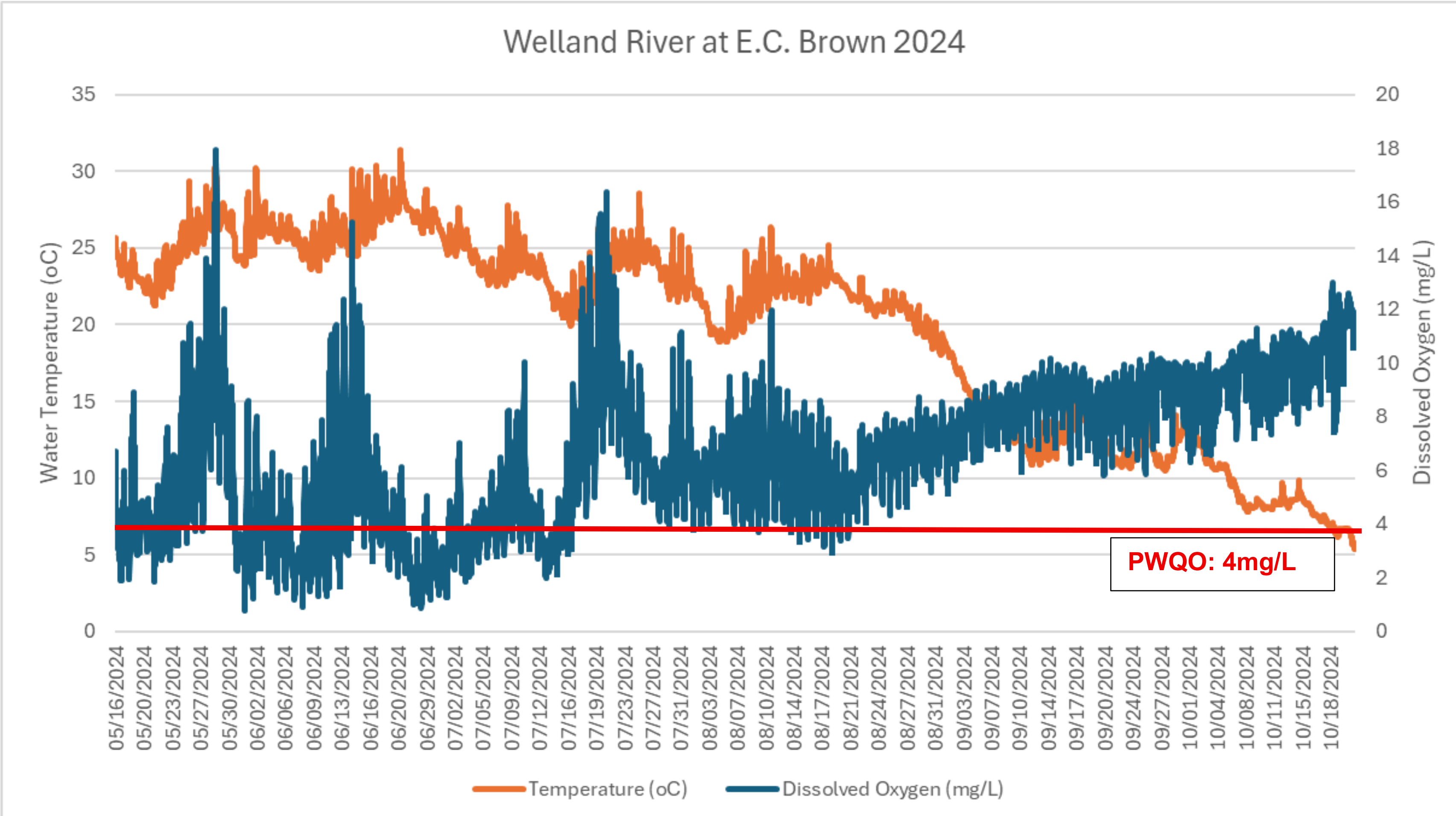

Figure 5: 2024 Water Temperature and Dissolved Oxygen of Welland River at E.C. Brown Conservation Area (Welland)

Welland River: Key Findings

Based on the 2020-2024 data, elevated concentrations of total phosphorus were a widespread cause of water quality impairment in the Welland River. Greater than 95% of samples collected in the main Welland River exceeded the PWQO, with some concentrations greater than 20 times the PWQO. High phosphorus in the Welland River stimulated the overgrowth of algae and duckweed throughout the watershed. When these plants transpire and decompose, they deplete dissolved oxygen in the water and this in turn increases stress levels on aquatic organisms such as fish and benthic invertebrates. Manure from livestock operations, sewage discharges, soil erosion, fertilizers, and pesticides are sources of total phosphorus in the Welland River.

Generally, the overall water quality of the Welland River downstream of the City of Welland is less stressed than the water upstream of the City of Welland. This is caused by the redirection of the Niagara River water down the Welland River in Chippawa for Ontario Power Generation (OPG). This results in a dilution effect that reduces the concentrations of water quality parameters. This effect was observed to the east of the City of Welland. However, upstream of the City of Welland, the river flow pattern caused by OPG operations and canal siphons are likely restricting the natural flushing of sediment, nutrients and other contaminants from the central Welland River watershed and exacerbating water quality issues in this watershed.

Water quality stations in the vicinity of Hamilton Airport (HIA) continue to have water quality designated as *Poor* due to elevated concentrations of chloride and zinc. Chloride concentrations were stable at WR001 but increased at WR002 despite the removal of the road salt storage pad. Zinc concentrations found at these stations consistently exceed the PWQO and are the highest observed in the NPCA water quality network. The current information that the HIA has suggests that zinc is coming off the brake system of the airplanes. It should be noted that zinc concentrations have been decreasing at both stations. The NPCA also has not observed any propylene glycol discharge in WR001 or WR002 in 2024. In 2011, the HIA expanded its facilities and upgraded its water quality safeguards to WR001 and WR002. Continued monitoring by the NPCA will track water quality changes at these tributaries. The NPCA does not monitor the water quality of the Hamilton Airport tributary identified as the potential source of Per- and polyfluoroalkyl substances (PFAS) that has been found in turtle/fish tissue sampled at Binbrook Conservation Area. Since 2015, Transport Canada and Procurement Canada have retained Arcadis Canada Inc. to conduct a risk assessment to investigate presence and distribution of PFAS in the Welland River downstream of the HIA. Through this assessment process Arcadis has released project updates to property owners and other groups with an interest in the risk assessment area. The final report is still pending. The MECP continues to provide fish consumption guidelines based on fish samples they have collected for this area and information is found on (https://www.ontario.ca/page/guide-eating-ontario-fish). The NPCA Watershed Monitoring and Reporting division added PFAS sampling of Lake Niapenco in 2012 as part of a Corporate Support Service and this information can be found in **Section 3.4**.

Welland River Tributaries

Fifteen tributaries of the Welland River are monitored through the NPCA Water Quality Monitoring Program. These tributaries include Buckhorn Creek, Elsie Creek, Mill Creek, Oswego Creek, Beaver Creek, Big Forks Creek, Coyle Creek, Drapers Creek, Feeder Canal, Mill Race Creek, Grassy Brook, Tee Creek, Thompson Creek, Power Canal, and Lyons Creek (**Figure 2**). Tributaries were selected based on drainage area, land use, restoration projects, and watershed plans. Additionally, the Feeder Canal is monitored and included with these tributaries for this analysis.

Welland River Tributaries: Water Quality Index

Based on the results of the WQI nine of sixteen Welland River tributary stations have water quality that is rated as *Poor* and six are rated as *Marginal* (**Table 6**). Five stations are rated *Fairly Poor*. WQI results are illustrated in **Appendix A.** Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020-2024 are found in **Appendix B** and **Appendix C.**

Table 6: Water quality monitoring results for Welland River tributaries, 2020-2024.				
Station	**WQI Rating ↔Stable ↓ Declining ↑ Improving**	**Hilsenhoff Family Biotic Index Rating**	**Factors Affecting Water Quality (% percentage reported if >50)**	**Indicator Parameter Trends (2020-2024)**
BF001 Big Forks	***Poor*** ↔	***Very Poor***	• Exceedances in total phosphorus (100%). • Agricultural runoff. • Excessive algae, sustained periods of low dissolved oxygen, duckweed growth, and zero baseflow in summer months.	• Increasing total phosphorus. • *E. coli*, total suspended solids, and chloride remain stable.
BU001 Buckhorn	***Poor*** ↔	***Fairly Poor***	• Exceedances in chloride (56%), and total phosphorus (95%). • Agricultural and road runoff. • Prone to zero baseflow in the summer.	• *E. coli* decreasing. • Phosphorus, total suspended solids, and chloride stable.
BV001 Beaver Creek	***Poor*** ↔	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff. • Excessive algae growth in summer.	• Indicator parameters remain stable.
CO001 Coyle Creek	***Marginal*** ↔	***Fairly Poor***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff. • Invasive Zebra Mussels present.	• Increasing phosphorus and chloride. • Decreasing total suspended solids. • *E. coli* remains stable.
DR001 Drapers Creek	***Marginal*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (90%), and total phosphorus (100%). • Agricultural and road runoff.	• Increasing *E. coli* and chloride. • Phosphorus and total suspended solids are stable.

EL001 **Elsie Creek**	***Poor*** ↔	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff. • Excessive algae growth and zero baseflow in summer months.	• Increasing total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.
GR001 **Grassy Brook**	***Marginal*** ↑	***Fairly Poor***	• Exceedances in *E. coli* (50%), and total phosphorus (100%). • Agricultural and road runoff. • Excessive algae growth and zero baseflow in summer months. • Significant construction has changed this Station over the past few years.	• Indicator parameters remain stable.
TE001 **Tee Creek**	***Poor*** ↔	***Very Poor***	• Exceedances in *E. coli* (51%), and total phosphorus (100%). • Agricultural and road runoff. • Prone to algae growth and zero baseflow in the summer months.	• Indicator parameters remain stable.
LY003 **Lyons Creek**	***Fair*** ↑	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff • Niagara River back flow influences this station.	• Decreasing phosphorus and chloride. • *E. coli* and total suspended solids remain stable.
MI001 **Mill Creek**	***Poor*** ↔	***Poor***	• Exceedances in total phosphorus (97%) • Agricultural and road runoff. • Excessive algae growth in summer months.	• Increasing chloride. • Decreasing *E. coli* and total suspended solids. • Stable phosphorus.
OS001	***Poor*** ↔	***Poor***	• Exceedances in *E. coli* (61%), total phosphorus (100%), and total suspended solids (67%).	• Increasing phosphorus and total suspended solids.

Oswego Creek			• Agricultural and road runoff. • Excessive algae growth in summer months.	• *E. coli* and chloride remain stable.
OS002 **Oswego Creek**	***Poor*** ↔	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff. • Excessive algae growth in summer months.	• Decreasing *E. coli*. • Phosphorus, total suspended solids, and chloride remain stable.
TC001 **Thompson Creek**	***Marginal*** ↑	***Poor***	• Exceedances in *E. coli* (54%), and total phosphorus (100%). • Agricultural and road runoff.	• Increasing chloride. • Decreasing *E. coli*. • Phosphorus and total suspended solids remain stable.
PR001 **Power Canal**	***Marginal*** ↔	***Insufficient Data***	• Urban runoff and Niagara Falls wastewater treatment plant. • Water source is from Niagara River potentially improving water quality.	• Decreasing phosphorus and *E. coli*. • Total suspended solids and chloride remain stable.
MR001 **Millrace Creek**	***Marginal*** ↑	***Insufficient Data***	• Exceedances in *E. coli* (56%), and total phosphorus (100%). • Agricultural and road runoff.	• Indicator parameters remain stable.
FC001 **Feeder Canal**	***Poor*** ↔	***Fairly Poor***	• Exceedances in total phosphorus (95%). • Agricultural runoff. • Excessive algae and plant growth in summer months.	• Decreasing *E. coli* and chloride. • Phosphorus and total suspended solid remain stable.

Welland River Tributaries: Hilsenhoff Biotic Index Results

HBI results indicate that water quality ranges from *Very Poor* to *Fairly Poor* at all Welland River tributary stations currently monitored (**Table 5**). Results from biological assessments completed between 2020-2024 are illustrated in **Appendix B**. Sediment loading, lack of in-stream habitat, and nutrient enrichment are the primary causes of impairment at all stations.

Welland River Tributaries: Key Findings

Based on the 2020-2024 data, elevated concentrations of total phosphorus are a widespread cause of water quality impairment in the Welland River tributaries. Approximately 95% of samples collected from the Welland River tributaries exceeded the PWQO with some concentrations greater than 30 times the PWQO. Concentrations of total phosphorus are very high in Beaver Creek, Big Forks Creek, Oswego Creek, Mill Race Creek, and Tee Creek. It is recommended that these subwatersheds be prioritized by Best Management Practice programs to reduce phosphorus loads. Sources of phosphorus include manure from livestock operations, sewage discharges, soil erosion, fertilizers, and pesticides.

Concentrations of *E. coli* frequently exceed the PWQO in Buckhorn Creek, Big Forks Creek, Beaver Creek, Coyle Creek, Drapers Creek, Elsie Creek, Mill Creek, and Oswego Creek.

Twenty Mile Creek Watershed

The Twenty Mile Creek watershed is the second largest watershed in the NPCA jurisdiction with a total drainage area of 302 km^2. Ten of 84 NPCA surface water quality monitoring stations are located within the Twenty Mile Creek watershed. There are six stations on the main channel. There are also monitoring stations for each of the subwatersheds which include Sinkhole Creek, Spring Creek, North Creek and Gavora Ditch (**Figure 3)**.

Twenty Mile Creek Watershed: Canadian Water Quality Index

Based on the results, the WQI ranges from *Poor* to *Fair*. WQI results are illustrated in **Appendix A**. Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020-2024 are found in **Appendix B** and **Appendix C**. Sinkhole Creek was added in 2022 and therefore has insufficient data for this report. Highlights of the water quality monitoring in the Twenty Mile Creek are summarized in **Table 7.**

Figure 6: Map of the Twenty Mile Creek subwatershed.

Table 7: Summary of NPCA water quality data for Twenty Mile Creek watershed, 2020-2024.

Station	WQI Rating ↔Stable ↓ Declining ↑ Improving	Hilsenhoff Family Biotic Index Rating	Factors Affecting Water Quality (% percentage reported if >50)	Indicator Parameter Trends (2020-2024)
TN001 Twenty Mile Creek	***Poor*** ↓	***Poor***	• Exceedances in *E. coli* and total phosphorus. • Agricultural and urban runoff. • Invasive Chinese Mystery Snails present.	• Decrease in total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.
TN002 Twenty Mile Creek	***Fair*** ↔	***Good***	• Exceedances in total phosphorus. • Agricultural and urban runoff. • Prone to zero baseflow in the summer months.	• Decrease in phosphorus. • *E. coli*, total suspended solids, and chloride remain stable.
TN003 Twenty Mile Creek	***Fair*** ↑	***Fairly Poor***	• Exceedances in total phosphorus. • Agricultural and urban runoff. • Excessive algae growth in summer months.	• Decrease in *E. coli*. • Phosphorus, total suspended solids, and chloride remain stable.
TN003A Twenty Mile Creek	***Marginal*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (50%) and total phosphorus (100%). • Agricultural and urban runoff. • Excessive algae growth in the summer months.	• Indicator parameters remain stable.
TN004 Twenty Mile Creek	***Marginal*** ↑	***Fairly Poor***	• Exceedances *E. coli* (66%) and total phosphorus (100%). • Agricultural and urban runoff. • Excessive algae growth in summer months.	• Indicator parameters remain stable.
TN006 Twenty Mile Creek	***Marginal*** ↑	***Fair***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff.	• Indicator parameters remain stable.

NC001 **North Creek**	***Poor*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (68%) and total phosphorus (97%). • Agricultural and road runoff. • Excessive algae growth and zero baseflow in summer months.	• Increase in chloride. • Decrease in total suspended solids. • Phosphorus and *E. coli* remain stable.
SP001 **Spring Creek**	***Poor*** ↓	***Fairly Poor***	• Exceedances in *E. coli* (61%) and total phosphorus (100%). • Agricultural and road runoff. • Excessive algae growth and zero baseflow in the summer months.	• Increase in chloride. • Decrease in total suspended solids. • Phosphorus and *E. coli* remain stable.
GV001 **Gavora Ditch**	***Marginal*** ↔	***Fairly Poor***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff. • Zero baseflow during summer months.	• Indicator parameters remain stable.
SK001 **Sinkhole Creek**	***Insufficient Data***	***Poor***	• Urban and agricultural runoff. • Prone to zero baseflow in the summer months.	• Insufficient data.

Twenty Mile Creek Watershed: Hilsenhoff Biotic Index Results

HBI results indicate that water quality ranges from *poor* to *good* at most Twenty Mile Creek monitoring stations (**Table 7**). Results from biological assessments completed between 2020 to 2024 are illustrated in **Appendix B.** Reduced baseflow, high sediment loading due to erosion, lack of in-stream habitat, and nutrient enrichment are primary causes of impairment at these stations.

Twenty Mile Creek: In-situ Monitoring

Twenty Mile Creek in-situ monitoring at Woodburn shows that it is prone to dissolved oxygen, turbidity, and conductivity fluctuations. Nutrient inputs leading to excessive vegetation growth likely contribute to dissolved oxygen fluctuations and low oxygen conditions. Water level fluctuations and high flow during rain events can be seen in turbidity fluctuations. Conductivity spikes are likely due to agricultural and road runoff. There is an incomplete dataset for 2024 due to sensor malfunction.

Twenty Mile Creek Watershed: Key Findings

Based on the data in 2020-2024, elevated concentrations of total phosphorus are a widespread cause of water quality impairment in the Twenty Mile watershed. Approximately 95% of samples collected from the Twenty Mile watershed exceeded the PWQO with some concentrations greater than 30 times the PWQO. *E. coli* and total suspended solid concentrations frequently exceed the provincial objective in Twenty Mile Creek watershed.

Lake Ontario Tributaries

Nineteen tributaries discharging into Lake Ontario are monitored through the NPCA Water Quality Monitoring Program. These tributaries include: Forty Mile Creek, Thirty Mile Creek, Eighteen Mile Creek, Sixteen Mile Creek, Fifteen Mile Creek, Twelve Mile Creek (see Section 4.6), Francis Creek, Richardson Creek, Walker's Creek, Eight Mile Creek, Six Mile Creek, Four Mile Creek, Two Mile Creek, One Mile Creek, Bartlett Creek, Prudhommes Drain, Welland Canal, Shriners Creek, and Beaver Dam Creek (**Figure 4**). Twelve Mile Creek and Twenty Mile Creek are also tributaries of Lake Ontario but are presented separately due to the expansion of monitoring in each watershed.

Lake Ontario Tributaries: Canadian Water Quality index

Based on the results of the WQI, thirteen of eighteen Lake Ontario tributary stations have water quality that is rated as *Poor*. Four stations were rated as *Marginal*. WQI results are illustrated in **Appendix A**. Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020 and 2024 are found in **Appendix B** and **Appendix C**. Highlights of the water quality monitoring in the Lake Ontario tributaries are summarized in **Table 8**.

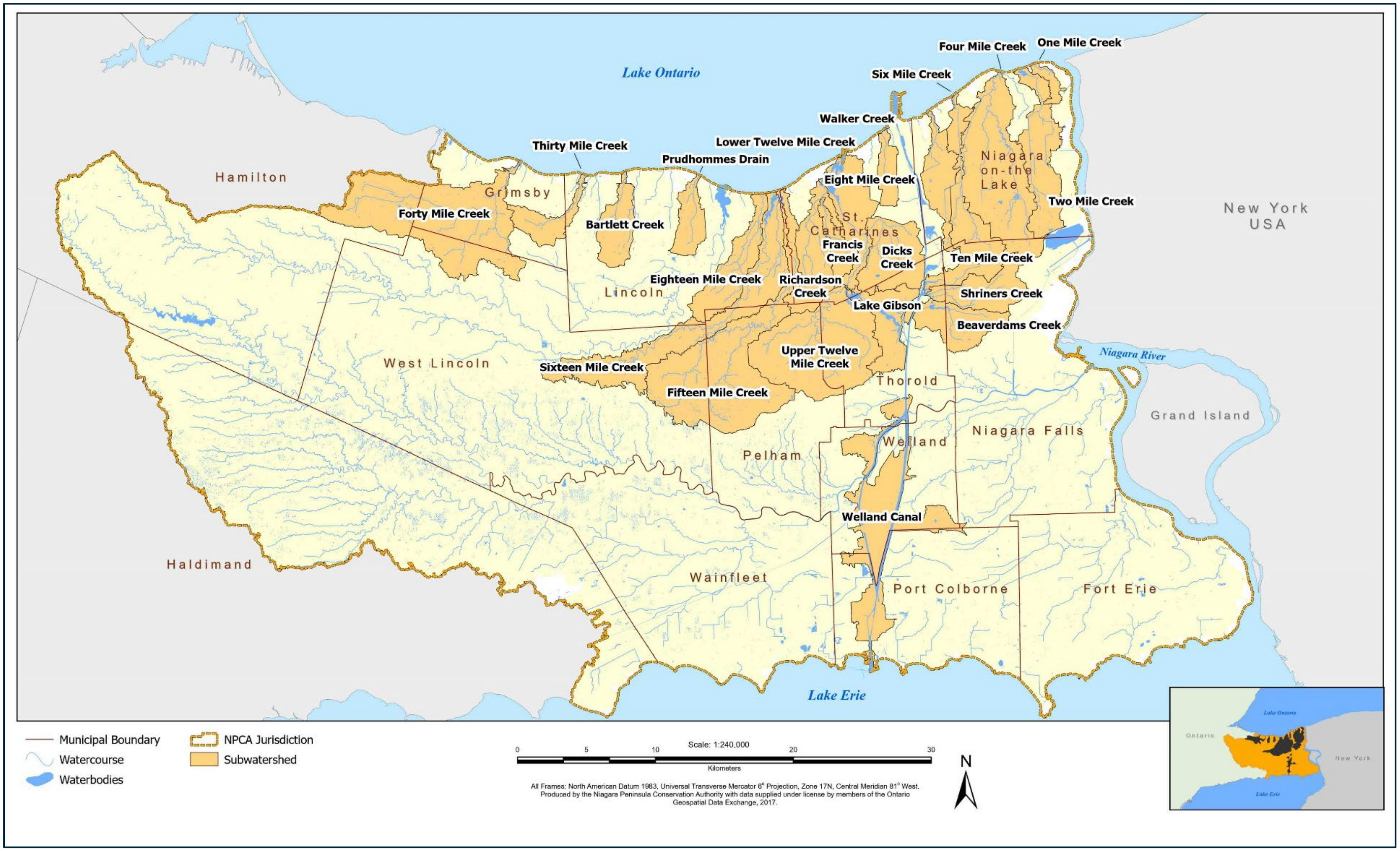

Figure 7: Map of the subwatersheds draining to Lake Ontario

Table 8: Summary of NPCA water quality data for Lake Ontario Tributaries, 2020-2024.				
Station	**WQI Rating ↔Stable ↓ Declining ↑ Improving**	**Hilsenhoff Family Biotic Index Rating**	**Factors Affecting Water Quality (% percentage reported if >50)**	**Indicator Parameter Trends (2020-2024)**
FM001 **Forty Mile Creek**	***Poor*** ↔	***Poor***	• Exceedances in chloride (79%), *E. coli* (78%), and total phosphorus (98%). • Road salt storage, quarry dewatering, agricultural and urban runoff. • Excessive algae growth in the summer months.	• Decrease in total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.
ET001 **Eighteen Mile Creek**	***Poor*** ↔	***Poor***	• Exceedances in copper (62%), *E. coli* (55%), total phosphorus (100%), and zinc (54%). • Greenhouse wastewater, agricultural runoff. • Frequent copper exceedances warrant further investigation.	• Indicator parameters remain stable.
FF001 **Fifteen Mile Creek**	***Marginal*** ↑	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural runoff. • Excessive algae and duckweed growth in the summer months.	• Decrease in total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.
SX001 **Sixteen Mile Creek**	***Poor*** ↔	***Poor***	• Exceedances in *E. coli* (50%) and total phosphorus (100%). • Agricultural runoff. • Excessive algae and duckweed growth in the summer months.	• Decrease in total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.
EI001 **Eight Mile Creek**	***Poor*** ↔	***Poor***	• Exceedances in *E. coli* (87%) and total phosphorus (100%). • Agricultural and road runoff.	• Indicator parameters remain stable.

FA001 **Francis Creek**	***Poor*** ↔	***Very Poor***	• Exceedances in chloride (97%), *E. coli* (89%), and total phosphorus (89%). • Agricultural and urban runoff.	• Indicator parameters remain stable.
RC001 **Richardson Creek**	***Poor*** ↔	***Very Poor***	• Exceedances in chloride (85%), copper (71%), *E. coli* (62%), nitrate (100%), total phosphorus (100%), and zinc (50%). • Agricultural and greenhouse wastewater.	• Increasing phosphorus and chloride. • *E. coli* and total suspended solids remain stable.
SI001 **Six Mile Creek**	***Poor*** ↔	***Poor***	• Exceedances in chloride (54%), *E. coli* (69%), and total phosphorus (74%). • Agricultural and road runoff.	• Indicator parameters remain stable.
FU004 **Four Mile Creek**	***Marginal*** ↑	***Very Poor***	• Exceedances in *E. coli* (68%), and total phosphorus (100%). • Agricultural and road runoff.	• Increase in phosphorus. • Decrease in *E. coli* and total suspended solids. • Chloride remains stable.
TM001 **Two Mile Creek**	***Poor*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (82%) and total phosphorus (97%). • Agricultural and road runoff. • High *E. coli* concentrations have been investigated.	• Decrease in total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.
OM001 **One Mile Creek**	***Poor*** ↔	***Very Poor***	• Exceedances in chloride (61%), *E. coli* (89%), and total phosphorus (100%). • Urban runoff. • Prone to zero baseflow in the summer months.	• Increasing phosphorus and chloride. • *E. coli* and total suspended solids remain stable.
TH001 **Thirty Mile Creek**	***Marginal*** ↔	***Fairly Poor***	• Exceedances chloride (66%), *E. coli* (79%), and total phosphorus (89%). • Agricultural runoff.	• Indicator parameters remain stable.
WC001 **Walkers Creek**	***Poor*** ↔	***Very Poor***	• Exceedances in chloride (62%), *E. coli* (89%), and total phosphorus (100%). • Urban runoff.	• Increase in phosphorus. • *E. coli*, total suspended solids, and chloride remain stable.

SH002 **Shriners Creek**	***Poor*** ↓	***Poor***	• Exceedances in chloride (74%), *E. coli* (51%), and total phosphorus (97%). • Urban runoff. • Excessive algae growth in summer months.	• Increase in phosphorus. • *E. coli*, total suspended solids, and chloride remain stable.
BE004 **Beaver Dam Creek**	***Marginal*** ↔	***Poor***	• Exceedances in total phosphorus (92%). • Industrial and urban runoff.	• Increase in total suspended solids, and chloride. • Decrease in phosphorus and *E. coli*.
WE001 **Welland Canal**	***Fair*** ↑	***Insufficient Data***	• Water source is predominantly Lake Erie.	• Indicator parameters remain stable.
PD001 **Prudhommes Drain**	***Poor*** ↔	***Very Poor***	• Exceedances in chloride (76%), *E. coli* (82%), and total phosphorus (92%). • Urban runoff. • Excessive algae and duckweed growth in summer months.	• Increase in chloride. • Decrease in phosphorus. • *E. coli* and total suspended solids remain stable.
BT001 **Bartlett Creek**	***Poor*** ↔	***Very Poor***	• Exceedances in chloride (74%) and total phosphorus (97%). • Agricultural and QEW runoff.	• Increase in phosphorus. • *E. coli*, total suspended solids, and chloride remain stable.

Lake Ontario Tributaries: Hilsenhoff Biotic Index Results

HBI results indicate that water quality ranged from *very poor to fairly poor* at Lake Ontario tributary stations (**Table 8**). Results from biological assessments completed between 2020 and 2024 are illustrated in **Appendix B**. Sediment loading, nutrient enrichment, and the lack of in-stream habitat are the primary causes of impairment at these stations.

Lake Ontario Tributaries: Key Findings

Based on the 2020-2024 data, all Lake Ontario tributaries have total phosphorus exceedances. The most impacted of these tributaries include Fifteen Mile Creek, Sixteen Mile Creek and Eighteen Mile Creek which had median concentrations nearly 7 times the PWQO. The upper portions of these watersheds need to be prioritized for BMPs to reduce phosphorus loads.

Median *E. coli* concentrations for Walkers Creek (St. Catharines) are the highest in the NPCA's surface water monitoring network and NPCA will work with the municipality to determine sources of contamination. One Mile Creek (OM001) and Two Mile Creek (TM001) in Town of Niagara-on-the-Lake's have elevated median concentrations of *E. coli* relative to other NPCA watersheds. Median *E. coli* concentrations in TM001 are currently lower than those reported in previous summary reports. However, statistical analysis indicates that these concentrations remain stable over time. Additional years of monitoring data will be required to detect any statistically significant downward trend that would demonstrate the effectiveness of the Town's remediation efforts. The Town is also aware of elevated *E. coli* concentrations in One Mile Creek and has indicated that further investigation is planned for this area in the future.

Richardson Creek consistently exceeds the Canadian Council of Ministers of the Environment (CCME) guideline for nitrate concentrations. NPCA data indicates the presence of a significant upstream source, which warrants further investigation to identify and characterize the origin of nitrate inputs. In 2025, the NPCA will conduct additional monitoring in upstream locations to narrow sources.

Twelve Mile Creek Watershed

Twelve Mile Creek (**Figure 4**) is split into the Upper and Lower watersheds. Upper Twelve Mile Creek is a unique groundwater fed coldwater stream fed by springs from a glacial sand deposit known as the Fonthill Kame Delta. The Upper Twelve Mile Creek is monitored at 8 locations by the NPCA. Lower Twelve Mile Creek begins in Thorold where Ontario Power Generation (OPG) operations and man-made reservoirs for drinking water divert water from the Welland Canal and influence Twelve Mile Creek (Durley, 2006). Lower Twelve Mile Creek is monitored in 2 locations by the NPCA, with only 1 Station with enough data to be analyzed in this report.

Twelve Mile Creek Watershed: Canadian Water Quality Index

Based on the results of the WQI, Twelve Mile Creek ranges from marginal to fair (**Table 9**). Based on the 2020-2024 data, three locations are rated *fair.* No Twelve Mile Creek Stations were rated poor. WQI results are illustrated in **Appendix A.** Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020 to 2024 are found in **Appendix B and Appendix C.** TW011 was added in 2021 and has insufficient data for this report. Highlights of water quality monitoring in Twelve Mile Creek are summarized in **Table 9** below.

Table 9: Summary of NPCA water quality data for the Twelve Mile Creek watershed, 2020-2024.

Station	WQI Rating ↔Stable ↓ Declining ↑ Improving	Hilsenhoff Family Biotic Index Rating	Factors Affecting Water Quality (% percentage reported if >50)	Indicator Parameter Trends (2020-2024)
TW001 St Johns Tributary	***Marginal*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (64%) and total phosphorus (71%). • Agricultural and urban runoff. • Online pond upstream.	• Increasing chloride. • Phosphorus, *E. coli*, and total suspended solids remain stable.
TW002 Effingham Tributary	***Fair*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (51%) and total phosphorus (61%). • Agricultural runoff.	• Decreasing phosphorus, *E. coli*, and total suspended solids. • Chloride remains stable.
TW003 St Johns Tributary	***Marginal*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (72%) and total phosphorus (97%). • Agricultural runoff. • Decommissioned landfill upstream.	• Increase in chloride. • Phosphorus, *E. coli*, and total suspended solids remain stable.
TW004 Effingham Tributary	***Marginal*** ↔	***Fairly Poor***	• Exceedances in nitrate (90%). • Agricultural and golf course runoff. • Nitrate exceedances warrant investigation.	• Increase in chloride. • Decrease in phosphorus. • *E. coli* and total suspended solids remain stable.
TW005 St Johns Tributary	***Marginal*** ↔	***Fairly Poor***	• Exceedances in *E. coli* (56%) and total phosphorus (70%). • Agricultural runoff.	• Increase in chloride. • Decrease in *E. coli* and total suspended solids. • Phosphorus remains stable.
TW006	***Fair*** ↔	***Fair***	• Exceedances in *E. coli* (62%) and total phosphorus (65%).	• Decrease in chloride.

Effingham Tributary			• Agricultural runoff.	• Phosphorus, *E. coli*, and total suspended solids remain stable.
TW007 **Main branch downstream of Short Hills**	***Marginal ↔***	***Fairly Poor***	• Exceedances in *E. coli* (69%) and total phosphorus (79%). • Agricultural runoff.	• Indicator parameters remain stable.
TW008 **Cataract Tributary**	***Marginal ↔***	***Poor***	• Exceedances in chloride (66%), *E. coli* (71%), and total phosphorus (100%). • Agricultural and highway (406) runoff.	• Increase in phosphorus. • *E. coli*, total suspended solids, and chloride remain stable.
TW009 **Port Dalhousie**	***Fair ↔***	***Insufficient data***	• Exceedances in *E. coli* (55%). • Urban and industrial runoff.	• Increase in *E. coli*. • Decrease in phosphorus and chloride. • Total suspended solids remain stable.
TW011 **Welland Vale**	***Insufficient data***	***Insufficient data***	• Urban runoff.	• Insufficient data.

Twelve Mile Creek: Hilsenhoff Biotic Index Results

Most upper Twelve Mile Creek stations are rated as *fairly poor* and Station TW006 is rated as *fair* (**Table 9**). Some upper Twelve Mile Creek tributaries can support several sensitive taxa such as mayflies and stoneflies due to cooler water temperatures, excellent riparian buffers and in-stream habitat, and suitable water quality. In some cases, the HBI rating is impacted by a large proportion of crustaceans, such as amphipods, in comparison to insects.

Twelve Mile Creek: Stream Temperature Monitoring

The NPCA monitored stream temperature at ten stations in 2024 (**Figure 9**). These stations were chosen due to the availability of background data, including water chemistry, benthic macroinvertebrate data, fisheries, stream morphology, hydrology data and stream temperature data. At seven of the locations, Onset HOBO Water Temperature dataloggers were deployed to capture stream temperature data. At the three remaining stations, the stream temperature data was collected from NPCA stream flow gauge stations. The HOBO temperature dataloggers were deployed May 13th, 2024, set to record every 15 minutes and extracted October 31st, 2024.

The methodology used by the NPCA, and many other conservation authorities to classify stream thermal stability was developed by Stoneman and Jones (1996). The approach uses daily maximum air temperature and water temperature at 16:00 from July 1st to September 10th. This method was determined to monitor the warmest period of the year. To analyze the stream temperature data, the NPCA uses modified nomograms (Stoneman and Jones 1996) to determine the stream thermal stability and to estimate the thermal regime of each stream station. This method classifies a stream to be coldwater, coolwater, or warmwater. Stoneman and Jones (1996) define the following 1) coldwater stations which support a large population of coldwater species; 2) coolwater stations that support a mix of coldwater-coolwater-warmwater; and 3) warmwater stations support few or no coldwater species.

Nomograms (**Figures 10 and 11**) were created for the Effingham and St Johns Tributaries of the Upper Twelve Mile Creek with the stream temperature data collected from July 1st to September 10th, 2024. The findings of these nomograms classify stations TW000 and TW003 as coldwater. TW001, TW002, TW004, TW005, TW006, TW007, TW012 and Sulphur Springs were classified as coolwater. No sites were classified as warmwater.

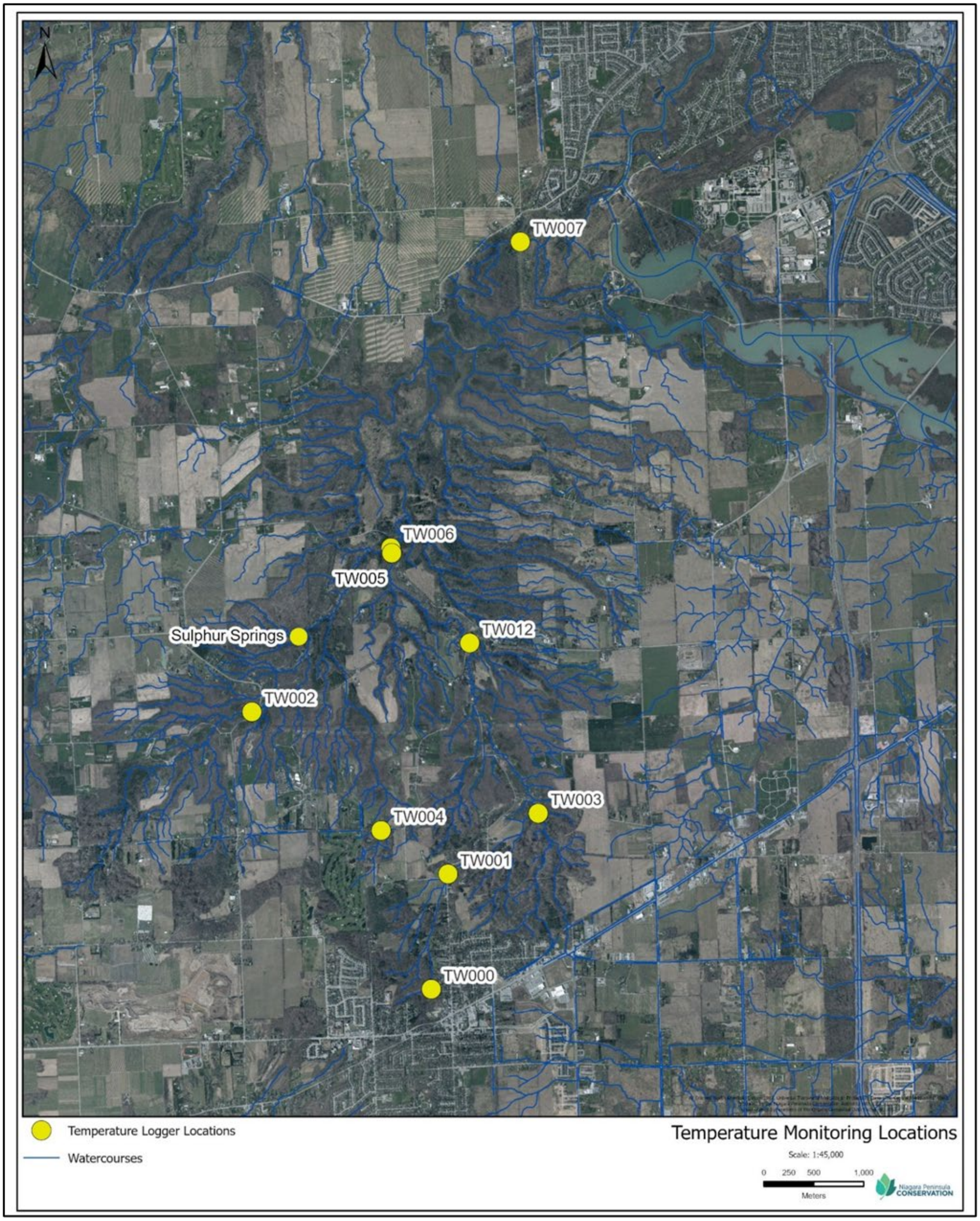

Figure 8: Temperature monitoring locations in the Upper Twelve Mile Creek watershed.

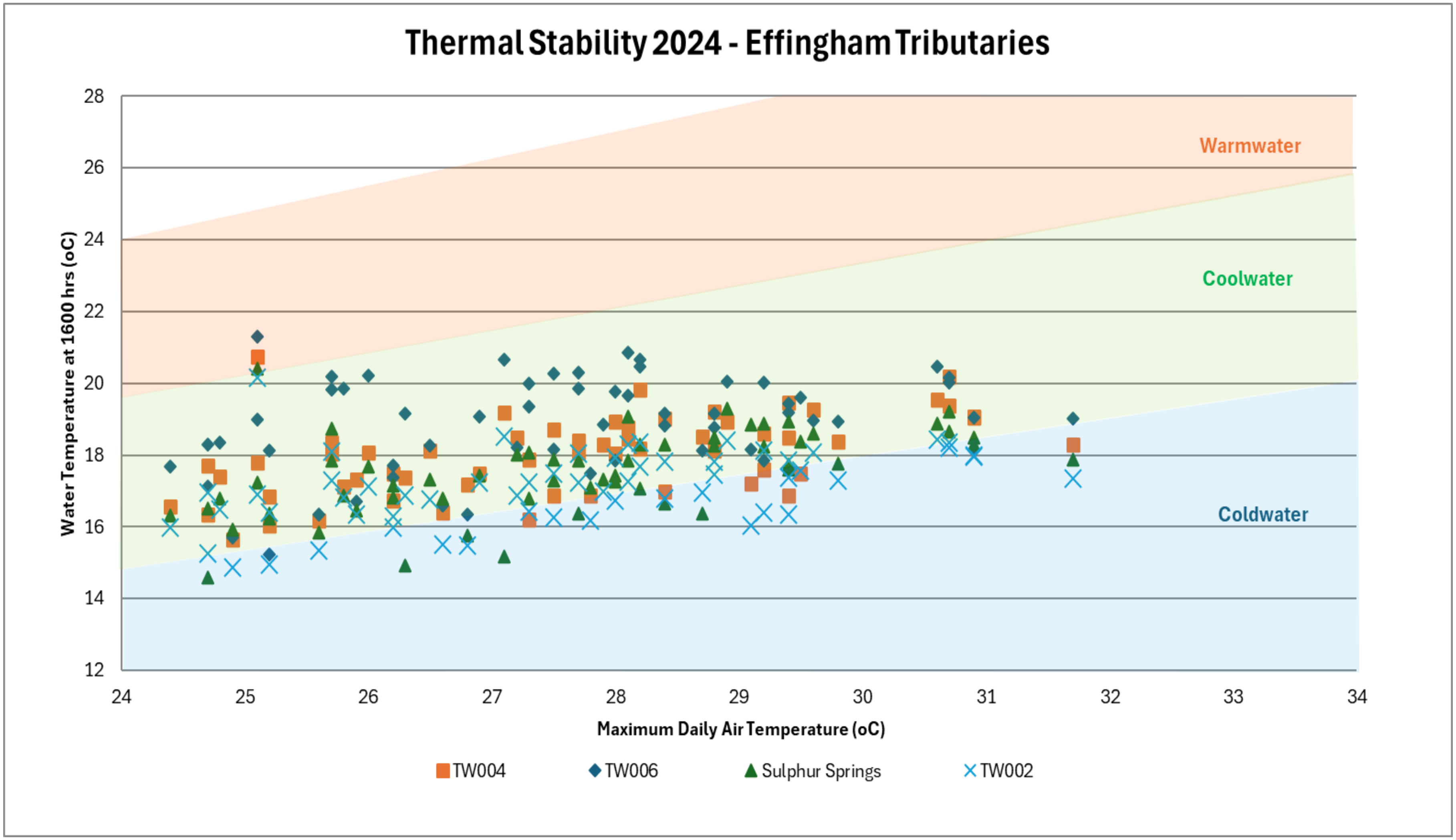

Figure 9: Thermal stability nomogram for Effingham Tributaries of Upper Twelve Mile Creek.

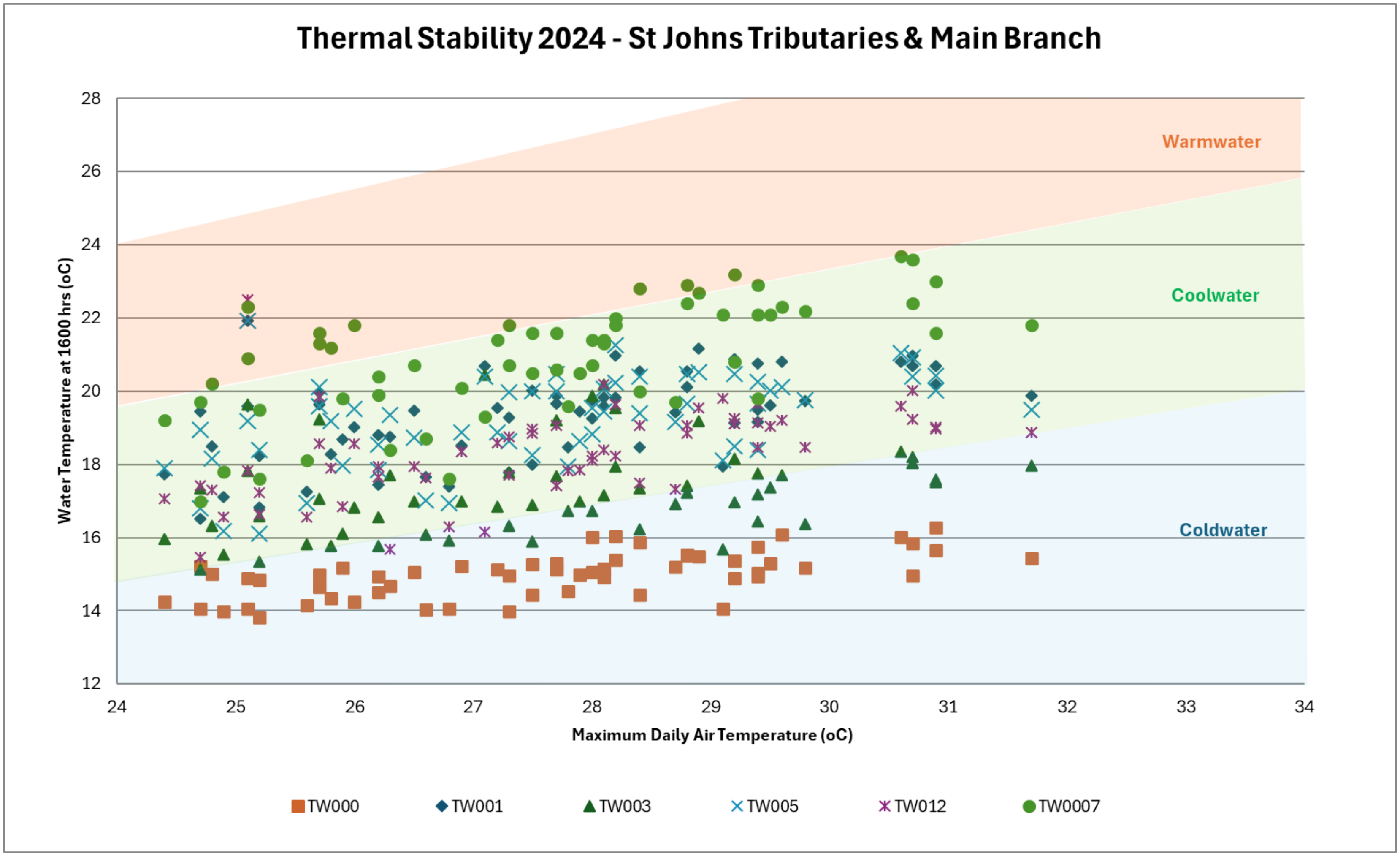

Figure 10: Thermal stability nomograms for St. Johns tributaries of Upper Twelve Mile Creek

Table 10: Stream classification summary 2020-2024 for Upper Twelve Mile Creek temperature monitoring locations.

Monitoring Site	2020	2021	2022	2023	2024
TW000	Cold Water	Cold Water	Cold Water	Cold Water	Cold Water
TW001	Cool Water	Cool Water	Cool Water	Cool Water	Cool Water
TW002	Cold Water	Cool Water	Cold Water		Cool Water
Sulphur Springs	Cold Water	Cool Water	Cold Water		Cool Water
TW003	Cold Water	Cool Water	Cold Water	Cold Water	Cold Water
TW004	Cool Water	Cool Water	Cold Water	Cool Water	Cool Water
TW005	Cool Water	Cool Water	Cool Water		Cool Water
TW006	Cool Water	Cool Water	Cool Water	Cool Water	Cool Water
TW007	Warm Water	Warm Water	Cool Water	Cool Water	Cool Water
TW012				Cool Water	Cool Water

Stream classifications 2020-2024 for Upper Twelve Mile Creek stream temperatures are summarized in **Table 10.** The headwaters of the St. Johns tributary have continued to maintain a coldwater classification from 2020-2024. Overall, every station in 2024 remained consistent with their previous classifications from 2023. In general, the classification of the monitoring stations has remained stable with previous assessments. The NPCA will continue to monitor stream temperature as an additional method to evaluate the health and status of watershed communities in the extremely significant coldwater streams of the upper Twelve Mile Creek.

Twelve Mile Creek: In-situ Monitoring

The multiparameter sonde deployment in Twelve Mile Creek downstream of Short Hills Provincial Park shows a creek that is highly impacted by high turbidity (**Figure 11**) fluctuations due to rain events and indicates high erosion occurring. The Upper Twelve Mile Creek watershed is flashy in nature and responds quickly and sharply to rain events. This, coupled with easily erodible sandy substrate, leads to large turbidity fluctuations and erosion.

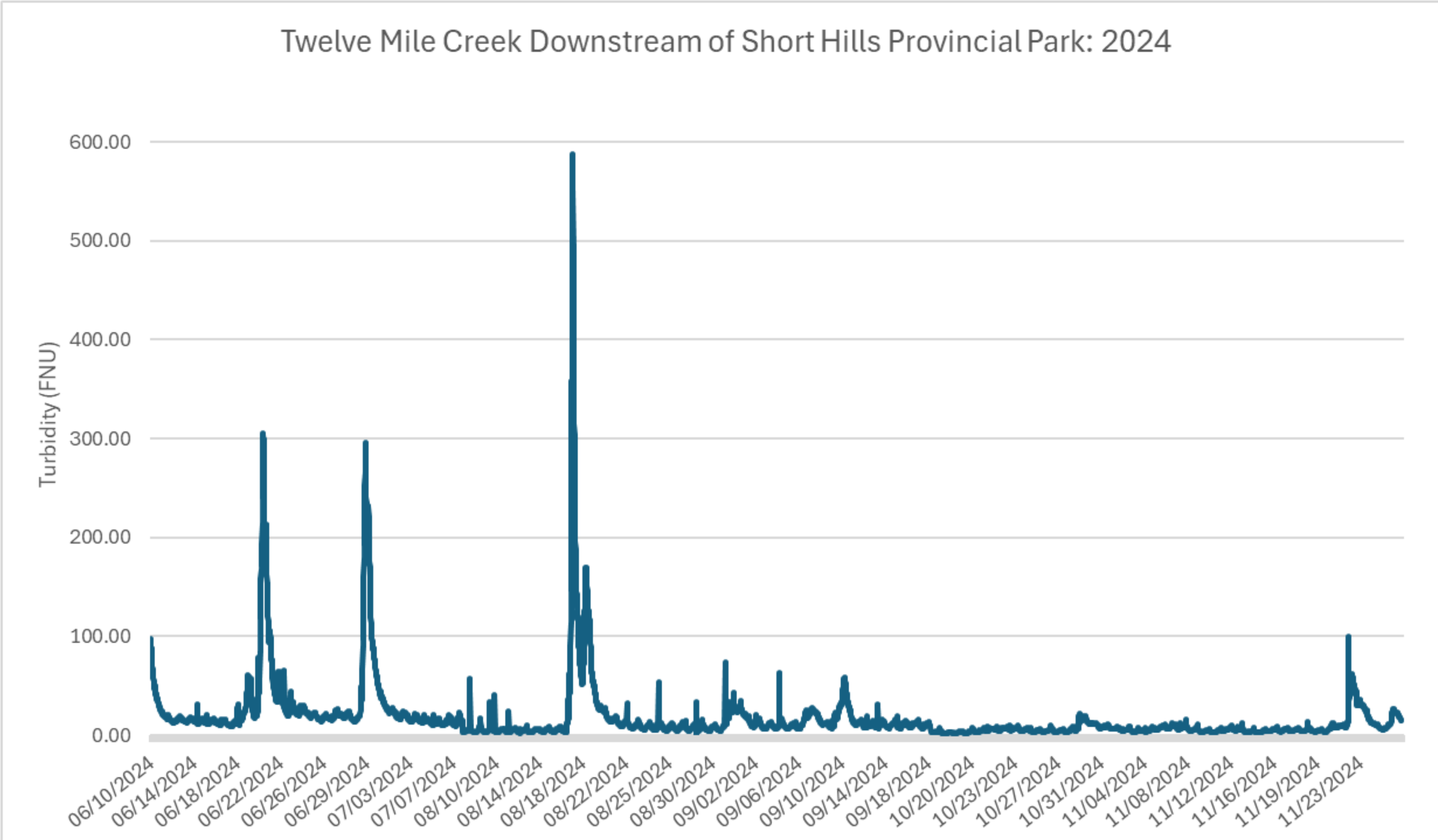

Figure 11: EXO Water Quality Sonde turbidity data Twelve Mile Creek downstream of Short Hills Provincial Park.

Twelve Mile Creek: Key Findings

The Upper Twelve Mile Creek watershed represents some of the best water quality in the Niagara Peninsula. The upper portion of Twelve Mile Creek supports brook trout and a rich macroinvertebrate community that is unique to this watershed. The main stresses to the aquatic community include exceedances of total phosphorus and *E. coli*. Nitrate contamination from an upstream source was identified as a potential stressor at TW004. The Upper Twelve Mile Creek watershed is prone to erosion and sediment deposition. Efforts to minimize these stressors through BMP initiatives will allow this watershed to remain in its current state.

Niagara River Tributaries

Four tributaries discharging to the Niagara River are monitored through the NPCA Water Quality Monitoring Program. These tributaries include Bayer Creek, Black Creek (including Beaver Creek), Frenchman's Creek, and Ussher's Creek (**Figure 5**).

Niagara River Tributaries: Canadian Water Quality Index

Based on the data from 2020-2024, Black Creek (BL003), Frenchman's Creek (FR003), and Beaver Creek (BR001) stations are rated as *marginal*. WQI results are illustrated in **Appendix A**. Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020 to 2024 are found in **Appendix B** and **Appendix C.** Highlights of the water quality monitoring in the Niagara River Tributaries are summarized in **Table 11.**

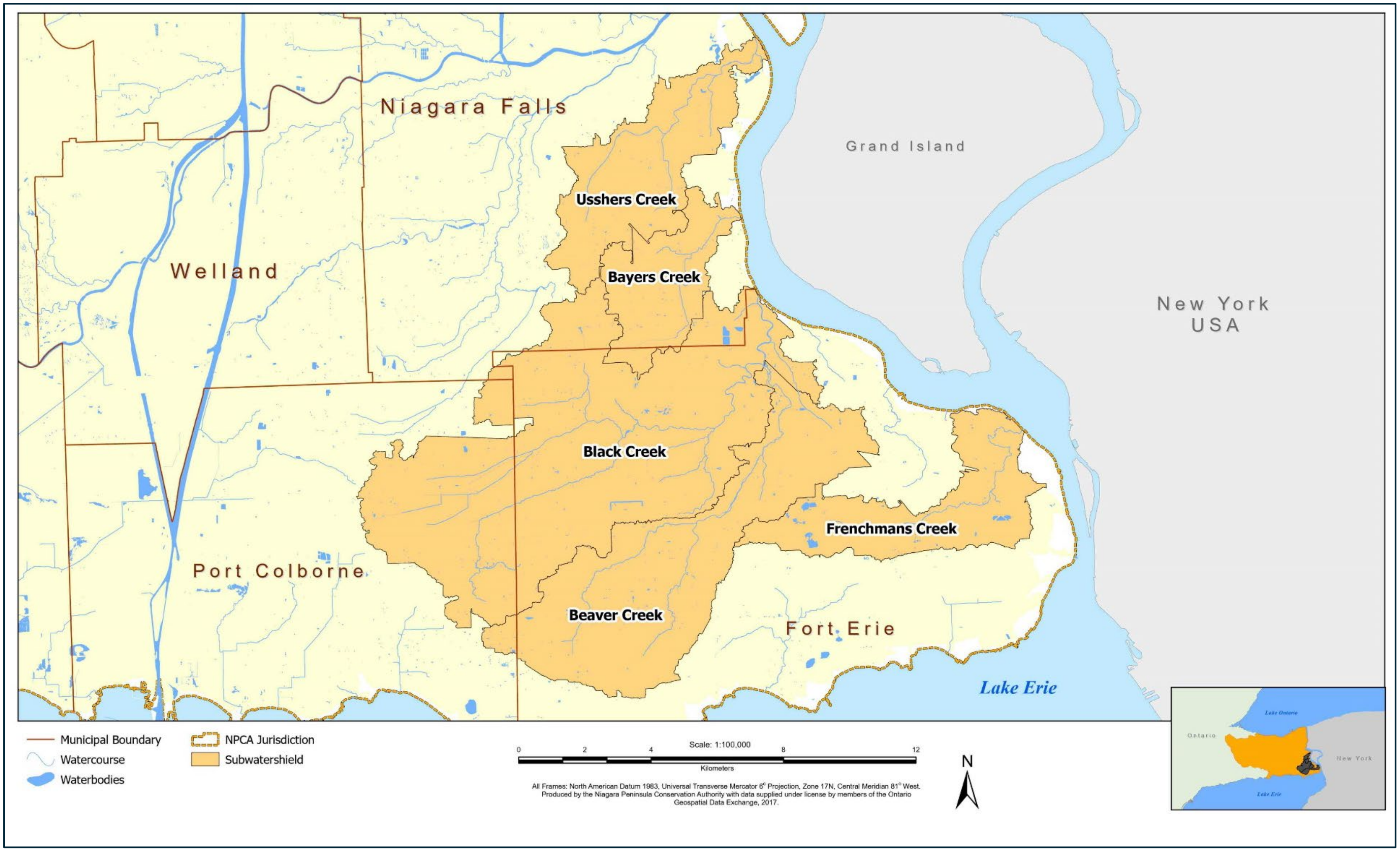

Figure 12: Map of subwatersheds that drain into the Niagara River.

Table 11: Summary of NPCA water quality data for the Niagara River Tributaries, 2020-2024.

Station	WQI Rating ↔Stable ↓ Declining ↑ Improving	Hilsenhoff Family Biotic Index Rating	Factors Affecting Water Quality (% percentage reported if >50)	Indicator Parameter Trends (2020-2024)
BA001 Bayer Creek	***Poor*** ↔	***Poor***	• Exceedances in *E. coli* (56%) and total phosphorus (100%). • Agricultural runoff.	• Indicator parameters remain stable.
BL003 Black Creek	***Marginal*** ↔	***Insufficient Data***	• Exceedances in total phosphorus (100%). • Agricultural and road runoff.	• Increase in *E. coli*. • Phosphorus, total suspended solids, and chloride remain stable.
BR001 Beaver Creek	***Marginal*** ↔	***Poor***	• Exceedances in total phosphorus (100%). • Agricultural runoff.	• Increase in phosphorus. • Decrease in total suspended solids. • *E. coli* and chloride remain stable.
FR003 Frenchman Creek	***Marginal*** ↔	***Poor***	• Exceedances in *E. coli* (56%) and total phosphorus (82%). • Agricultural runoff.	• Decrease in phosphorus and chloride. • *E. coli* and total suspended solids remain stable.
US001 Ussher's Creek	***Poor*** ↔	***Very Poor***	• Exceedances in total phosphorus (82%). • Agricultural runoff. • Prone to zero baseflow and excessive algae growth in the summer months.	• Increase in total suspended solids. • Phosphorus, *E. coli*, and chloride remain stable.

Niagara River Tributaries: Hilsenhoff Biotic Index

HBI ratings ranged from *very poor* to *poor* at three Niagara River tributary stations (**Table 11**). Results from biological assessments completed between 2020 and 2024 are illustrated in **Appendix B**. Sediment loading, reduced baseflow, lack of in-stream habitat, and nutrient enrichment are primary causes of impairment at these stations. Samples have not been collected from station BL003 due to high water depth, channel morphology, and access restrictions.

Niagara River Tributaries: Key Findings

Three of five Niagara River tributaries monitored were found to have marginal WQI and two had poor WQI. The degree of land use impacts from urban and rural pressures are significantly less in this watershed.

Based on the 2020-2024 data, all the Niagara River tributaries had *E. coli* and total phosphorus exceedances. The most impacted of these tributaries is Ussher's Creek which had a median concentration of 6 times the PWQO for total phosphorus. These watersheds would benefit from BMP works to reduce phosphorus loads.

Lake Erie Tributaries

Eight tributaries discharging to Lake Erie are monitored through the NPCA Water Quality Monitoring Program. These tributaries include Beaver Dam Creek, Casey Drain, Eagle Marsh Drain, Kraft Drain, Low Banks Drain, Point Abino Drain, Six Mile Creek, and Wignell Drain (**Figure 6**). In addition, the Welland Canal monitoring point in Port Colborne is also included with the Lake Erie tributaries. Water at this station enters the Welland Canal and outlets in Lake Ontario.

Lake Erie Tributaries: Canadian Water Quality Index

Based on the results of the WQI, two of nine Lake Erie tributary stations are rated as having *poor* water quality, five stations are rated as *marginal*, one station (PA001) rated as fair, and one station (WE000) rated as *excellent* (**Table 12**). WQI results are illustrated in **Appendix A**. Mapping showing the spatial distribution and boxplots of the eight indicator parameters from 2020 to 2024 are found in **Appendix B** and **Appendix J**. Highlights of the water quality monitoring in the Lake Erie Tributaries are summarized in **Table 12.**

Figure 13: Map of monitored watersheds that drain into Lake Erie

Table 12: Summary of NPCA water quality data for Lake Erie North Shore tributaries, 2020-2024.

Station	WQI Rating ↔Stable ↓ Declining ↑ Improving	Hilsenhoff Family Biotic Index Rating	Factors Affecting Water Quality (% percentage reported if >50)	Indicator Parameter Trends (2020-2024)
BD001 **Beaver Dam Drain**	***Marginal* ↔**	***Very Poor***	• Exceedances in *E. coli* (59%) and total phosphorus (100%). • Historical industrial pollution and agricultural runoff. • Sustained periods of low dissolved oxygen in summer	• Indicator parameters remain stable.
CD001 **Casey Drain**	***Poor* ↔**	***Very Poor***	• Exceedances in *E. coli* (68%) and total phosphorus (100%). • Agricultural runoff.	• Increase in total phosphorus. • Decrease in chloride. • *E. coli* and total suspended solids remain stable.
EM001 **Eagle Marsh Drain**	***Marginal* ↑**	***Very Poor***	• Exceedances in chloride (67%), *E. coli* (51%), and total phosphorus (95%). • Quarry dewatering and agricultural runoff.	• Increase in phosphorus. • Decrease in *E. coli*, total suspended solids, and chloride.
KD001 **Kraft Drain**	***Marginal* ↑**	***Poor***	• Exceedances in *E. coli* (79%) and total phosphorus (97%). • Agricultural and urban runoff.	• Decrease in chloride. • Phosphorus, *E. coli*, and total suspended solids remain stable.
LB001 **Lowbanks Drain**	***Marginal* ↔**	***Poor***	• Exceedances in *E. coli* (53%) and total phosphorus (92%). • Agricultural runoff.	• Decrease in chloride. • Phosphorus, *E. coli*, and total suspended solids remain stable.
PA001	***Fair* ↔**	***Poor***	• Exceedances in *E. coli* (58%) and total phosphorus (97%).	• Increase in *E. coli* and chloride.

Point Abino Drain			• Agricultural runoff. • Back flow from Lake Erie.	• Decrease in total suspended solids. • Phosphorus remains stable.
SM001 **Six Mile Creek**	***Marginal ↔***	***Poor***	• Exceedances in *E. coli* (59%) and total phosphorus (100%). • Agricultural runoff.	• Increase in phosphorus. • Decrease in total suspended solids and chloride. • *E. coli* remains stable.
WD001 **Wignell Drain**	***Poor ↔***	***Very Poor***	• Exceedances in *E. coli* (54%) and total phosphorus (100%). • Agricultural runoff. • Excessive algae/ duckweed growth and sustained periods of low dissolved oxygen in the summer months.	• Increase in phosphorus. • Decrease in total suspended solids. • *E. coli* and chloride remain stable.
WE000 **Welland Canal**	***Excellent ↑***	***Insufficient Data***	• No exceedances. • Lake Erie is the main water source.	• Decrease in chloride. • Phosphorus, *E. coli*, and total suspended solids remain stable.

Lake Erie Tributaries: Hilsenhoff Biotic Index

HBI results ranged from *very poor* to *poor* at Lake Erie tributaries monitored (**Table 12**). Results from biological assessments for these stations are illustrated in **Appendix B**. Sediment loading, reduced baseflow, lack of in-stream habitat, and nutrient enrichment are primary causes of impairment at these stations.

Lake Erie Tributaries: Key Findings

Based on the 2020 and 2024 data, all the Lake Erie tributaries have *E. coli* and total phosphorus exceedances except for the Welland Canal. The most impacted of these tributaries is Wignell Drain which had median concentrations 10 times the Provincial Water Quality Objective. Wignell Drain watershed needs to be prioritized for Best Management Practice (BMPs) works to reduce phosphorus loads to Lake Erie.

Nickel is not included in the WQI calculation; however, nickel concentrations were found to frequently exceed the PWQO at Beaver Dam Creek station BD001 and Wignell Drain station WD001. These nickel exceedances are likely from previous industrial land use.

2.1.5 Summary of Surface Water Quality Results

Water Chemistry-Canadian Water Quality Index Rating Summary

In 2024, 84 surface water stations were monitored, and 730 surface water samples were collected. Benthic macroinvertebrates were collected at 14 stations in 2024. Forty-one groundwater samples were collected. Seventeen water quality sensors were deployed by the NPCA.

Based on the Canadian Water Quality index for data from 2020-2024,

- 39% of stations are poor. This is down from 48% (2019-2023).
- 46% of stations are marginal. This is up from 40% (2019-2023).
- 13% of stations are fair. This is up from 10% (2019-2023).
- 1% of the stations are good. This is down from 2% (2019-2023).
- 1% of stations are rated excellent. This is up from 0% (2019-2023).

In general, WQI ratings remained relatively stable for the analysis of 2020-2024 compared to the previous analysis of 2019-2023. Fourteen (14) stations had improved WQI ratings while four (4) stations decreased in WQI rating compared to 2019-2023.

Benthic Macroinvertebrates-Hilsenhoff Biotic Index Summary

Based on the Hilsenhoff Biotic Index (HBI),

- 24% of stations are very poor, down from 26% (2019-2023).
- 39% of stations are poor, down from 43% (2019-2023).

- 33% of stations are fairly poor, up from 29% (2019-2023).
- 3% of stations are fair, up from 1% (2019-2023).
- 1% of stations are good, the same as 1% in 2019-2023.
- 0% of stations are very good or excellent, the same as in 2019-2023.

Hilsenhoff Biotic Index ratings typically show significant impairment in the NPCA watershed. WQI and HBI do not always agree entirely in the impairment levels at each creek. This could be due in part to data set size, in-stream habitat availability, and taxonomic resolution.

Water Quality Parameter Summary

Total phosphorus exceedances are found at most NPCA water quality stations due to significant agricultural land use. Total phosphorus is the most common exceedance, and the magnitude of exceedances are the largest cause of impaired water quality ratings. Improvements in WQI ratings were seen in the Upper Welland River and Twenty Mile Creek watersheds largely due to decreases in total phosphorus and total suspended solids.

Exceedances in *E. coli* also contribute greatly to poor water quality ratings in Niagara. Approximately 60% of stations have a median concentration of *E. coli* greater than the PWQO. The NPCA has initiated DNA track down investigations in watercourses with high magnitude *E. coli* exceedances. Two Mile Creek, in the town of Niagara-on-the-Lake, was found to have high concentrations of human source *E. coli*. The Town is working to implement infrastructure upgrades to eliminate the source. The NPCA will continue to work with municipalities to identify *E. coli* sources.

Increases in chloride concentrations were found in several Lake Ontario tributaries including Twelve Mile Creek. Chloride exceedances are mainly related to road salt impacts to surface water from urban runoff as the main source.

Exceedances for metals (copper, lead, and zinc), nitrate, and total suspended solids were less common in the NPCA watershed. Elevated copper exceedances in Richardsons Creek (St. Catharines) and Eighteen Mile Creek (Lincoln) warrants further investigation. Nitrate exceedances in Richardson Creek and the upper Twelve Mile Creek may be related to nearby commercial operations in the area. Total suspended solids are mainly related to wet weather events and inadequate riparian buffers along watercourses.

2.2 Groundwater Monitoring Program

The NPCA Groundwater Monitoring Network (**Figure 14**) is comprised of two components. The first component is the Provincial Groundwater Monitoring Network (PGMN) which is a partnership between the MECP and the Conservation Authorities of Ontario. The PGMN was initiated in 2001 and is a province-wide groundwater monitoring program designed to collect long-term baseline data on groundwater quantity and quality in special areas of interest. There are currently 470 ambient groundwater monitoring wells in the program. Groundwater is monitored through a network of 15 monitoring wells located throughout the NPCA watershed in locally significant hydrogeological areas. Most PGMN monitoring wells are sampled yearly for water geochemistry and all wells are instrumented with datalogging equipment which records hourly groundwater levels. In 2024, a subset of PGMN wells were also sampled in the Spring in addition to the regular fall sampling.

The second component of the NPCA Groundwater Monitoring Network is a network of 31 monitoring wells installed at 23 different locations across the NPCA watershed through a project between the NPCA and the Ontario Geological Survey (OGS). Each of the 23 locations has groundwater monitoring well installed at the top of bedrock in an aquifer zone commonly known as the Contact-Zone Aquifer. Three (3) of 23 locations have a set of nested monitoring wells installed at various depths within the overburden sediments. These wells were initially installed to investigate regional groundwater flow of five distinct features within the NPCA jurisdiction, which include: three (3) buried bedrock valleys (Erigan Channel, Chippawa-Niagara Falls Channel and Crystal Beach Channel) and their groundwater relationships to Lake Erie, Lake Ontario and the Niagara River; The Fonthill-Kame Delta Complex/Twelve Mile Creek watershed area; and The Upper Welland River watershed. The NPCA samples water geochemistry of these wells yearly, in the fall, and all these wells are instrumented with datalogging equipment which records hourly groundwater levels.

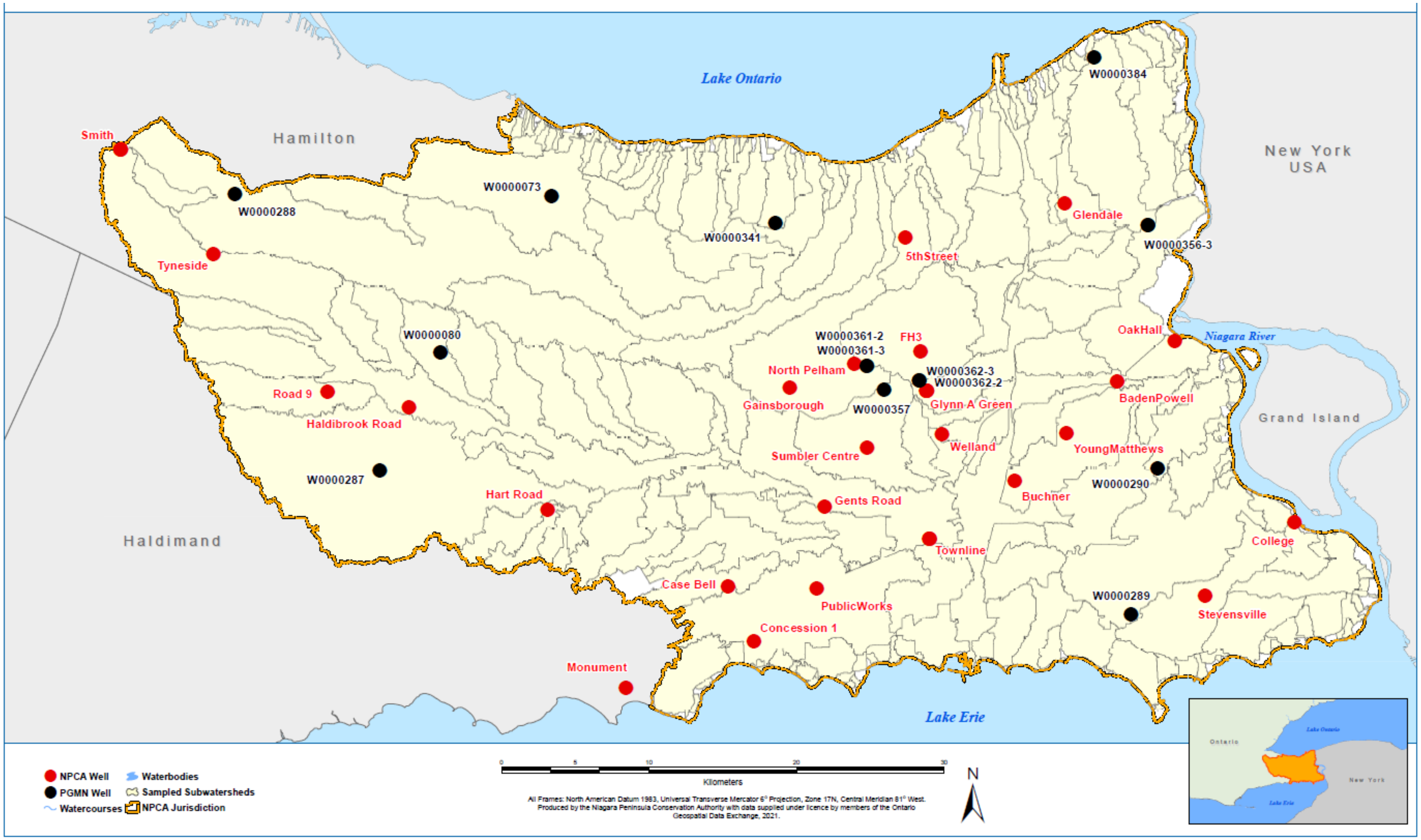

Figure 1: NPCA Groundwater monitoring network

2.2 Groundwater Monitoring Results

Groundwater Levels

The NPCA has been monitoring water levels at all PGMN wells since 2003 and other NPCA wells since 2014. Groundwater levels are typically at their highest during late-winter and spring but begin to drop during the dry summer months and are lowest in the fall. There is also yearly variation in the groundwater levels which is dependent on precipitation. In dry years (such as 2016), water levels can drop substantially from their seasonal highs; and conversely the water level drops in wet years (2009) are not as substantial. PGMN monitoring wells each have water levels that are seasonally and yearly variable due to several factors (geologic formation the well is installed in, soils, precipitation, etc.). The groundwater level data from the NPCA groundwater monitoring network will be used to help better understand the impacts of local/provincial scale drought events and its connection to climate change. Groundwater level data is available upon request.

Groundwater Geochemistry Results

Groundwater quality samples are analyzed for general chemistry, nutrients, metals, and project specific parameters. Groundwater chemistry results are compared to the Ontario Drinking Water Standards (ODWS, MOE 2003) to provide an indication of overall groundwater quality across the NPCA. **Table 13** summarizes the health-related exceedances of the ODWS from 2020-2024 for the NPCA Groundwater Monitoring Network. All health related ODWS exceedances in PGMN wells are flagged by the MECP and are reported to the NPCA, Region of Niagara Public Health Department and local municipalities. Wells with reported exceedances are subsequently re-sampled by the MECP to confirm the initial exceedance. Based on the type and source of exceedance, these agencies formulate an action plan to protect human health. In the case of the non-PGMN wells, exceedances were reviewed through the OGS Ambient Geochemistry program (L. Colgrove and S. Hamilton 2018).

Table 13: NPCA Groundwater Monitoring Network stations and health-related exceedances (ODWS), 2020-2024.

			Monitoring Year				
Well ID	**Well Type**	**Formation**	**2020**	**2021**	**2022**	**2023**	**2024**
W0000073 (Grimsby)*	Bedrock	Guelph-Lockport	Sodium	Sodium	Sodium	Sodium	Sodium
W0000080 (West Lincoln)*	Bedrock	Guelph-Lockport	Sodium Fluoride Uranium	Sodium Fluoride Uranium	Sodium Fluoride Uranium	Sodium Fluoride Uranium	Sodium Fluoride Uranium
W0000288 (Hamilton)*	Bedrock	Guelph-Lockport	No Exceedance	No Exceedance	No Exceedance	No Exceedance	No Exceedance
Gainsborough (West Lincoln)	Bedrock	Guelph	Fluoride Sodium	Fluoride Sodium	Fluoride Sodium	Fluoride Sodium	Fluoride Sodium
Welland (Welland)	Bedrock	Guelph	Sodium	Sodium	Sodium	Sodium	Sodium
Smith Road (Hamilton)	Bedrock	Guelph	Sodium	No Exceedance	Sodium	No Exceedance	Sodium
Tyneside (Hamilton)	Bedrock	Guelph	Sodium	Sodium	Sodium	Sodium	Sodium
Oak Hall (Niagara Falls)	Bedrock	Guelph	Sodium	Sodium	Sodium	Sodium	Sodium
Glynn A Green (Pelham)	Bedrock	Lockport	Sodium Fluoride Arsenic	Sodium Fluoride Arsenic	Sodium Fluoride Arsenic	Sodium Fluoride Arsenic	Sodium Fluoride
W0000289 (Port Colborne)*	Bedrock	Onondaga	No Exceedance	No Exceedance	No Exceedance	Sodium	Sodium
W0000341 (Lincoln)*	Bedrock	Clinton	Sodium	Sodium	Sodium	Sodium	Sodium
W0000357 (Pelham)*	Overburden	Fonthill Kame	Unable to sample	Unable to sample	Sodium	Unable to sample	Unable to sample
W0000361-2 (Pelham)*	Overburden	Fonthill Kame	Sodium	Sodium	Sodium Nitrate**	Sodium Nitrate**	Nitrate**
W0000361-3	Overburden	Fonthill Kame	Sodium	Sodium	Sodium	Sodium	Sodium

(Pelham)*							
W0000362-2 (Pelham)*	Overburden	Fonthill Kame	Sodium	Sodium	Sodium	Sodium	Sodium
W0000362-3 (Pelham)*	Overburden	Fonthill Kame	Sodium	Sodium	Sodium	Sodium	Sodium
W0000384 (NOTL)*	Overburden	Iroquois Sandplain	Sodium	Sodium	Sodium	Sodium	Sodium
Concession 1 (Wainfleet)	Bedrock	Bertie	Sodium	Fluoride Sodium	Sodium	Fluoride Sodium	Fluoride Sodium
Stevensville (Fort Erie)	Bedrock	Bertie	Sodium	Sodium	Sodium	Sodium	Sodium
Monument (Haldimand County)	Bedrock	Bois Blanc	Sodium	Sodium	Sodium	Sodium	Sodium
North Pelham (Pelham)	Bedrock	Eramosa	Sodium	Sodium	Sodium	Sodium	Sodium
5th Street (St. Catharines)	Bedrock	Queenston	Sodium	Sodium	Sodium	Sodium	Sodium
Baden Powell (Niagara Falls)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Townline (Port Colborne)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Young Matthews (Niagara Falls)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Buchner (Welland)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
College (Fort Erie)	Bedrock	Salina	Sodium Boron	Sodium Boron	Sodium Boron	Sodium Boron	Sodium Boron
Gents Road (Wainfleet)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Sumbler Centre (Pelham)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Public Works (Wainfleet)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium

Road 9 (Haldimand County)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Haldibrook Road (Haldimand County)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Hart Road (Haldimand County)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
Case Bell (Wainfleet)	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
W0000287 (Haldimand County)*	Bedrock	Salina	Sodium	Sodium	Sodium	Sodium	Sodium
W0000290 (Niagara Falls)*	Bedrock	Salina	Sodium Boron	Sodium Boron	Sodium Boron	Sodium Boron	Sodium Boron

*Note: Well IDs with blue cells are Provincial

Groundwater Quality Summary

Exceedances of Ontario Drinking Water Standards (ODWS) for boron (W290-1 & College), fluoride (W080-1, Glynn A Green, Concession 1), and uranium (W080-1) were observed. These have been attributed to natural groundwater conditions by MECP's Environmental Monitoring and Reporting Branch (EMRB) and the OGS Ambient Geochemistry Program (Colgrove & Hamilton, 2018). These elements occur naturally due to mineral dissolution in bedrock. No anthropogenic sources were identified. As this appears to be an aquifer-wide issue, regular testing and treatment is recommended for drinking water use.

Most NPCA wells also show sodium levels exceeding 20 mg/L, a health-related ODWS threshold. MECP has notified local health units to inform physicians, especially for patients on sodium-restricted diets. These exceedances are also linked to natural conditions and possibly road salt in shallow wells. Regular testing and treatment are advised.

Elevated nitrate levels were recorded W361-2 between 2003–2019 and again at W361-2 from 2022–2024. These were likely due to agricultural runoff or faulty septic systems. Follow-up testing of nearby private wells in 2008–2009 found only one exceedance, linked to a poorly constructed shallow well. From 2018–2021, nitrate levels dropped possibly due to land use change but have since risen again at W361-2, suggesting a continued local source.

Overall, groundwater across the NPCA shows elevated chloride, iron, manganese, sodium, and sulfate, exceeding ODWS aesthetic objectives. While there are no health risks, these can affect water taste and usability (e.g., staining, buildup). Routine testing and treatment are recommended for all uses.

2.3 Terrestrial Monitoring Program

The Niagara Peninsula Conservation Authority (NPCA) has initiated the building of a comprehensive Integrated Watershed Monitoring Program as part of its 2021-2031 Strategic Plan. As part of this Plan, the NPCA has expanded its existing monitoring to include a new long-term terrestrial monitoring program to further identify and understand the watershed's ecological integrity. In 2024, the NPCA commissioned a priori statistical analysis to determine the effort that is required to achieve a high probability of detecting ecological effects with its monitoring program. This also ensures the monitoring program is designed correctly to determine sampling size requirements, time scale, funding, staff effort and resources. Forests, wetlands and birds were identified components to be monitored over time to assess ecological health and changes. This statistical 'Power analysis' was used as a tool for balancing the needs of evaluating both ecological status and trends, with the available NPCA resources.

Following the results of the power analysis, the first phase of this program was implemented, to establish forest monitoring plots within deciduous forest communities of the NPCA's conservation areas (**Figure 15**). These plots were established first, recognizing forest communities as being the most abundant data resource, and with many parameters and protocols available for completing such ecological assessments. In 2024, thirty deciduous forest plots were identified using existing ecological Land Classification, and established in areas of similar conditions, away from existing trails, vegetation community edges, and disturbances. Seventeen of the total thirty forest plots were installed in 2024 by NPCA staff. The installation of the remaining 13 plots is scheduled for completion in 2025.

The NPCA's terrestrial forest monitoring program incorporates standardized methods from the Ecological Monitoring and Assessment Network (EMAN) protocol to ensure consistency, scientific rigor, and comparability across sites and over time (Patricia and Gillespie 1999). This protocol supports the long-term assessment of forest ecosystem health and biodiversity. Key data endpoints extracted from the program include tree species identification, diameter at breast height (DBH), tree health and mortality, coarse woody debris volume, regeneration rates of seedlings and saplings, and the presence of invasive species. Additional indicators may include soil conditions, ground flora diversity, and canopy closure. This data provides valuable insight into forest dynamics, supports adaptive management, and informs broader watershed planning and conservation strategies across the region.

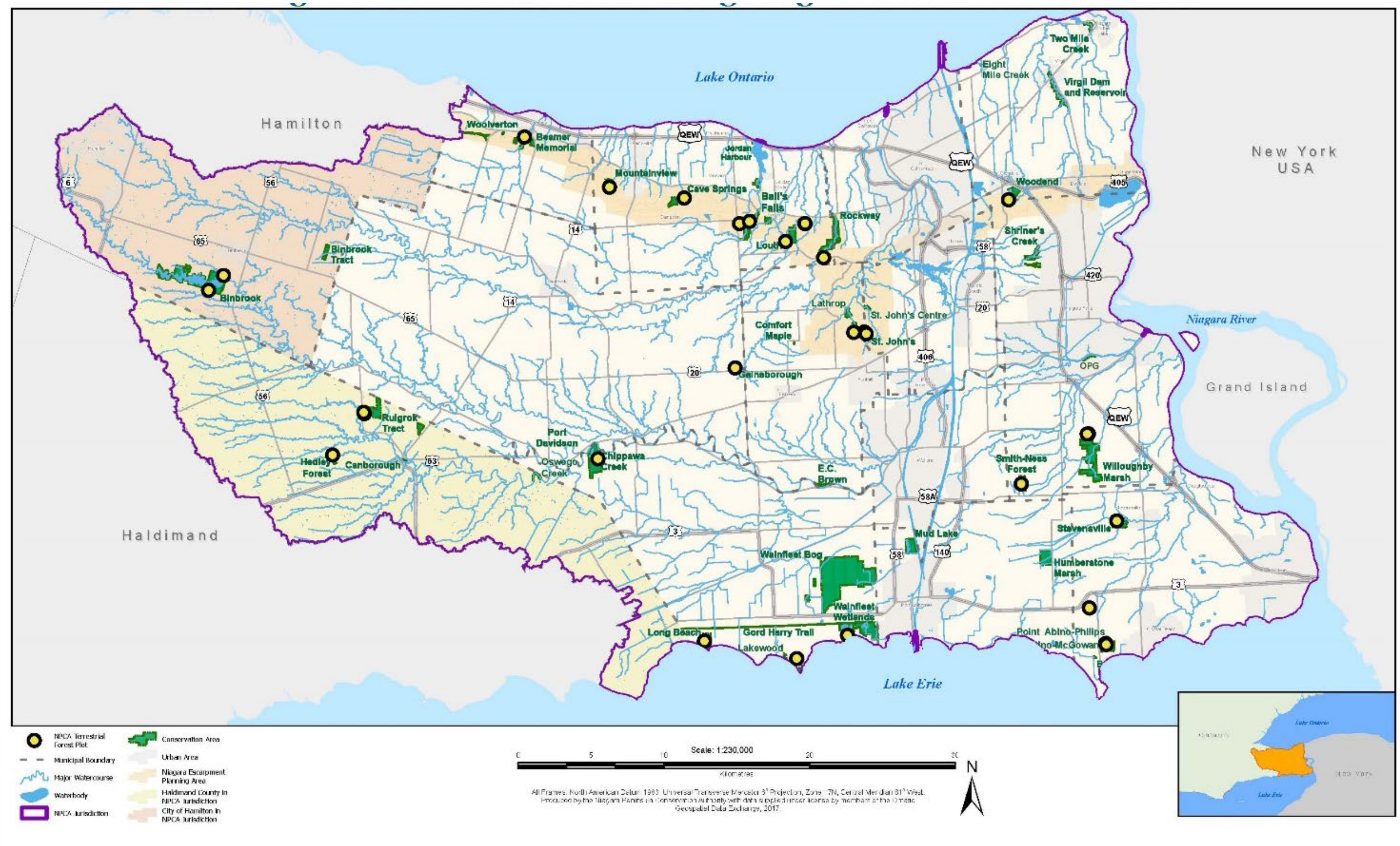

Figure 15: Map of the NPCA's long-term terrestrial monitoring program forest plot locations.

2.4 Hydrometric Monitoring

The NPCA's Hydrometric Monitoring Program is crucial monitoring unit that assesses the surface water quantity and climate conditions of the NPCA. That distribution of the NPCA's Hydrometric network is shown in **Figure 16** and its monitoring components are summarized in **Table 14**. This program is designed to collect data from a variety of hydrological parameters, providing invaluable data for understanding water dynamics and climate impacts. This program ensures the ongoing collection of accurate and reliable information on stream water levels, flow rates, and meteorological factors.

Table 14: Water Quantity and Climate Monitoring Components

Total Number of Stations	Sample	Frequency of Sampling	Sampling Protocol
21	Water Level	Continuous 5 to 15 minutes readings	NPCA and Water Surveys Canada
7	Water Flow	Continuous 5 to 15 minutes readings	
7	Snow	10 sampling points per Site November to April	Ontario Snow Surveying Manual
11	Precipitation	Continuous 5 to 15 minutes readings	NPCA
7	Wind	Continuous 5 to 15 minutes readings	

The NPCA's Hydrometric Monitoring Network plays a critical role in supporting the Flood Forecasting and Warning function mandated under the Conservation Authorities Act and O. Reg. 686/21: Mandatory Programs and Services. As part of this responsibility, the NPCA monitors surface water quantity and climate conditions to forecast where and when flooding may occur. When flooding is possible or imminent, the NPCA issues flood messages to municipal emergency management officials and the media. Municipalities then use this information to alert residents, activate emergency response plans, and carry out evacuations if necessary. This program ensures that timely and accurate information supports the safety and preparedness of communities across the watershed

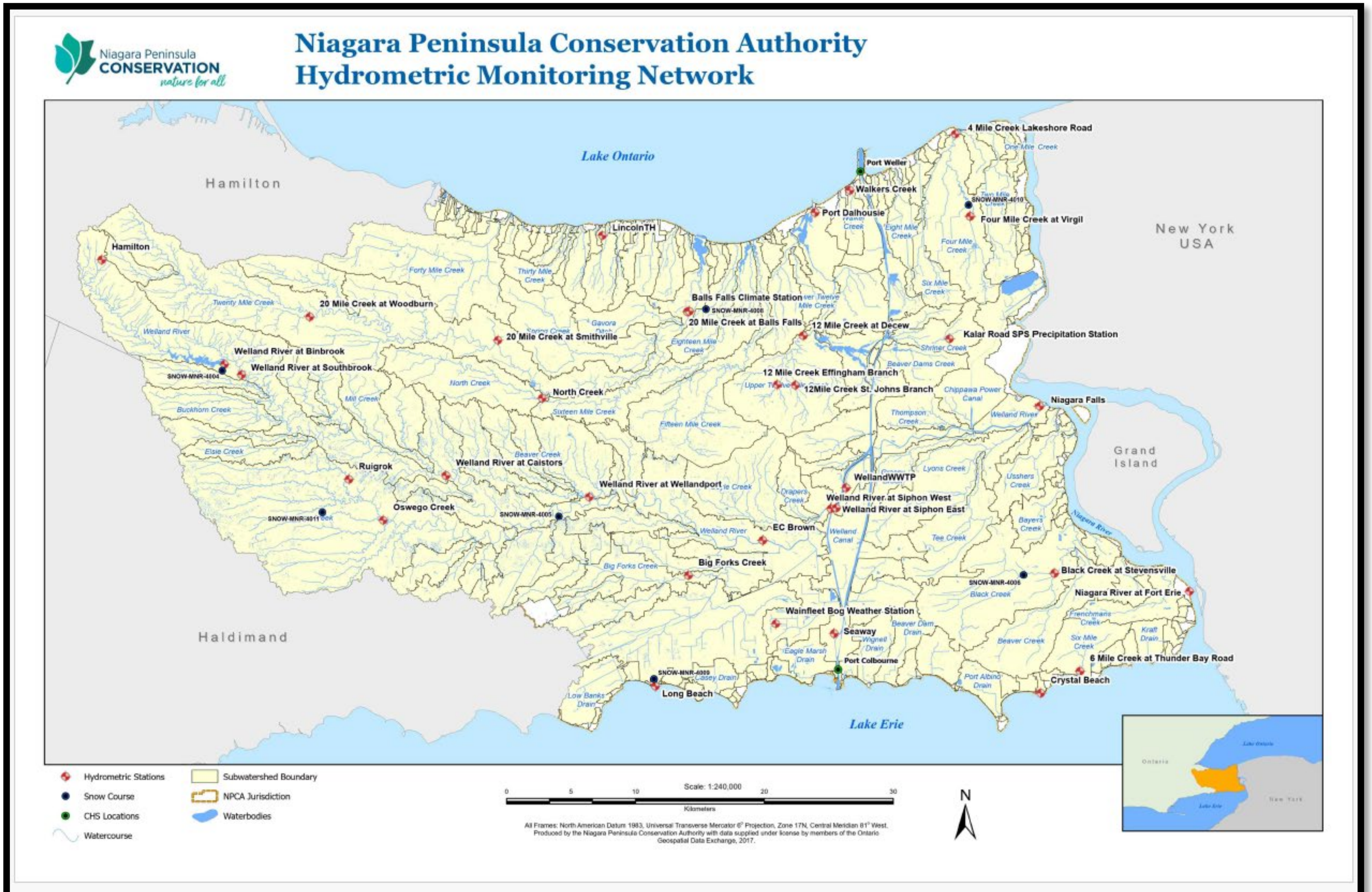

Figure 16: Hydrometric Monitoring Network

Hydrometric monitoring data collected by the NPCA is not included in this report. However, real-time and historical data on streamflow and water levels are available through the NPCA's online Flooding and Stream Flow Monitoring portal at https://npca.ca/watershed-health#flooding-stream-flow-monitoring. This platform provides essential information to support flood forecasting, water resource management, and public awareness initiatives.

2.5 Data Users

The NPCA Water Quality Monitoring Program continues to generate a large wealth of scientific data that is a valuable resource to the public, environmental consultants, community groups, educational institutions, and other governmental agencies. In 2024, the NPCA processed 43 data requests for a variety of environmental monitoring data to assist its partners.

The NPCA Water Quality Monitoring Program generates a large wealth of scientific data that is a valuable resource for several clients. In 2024, the NPCA water quality monitoring program completed 43 data requests from a variety of agencies and the public. These include:

- Ontario Ministry of the Environment, Conservation and Parks
- Ontario Ministry of Natural Resources
- Academia (Brock University, University of Guelph, Niagara College)
- Environment and Climate Change Canada
- Municipalities (Upper and Lower Tier)
- Consultants
- Non-Governmental Agencies
- Public

3.0 CORPORATE SUPPORT SERVICES

NPCA's Integrated Watershed Monitoring Program includes a Corporate Support Services Area that is comprised of several programs that service the NPCA with crucial monitoring data to inform operational activities across multiple NPCA departments and divisions. The type and number of Corporate Support Services that the NPCA implements is dynamic and driven by NPCA program and project needs.

3.1 Conservation Area Water Quality Monitoring

The NPCA Water Quality Monitoring Program was expanded in 2017 to include the waterbodies of the Conservation Areas: Dils Lake, Jordan Harbour, Lake Niapenco, Mud Lake, St. John's Pond, Virgil Reservoir, Wainfleet Wetlands and Wainfleet Bog. In 2024, stations at Beamer Memorial Conservation Area and Rockway Conservation Area were added. These two new sites are not included in this analysis due to the small sample size. Water samples are collected quarterly or seasonally during the year and analyzed for general chemistry, nutrients, metals, and bacteria.

The water quality results for the NPCA Conservation Area locations are shown in **Appendix C**. Generally, the water quality observed in the Conservation Areas met environmental threshold values, but some exceedances were found. Total phosphorus exceeded the PWQO at most Conservation Areas, but Virgil Reservoir, Mud Lake and Wainfleet Bog had notably higher observed concentrations. The lentic Conservation Area environments (St. Johns, Binbrook, Mud Lake, Dils Lake and Virgil Reservoir) which have higher water temperatures, greater sunlight exposure, and reduced water flow are particularly vulnerable to excessive phosphorus concentrations which can stimulate the overgrowth and decomposition of plants and algae causing water quality concerns. Multiparameter sonde deployment in Lake Niapenco (Binbrook Conservation Area) shows stable parameters and reflects a typical lake environment. Dissolved oxygen and temperature are plotted in **Figure 17.**

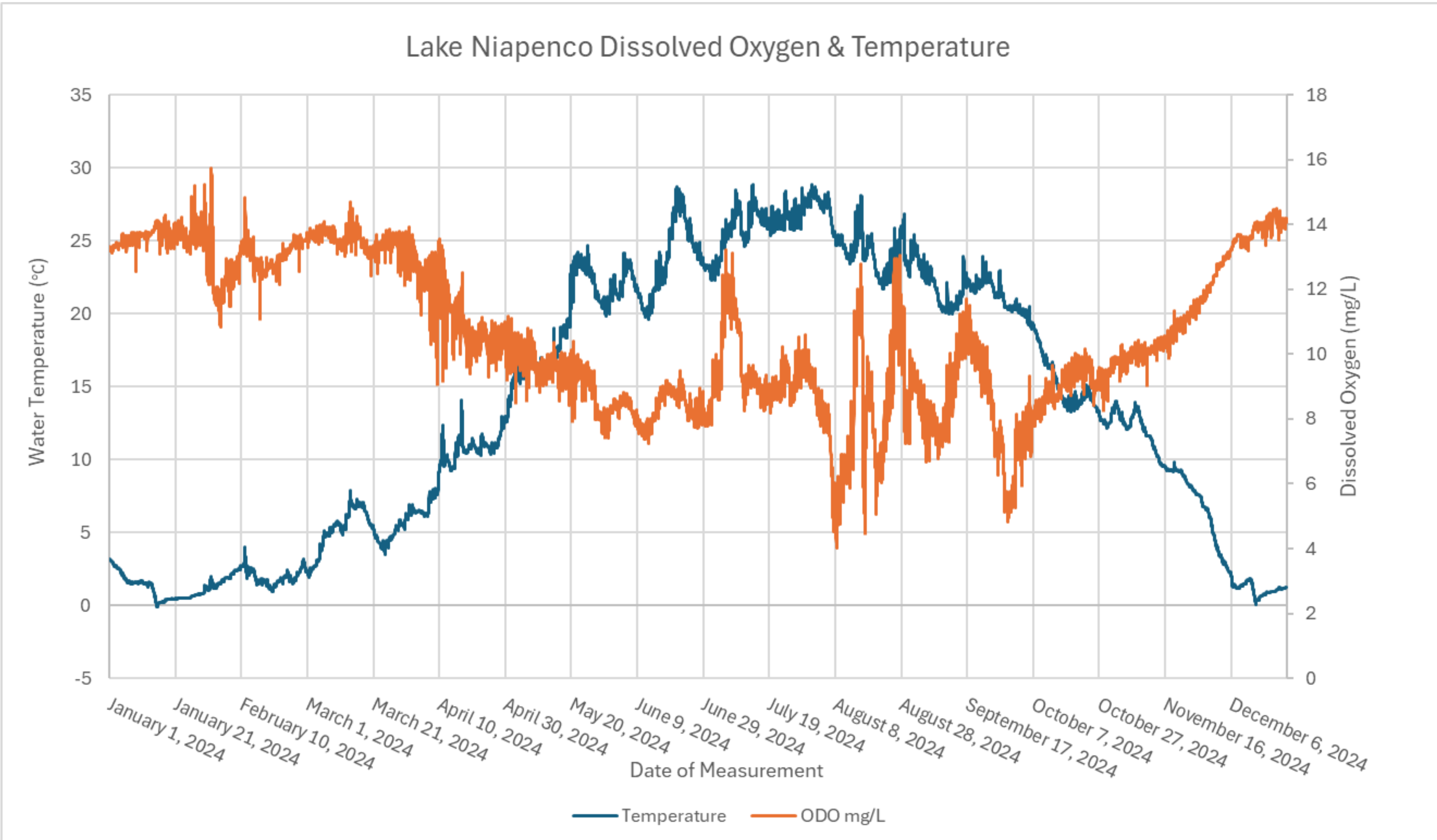

Figure 17: Lake Niapenco water quality sensor data for 2024. Water temperature plotted with dissolved oxygen from January 1st, 2024, to December 31st, 2024.

There were chloride, copper, total suspended solids, and nitrate exceedances observed in Virgil Reservoir, and these are likely due to the rural land uses, the proximity to Four Mile Creek Road and an abundance of carp in the reservoir. The pH of Wainfleet Bog also exceeded the lower threshold of the PWQO however this type of wetland is naturally acidic. This acidity is a by-product of microbial decay processes, cation exchange of the Sphagnum moss vegetation and input of additional acids from the atmosphere. Copper and zinc exceedances were observed at Wainfleet Bog main drainage ditch. This may be due to past levels of atmospheric metal depositions that have accumulated in the peat soils and now being released in the surface water of the drainage ditch. The NPCA will continue to investigate the source of these metal exceedances.

In 2024, the NPCA also sampled three Conservation Areas (Beamer Memorial, St. John's and Rockway) to provide data for future Conservation Area management plans. These stations were sampled using the Ontario Stream Assessment Protocol (OSAP) fish monitoring module. The largest were measured and weighed, while the rest were counted and weighed in bulk (Stanfield 2010).

3.2 Conservation Area Ecological Studies

Ecological Studies of plants, small mammals, frogs/toads, salamanders, and bats were completed for Beamer Memorial, Rockway and Woodend Conservation Areas. Outlined below are the general key findings of each site. More details are available within each site report.

Beamer Memorial Conservation Area

Results of the Beamer Memorial Conservation Area Ecological Study highlight key site features and habitat. Of significance are escarpment slopes and cliffs with extensive deciduous talus forests and valley rims, mixed forest, as open scree; seepage zones and a small wetland community Moreover, the critical habitat for consideration of protection consist of: rock crevices, underground openings, escarpment slopes and cliffs, south facing quarry slope, loose bark/peeling trees; in addition to the open forage riparian and wetland areas, as well as, mast tree areas, as crucial components of food, reproduction and possible overwintering areas for Species at Risk, including bat and bird species which make this site significant ecologically. Combined, these plant and geologic features are of province and international importance with noted designations in the life and earth science area.

Rockway Conservation Area

Results of the Rockway Ecological Study highlight key areas of critical habitat for consideration of protection. These significant habitat areas include the following: rock crevices/cliffs and talus slopes; deciduous foliage, loose bark tree species and mature/old growth trees; as well as riparian areas, meadows, and site surface pools and marshes, as critical components of food, reproduction and possible overwintering areas for Species at Risk, including bat, bird and plant species. The area is also designated with provincially significant representative life and earth science areas for escarpment incised valley, plain and rim; lake plain valley & bottom and escarpment slope, escarpment terrace and terrace valley and exposed accessible bedrock, making it a unique area of natural heritage as well as picturesque for social /mental benefits to humans. As a result, it is a 'core area' with a self-sustaining habitat block with distinctive biotic and landform characteristics.

Woodend Conservation Area

Results of the Woodend Conservation Area Ecological Study highlight key areas of critical habitat for consideration of protection. These include broad talus slopes, rock crevices and caves/underground rock areas; as well as, floodplain lowlands, loose/peeling bark tree species, cavity/ mature trees, and canopy trees; as well as crucial components of food, reproduction and possible overwintering areas for Species at Risk and adjacent wetland foraging features, including bat and bird species. Moreover, its significance is recognized regionally and internationally in life and earth science.

3.3 Conservation Area Beach Monitoring

The NPCA monitors beach conditions at three conservation area beaches. The beach monitoring is guided by protocols from the Ministry of Health and Long-Term Cares' Operational Approaches for Recreational Water Guideline (2018). The Conservation Area Beach Monitoring Program was reenacted in 2020 by the NPCA, after local public health units had previously completed the sampling. This program is in place to communicate beach conditions to all park visitors and for the NPCA to determine trends in the beach environment over time.

In 2024, the NPCA conducted beach monitoring at Dils Lake, located at Chippawa Creek Conservation Area, Long Beach Ramp and Long Beach Ridge beaches, both located on the shores of Lake Erie at Long Beach Conservation Area. The Conservation Area Beach Monitoring Program usually occurs from the first week in June to the last week of August. On average there are fourteen weeks of sampling completed each season. Following the Operational Approaches for Recreational Water Guideline (2018), there are five water samples taken at each location, which are tested for *E. coli*. The five samples are used to generate a geometric mean, which has a maximum acceptable concentration of 200 CFUs/100 mL. The guideline also states there is an exceedance of *E. coli* when one single sample is above 400CFUs/100mL of water.

The NPCA generally samples at the same location at the beaches, on the same day of the week and at the same time of day to ensure consistency in sampling methods. The samples are then taken to a local private lab where the results are reported between 48 and 72 hours. The NPCA posts the results on the NPCA website each week and displays them at the conservation area if an exceedance occurs.

2024 Beach Water Quality Results

In 2024, the NPCA sampled the conservation area beach locations over thirteen weeks. Sampling began on June 4th and was completed on August 27th. Throughout the sampling season, Dils Lake had zero *E. coli* exceedances. Whereas Long Beach Ramp and Long Beach Ridge beaches both exceeded

200 CFUs/100mL three weeks of the thirteen sampled. The three weeks equated to exceedances for 23% of the sampling season. **Table 15** summarizes the weeks of *E. coli*. exceedances in 2024. Throughout the sampling season, the average geometric means of *E. coli*. for Dils Lake was 62.03 CFUs/100mL, Long Beach Ramp 163.02 CFU/100mL and Long Beach Ridge 72.97 CFUs/100mL **Table 16**.

Table 15: NPCA Conservation Area beach E. coli exceedances, 2024.

Name of Beach	Total # of Weeks Sampled (2024)	# of Weeks without an Exceedance	% of Weeks without an Exceedance	% Of Weeks with an Exceedance
Dils Lake	13	13	100%	0%
Long Beach Ramp	13	10	77%	23%
Long Beach Ridge	13	10	77%	23%

Table 16: NPCA Conservation Area beach E. coli average geometric mean, 2024.

Name of Beach	Average Geometric Mean (2024)
Dils Lake	62.03
Long Beach Ramp	163.02
Long Beach Ridge	72.97

Beach Water Quality Trends (2020-2024)

When analyzing the geometric means (**Figure 18**) from 2020-2024 there are a few overall trends. In general, Long Beach Ramp has had the highest geometric mean for all five years. Long Beach Ramp has also had an *E. coli* exceedance every sampling season. In comparison, Dils Lake has had the lowest geometric mean throughout the five years, with an exceedance only once in 2022. Sampling at Long Beach Ridge began in 2022, and has experienced approximately half of the exceedances Long Beach Ramp has in the past three yea

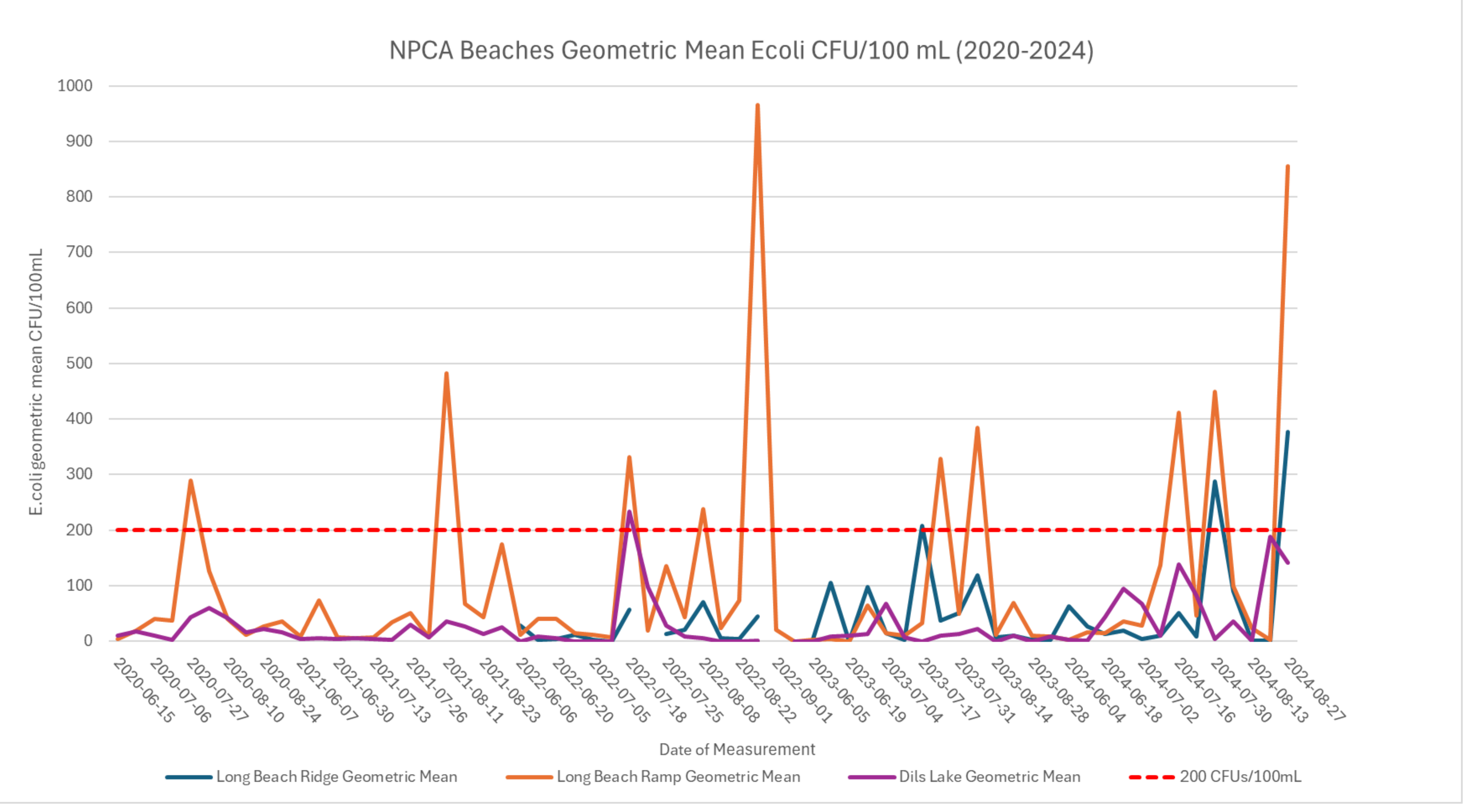

Figure 18: NPCA beaches geometric mean *E. coli* CFU/100 mL, 2020-2024

3.4 Lake Niapenco Perfluorinated Compound Monitoring

Since 2012, the NPCA has been monitoring for Per- and polyfluoroalkyl substances (PFAS) in Lake Niapenco at Binbrook Conservation Area. PFAS were found in the plasma of snapping turtles at Lake Niapenco in 2009 and 2010 by an Environment Canada (EC) scientist as part of an organic toxins accumulation study (de Solla et al. 2012). PFAS track down studies by MECP confirmed the presence of PFAS in Lake Niapenco and identified John C. Munro International Airport (HIA) as the source of contamination (Fowler 2011). Since 2015, Transport Canada and Procurement Canada have retained Arcadis Canada Inc. to conduct a risk assessment to investigate presence and distribution of PFAS in the Welland River downstream of the HIA.

NPCA collected a water sample at Lake Niapenco on July 5, 2024. **Figure 19** shows the sample location in the Conservation Area. The sampling protocol was as follows: 1) Lake Niapenco samples were collected in waist-deep water at the beach (**Figure 20**); 2) Samples were collected and placed in a cooler with ice and shipped the next day for PFAS analysis.

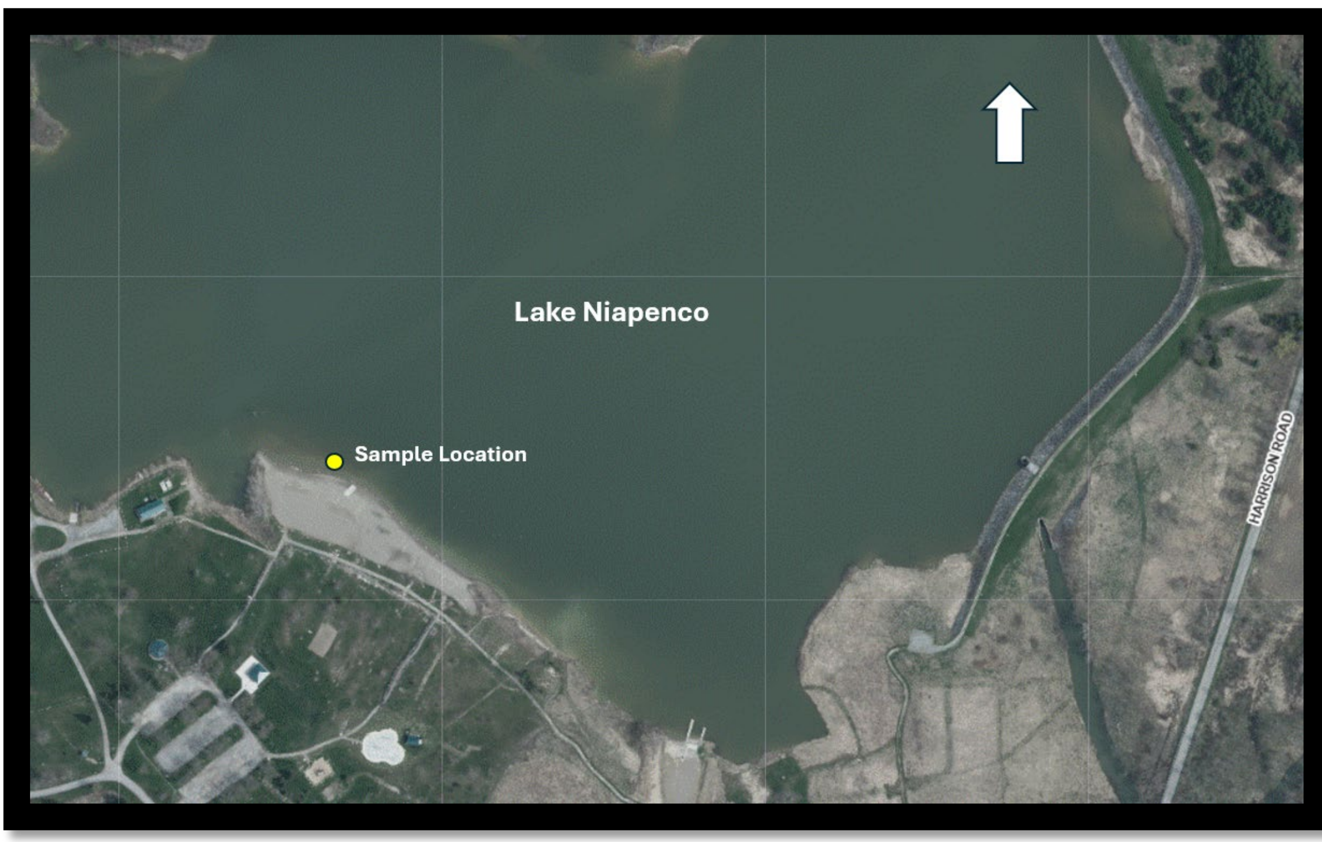

Figure 19: Lake Niapenco sampling location for PFAS.

Figure 20: Beach sampling for PFAS in Lake Niapenco.

The water chemistry results from Lake Niapenco indicated the presence of Perfluorooctane sulfonate (PFOS), a type of PFAS at concentrations that generally match the concentrations observed in previous NPCA sampling events (**Figure 21**). It is expected PFAS with PFOS will continue to be present in Lake Niapenco due to the persistence of these compounds in the environment. Hamilton Public Health has reviewed historical PFAS water quality data from the Binbrook Conservation Area and concluded that the concentration which is consistent with current levels does not pose a health risk to park users. The NPCA will continue to collaborate with Transport Canada and the Risk Assessment Team to better understand the presence and distribution of PFAS in the Welland River downstream of Hamilton International Airport.

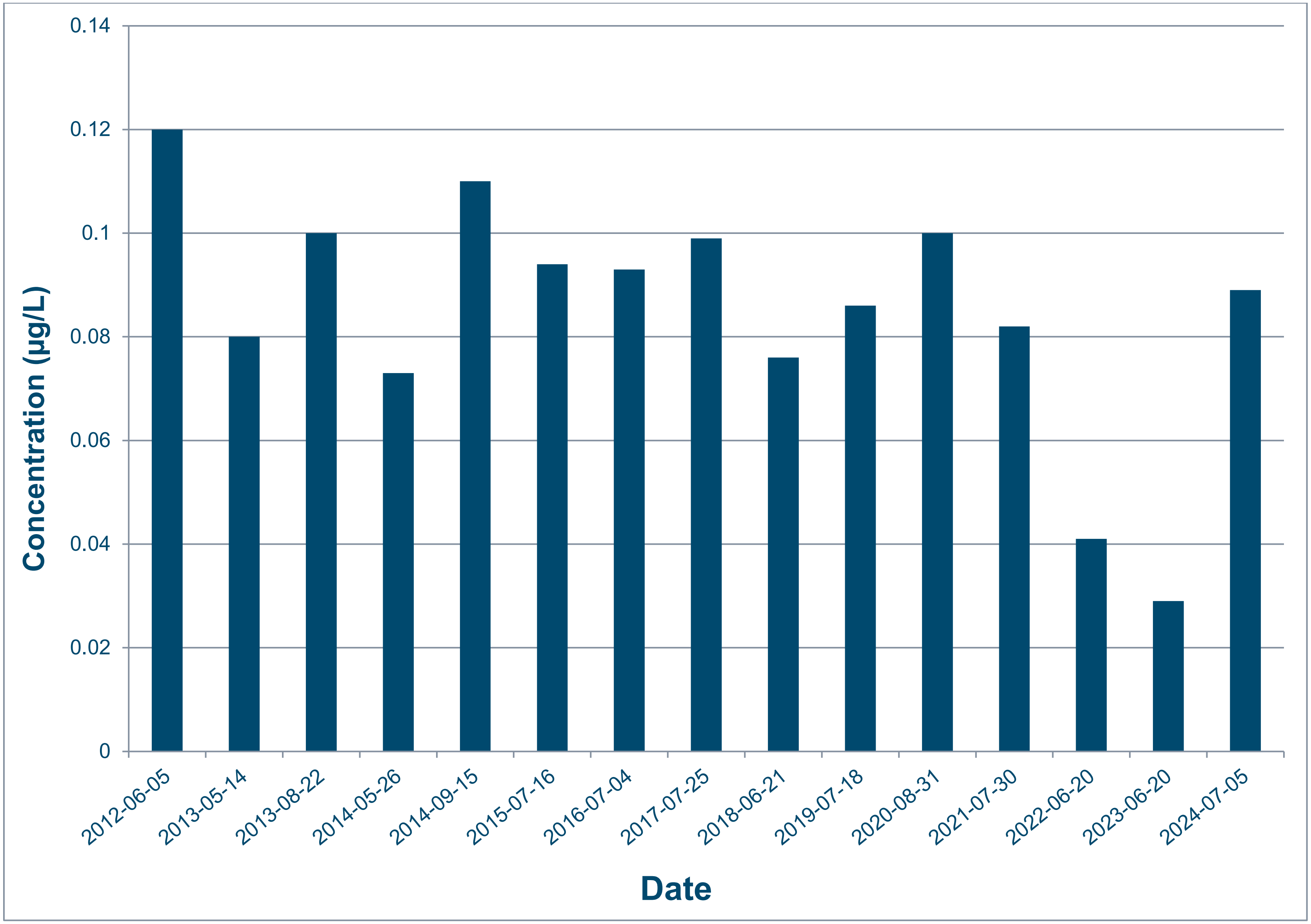

Figure 21: Lake Niapenco PFOS sampling results 2012-2024.

4.0 MONITORING SERVICE PROVIDER

The NPCA's IWMP includes a Monitoring Service Provider Area with the intent of highlighting its ability to provide environmental monitoring services to its watershed partners such as municipalities, provincial and federals agencies as well as private companies. The NPCA has a dedicated team of experts specializing in hydrometric, groundwater, surface water, and terrestrial monitoring programs and staff are trained to utilize state-of-the-art technologies, monitoring protocols, and analyze robust data, enabling NPCA to provide environmental monitoring services.

4.1 Hamilton International Airport Monitoring

Since 1998, the NPCA has been commissioned and funded by Hamilton International Airport (HIA) to complete annual biological assessments of water quality near their property. The goal of the annual assessment is to determine if stormwater runoff and de-icing fluids such as propylene glycol are impacting surface water quality in two headwater tributaries of the Welland River. The NPCA generates this separate report for the HIA for their exclusive information and use.

4.2 Glanbrook Landfill Monitoring

Since 1998, the NPCA has been commissioned and funded by the City of Hamilton to complete biennial biological assessments of water quality for the Glanbrook Landfill. The Glanbrook Landfill is owned and operated by the City of Hamilton, and is designed to receive domestic, commercial, and non-hazardous solid industrial waste. The purpose of the biennial assessments is to determine if stormwater runoff and leachate from the landfill are negatively impacting water quality and aquatic biota in the Welland River and Buckhorn Creek. The NPCA generates this separate report for the City of Hamilton for their exclusive information and use.

4.3 Unrated Drain Classification

In 2024, the NPCA added fish monitoring as part of the biological monitoring program. The water quality team used a Smith-Root LR-24 backpack electrofisher for all monitoring completed in 2024.

The NPCA sampled 10 unrated municipal drains following Department of Fisheries and Oceans protocols. Following this protocol, a drain segment is sampled a minimum of 3 times. This protocol aims to classify a drain by determining which of the following groups are present in the drain: spring spawners, fall spawners, and/or sensitive species (DFO 2021).

4.4 Lower Twelve Mile Creek total PCBs Monitoring

In 2020, MECP and City of St. Catharines had been investigating potential offsite impacts on surface water of Twelve Mile Creek from the former GM industrial area. To support agency partners, the NPCA has provided monthly samples (beginning September 2020) upstream and downstream of the former GM plant on 12 Mile Creek. This project included enhanced monitoring at the PWQMN station at Lakeport Road (TW009) and the reactivation of a former monitoring station (TW011) at Welland Vale Road (See **Figure 22**). Samples collected are being analyzed for general chemistry, metals, nutrients, bacteria, and total PCBs.

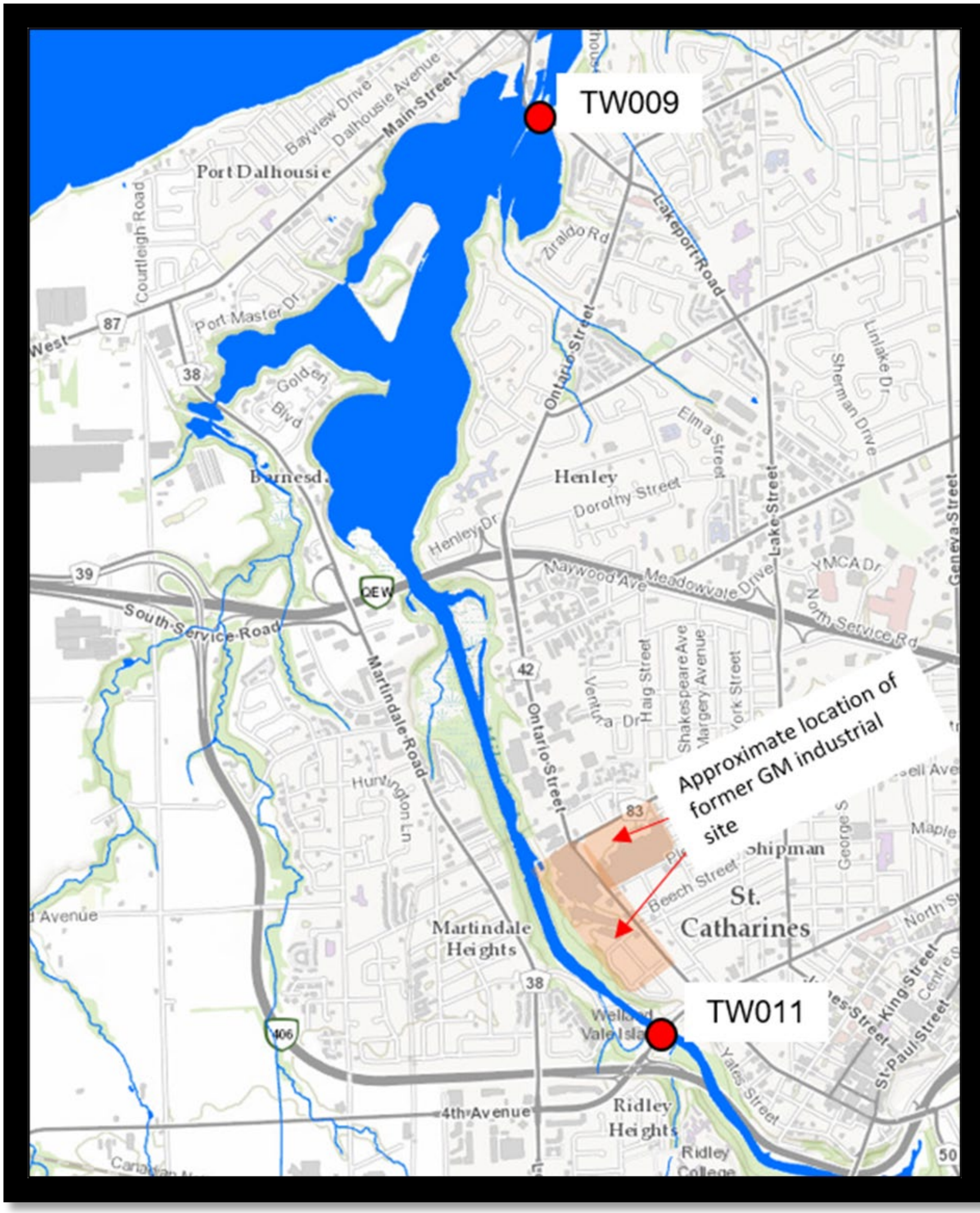

Figure 22: PCBs sampling locations in the Lower Twelve Mile Creek watershed.

Table 17: Twelve Mile Creek surface water quality laboratory results from upstream (TW011) and downstream (TW009) of the former GM industrial area, 2024.

NPCA Site ID	Date	Total PCBs ug/L	Aluminum mg/L	Alkalinity mg/L	Barium mg/L	Beryllium mg/L	Cadmium mg/L	Chloride mg/L	Cobalt mg/L	Conductivity uS/cm	Chromium mg/L	Copper mg/L	Escherichia Coli ct/100mL	Iron mg/L	Lithium mg/L	Magnesium mg/L	Manganese mg/L	Molybdenum mg/L	Sodium mg/L	Nickel mg/L	Nitrite mg/L	Nitrate mg/L	Total Phosphorus mg/L	Lead mg/L	pH	Silver mg/L	Titanium mg/L	Total Suspended Solids mg/L	Uranium mg/L	Vanadium mg/L	Zinc mg/L
PWQO/CWQG		**0**	**0.08**			**1.1**	**2E-04**	**120**				**0.005**	**100**	**0.3**				**0.04**		**0.025**	**0.06**	**2.93**	**0.03**	**0.005**	**6.5-8.5**			**30**	**0.005**	**0.006**	**0.03**
TW011	01/10/	<0.1	0.96	104	0.03	<0.0005	<0.0001	23.4	<0.0002	255	<0.001	0.001	100	0.54	0	9	0.02	<0.005	16	<0.005	<0.1	0.26	0.03	<0.001	8.13	<0.0001	0.04	22	<0.001	0.002	<0.01
TW009	01/10/	<0.1		96.1				28		324											0.01	0.34	0.09		8.12			40			
TW011	02/28/	<0.1	0.15	113	0.03	<0.0005	<0.0001	23.1	<0.0002	267	<0.001	0.001	180	0.12	0	10	<0.01	<0.005	15	<0.005	<0.1	0.45	0.02	<0.001	8.02	<0.0001	<0.01	5	<0.001	<0.001	0.01
TW009	02/28/	<0.1		102				22.7		338											<0.1	0.51	0.02		8.22			33.7			
TW011	03/25/	<0.1	0.22	110	0.03	<0.0005	<0.000	22.2	<0.0002	276	<0.001	<0.001	650	0.24	0	10	0.01	<0.005	16	<0.005	<0.1	0.5	0.02	<0.00	8.13	<0.0001	<0.01	15	<0.001	<0.001	<0.01
TW009	03/25/	<0.1	0.08	113	0.02	<0.0001	<0.0009	26.1	<0.0001	353	<0.001	0.002		0.1	0.01	9.72	0.05	<0.002	16.4	<0.002	<0.1	0.58	0.02	<0.007	8.29	<0.0009	0.002	7.1	<0.003	<0.001	0.004
TW011	04/22/	<0.1	0.16	103	0.02	<0.0005	<0.000		<0.0002	247	<0.001	<0.001	230	0.16	0	9	<0.01	<0.005	12	<0.005	<0.1	0.27	0.02	<0.00	8	<0.0001	<0.01	7	<0.00	<0.001	<0.01
TW009	04/22/	<0.1	0.14	102	0.03	<0.0001	<0.000	20.4	<0.0001	304	<0.001	0.002		0.12	0.01	9.1	0.01	<0.002	58.6	0.002	<0.1	0.35	0.03	<0.007	8.25	<0.0009	0.004	10	0.004	0.001	0.004
TW011	05/27/	<0.1	0.14	100	0.02	<0.0005	<0.0001	19.9	<0.0002	249	<0.001	0.001	750	0.23	0	9	0.01	<0.005	12	<0.005	<0.1	0.25	0.02	<0.001	7.98	<0.0001	<0.01	12	<0.001	<0.001	<0.01
TW009	05/27/	<0.1	0.21	98.7	0.03	<0.0001	<0.000	18.6	<0.0001	262	<0.001	0.002		0.15	0.01	8.64	0.01	<0.002	75.9	<0.002	<0.1	0.31	0.03	<0.007	8.21	<0.0009	0.007	8.5	<0.003	0.001	0.005
TW011	06/24/	<0.1	0.2	98	0.02	<0.0005	<0.000	17.9	<0.0002	234	<0.001	0.001	210	0.24	0	9	0.02	<0.005	12	<0.005	<0.1	0.23	0.02	<0.00	8.07	<0.0001	<0.01	12	<0.00	<0.001	<0.01
TW009	06/24/	<0.1	0.12	95.5	0.02	<0.0001	<0.000	18.1	<0.0001	304	<0.001	0.002		0.17	0.01	8.66	0.02	<0.002	36.9	<0.002	<0.1	0.27	0.03	<0.007	8.28	<0.0009	0.003	16.6	<0.003	<0.001	0.005
TW011	07/24/	<0.1	0.1	97	0.02	<0.0005	<0.0001	19.6	<0.0002	244	<0.001	0.001	65	0.06	0	9	<0.01	<0.005	12	<0.005	<0.1	0.18	0.01	<0.001	8.11	<0.0001	<0.01	4	<0.001	<0.001	<0.01
TW009	07/24/	<0.1	0.08	97	0.03	<0.0005	<0.000	19.7	<0.0002	242	<0.001	0.002	60	0.08	0	9	0.01	<0.005	12	<0.005	<0.1	0.16	0.02	<0.00	8.14	<0.0001	<0.01	6	<0.00	<0.001	<0.01
TW011	08/26/	<0.1	0.07	100	0.03	<0.0005	<0.0001	21.2	<0.0002	260	<0.001	0.001	90	0.06	0	9	<0.01	<0.005	14	<0.005	<0.1	0.14	0.01	<0.001	7.99	<0.0001	<0.01	2	<0.001	<0.001	<0.01
TW009	08/26/	<0.1	0.04	97.6	0.02	<0.0001	<0.000	21.7	<0.0001	326	<0.001	0.002		0.05	0.01	9.48	0.01	<0.002	15	<0.002	<0.1	0.15	0.02	<0.007	8.42	<0.0009	0.008	1.93	<0.003	<0.001	0.003
TW011	09/23/	<0.1	0.1	96	0.02	<0.0005	<0.0001	18.7	<0.0002	239	<0.001	0.001	870	0.14	0	9	<0.01	<0.005	12	<0.005	<0.1	<0.1	0.01	<0.001	7.96	<0.0001	<0.01	6	<0.001	<0.001	<0.01
TW009	09/23/	<0.1	0.12	95.6	0.02	<0.0001	<0.000	18.5	<0.0001	279	<0.001	0.002		0.13	0.01	8.67	0.01	<0.002	11.6	<0.002	<0.1	0.05	0.01	<0.007	8.26	<0.0009	0.004	8.47	<0.003	<0.001	0.005
TW011	10/28/	<0.1	0.07	101	0.02	<0.0005	<0.0001	17.8	<0.0002	228	<0.001	<0.001	185	0.06	0	7	<0.01	<0.005	14	<0.005	<0.1	<0.1	0.01	<0.001	8.01	<0.0001	<0.01	6	<0.001	<0.001	<0.01
TW009	10/28/	<0.1	0.04	94.4	0.02	<0.0001	<0.000	17.2	<0.0001	272	0.001	0.001		0.06	0.01	8.66	0.01	<0.002	11.3	<0.002	<0.1	0.11	0.01	<0.007	8.14	<0.0009	0.001	5.74	<0.003	<0.001	0.003
TW011	11/18/	<0.1	0.09	100	0.02	<0.0005	<0.000		<0.0002	226	<0.001	<0.001	190	0.08	0	9	<0.01	<0.005	10	<0.005	<0.1	<0.1	0.01	<0.00	8.12	<0.0001	<0.01	8	<0.00	<0.001	<0.01
TW009	11/18/	<0.1		97.2				16.4		279											0	0.11	0.01		8.19			7.35			
TW011	12/10/	<0.1	0.18	101	0.02	<0.0005	<0.000	19.6	<0.0002	243	<0.001	0.001	350	0.23	0	9	0.01	<0.005	11	<0.005	<0.1	0.12	0.02	<0.00	8.16	<0.0001	<0.01	8	<0.00	<0.001	<0.01
TW009	12/10/	<0.1	0.18	102	0.03	<0.0005	<0.000	19.9	<0.0002	246	0.002	0.001	210	0.2	0	9	0.01	<0.005	11	<0.005	<0.1	0.15	0.01	<0.00	8.14	<0.0001	<0.01	8	<0.00	<0.001	<0.01

In 2024, most water quality observed met environmental thresholds (**Table 17**). Exceedances were found in *E. coli* which could be due to human or animal sources. Exceedances in some metals and total phosphorus were observed which are from a combination of natural and anthropogenic sources. Aluminum routinely exceeded the PWQO which is likely due to the contribution of naturally elevated levels of aluminum found in the soils of the watershed. All total PCBs results for both stations were less than the laboratory detection in 2024. Based on the NPCA data since 2020 there is not sufficient information to conclude that runoff from the former GM industrial area is impacting Twelve Mile Creek, and this sampling program will be discontinued from 2025 onward.

5.0 SPECIAL PROJECTS

5.1 Canada-Ontario Agreement Climate Change Monitoring Networks Review Project

A climate change sensitivity assessment completed by the MECP in 2009 identified the NPCA watershed as one of several southern Ontario watersheds that are highly vulnerable to the impacts of climate change. Indicators used in their analysis were related to water quality and quantity for both surface and groundwater resources. These indicators included frequency of low water levels, water use, water quality at active PWQMN stations, shallow well vulnerability, and baseflow. As a follow-up to this assessment, the NPCA conducted a detailed assessment in 2009-2010 of their existing monitoring networks and made specific recommendations for climate change detection and adaptation monitoring. Based on the NPCA and MECP assessments the existing monitoring station at Balls Falls Conservation Area was upgraded to an integrated monitoring station in 2015 which includes a rain gauge, soil moisture sensors and extended laboratory analysis for event sampling. The NPCA took 12 samples at this location in 2024.

5.2 Water Well Decommissioning Program

In 2024, the NPCA continued to provide grants to watershed residents interested in properly decommissioning abandoned water wells on their property through the NPCA Water Well Decommissioning Program. The grant program offers an 80% subsidy for water well decommissioning to a maximum of $1000 per well. Grant applications are prioritized in areas designated as highly susceptible to groundwater contamination in the NPCA Groundwater Study (Waterloo Hydrogeologic Inc. 2005), areas where there is a high density of private wells used for domestic purposes, and areas where a watershed plan has been completed or is underway. Numerous improperly abandoned water wells are known to exist in the NPCA watershed, and these wells can serve as a direct pathway between potential contaminants on ground surface and deeper aquifers. The implementation of this program will reduce the risk of groundwater contamination and fulfill a recommendation made in the Groundwater Management Strategy of the NPCA Groundwater Study (Waterloo Hydrogeologic Inc. 2005). To date, 117 water wells have been decommissioned with the NPCA water well decommissioning program. An example of a water well decommissioning project is shown in **Figure 23.**

Figure 23: Before and after photos from a water well decommissioning project.

6.0 RECOMMENDATIONS

The following recommendations are based on the NPCA Watershed Monitoring Technical Report for 2024:

IWMP Recommendation

- In 2024, the NPCA successfully transitioned to an Integrated Watershed Monitoring Program. To maintain momentum of this enhanced program it is recommended that there be continued support and investment to ensure continued alignment with the NPCA's Strategic Plan (2021–2031).

Long-Term Monitoring Recommendations

- NPCA should continue its commitment to collecting reliable, watershed monitoring data across its jurisdiction. This data should remain publicly accessible to promote transparency, community engagement, and informed decision-making.
- NPCA's watershed monitoring data should be routinely analyzed to identify significant data gaps, trends, anomalies, and emerging issues. Where abnormalities are detected, follow-up investigations should be conducted to determine causes and inform appropriate mitigation strategies.
- NPCA should maintain and strengthen partnerships with municipalities, MECP and other agencies to identify and mitigate sources of environmental degradation, as revealed through the IWMP.
- NPCA should continue leveraging its internal programs like Watershed Restoration & Stewardship, Community Outreach and Volunteering, and Niagara River Remedial Action Plan to actively improve watershed health.
- NPCA should further develop and refine its data management systems to ensure efficient storage, integration, and accessibility of growing datasets, supporting both internal analysis and external reporting.

Corporate Support Service Recommendations

- NPCA's IWMP should continue to support and coordinate environmental monitoring efforts that are critical to the effective management and stewardship of NPCA's conservation areas. This includes ongoing monitoring to inform Conservation Area Management Plans, ensure public safety at conservation area beaches, meet Environmental Compliance Approval (ECA) requirements, assess PFAS levels in Lake Niapenco, and conduct ecological studies that track biodiversity and habitat health. Sustained investment in these monitoring activities will ensure regulatory compliance, data-driven planning, and the long-term ecological integrity of NPCA-managed lands.

Service Provider Recommendations

- NPCA continues to be recognized as a reliable and professional service provider, delivering high-quality technical expertise and environmental services to municipal and private sector partners. It is recommended that the NPCA should continue to pursue new service opportunities while maintaining strong relationships and performance on existing contracts. Ongoing investment in staff capacity and resources will ensure the NPCA remains a preferred partner for environmental monitoring, compliance, and planning services across the watershed.

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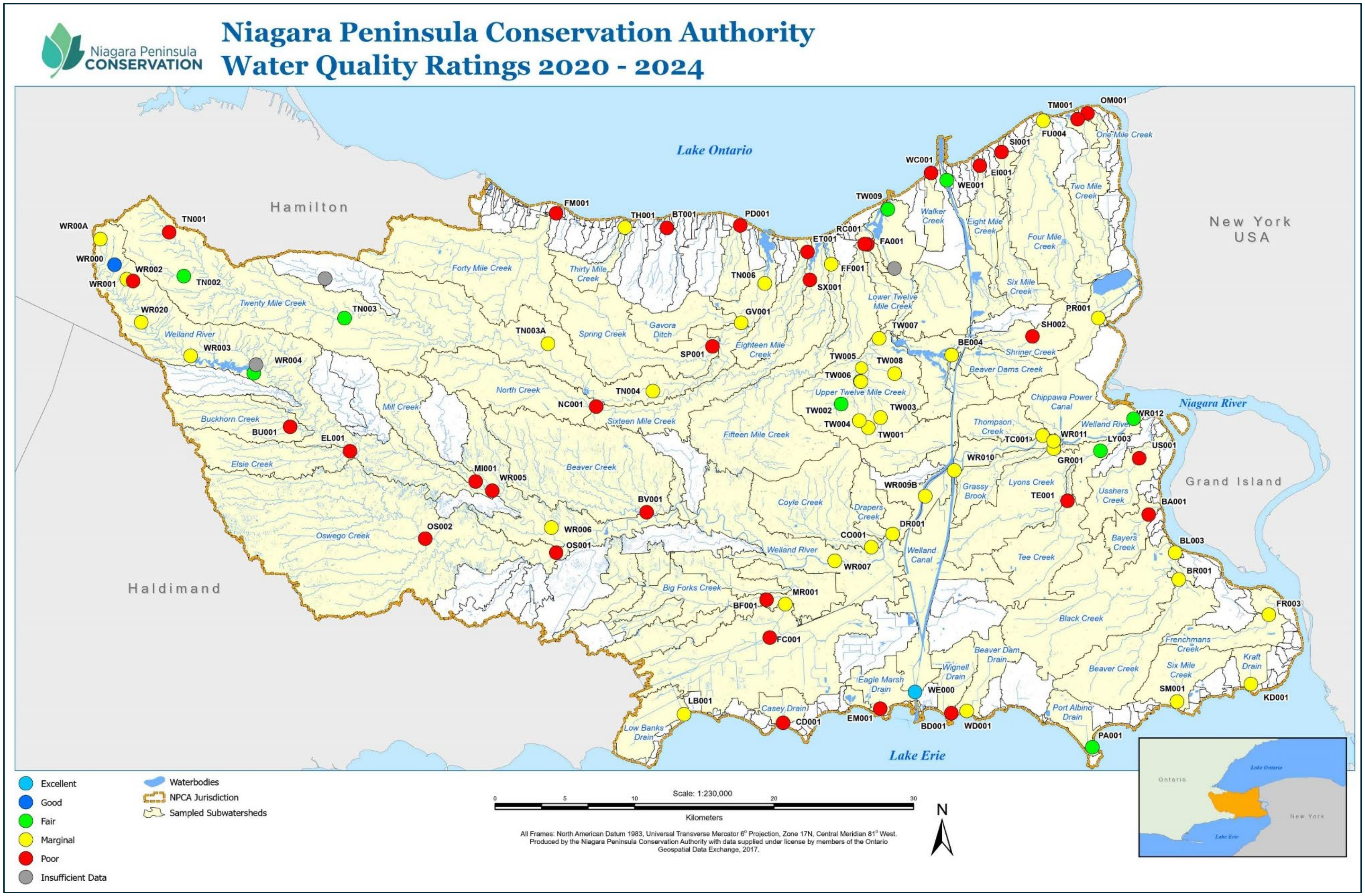
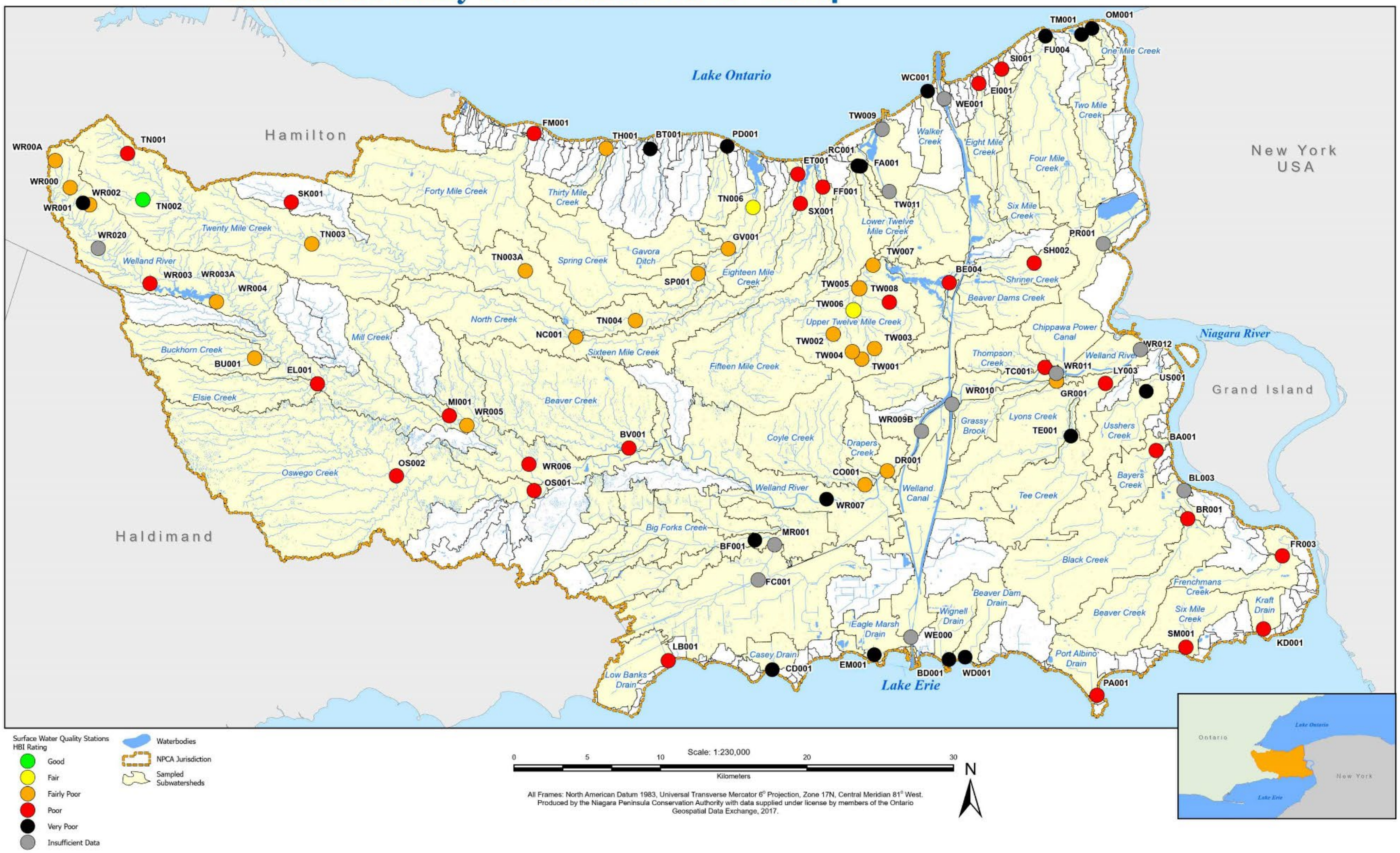
Appendix A: 2020-2024 Canadian Water Quality Index Ratings


Niagara Peninsula Conservation Authority
Water Quality Ratings 2020 - 2024
Niagara Peninsula CONSERVATION
Lake Ontario
Lake Erie
Hamilton
Haldimand
New York USA
Grand Island
Niagara River
Excellent
Good
Fair
Marginal
Poor
Insufficient Data
Waterbodies
NPCA Jurisdiction
Sampled Subwatersheds
Scale: 1:230,000
Kilometers
All Frames: North American Datum 1983, Universal Transverse Mercator 6° Projection, Zone 17N, Central Meridian 81° West.
Produced by the Niagara Peninsula Conservation Authority with data supplied under license by members of the Ontario Geospatial Data Exchange, 2017.
N

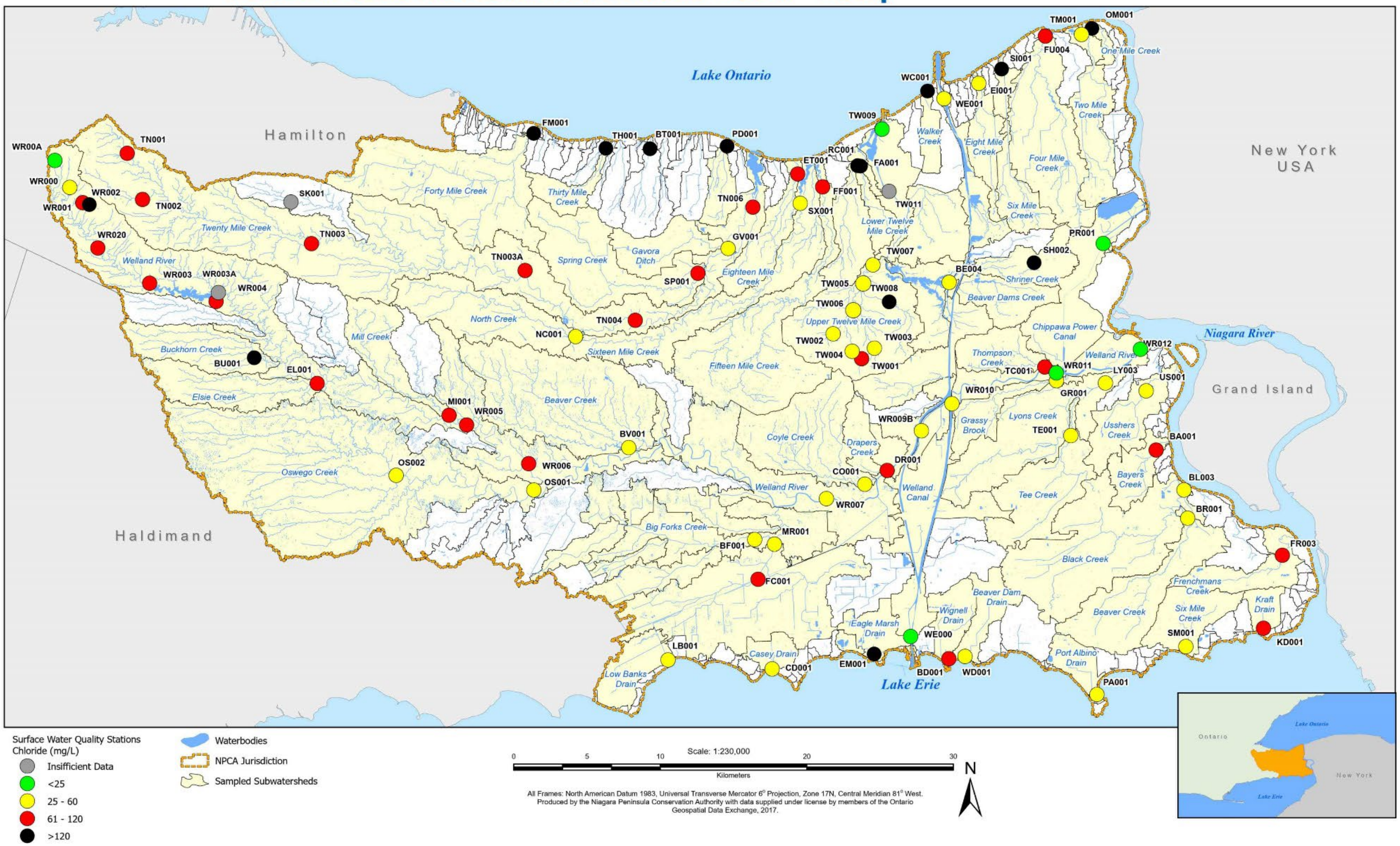
Appendix B: 2020-2024: Hilsenhoff Family Biotic Index

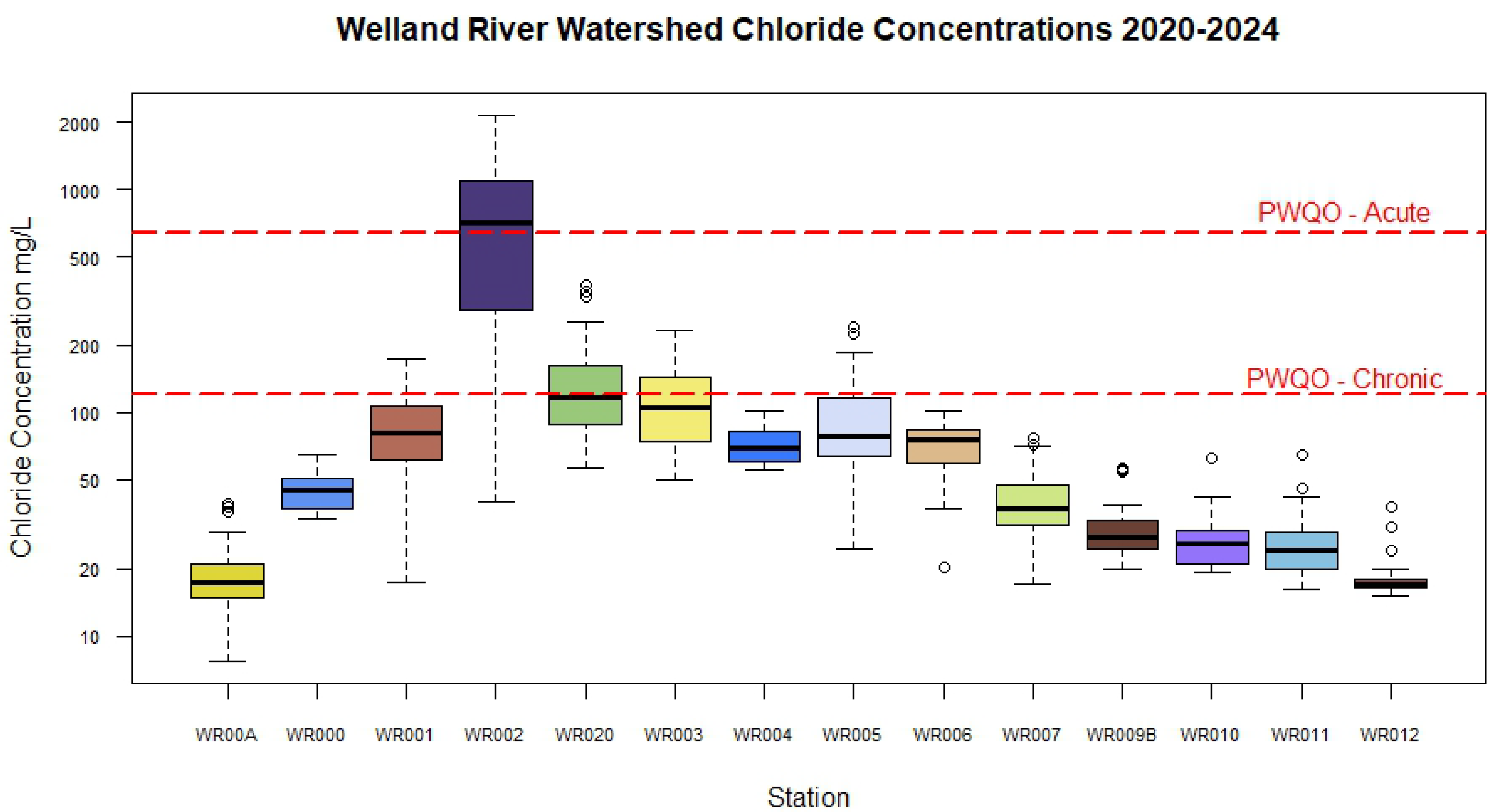
Niagara Peninsula Conservation Authority
Hilsenoff Family Biotic Index 2020 - 2024

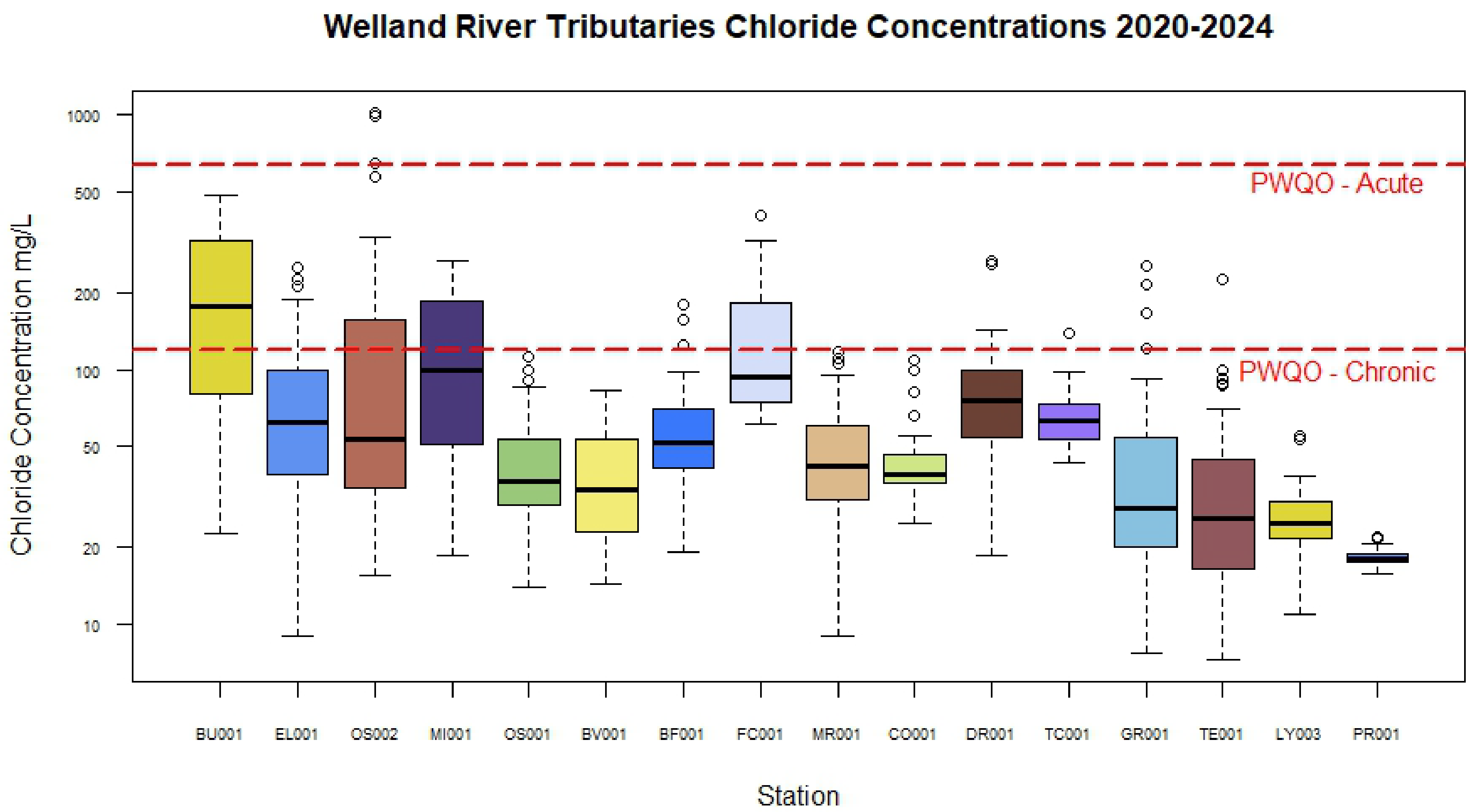


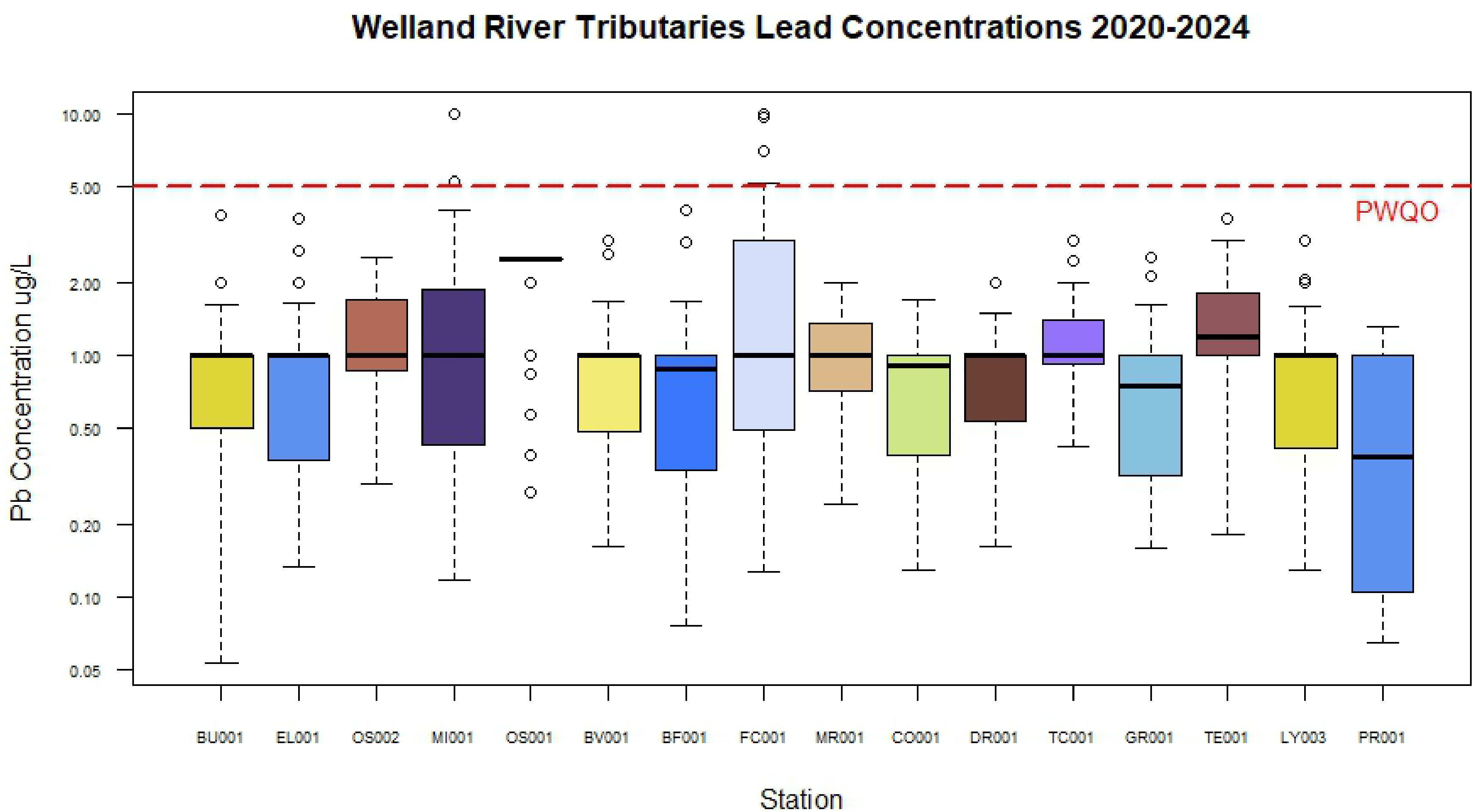
Appendix C: 2020-2024: Median Chloride Concentrations and Summary Boxplots

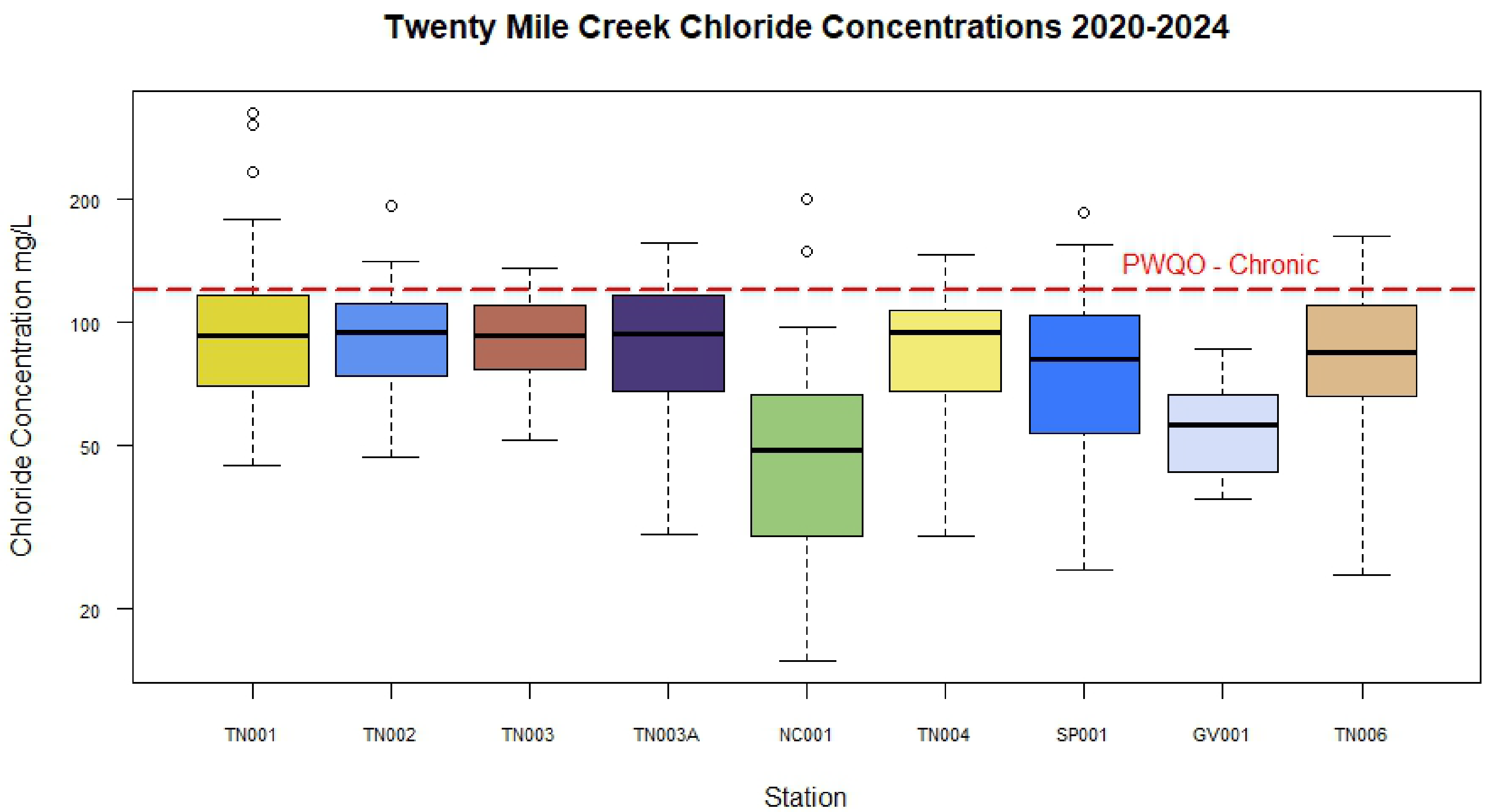
Niagara Peninsula Conservation Authority Median Chloride Concentrations 2020 - 2024

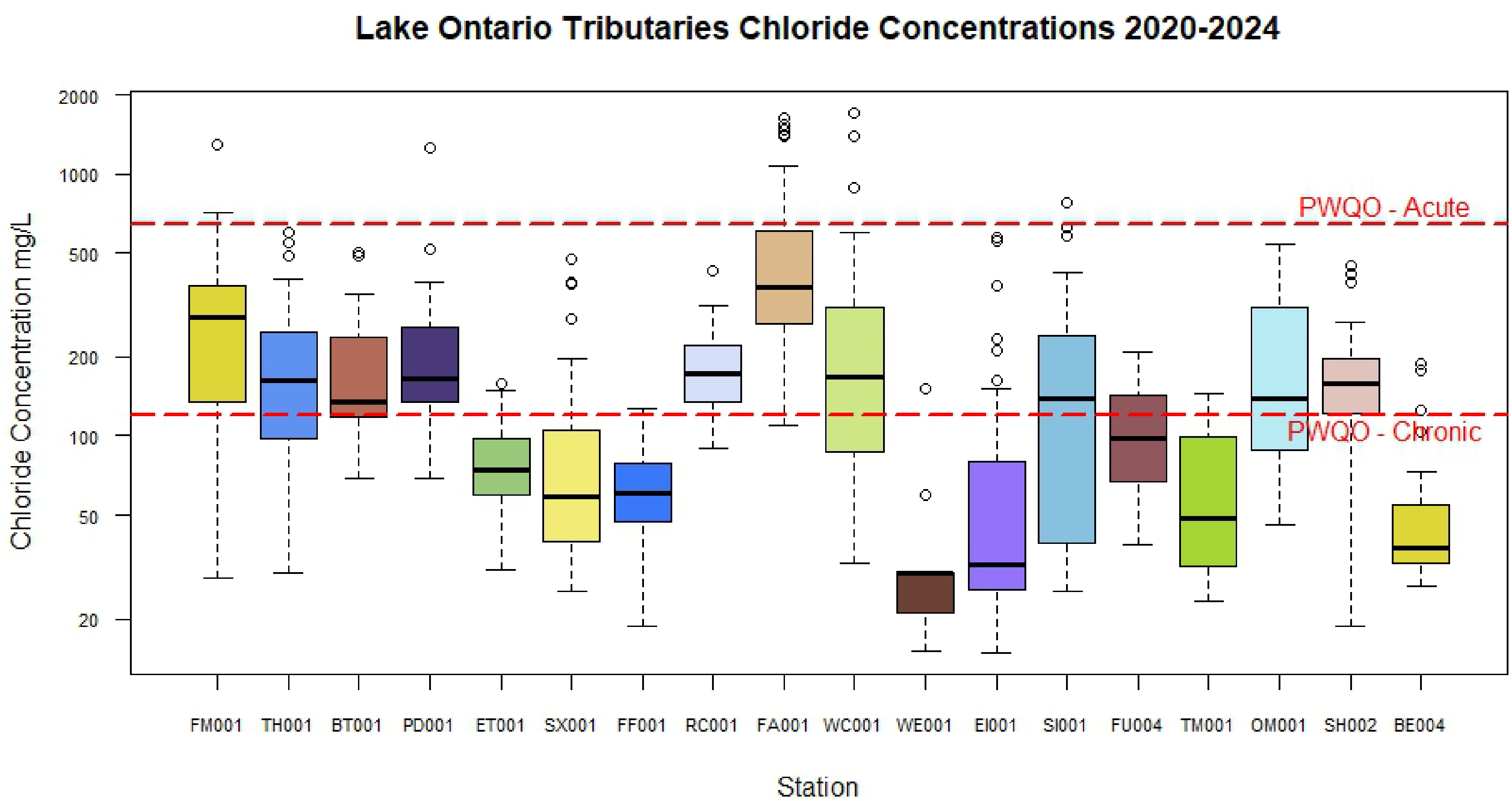


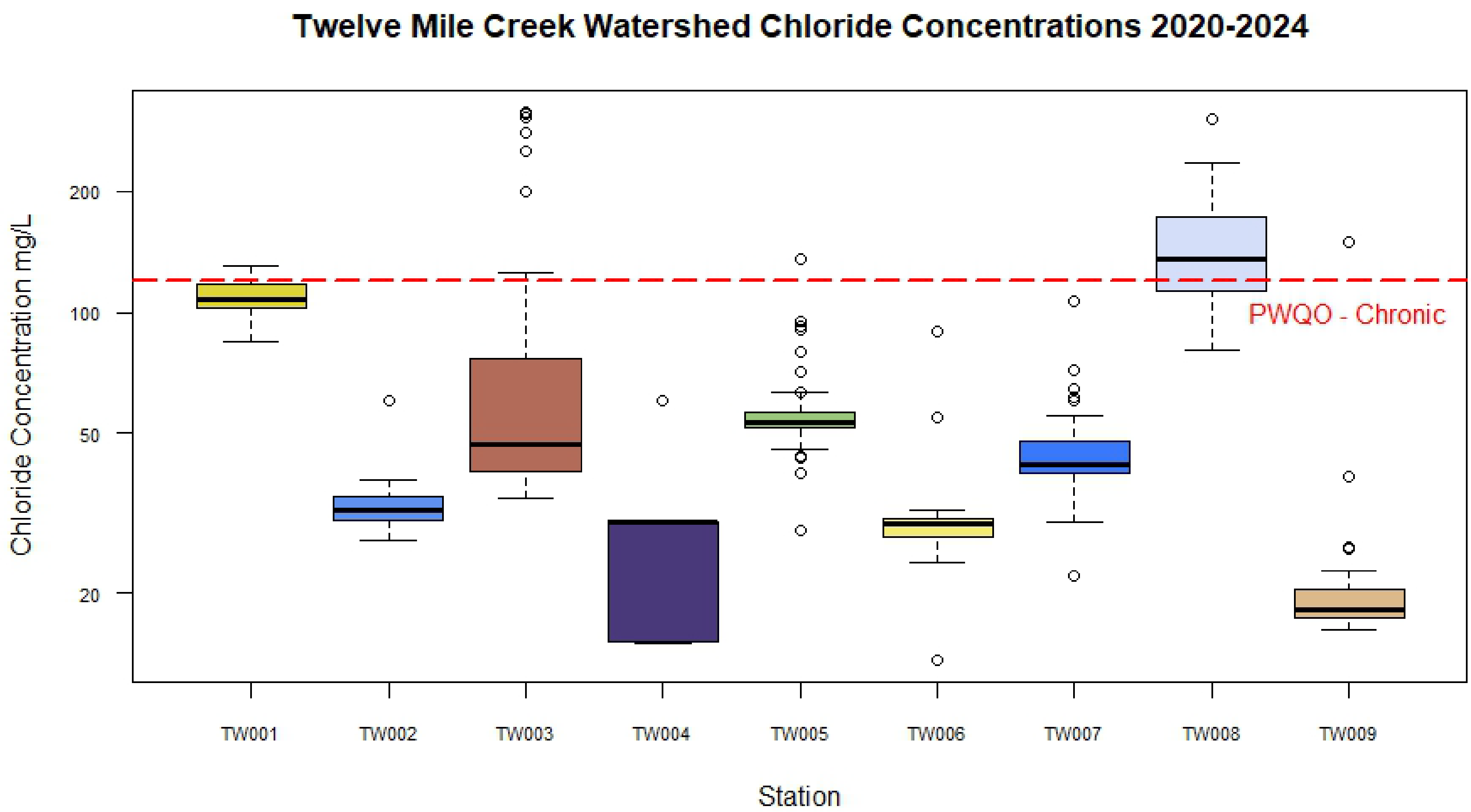

Welland River Watershed Chloride Concentrations 2020-2024
Chloride Concentration mg/L
2000
1000
500
200
100
50
20
10
PWQO - Acute
PWQO - Chronic
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

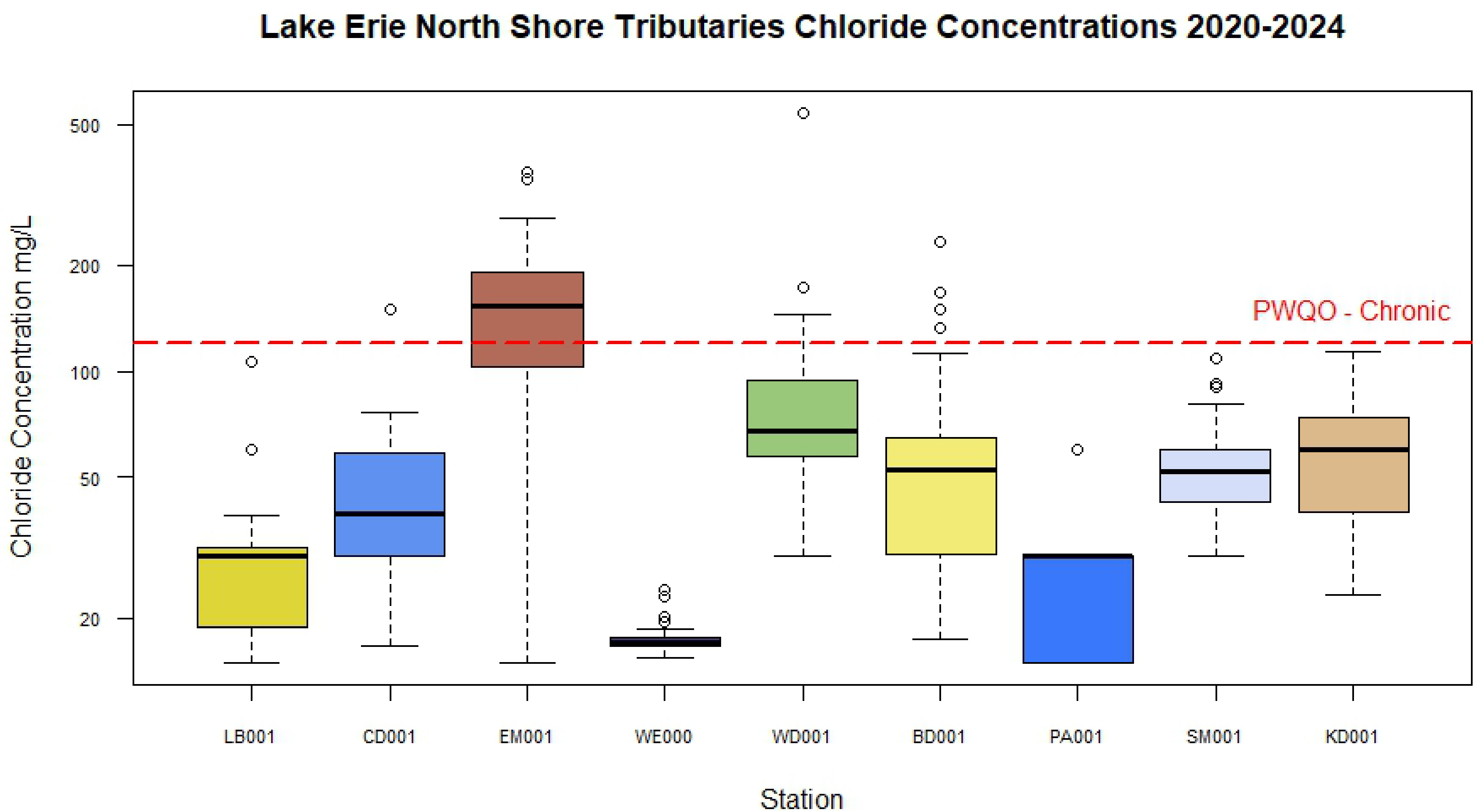

Welland River Tributaries Chloride Concentrations 2020-2024
Chloride Concentration mg/L
1000
500
200
100
50
20
10
PWQO - Acute
PWQO - Chronic
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

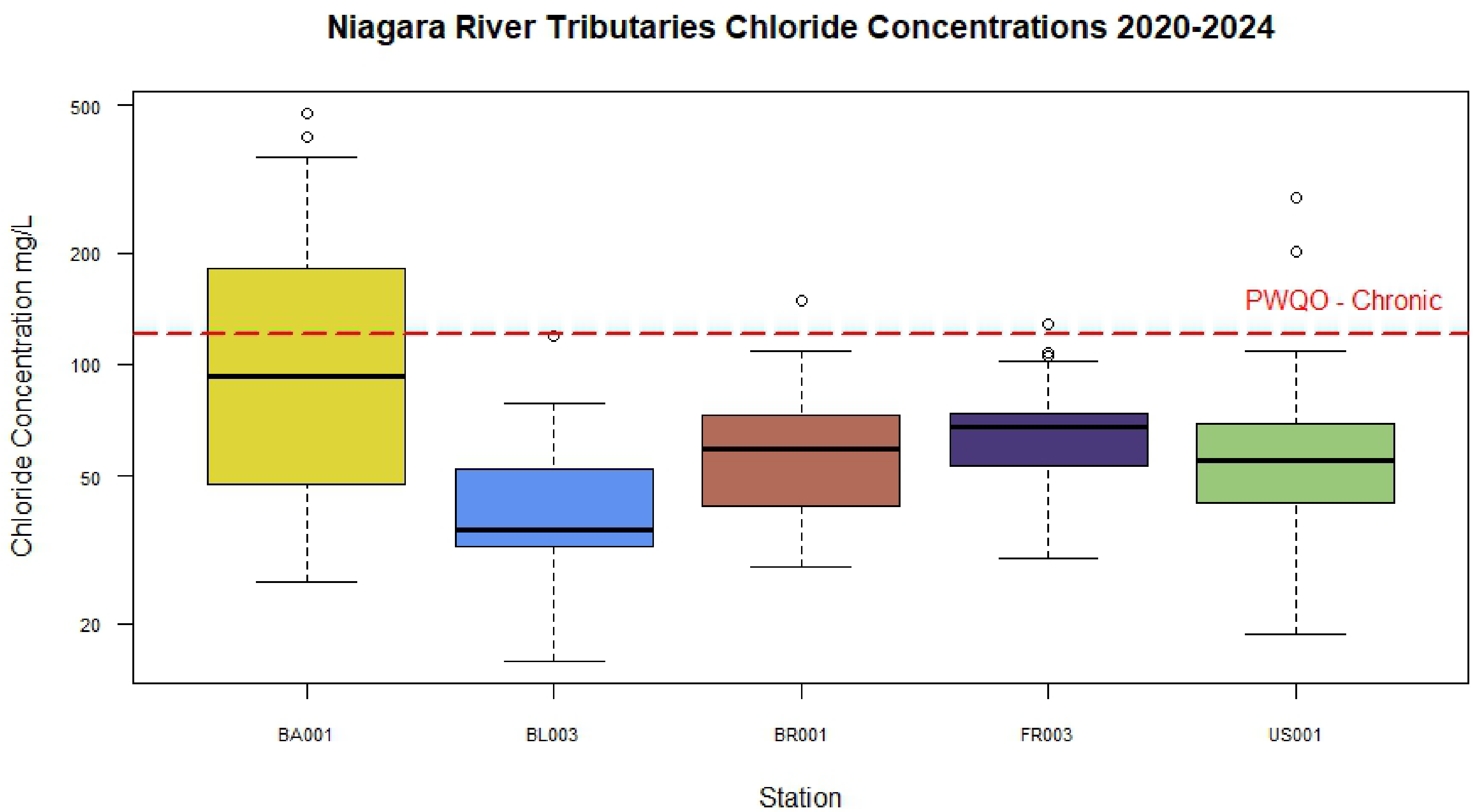

Welland River Tributaries Lead Concentrations 2020-2024
Pb Concentration ug/L
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

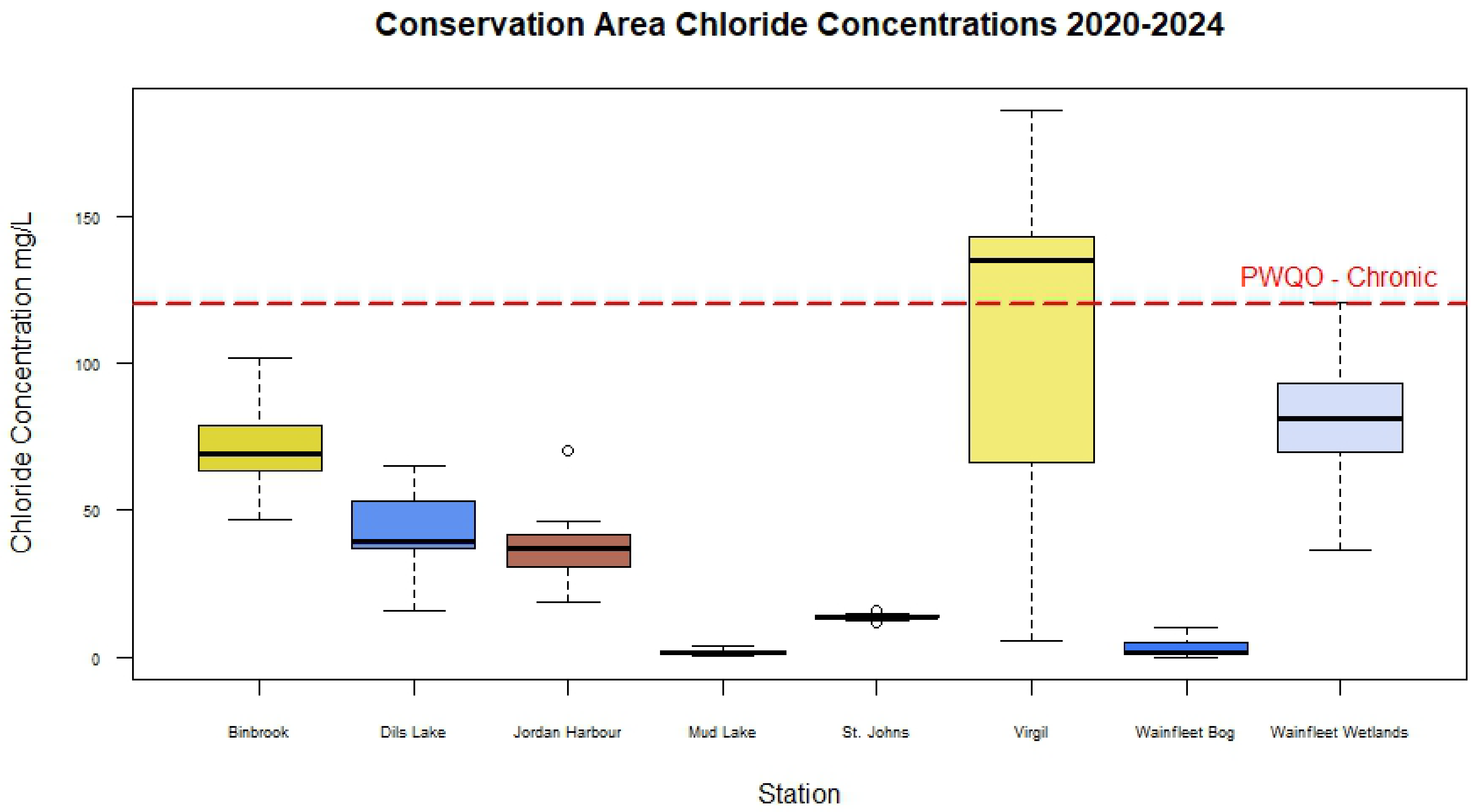

Twenty Mile Creek Chloride Concentrations 2020-2024
Chloride Concentration mg/L
200
100
50
20
PWQO - Chronic
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station


Lake Ontario Tributaries Chloride Concentrations 2020-2024
Chloride Concentration mg/L
2000
1000
500
200
100
50
20
PWQO - Acute
PWQO - Chronic
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station

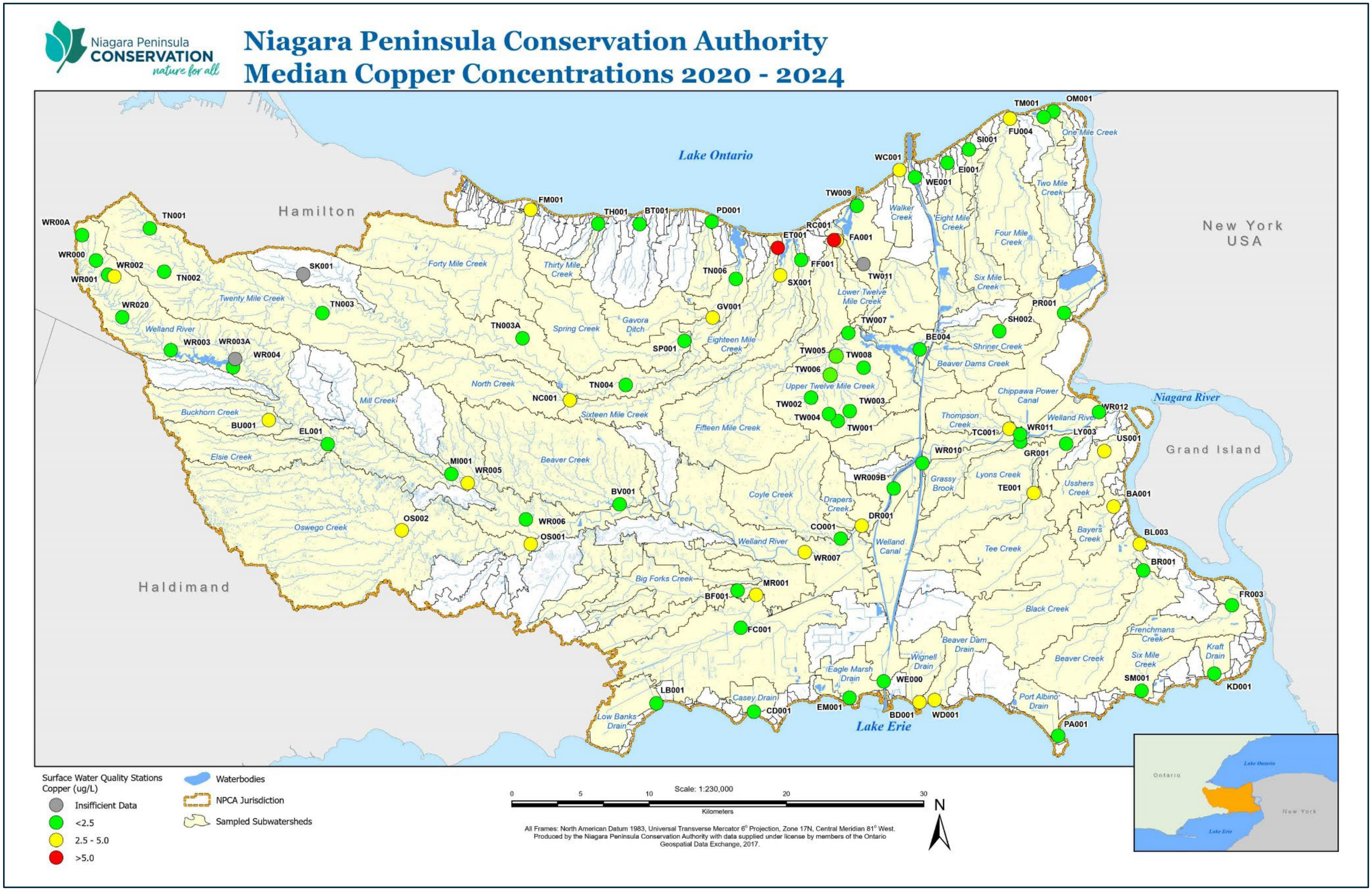

Twelve Mile Creek Watershed Chloride Concentrations 2020-2024
Chloride Concentration mg/L
200
100
50
20
PWQO - Chronic
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

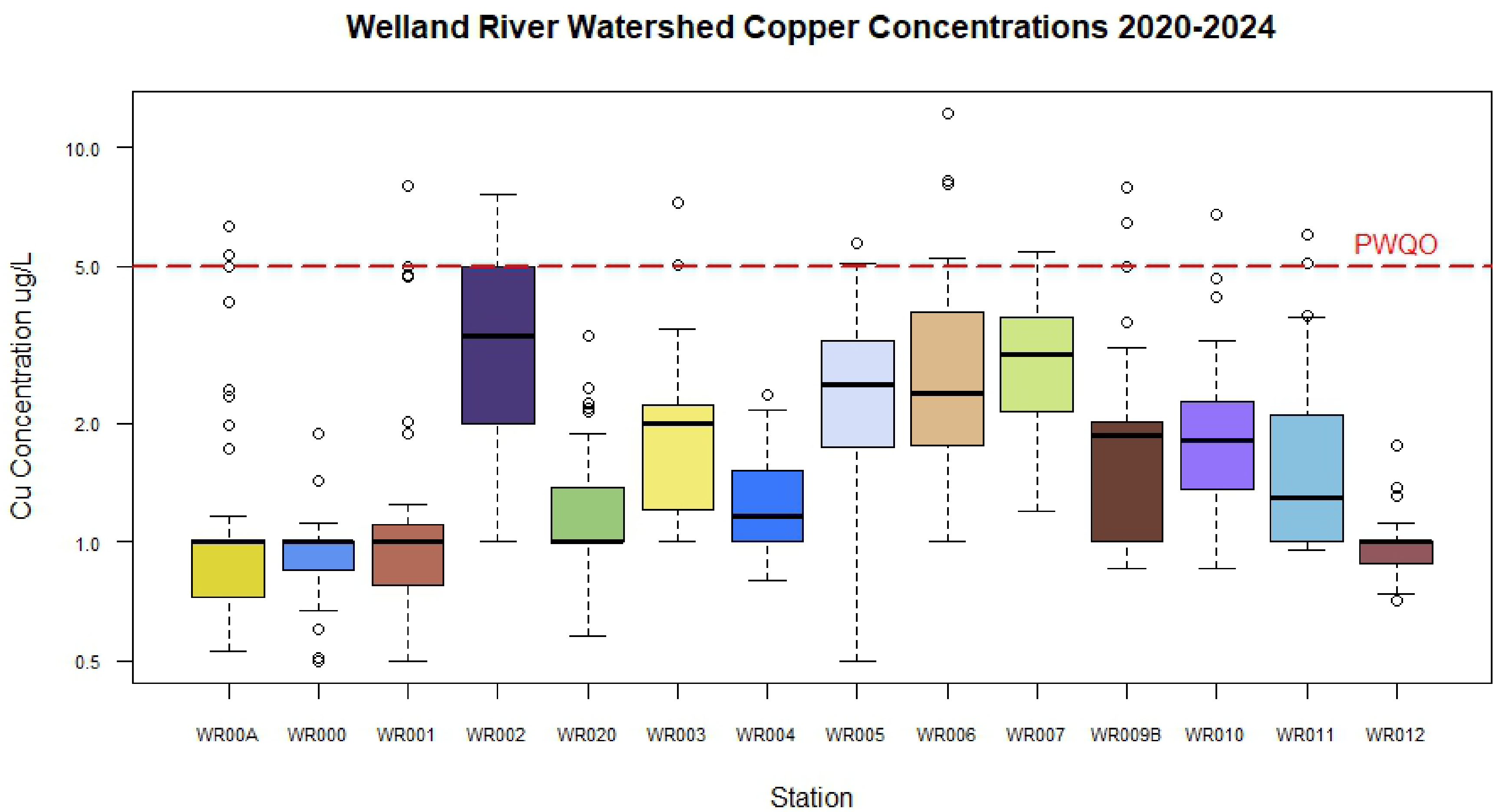

Lake Erie North Shore Tributaries Chloride Concentrations 2020-2024
Chloride Concentration mg/L
500
200
100
50
20
PWQO - Chronic
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

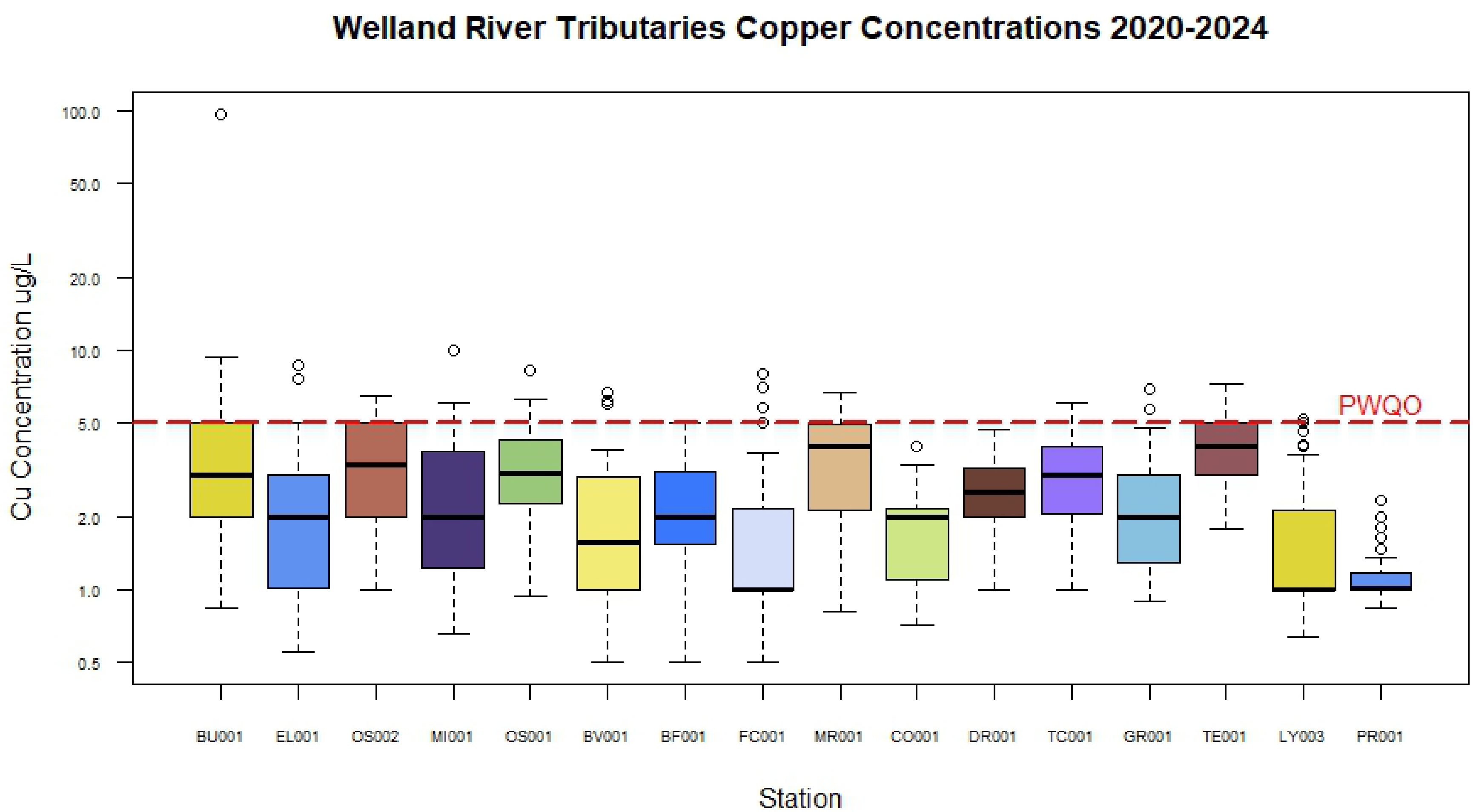

Niagara River Tributaries Chloride Concentrations 2020-2024
Chloride Concentration mg/L
500
200
100
50
20
PWQO - Chronic
BA001
BL003
BR001
FR003
US001
Station

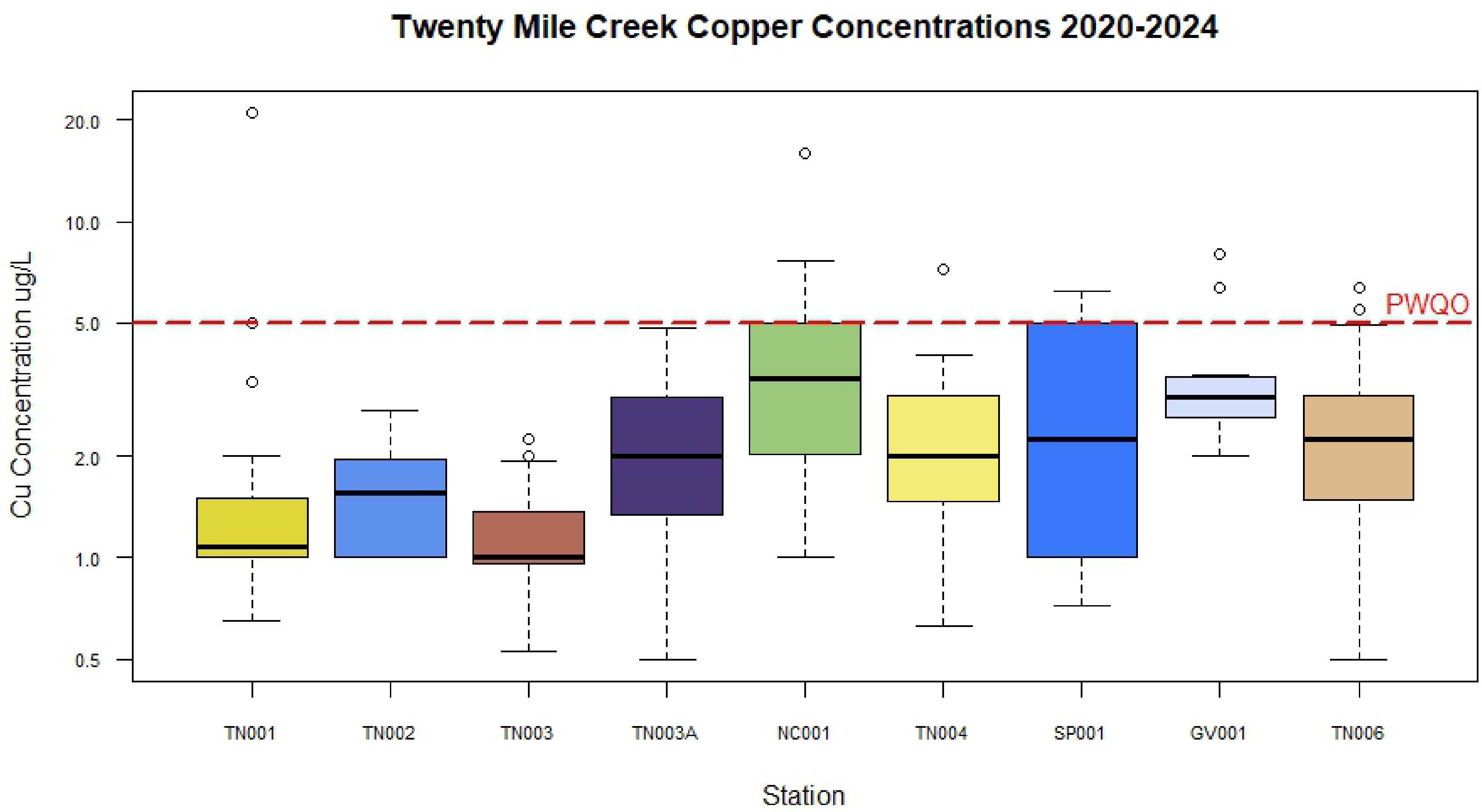

Conservation Area Chloride Concentrations 2020-2024
Chloride Concentration mg/L
150
100
50
0
PWQO - Chronic
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

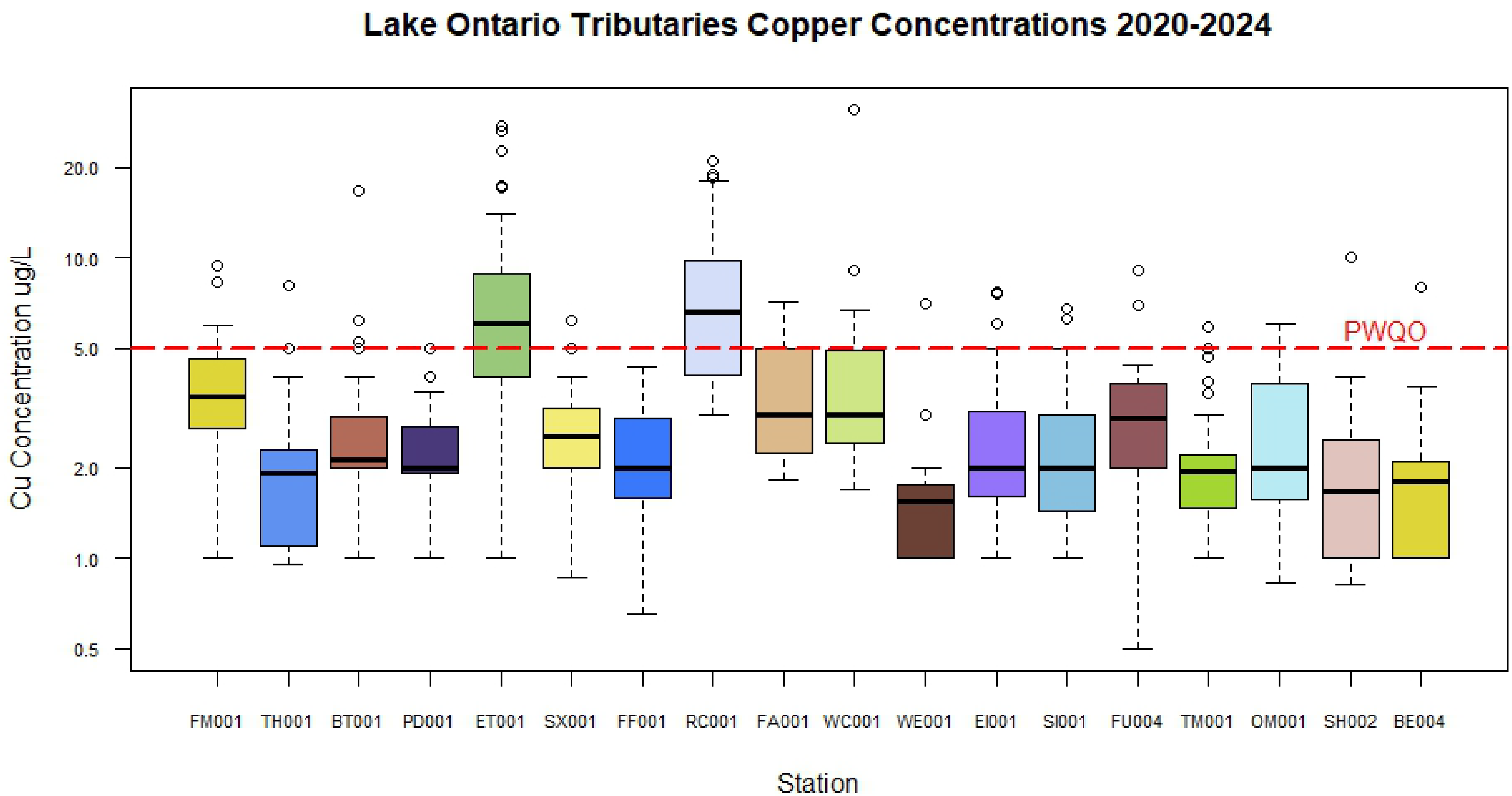
Appendix D: 2020-2024 Median Copper Concentrations and Summary Boxplots

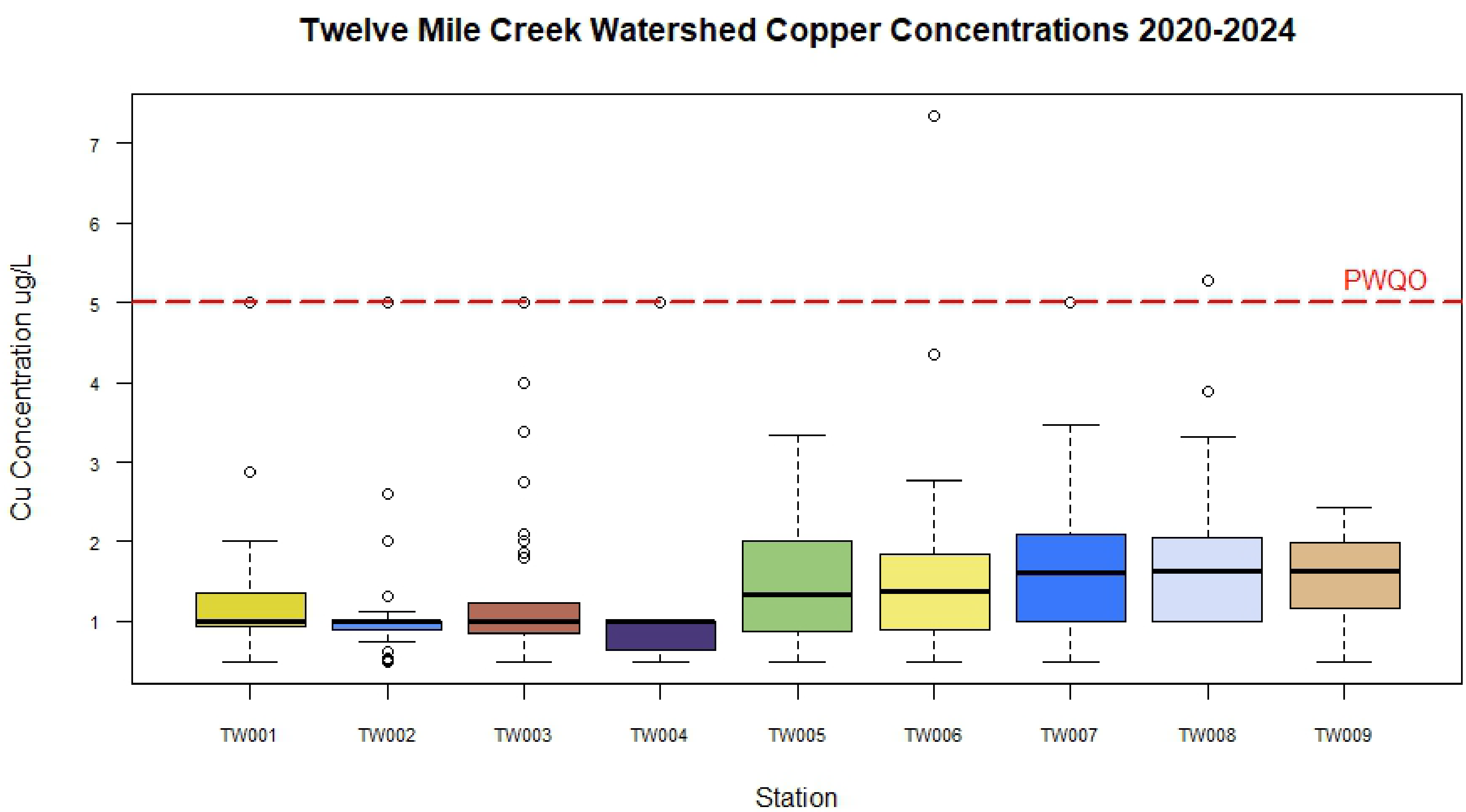

Niagara Peninsula Conservation Authority
Median Copper Concentrations 2020 - 2024
Lake Ontario
Lake Erie
Hamilton
Haldimand
New York USA
Grand Island
Niagara River
Surface Water Quality Stations Copper (ug/L)
Insufficient Data
<2.5
2.5 - 5.0
>5.0
Waterbodies
NPCA Jurisdiction
Sampled Subwatersheds
Scale: 1:230,000
Kilometers
All Frames: North American Datum 1983, Universal Transverse Mercator 6° Projection, Zone 17N, Central Meridian 81° West.
Produced by the Niagara Peninsula Conservation Authority with data supplied under license by members of the Ontario Geospatial Data Exchange, 2017.

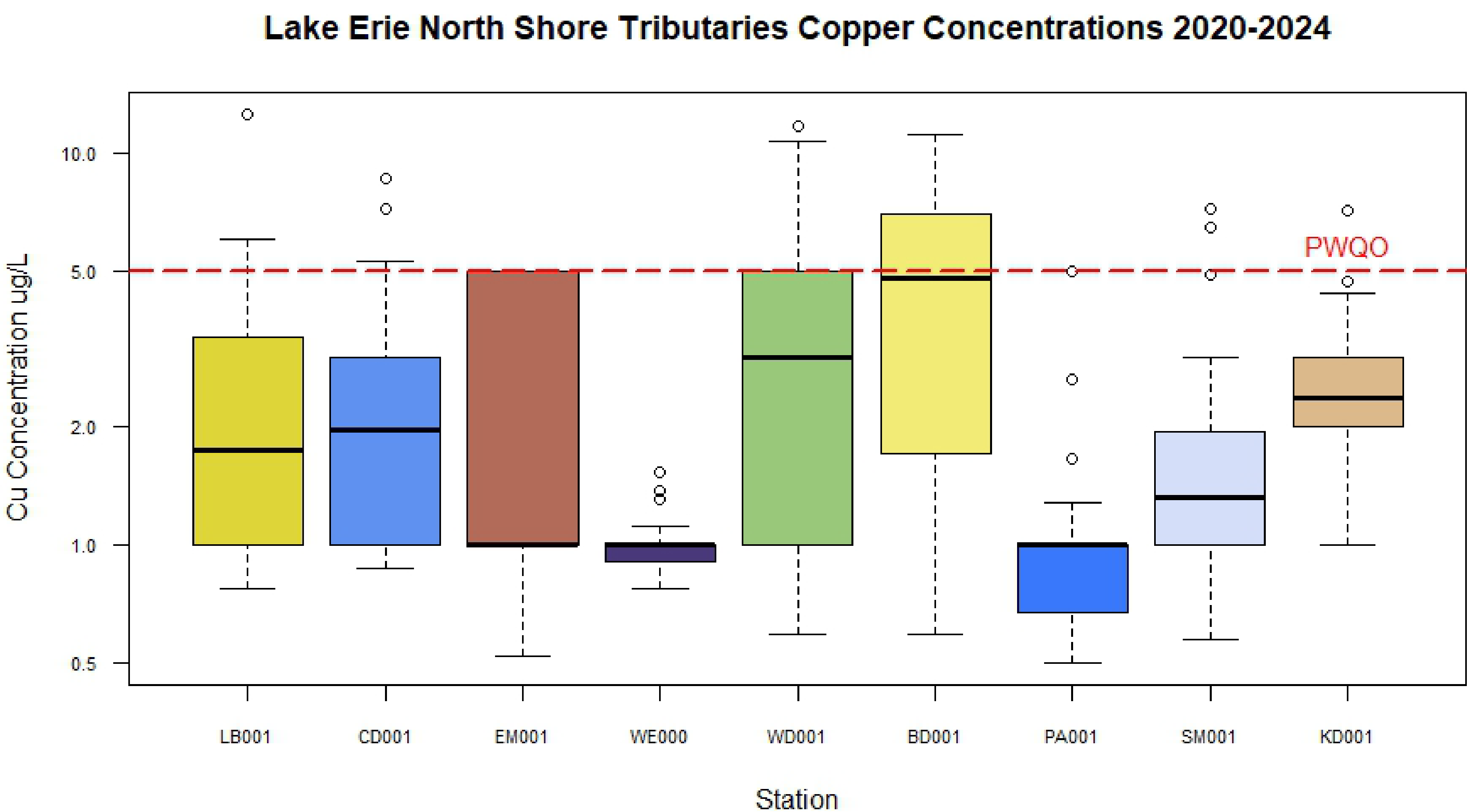

Welland River Watershed Copper Concentrations 2020-2024
Cu Concentration ug/L
10.0
5.0
2.0
1.0
0.5
PWQO
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

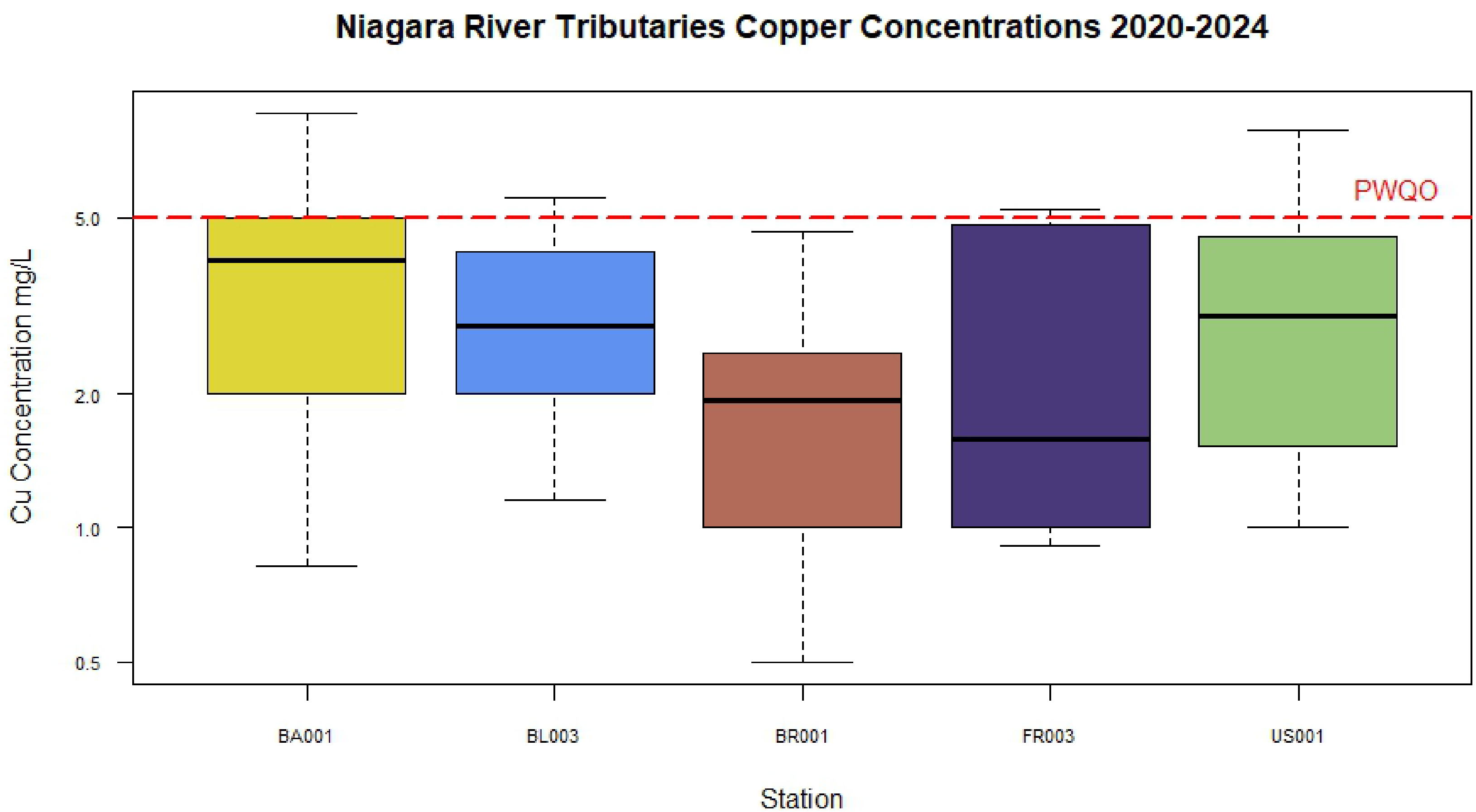

Welland River Tributaries Copper Concentrations 2020-2024
Cu Concentration ug/L
100.0
50.0
20.0
10.0
5.0
2.0
1.0
0.5
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station


Twenty Mile Creek Copper Concentrations 2020-2024
Cu Concentration ug/L
20.0
10.0
5.0
2.0
1.0
0.5
PWQO
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station

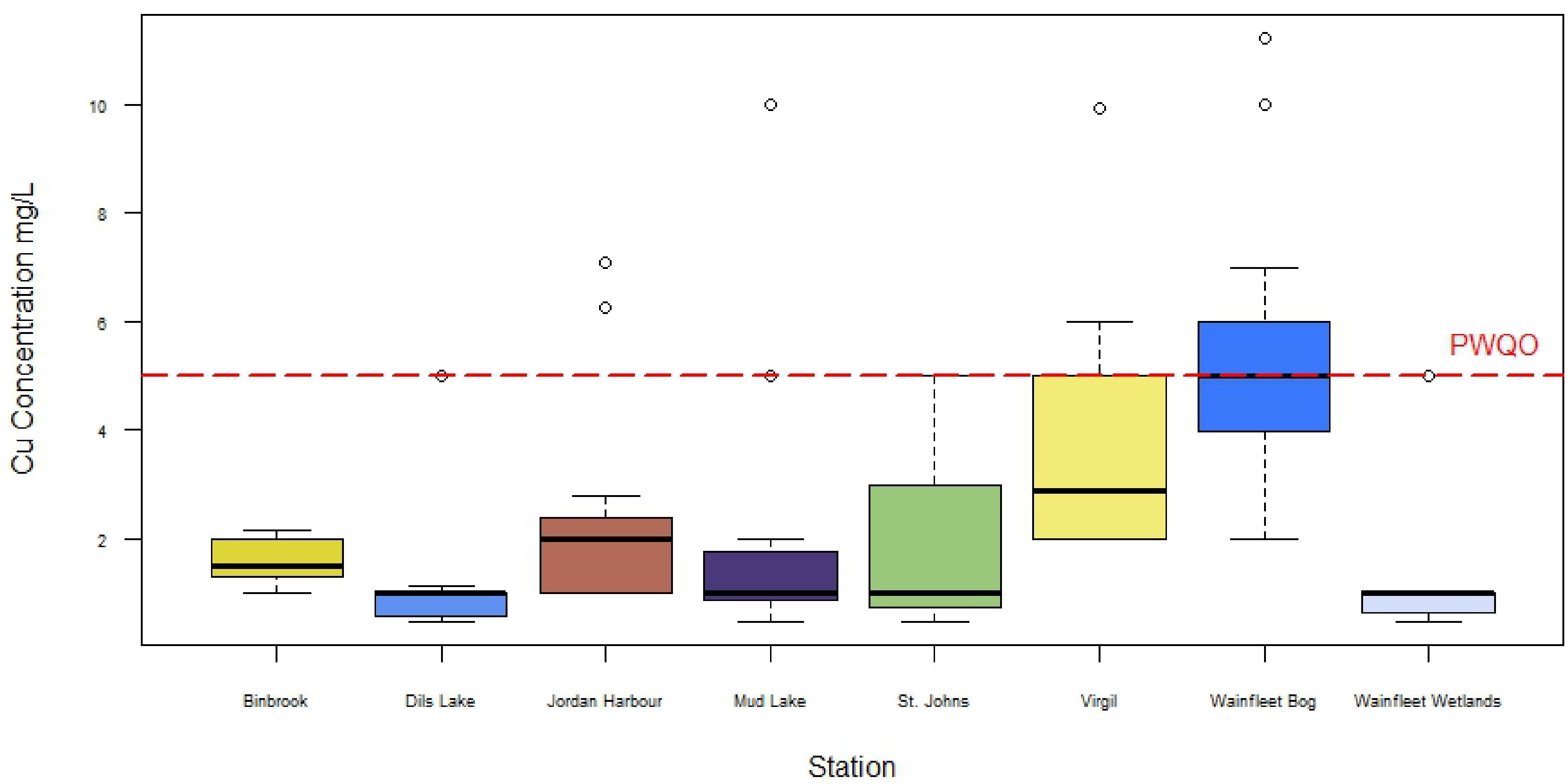

Lake Ontario Tributaries Copper Concentrations 2020-2024
Cu Concentration ug/L
20.0
10.0
5.0
2.0
1.0
0.5
PWQO
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station


Twelve Mile Creek Watershed Copper Concentrations 2020-2024
Cu Concentration ug/L
7
6
5
4
3
2
1
PWQO
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

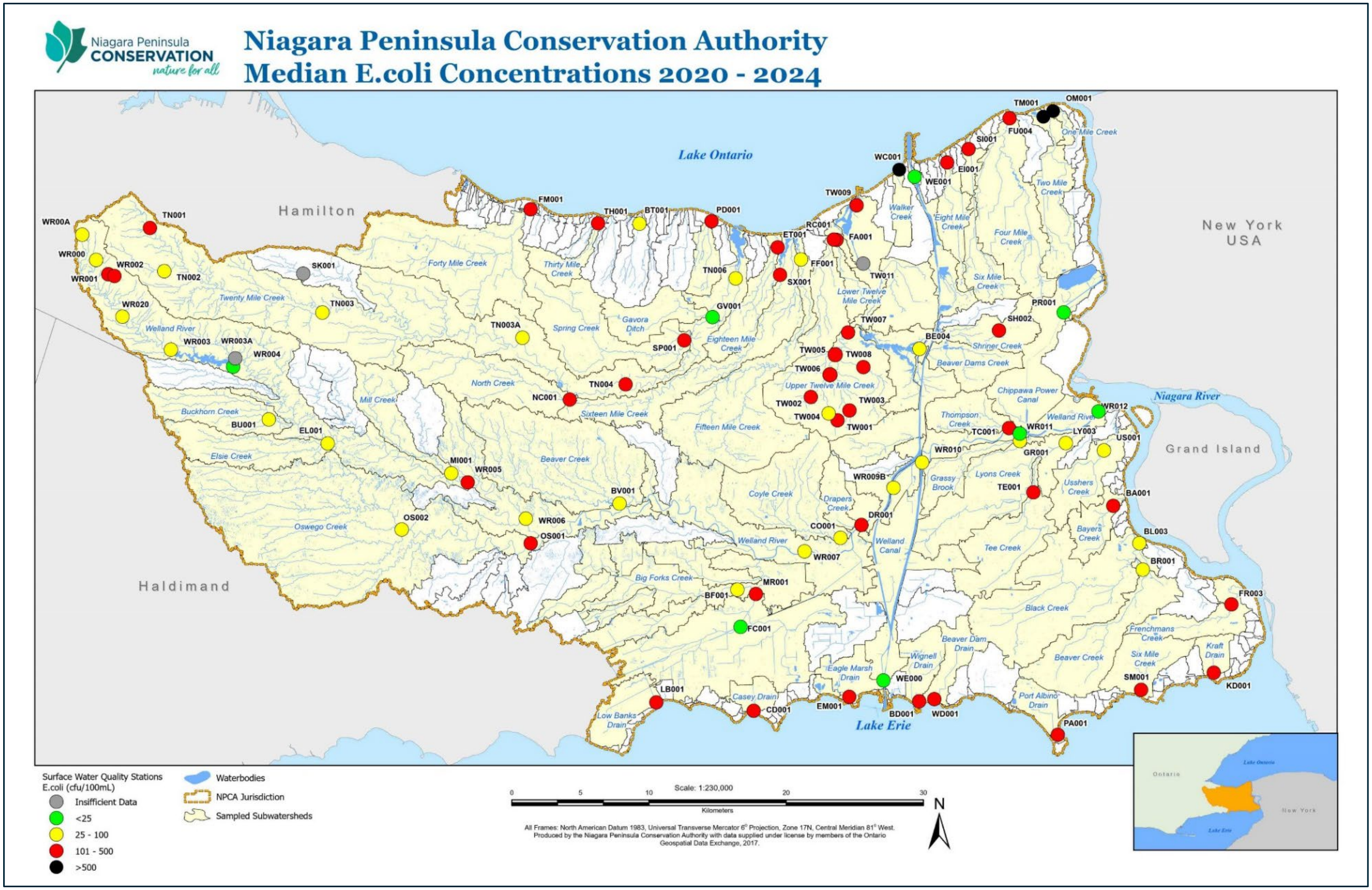

Lake Erie North Shore Tributaries Copper Concentrations 2020-2024
Cu Concentration ug/L
10.0
5.0
2.0
1.0
0.5
PWQO
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

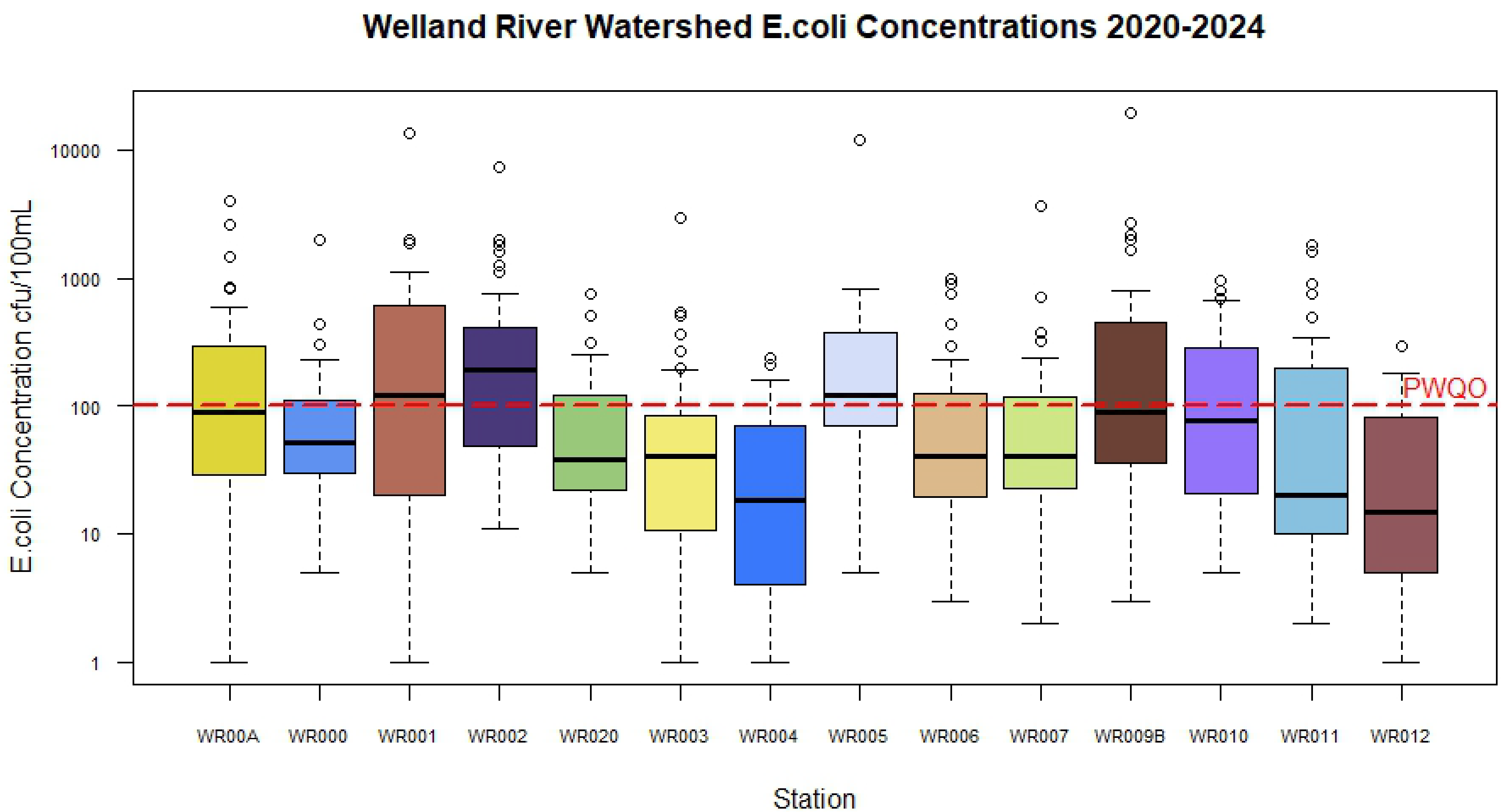

Niagara River Tributaries Copper Concentrations 2020-2024
Cu Concentration mg/L
5.0
2.0
1.0
0.5
PWQO
BA001
BL003
BR001
FR003
US001
Station

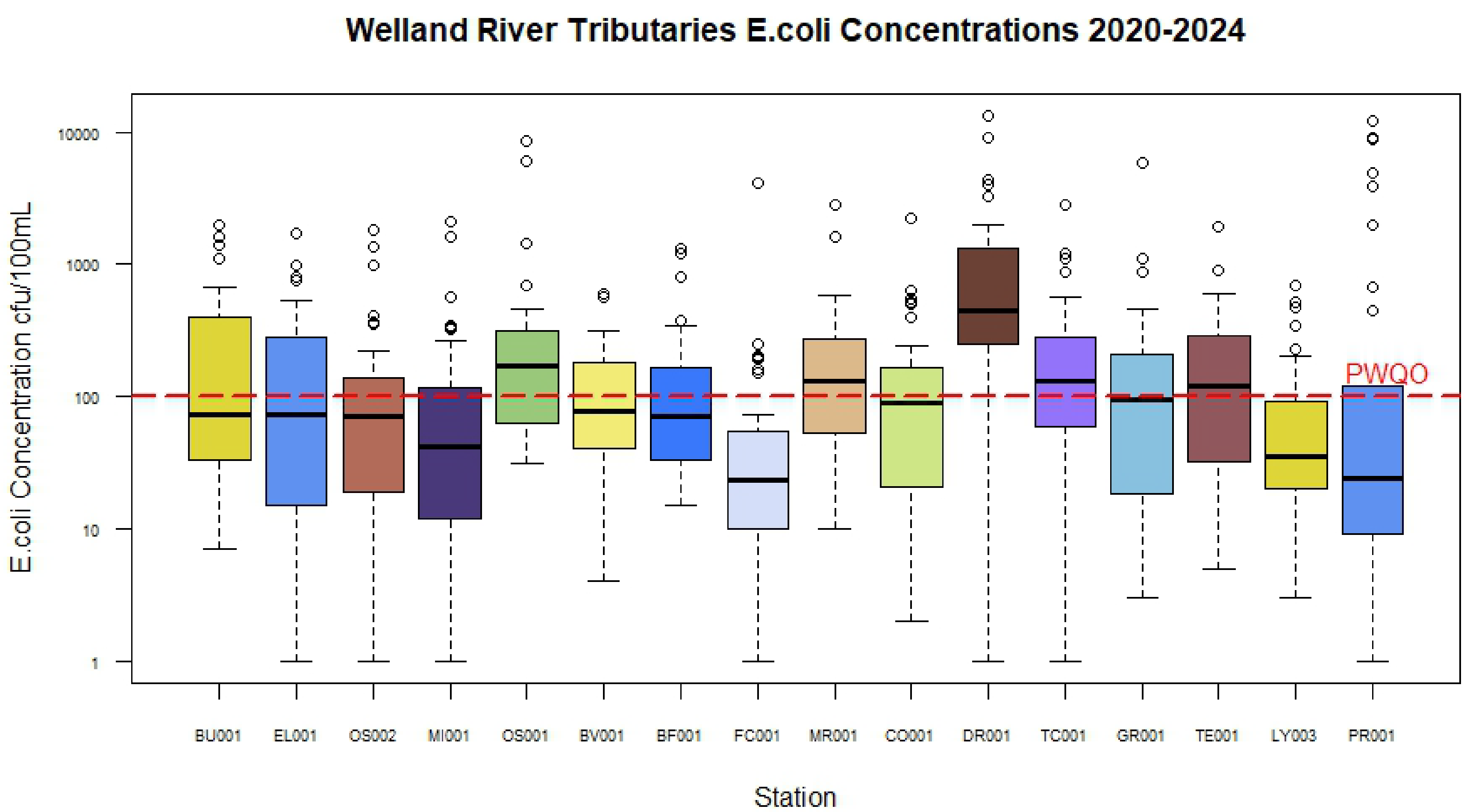
Conservation Area Copper Concentrations 2020-2024

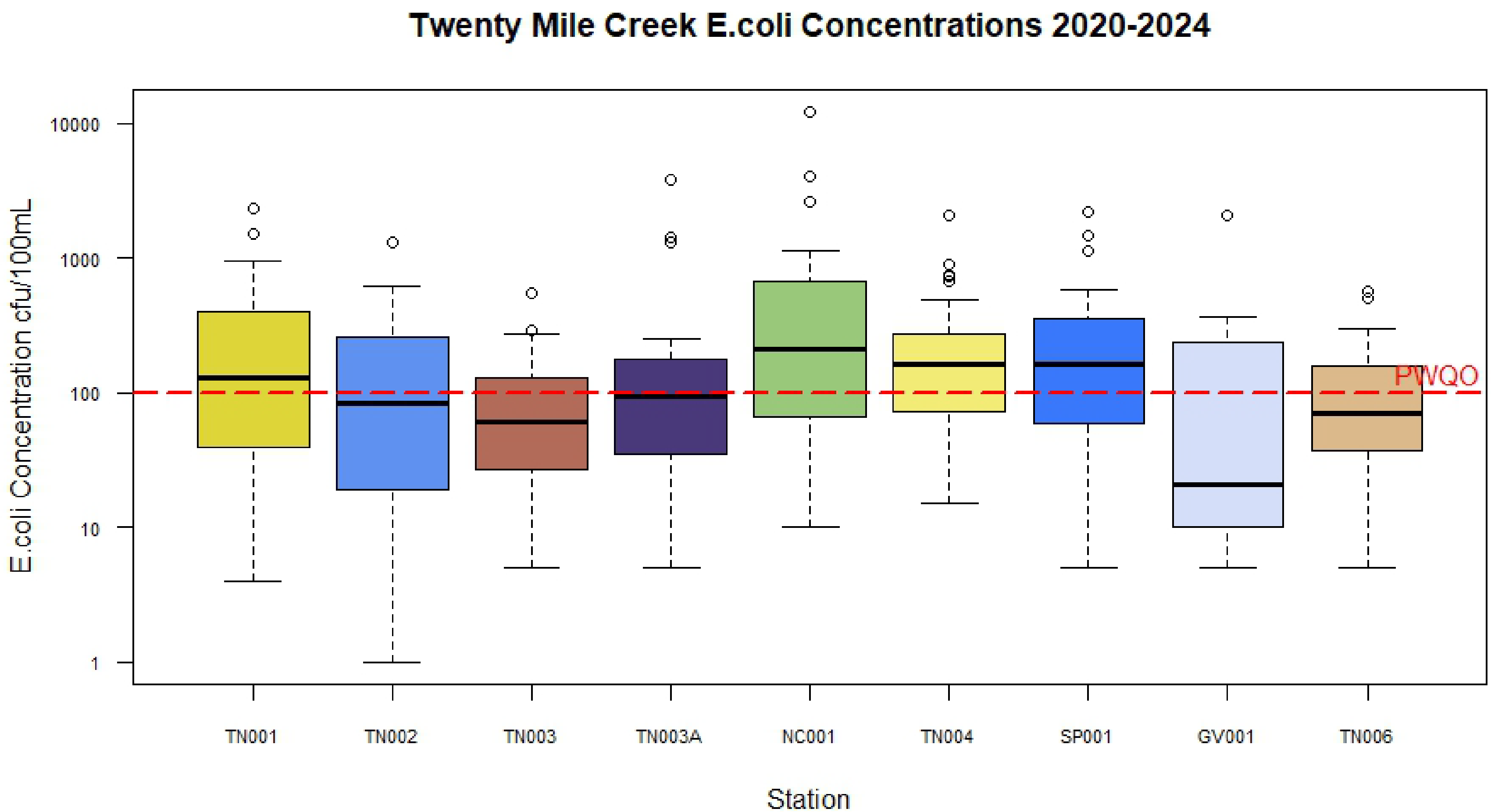


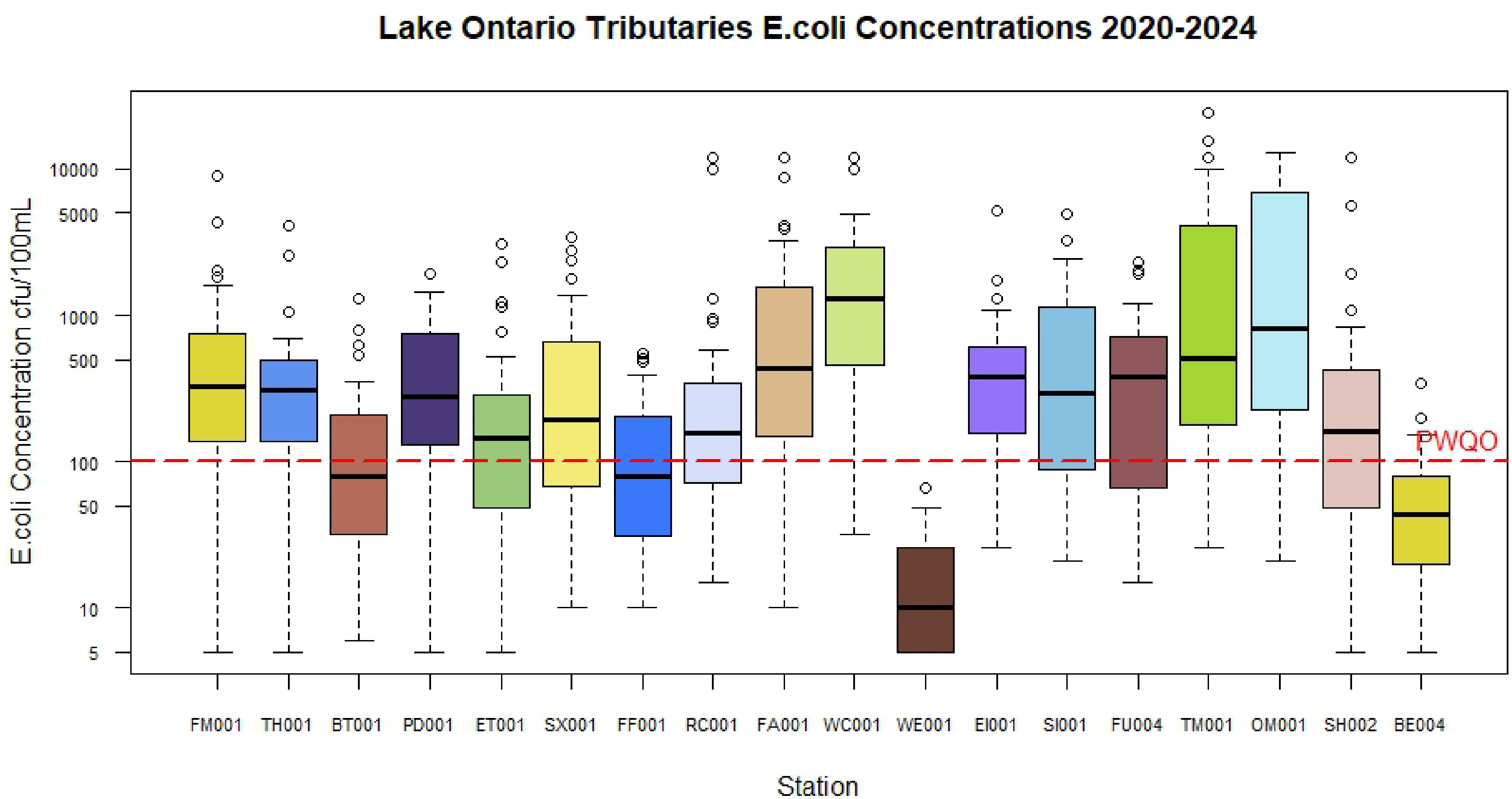
Appendix E: 2020-2024 Median *E.coli* Concentrations and Summary Boxplots

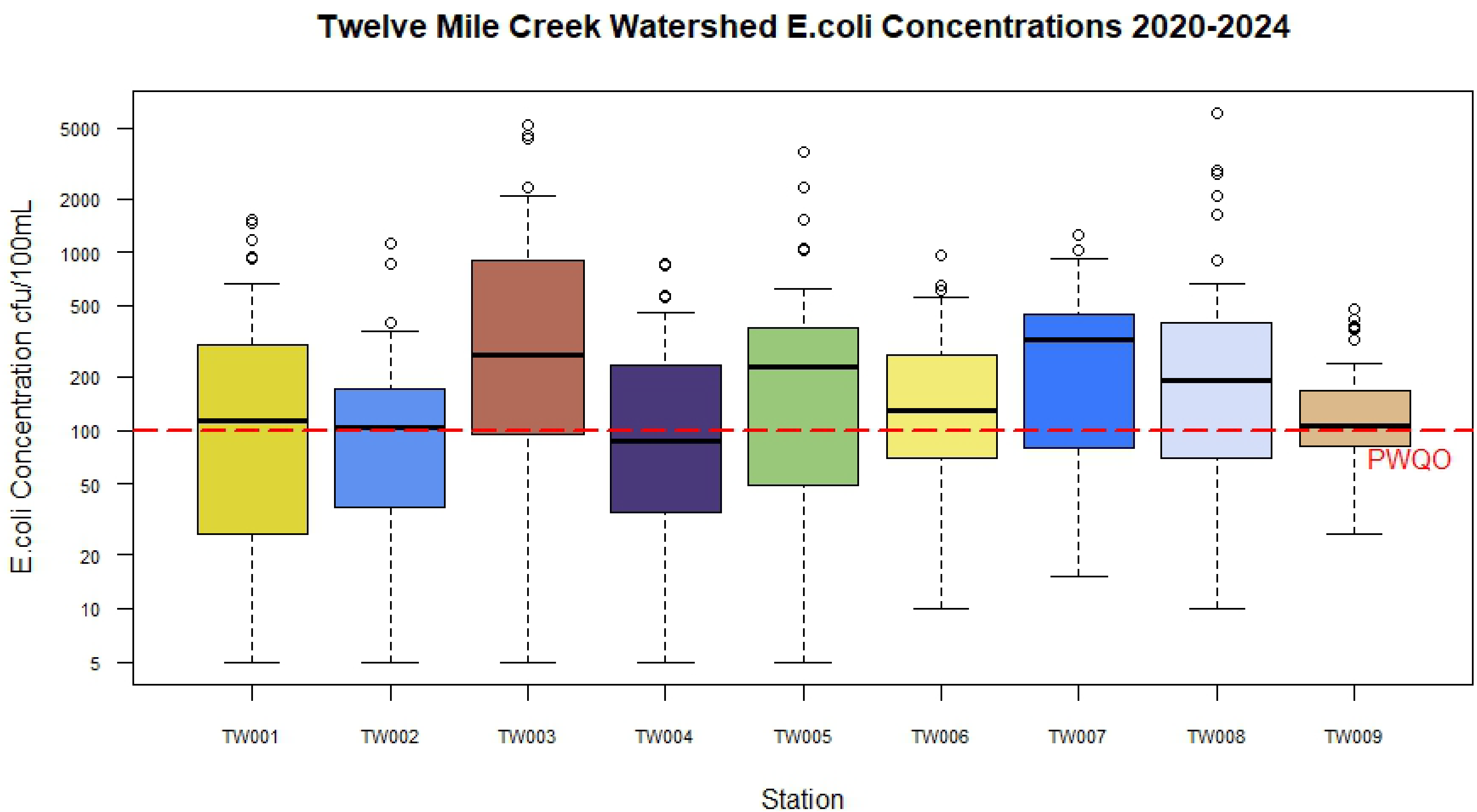

Niagara Peninsula Conservation Authority
Median E.coli Concentrations 2020 - 2024
Lake Ontario
Lake Erie
Hamilton
Haldimand
New York USA
Grand Island
Niagara River
Welland River
Welland Canal
Twenty Mile Creek
Forty Mile Creek
Sixteen Mile Creek
Fifteen Mile Creek
Eighteen Mile Creek
Beaver Creek
Oswego Creek
Coyle Creek
Black Creek
Frenchmans Creek
Usshers Creek
Lyons Creek
Tee Creek
Big Forks Creek
Buckhorn Creek
Elsie Creek
North Creek
Spring Creek
Thirty Mile Creek
Gavora Ditch
Mill Creek
Twelve Mile Creek
Upper Twelve Mile Creek
Lower Twelve Mile Creek
Walker Creek
Eight Mile Creek
Four Mile Creek
Six Mile Creek
Two Mile Creek
One Mile Creek
Shriner Creek
Beaver Dams Creek
Chippawa Power Canal
Thompson Creek
Grassy Brook
Drapers Creek
Bayers Creek
Beaver Dam Drain
Wignell Drain
Eagle Marsh Drain
Casey Drain
Low Banks Drain
Port Albino Drain
Kraft Drain
Surface Water Quality Stations
E.coli (cfu/100mL)
Insifficient Data
<25
25 - 100
101 - 500
>500
Waterbodies
NPCA Jurisdiction
Sampled Subwatersheds
Scale: 1:230,000
0 5 10 20 30
Kilometers
N
All Frames: North American Datum 1983, Universal Transverse Mercator 6° Projection, Zone 17N, Central Meridian 81° West.
Produced by the Niagara Peninsula Conservation Authority with data supplied under license by members of the Ontario Geospatial Data Exchange, 2017.
Ontario
New York
Lake Ontario
Lake Erie

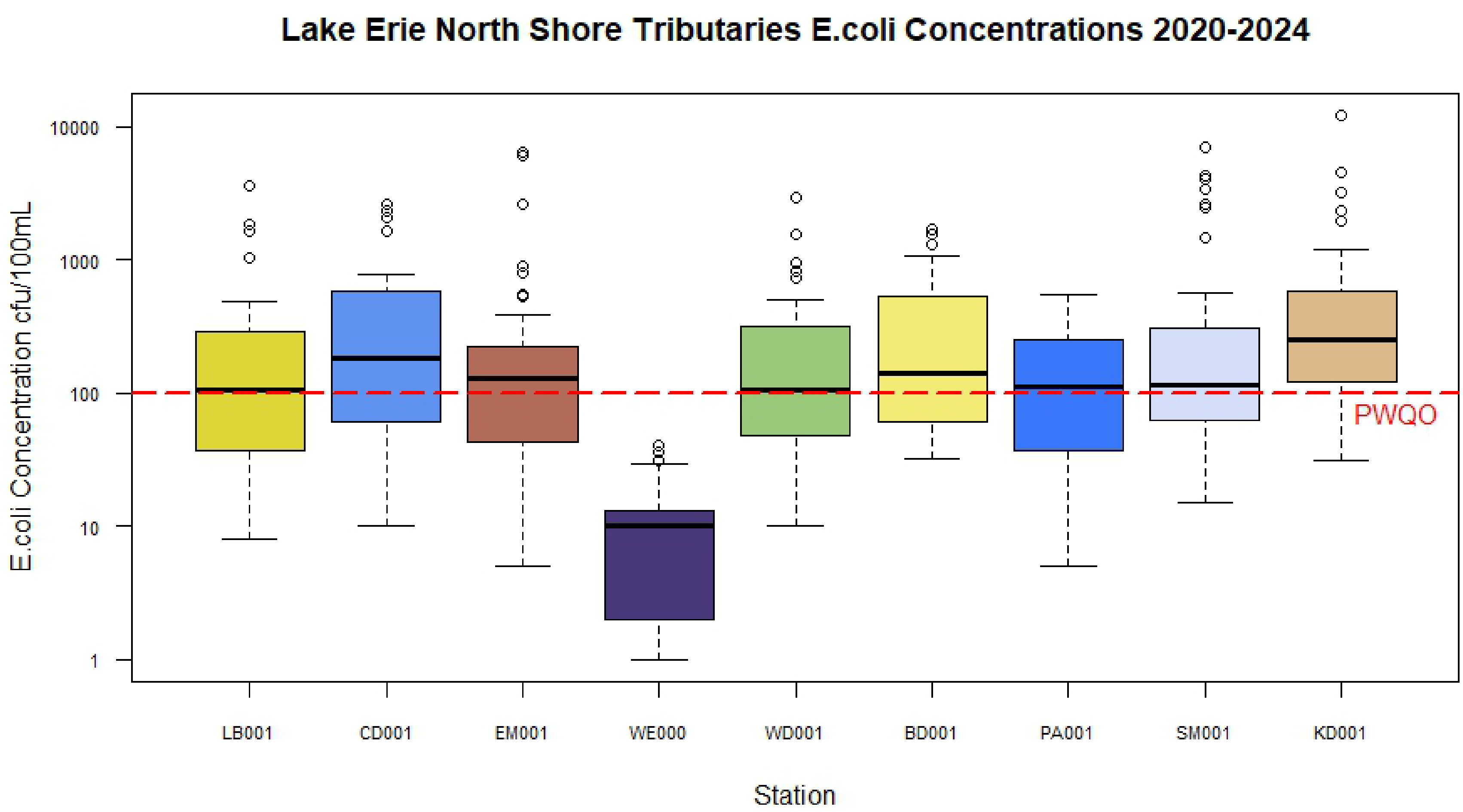

Welland River Watershed E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
10000
1000
100
10
1
PWQO
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

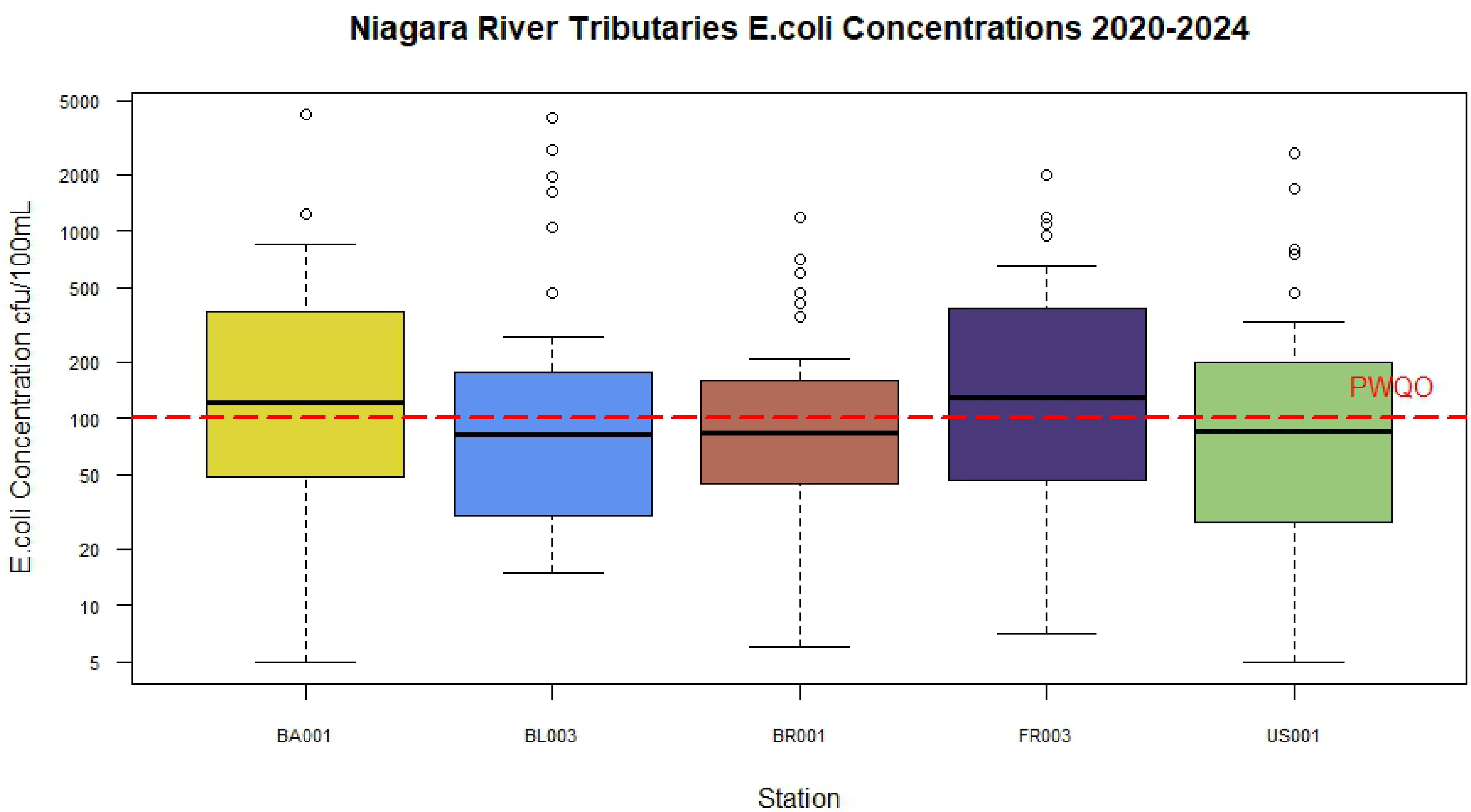

Welland River Tributaries E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
10000
1000
100
10
1
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

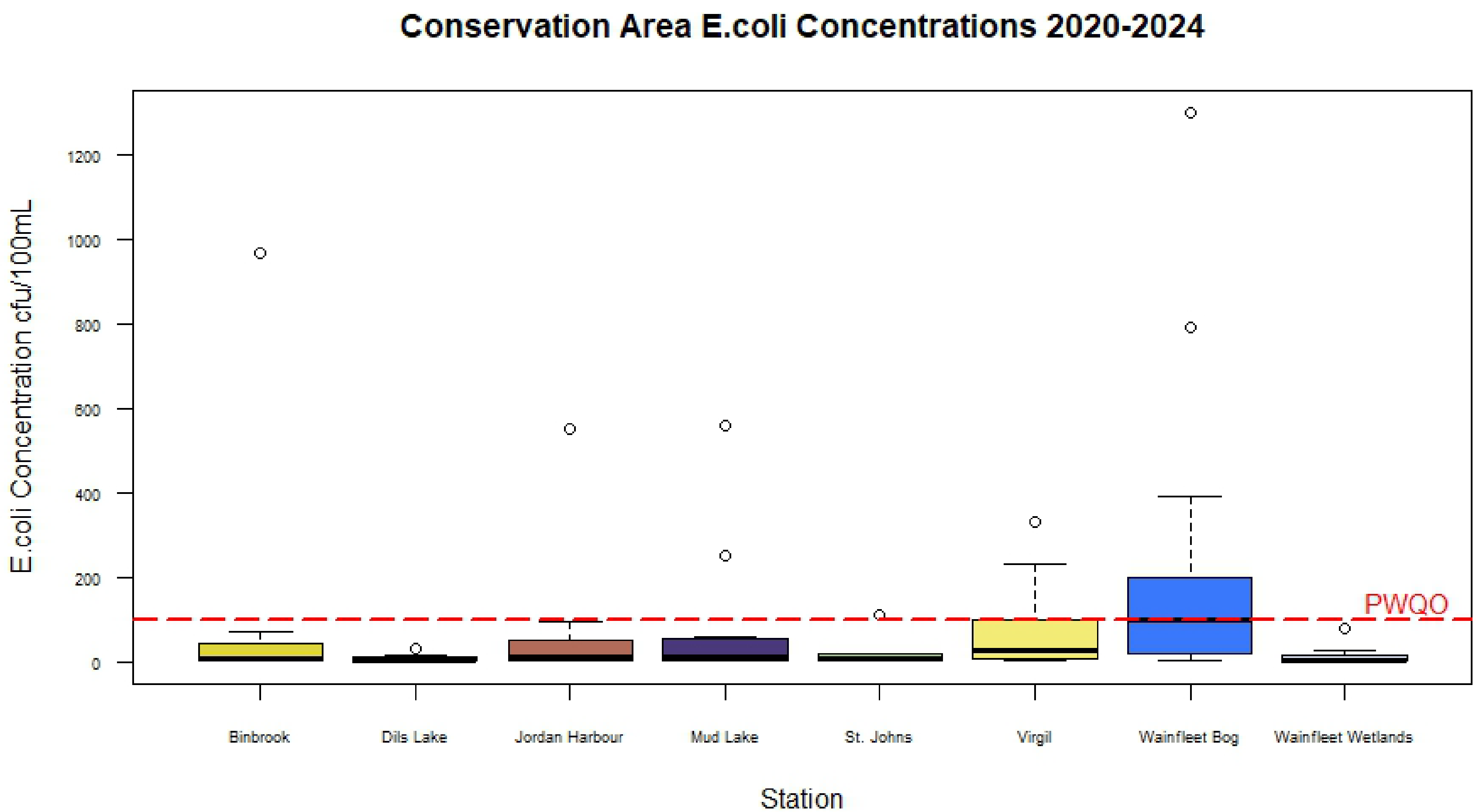

Twenty Mile Creek E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
10000
1000
100
10
1
PWQO
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station


Lake Ontario Tributaries E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
10000
5000
1000
500
100
50
10
5
PWQO
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station

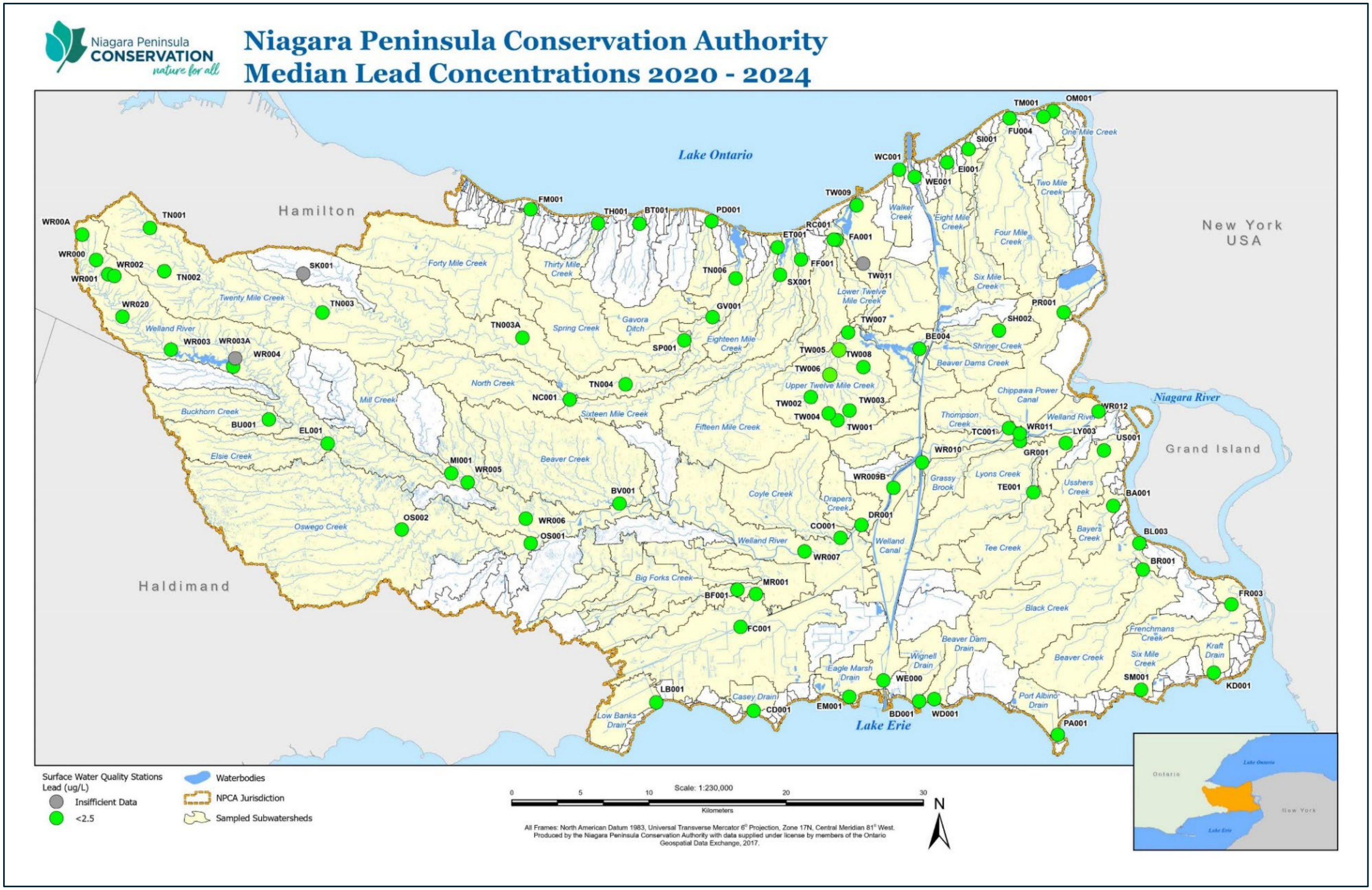

Twelve Mile Creek Watershed E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
5000
2000
1000
500
200
100
50
20
10
5
PWQO
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

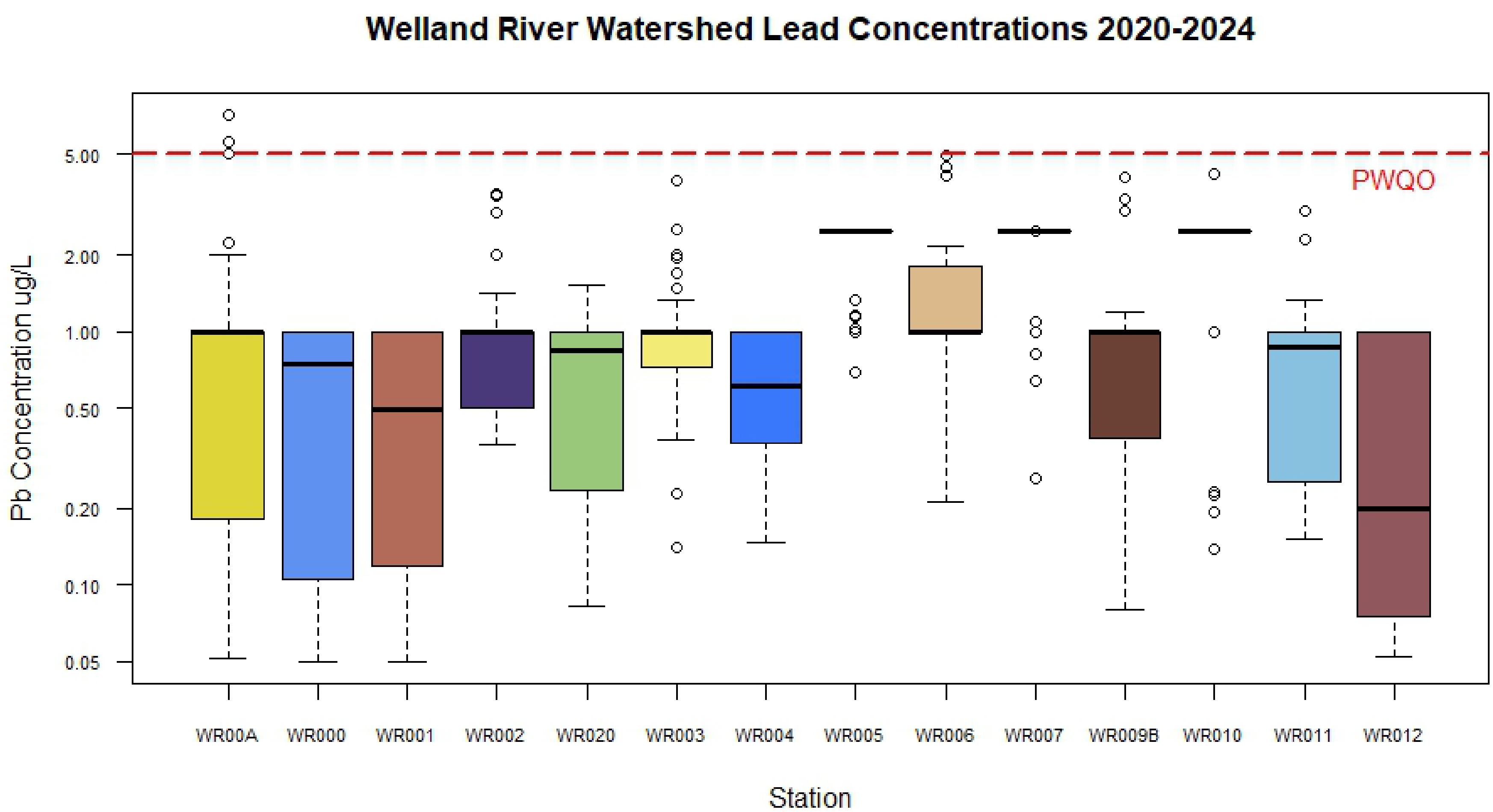

Lake Erie North Shore Tributaries E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
10000
1000
100
10
1
PWQO
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

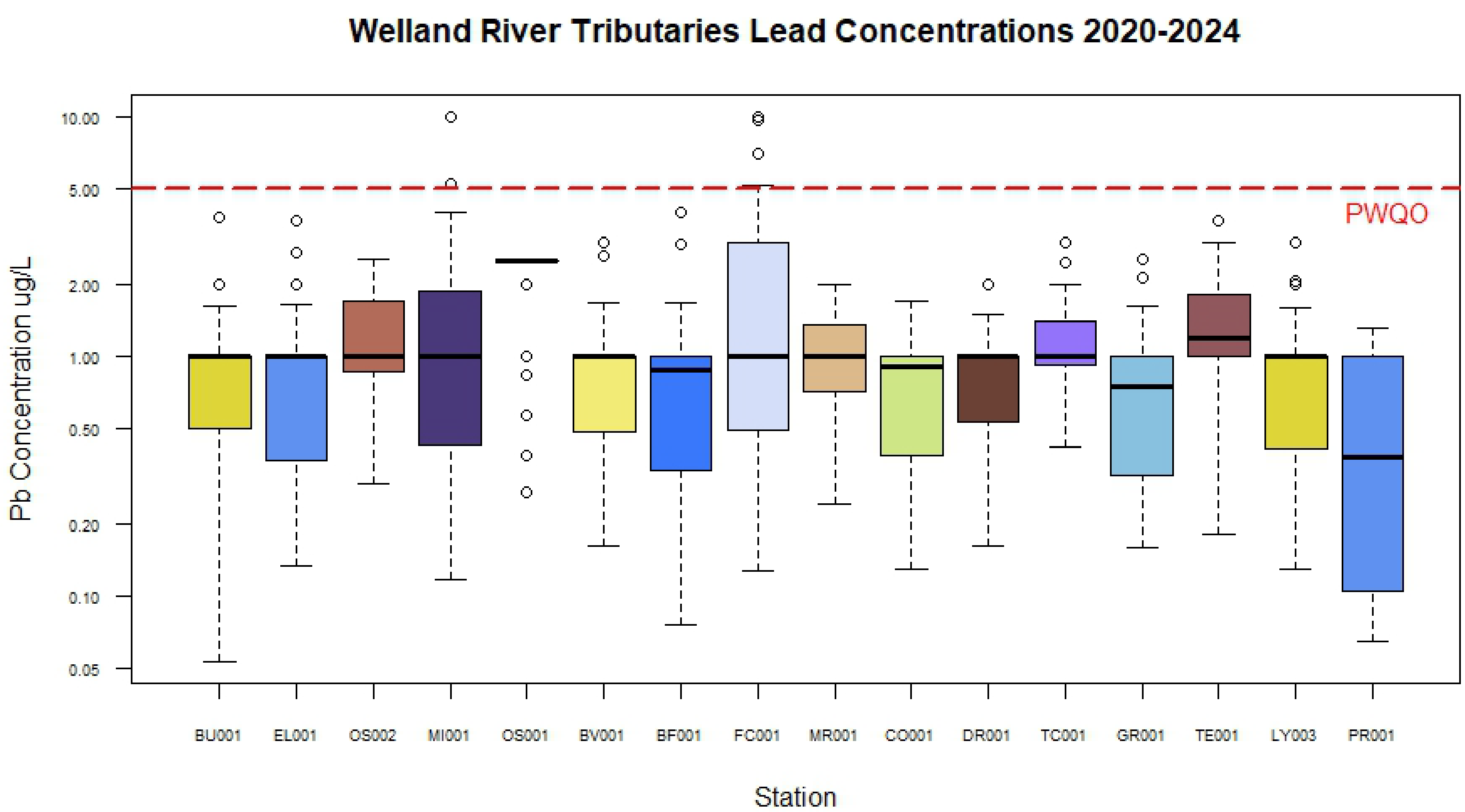

Niagara River Tributaries E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
5000
2000
1000
500
200
100
50
20
10
5
PWQO
BA001
BL003
BR001
FR003
US001
Station

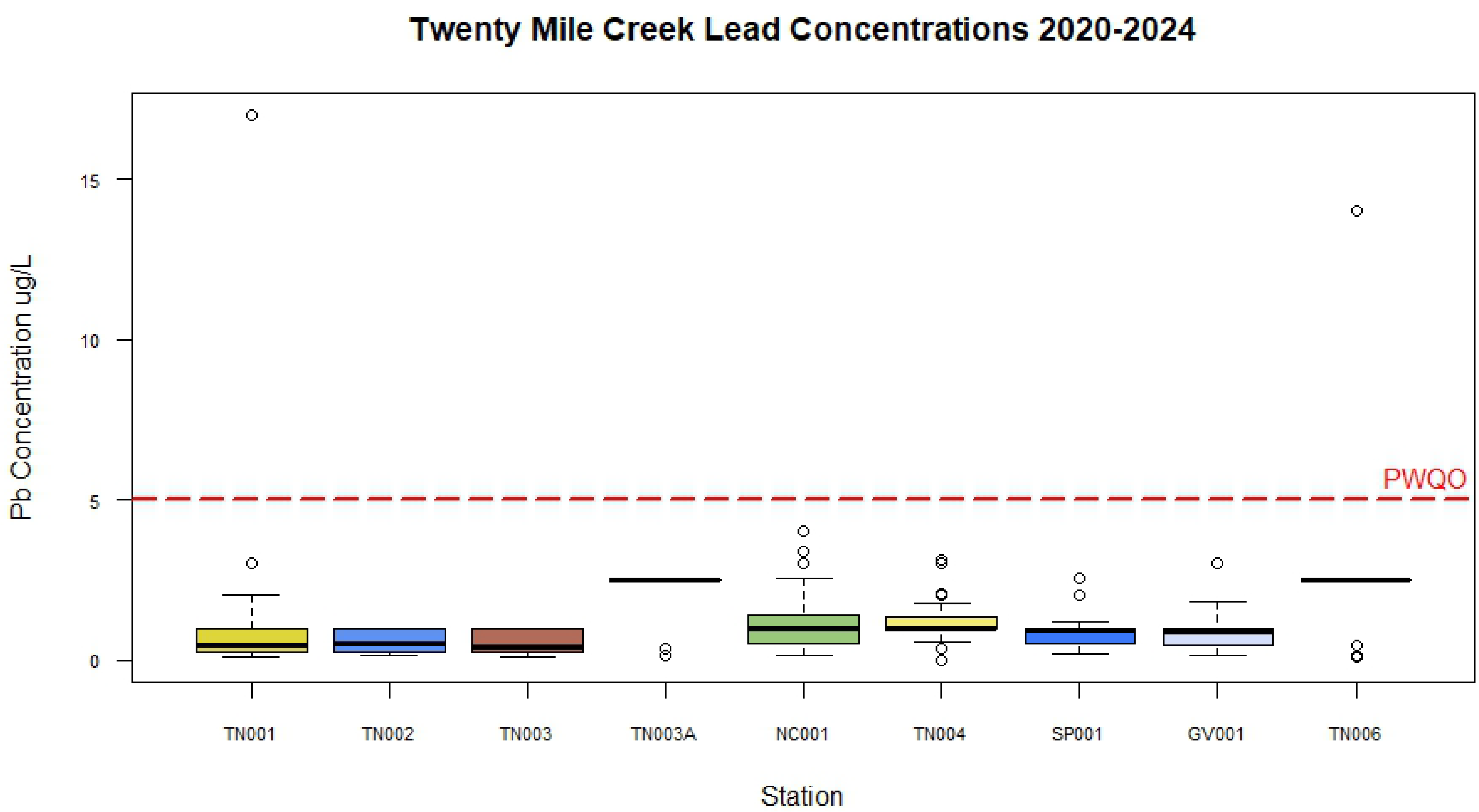

Conservation Area E.coli Concentrations 2020-2024
E.coli Concentration cfu/100mL
0
200
400
600
800
1000
1200
PWQO
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

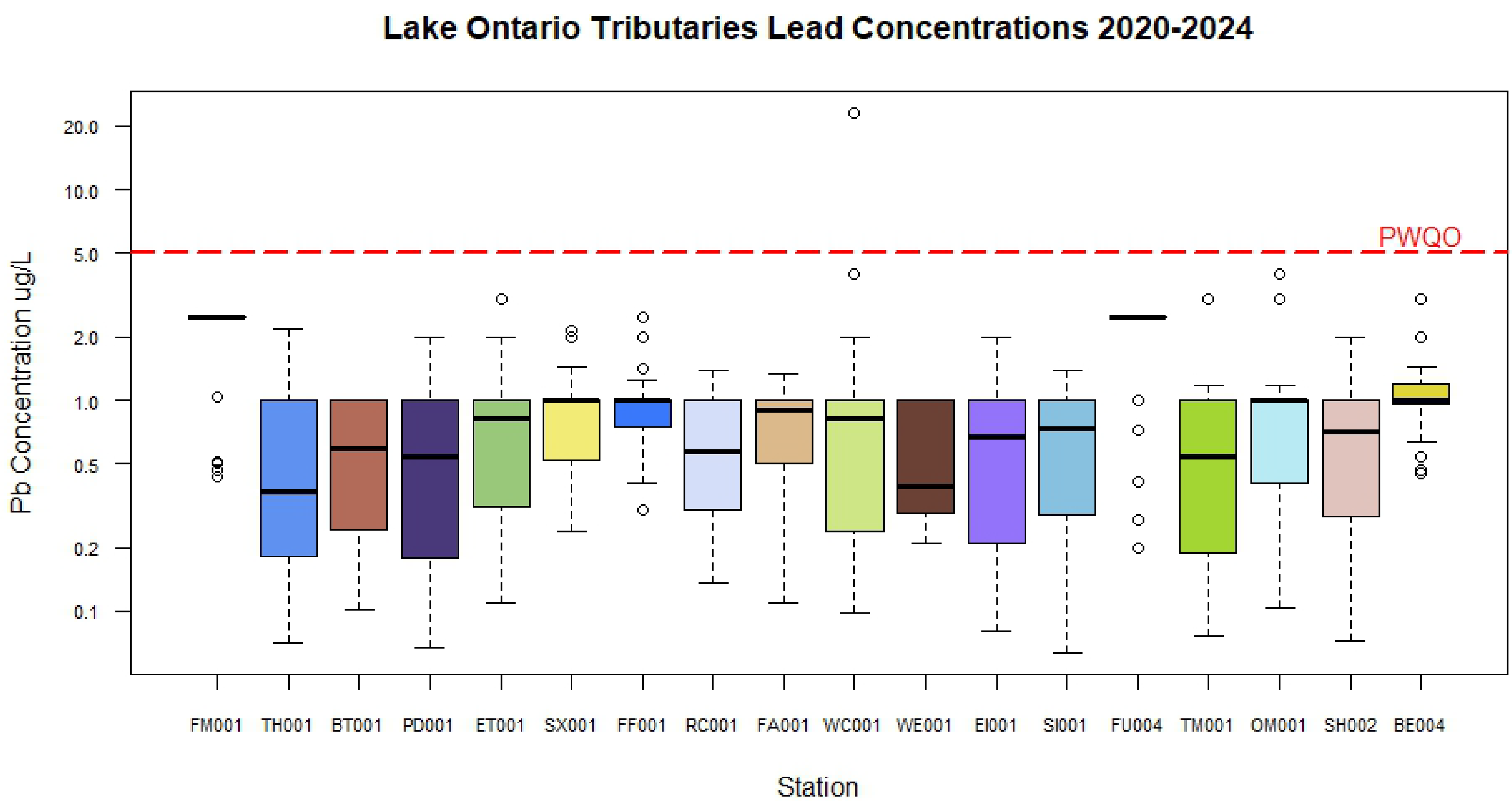
Appendix F: 2020-2024 Median Lead Concentrations and Summary Boxplots

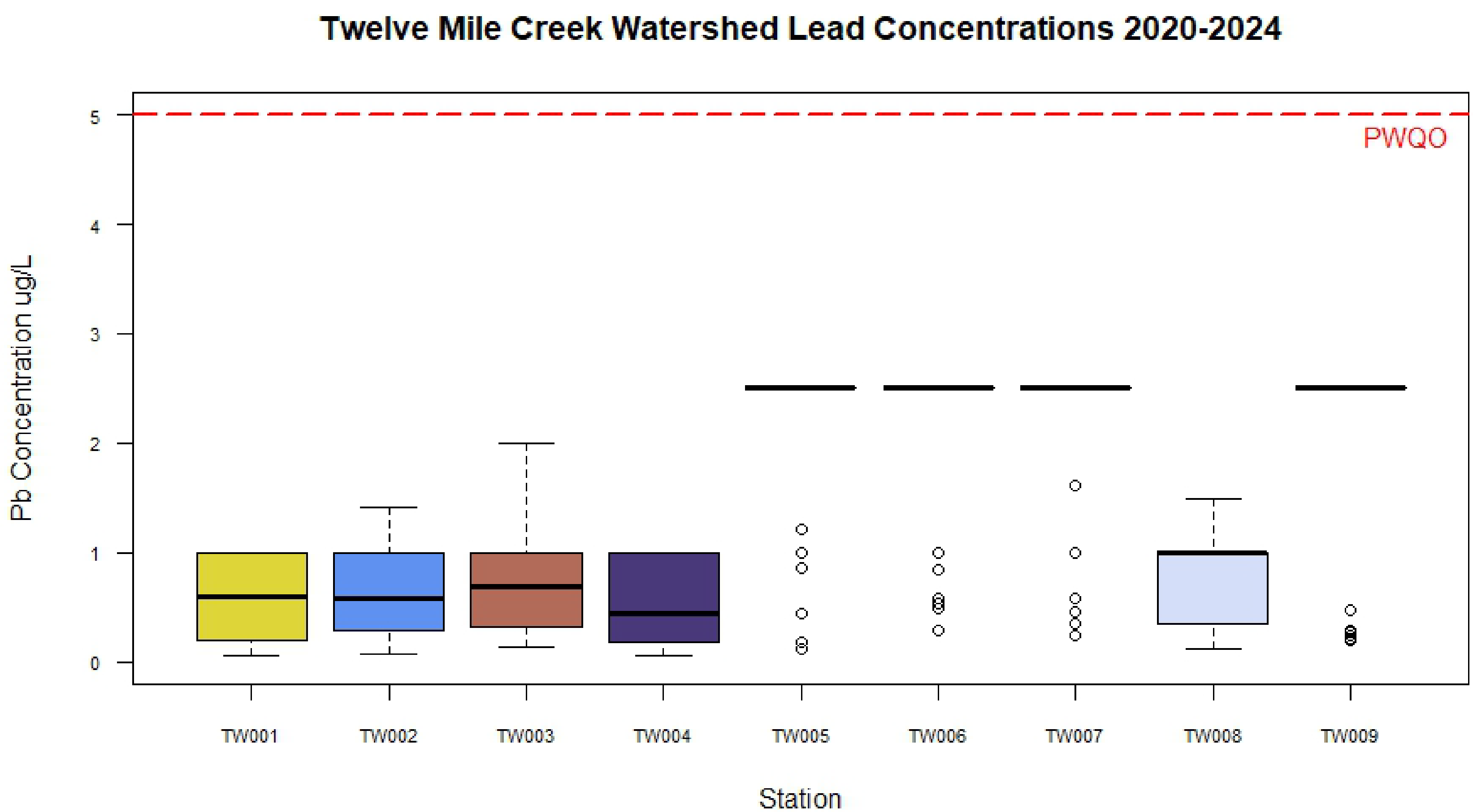

Niagara Peninsula Conservation Authority
Median Lead Concentrations 2020 - 2024
Lake Ontario
Hamilton
Haldimand
New York USA
Grand Island
Niagara River
Lake Erie
Surface Water Quality Stations Lead (ug/L)
Insufficient Data
<2.5
Waterbodies
NPCA Jurisdiction
Sampled Subwatersheds
Scale: 1:230,000
Kilometers
N
All Frames: North American Datum 1983, Universal Transverse Mercator 6° Projection, Zone 17N, Central Meridian 81° West.
Produced by the Niagara Peninsula Conservation Authority with data supplied under license by members of the Ontario Geospatial Data Exchange, 2017.

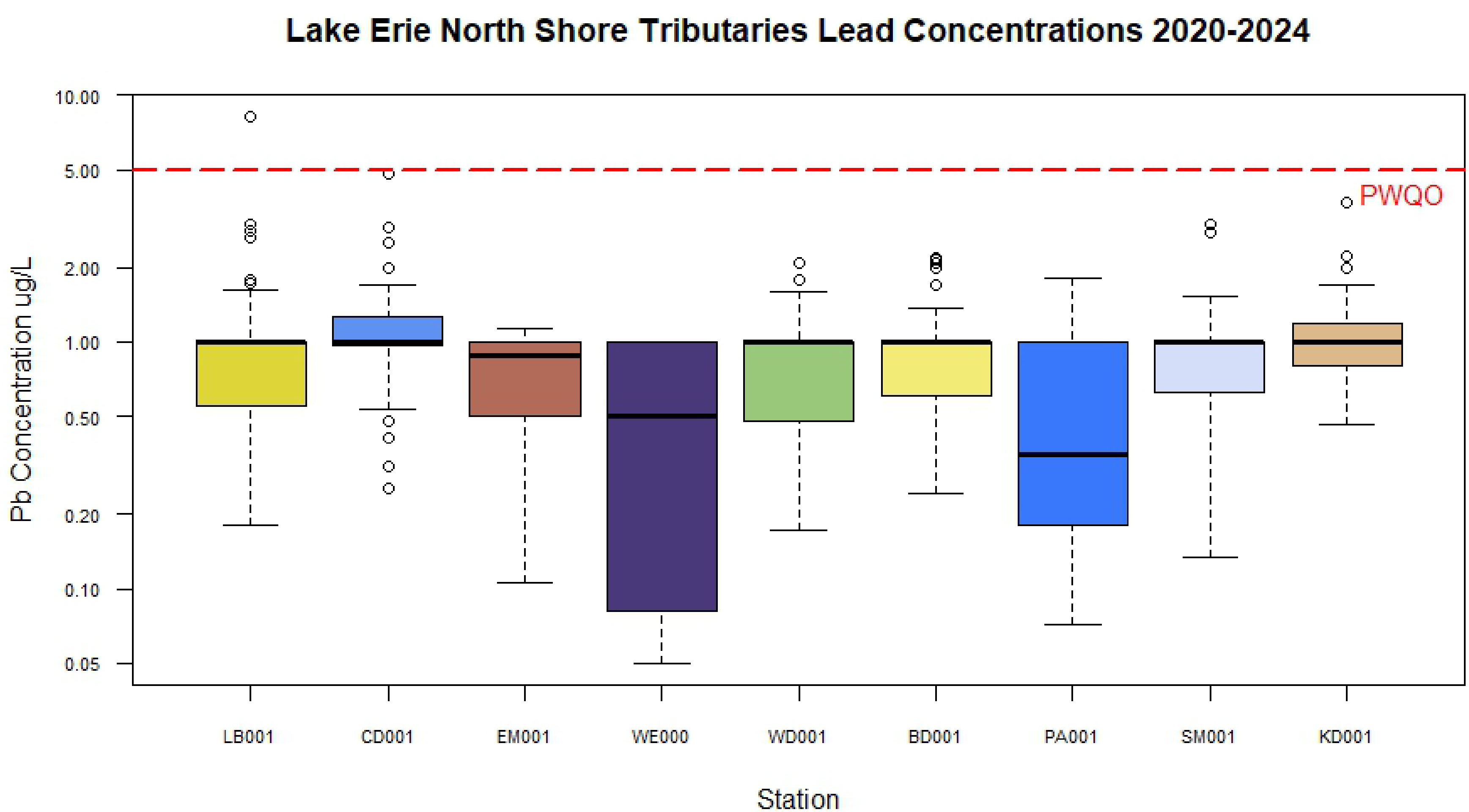

Welland River Watershed Lead Concentrations 2020-2024
Pb Concentration ug/L
5.00
2.00
1.00
0.50
0.20
0.10
0.05
PWQO
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

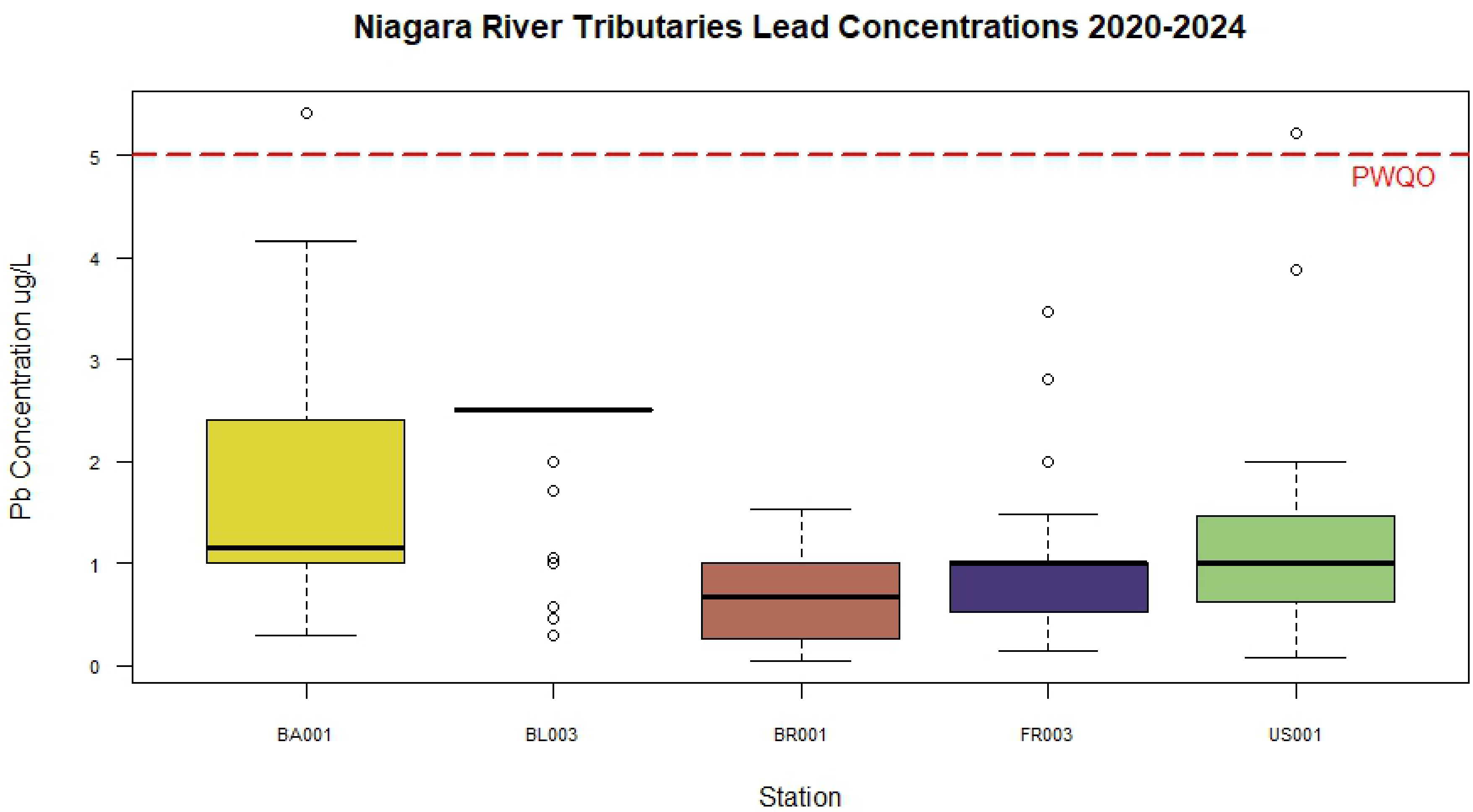

Welland River Tributaries Lead Concentrations 2020-2024
Pb Concentration ug/L
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

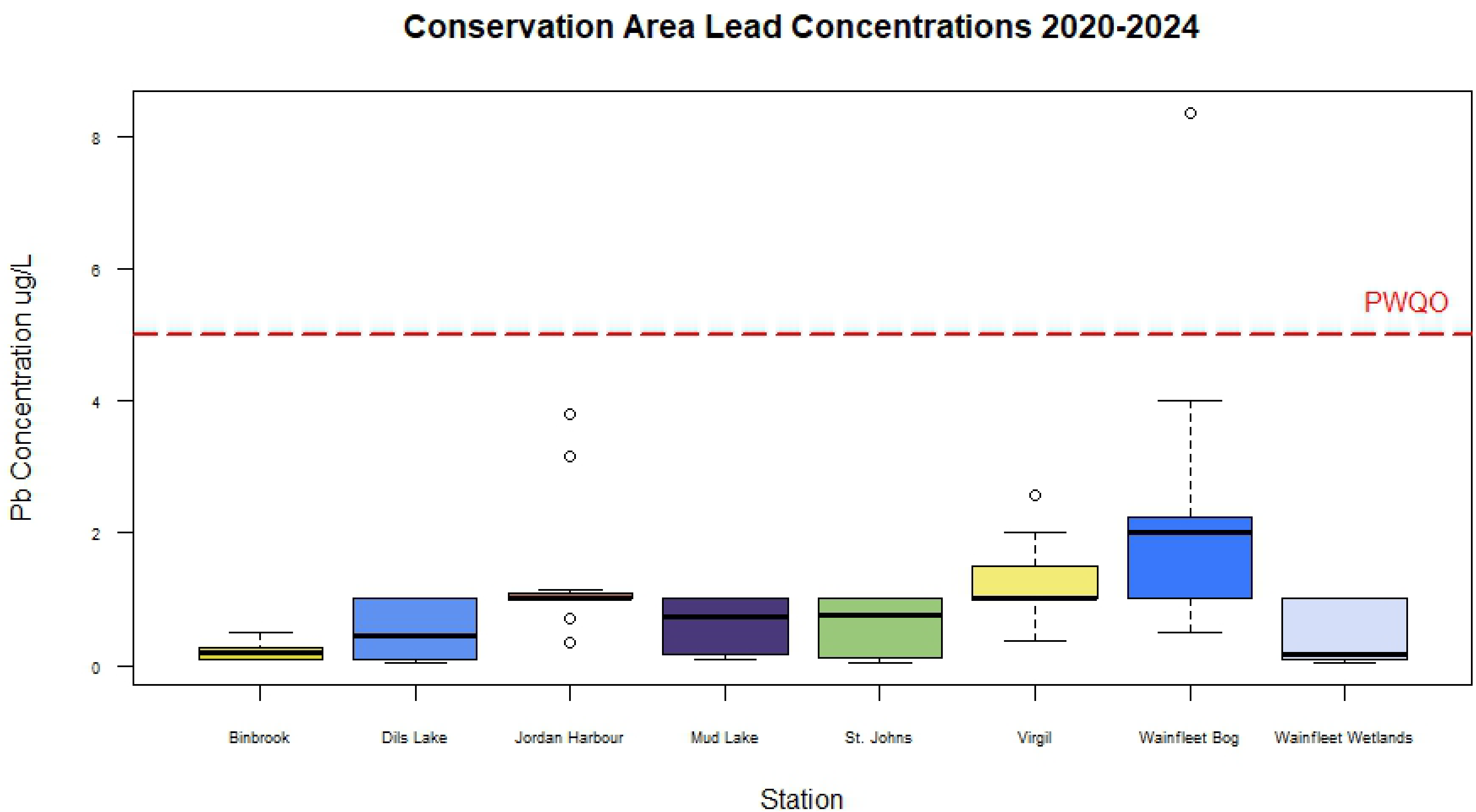

Twenty Mile Creek Lead Concentrations 2020-2024
Pb Concentration ug/L
15
10
5
0
PWQO
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station


Lake Ontario Tributaries Lead Concentrations 2020-2024
Pb Concentration ug/L
20.0
10.0
5.0
2.0
1.0
0.5
0.2
0.1
PWQO
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station


Twelve Mile Creek Watershed Lead Concentrations 2020-2024
PWQO
Pb Concentration ug/L
0
1
2
3
4
5
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

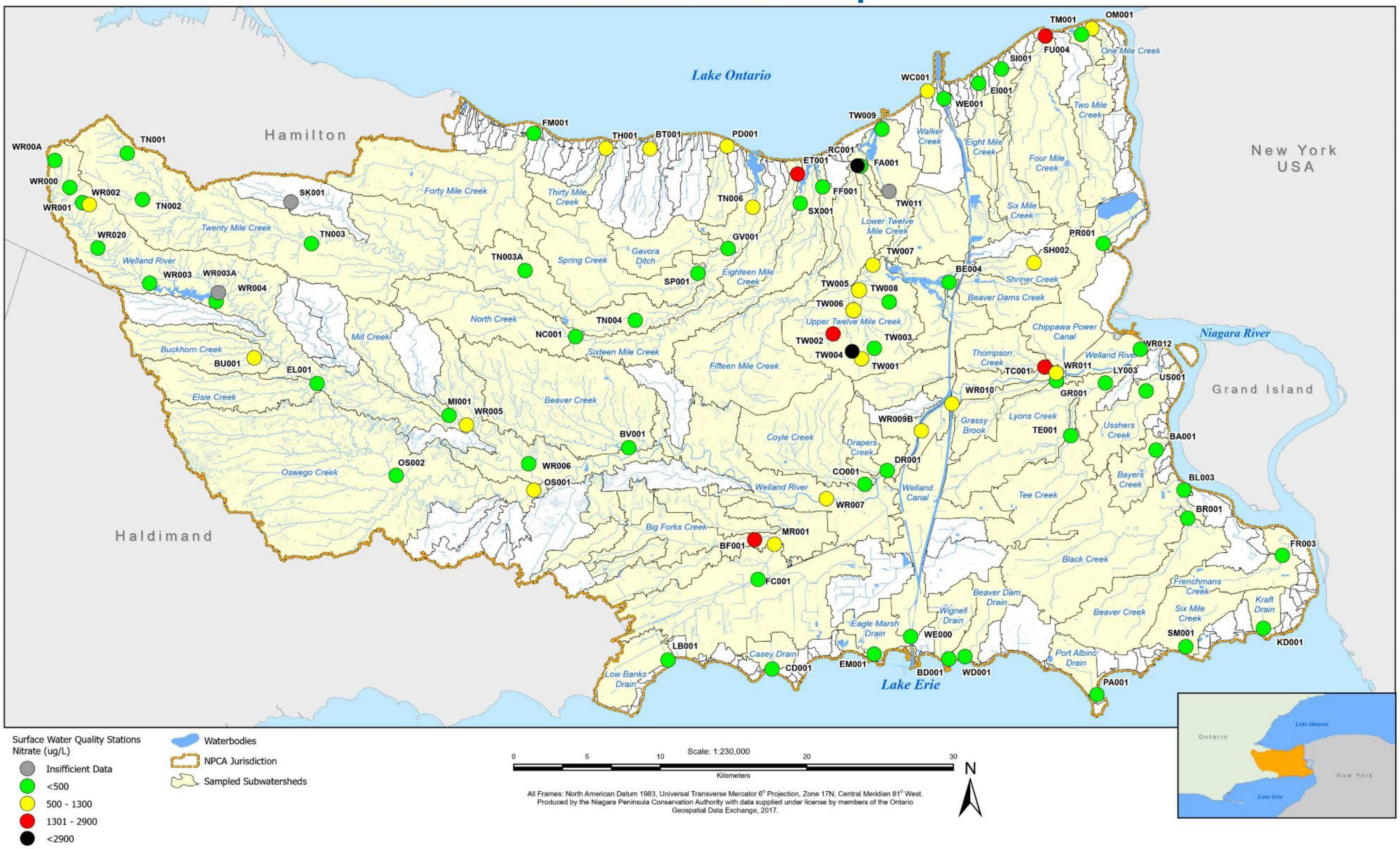

Lake Erie North Shore Tributaries Lead Concentrations 2020-2024
Pb Concentration ug/L
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
PWQO
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

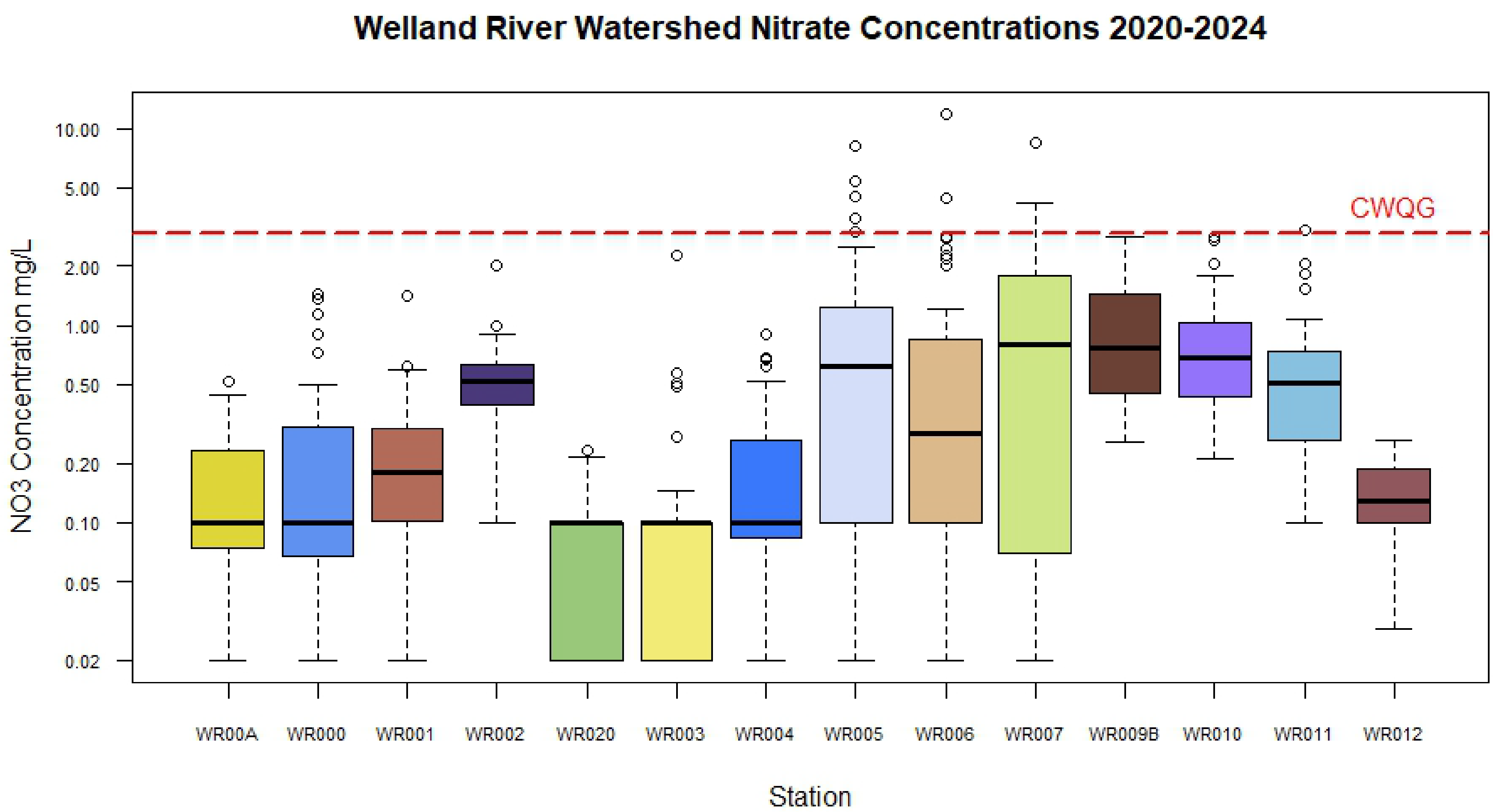

Niagara River Tributaries Lead Concentrations 2020-2024
Pb Concentration ug/L
0
1
2
3
4
5
PWQO
BA001
BL003
BR001
FR003
US001
Station

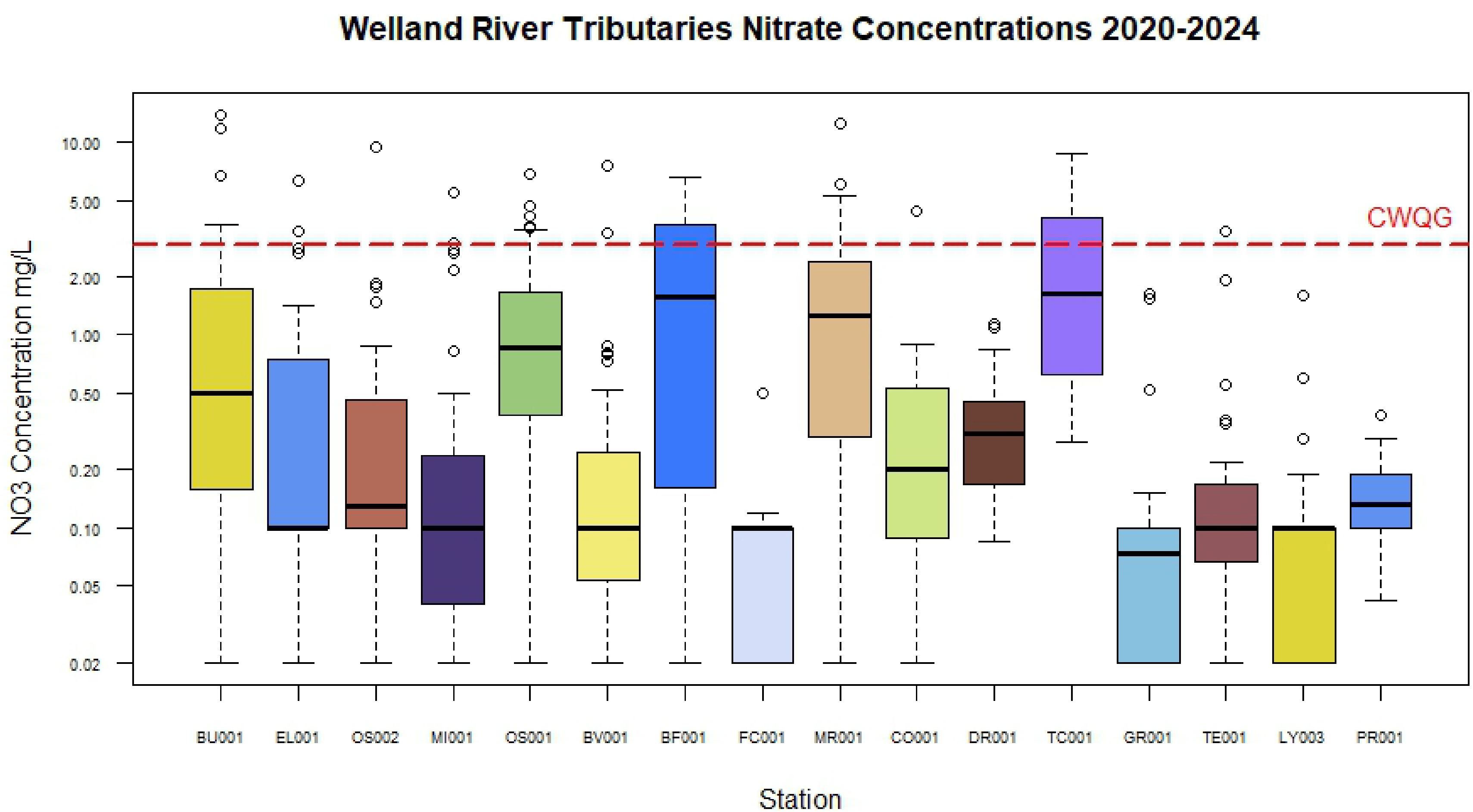

Conservation Area Lead Concentrations 2020-2024
Pb Concentration ug/L
8
6
4
2
0
PWQO
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

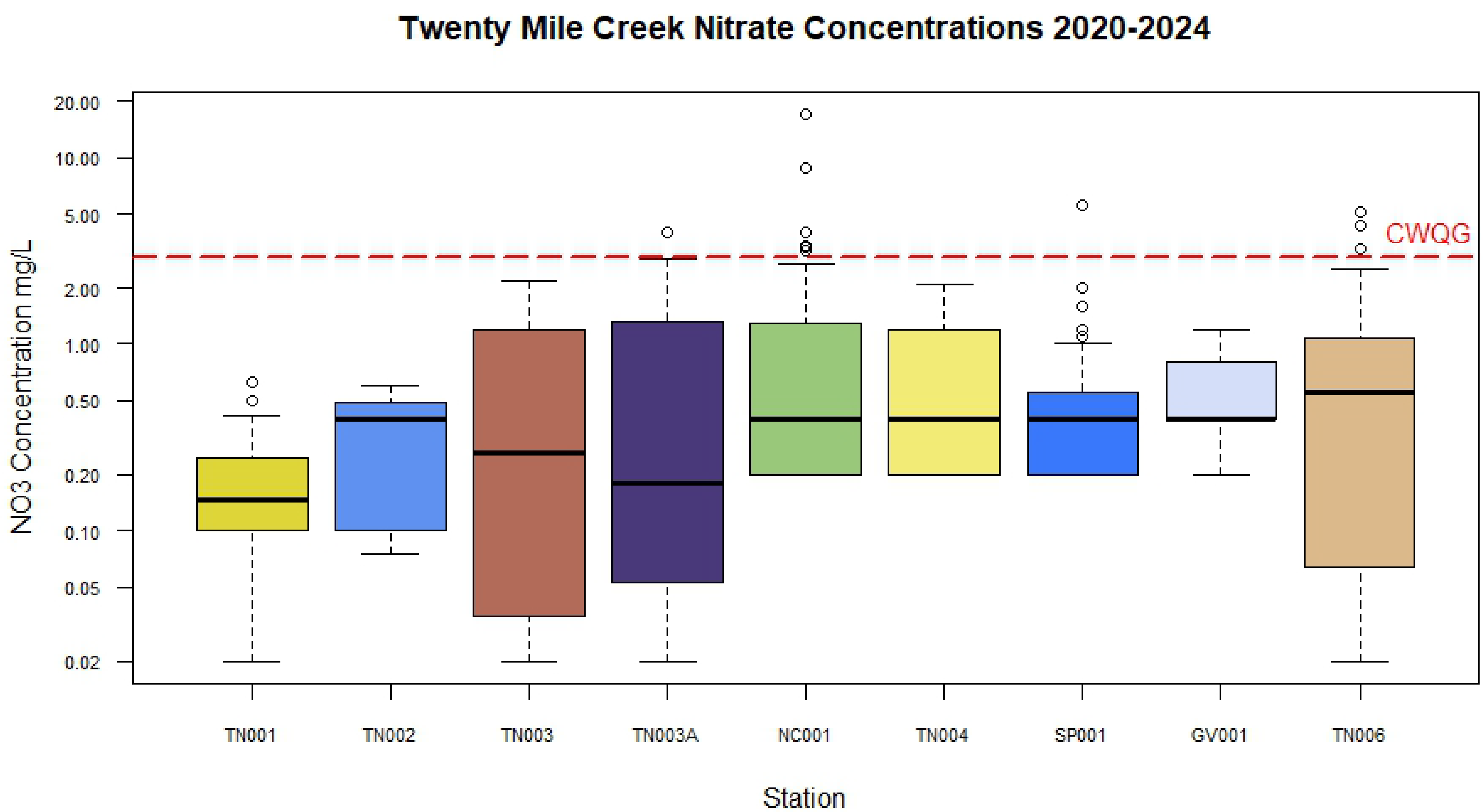
Appendix G: 2020-2024 Median Nitrate Concentrations and Summary Boxplots

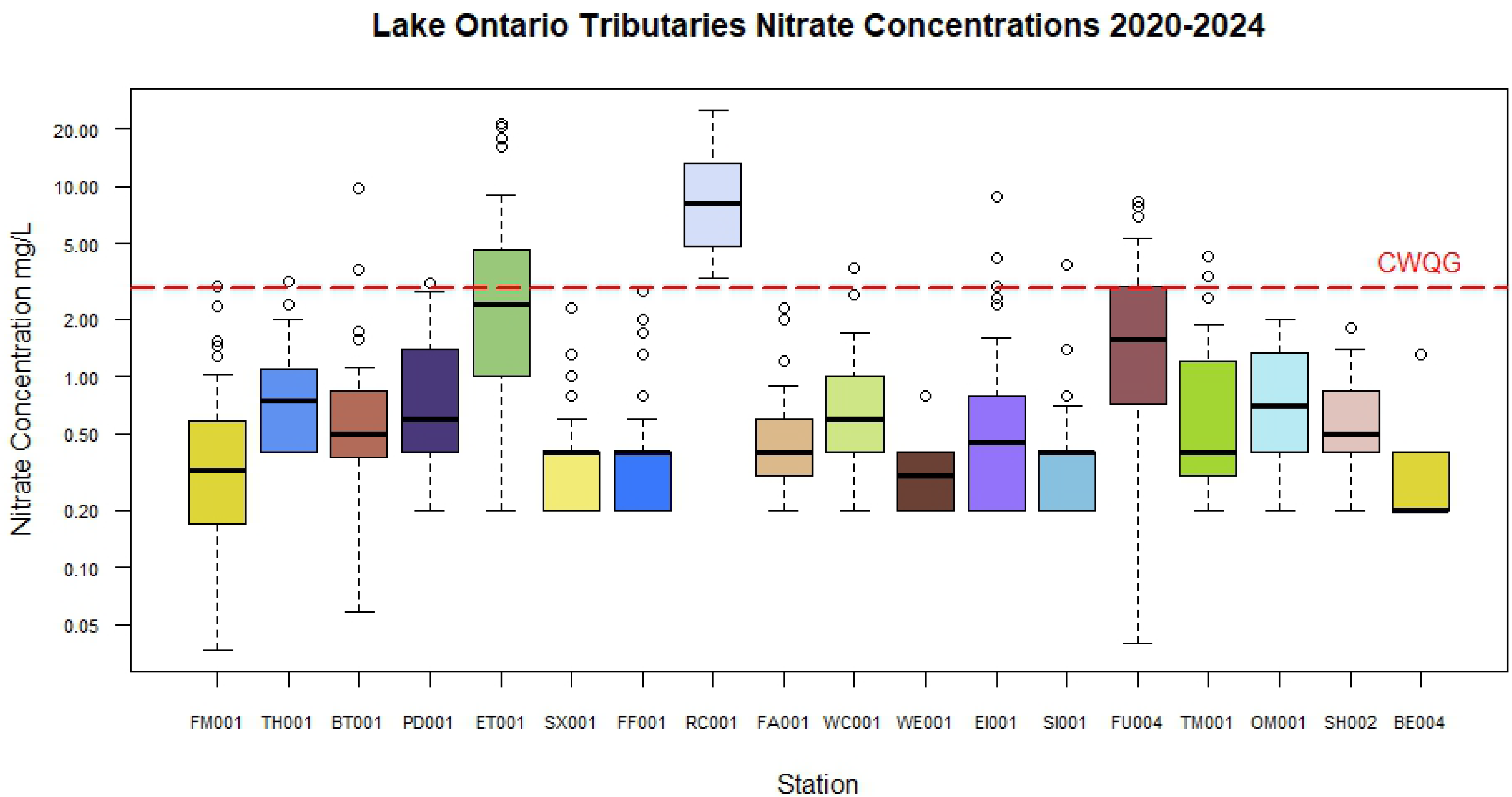
Niagara Peninsula Conservation Authority
Median Nitrate Concentrations 2020 - 2024

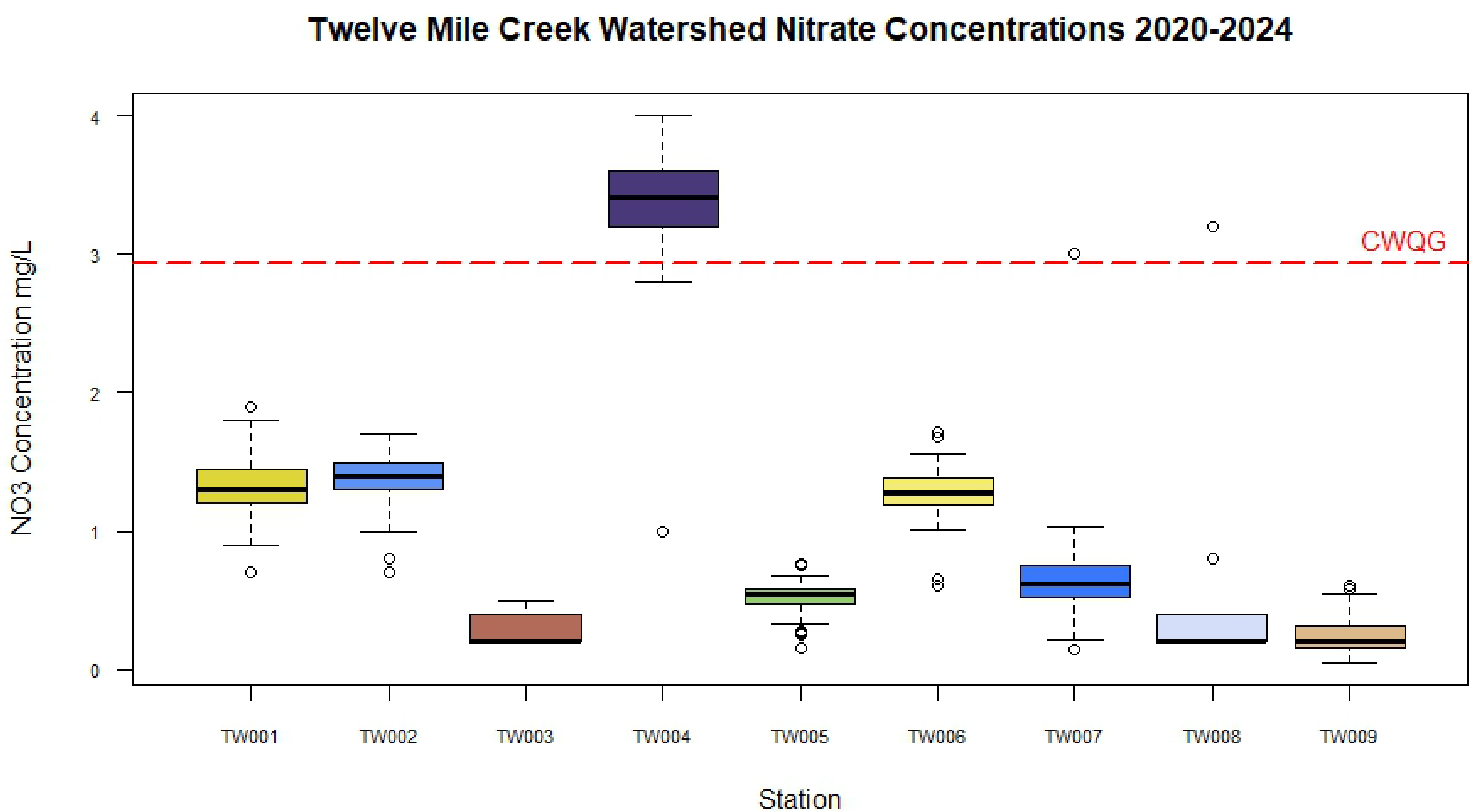


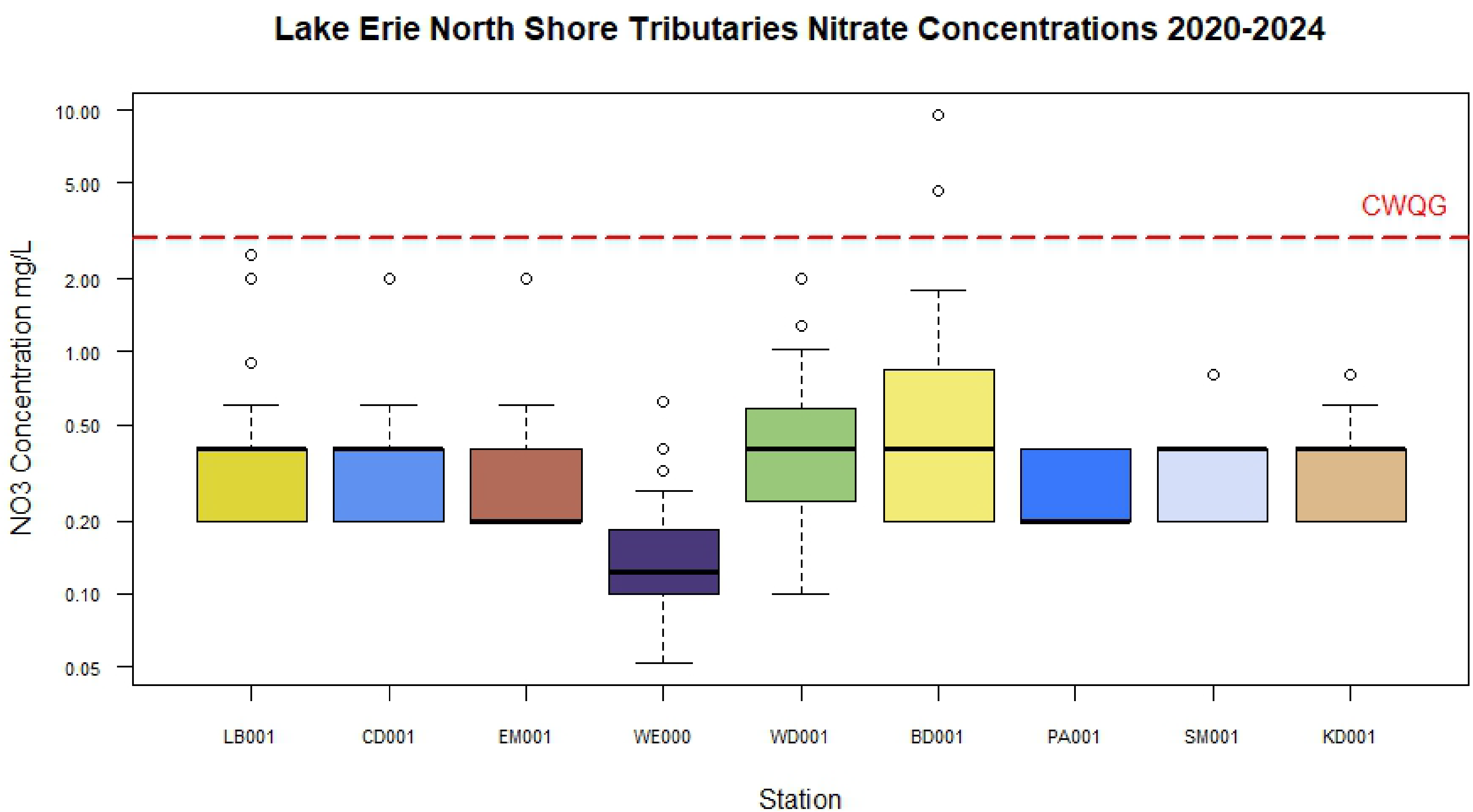

Welland River Watershed Nitrate Concentrations 2020-2024
NO3 Concentration mg/L
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
0.02
CWQG
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

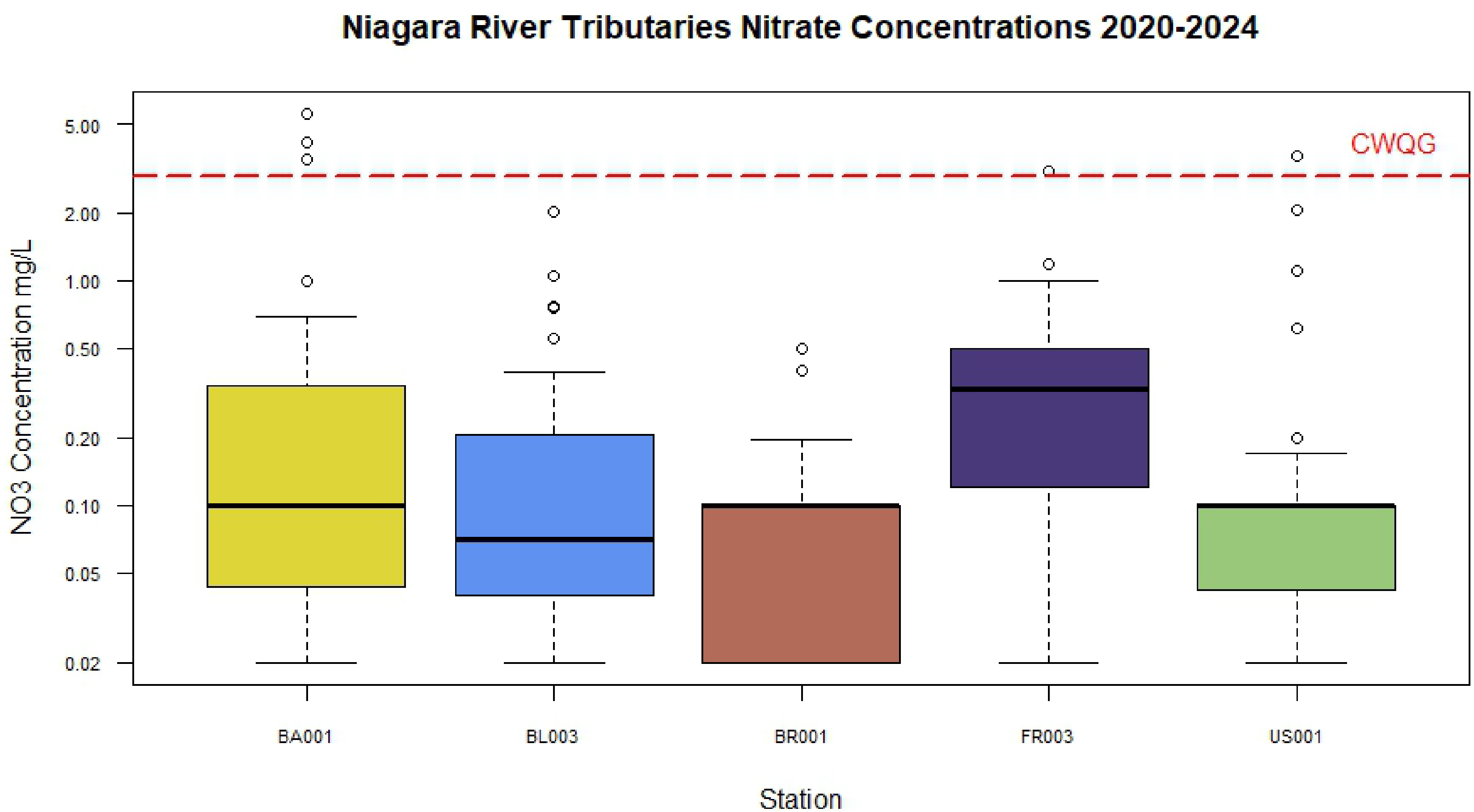

Welland River Tributaries Nitrate Concentrations 2020-2024
NO3 Concentration mg/L
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
0.02
CWQG
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

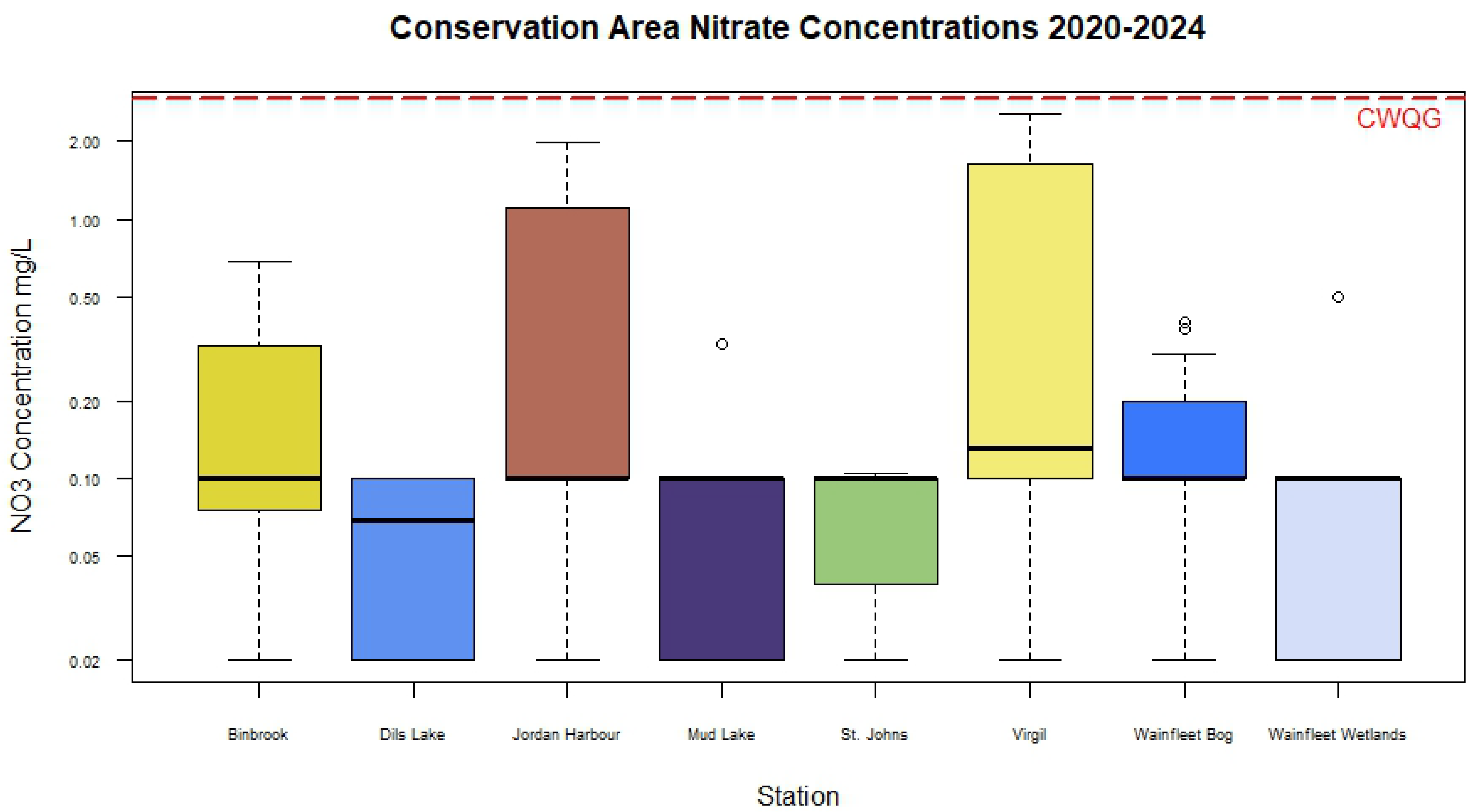

Twenty Mile Creek Nitrate Concentrations 2020-2024
NO3 Concentration mg/L
20.00
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
0.02
CWQG
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station


Lake Ontario Tributaries Nitrate Concentrations 2020-2024
Nitrate Concentration mg/L
20.00
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
CWQG
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station


Twelve Mile Creek Watershed Nitrate Concentrations 2020-2024
NO3 Concentration mg/L
0
1
2
3
4
CWQG
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

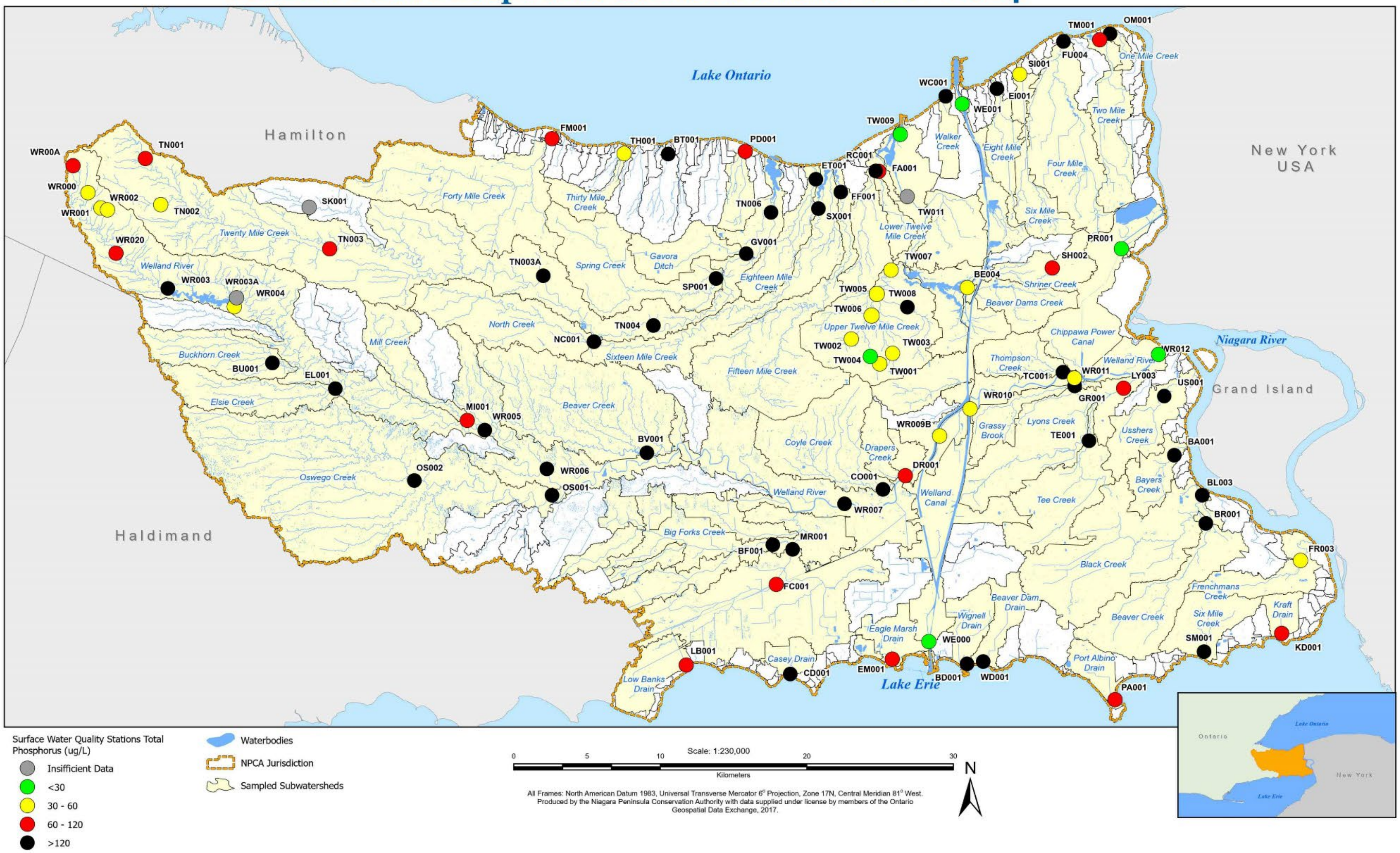

Lake Erie North Shore Tributaries Nitrate Concentrations 2020-2024
NO3 Concentration mg/L
10.00
5.00
2.00
1.00
0.50
0.20
0.10
0.05
CWQG
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

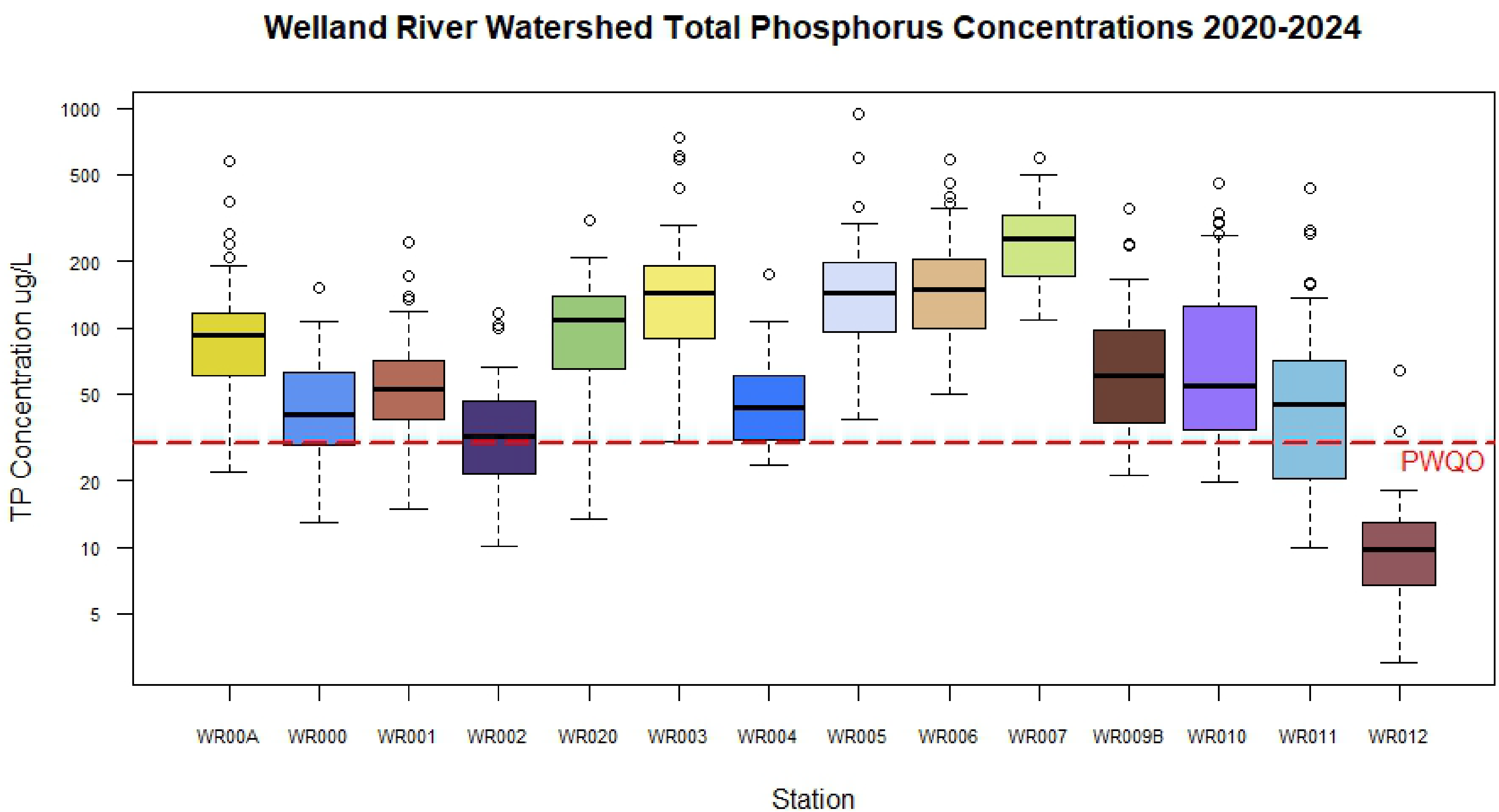

Niagara River Tributaries Nitrate Concentrations 2020-2024
CWQG
NO3 Concentration mg/L
5.00
2.00
1.00
0.50
0.20
0.10
0.05
0.02
BA001
BL003
BR001
FR003
US001
Station

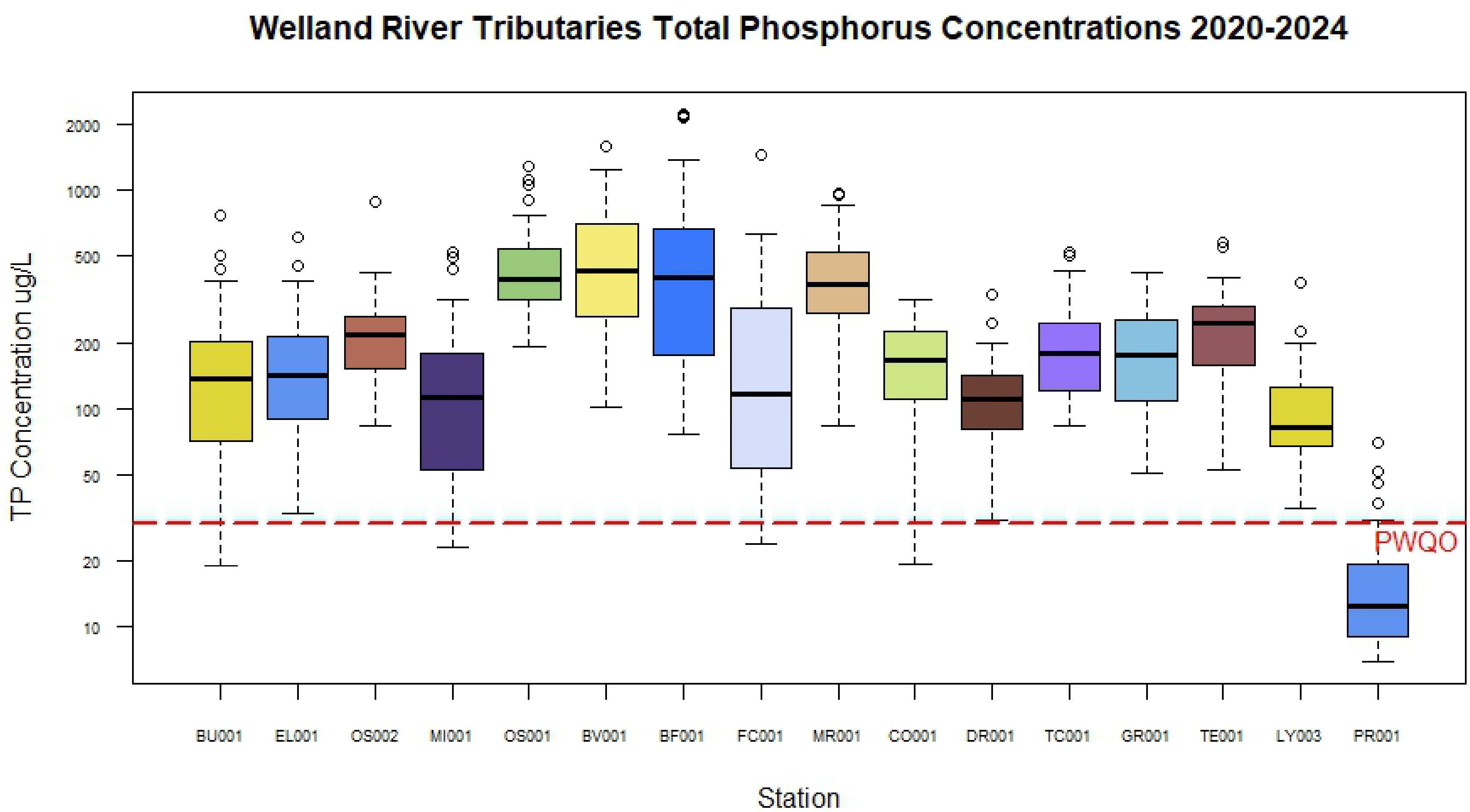

Conservation Area Nitrate Concentrations 2020-2024
CWQG
2.00
1.00
0.50
0.20
0.10
0.05
0.02
NO3 Concentration mg/L
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

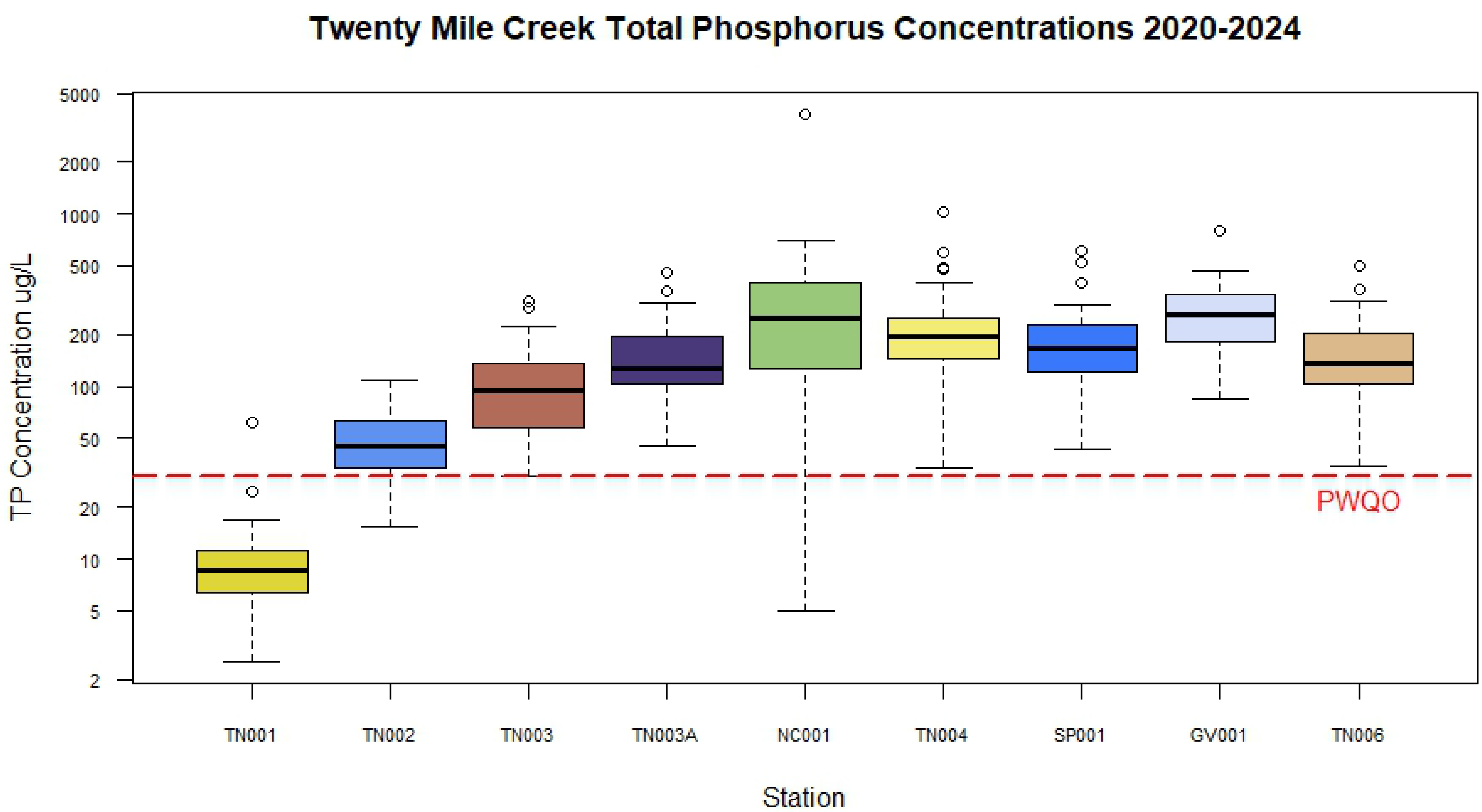
Appendix H: 2020-2024 Median Total Phosphorus Concentrations and Summary Boxplots

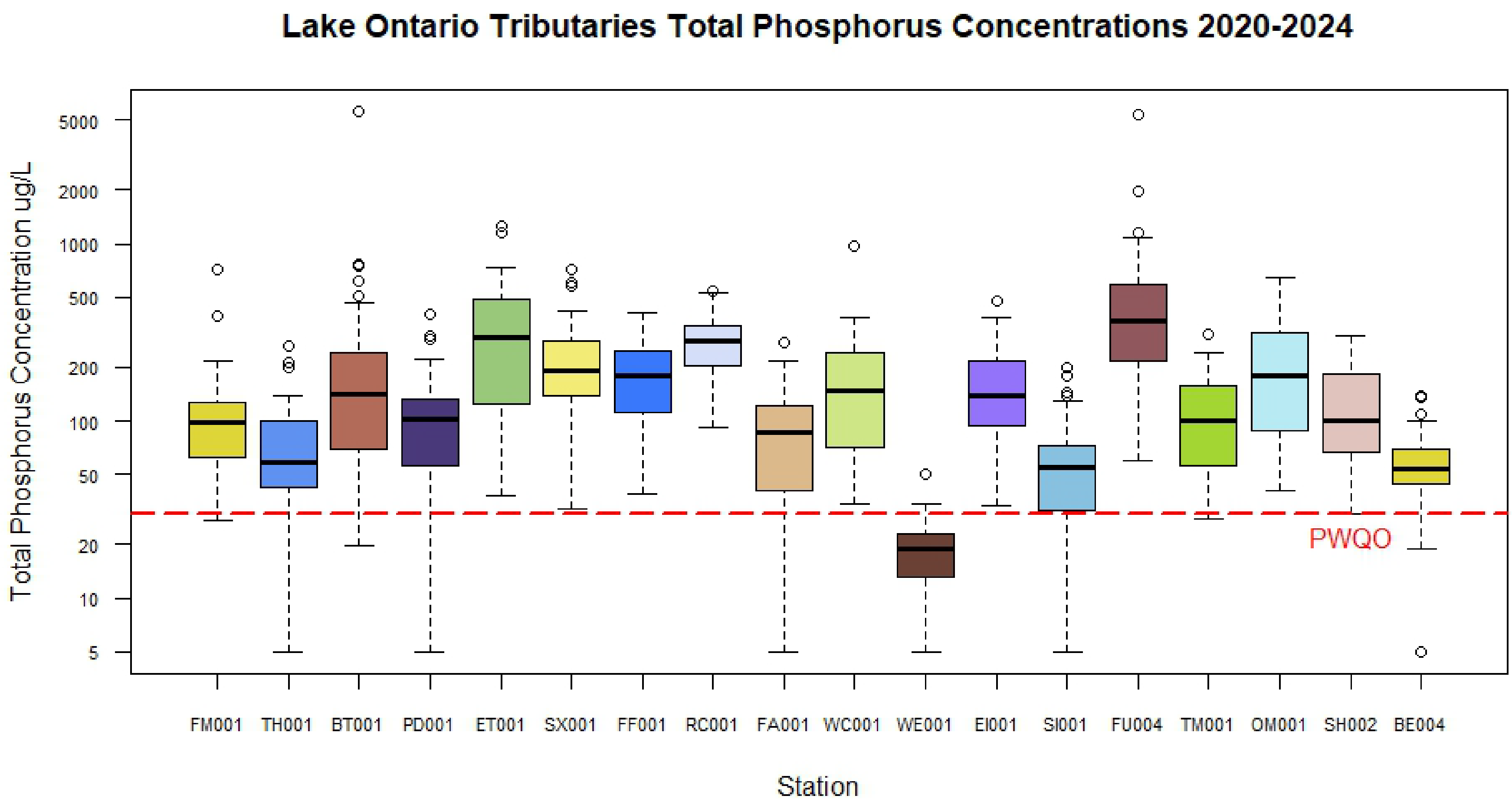
Niagara Peninsula Conservation Authority
Median Total Phosphorus Concentrations 2020 - 2024

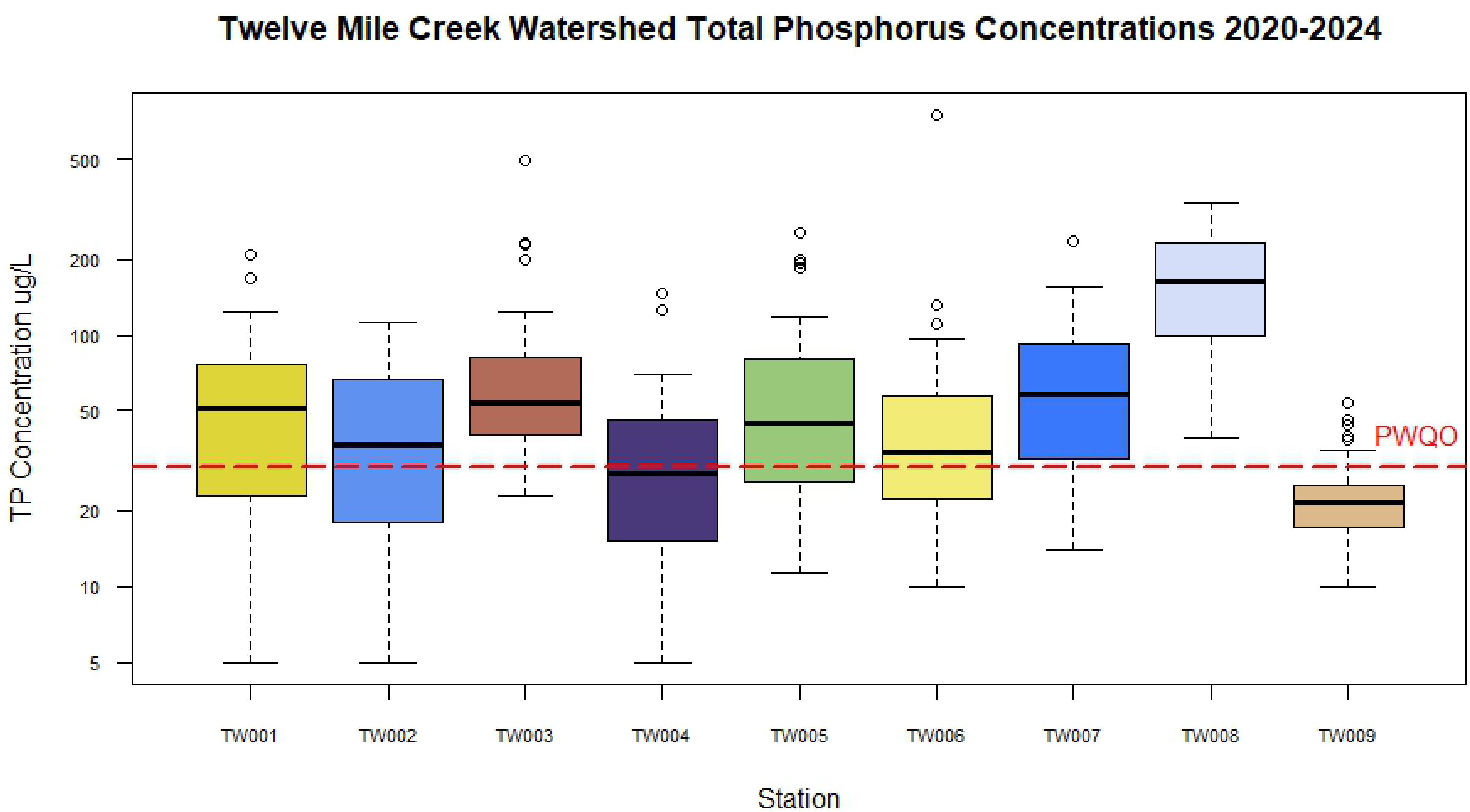


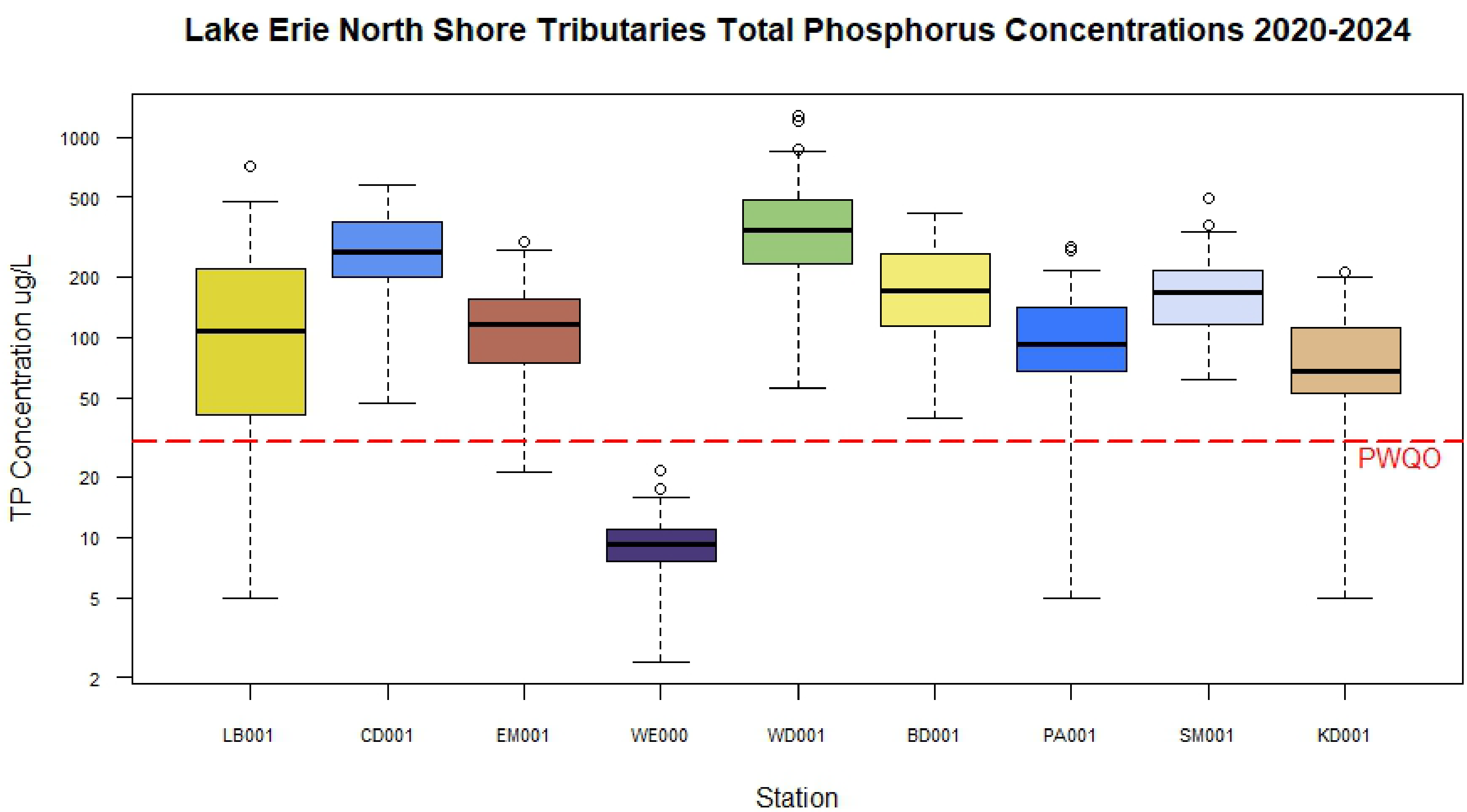

Welland River Watershed Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
1000
500
200
100
50
20
10
5
PWQO
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

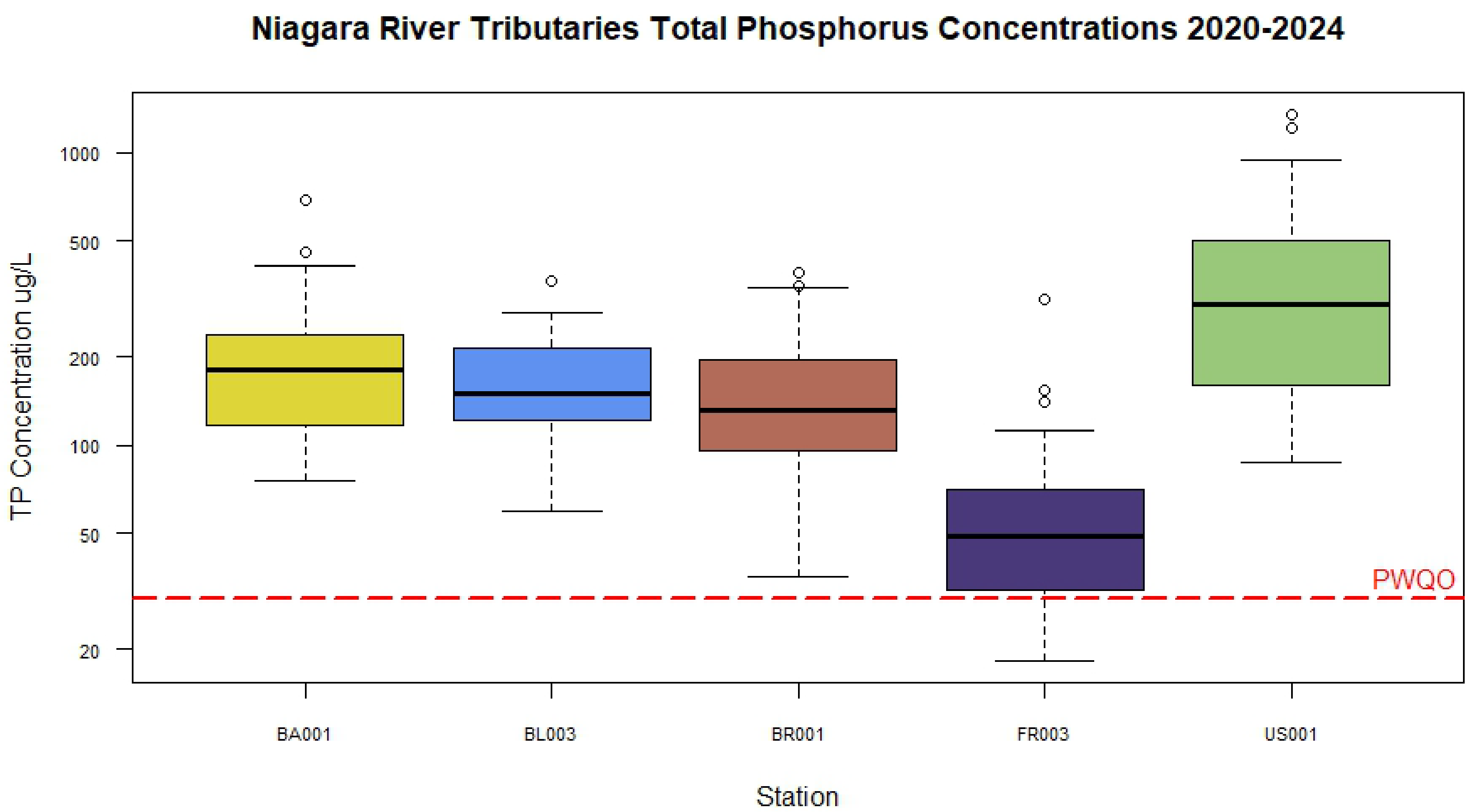

Welland River Tributaries Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
2000
1000
500
200
100
50
20
10
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

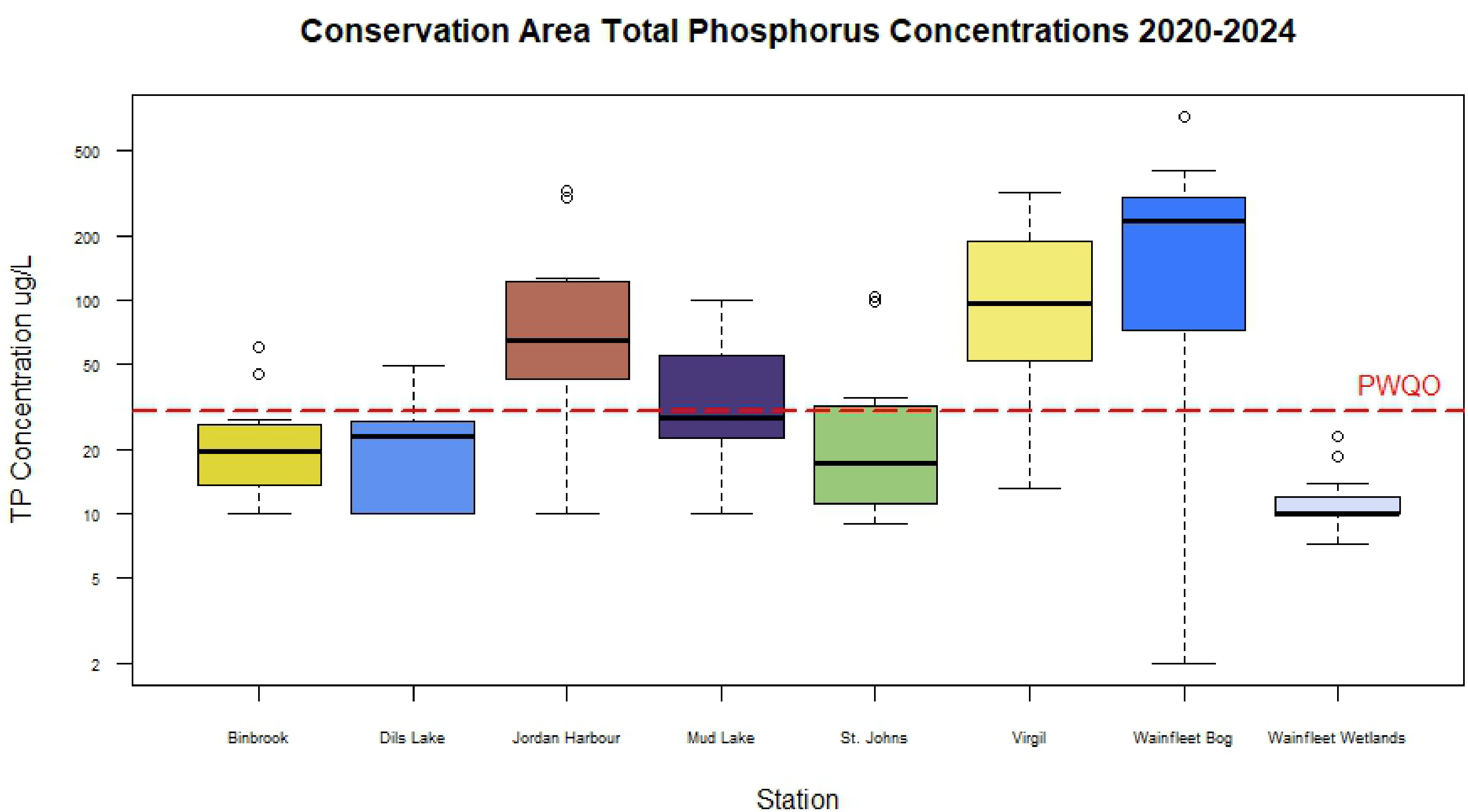

Twenty Mile Creek Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
5000
2000
1000
500
200
100
50
20
10
5
2
PWQO
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station


Lake Ontario Tributaries Total Phosphorus Concentrations 2020-2024
Total Phosphorus Concentration ug/L
5000
2000
1000
500
200
100
50
20
10
5
PWQO
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station

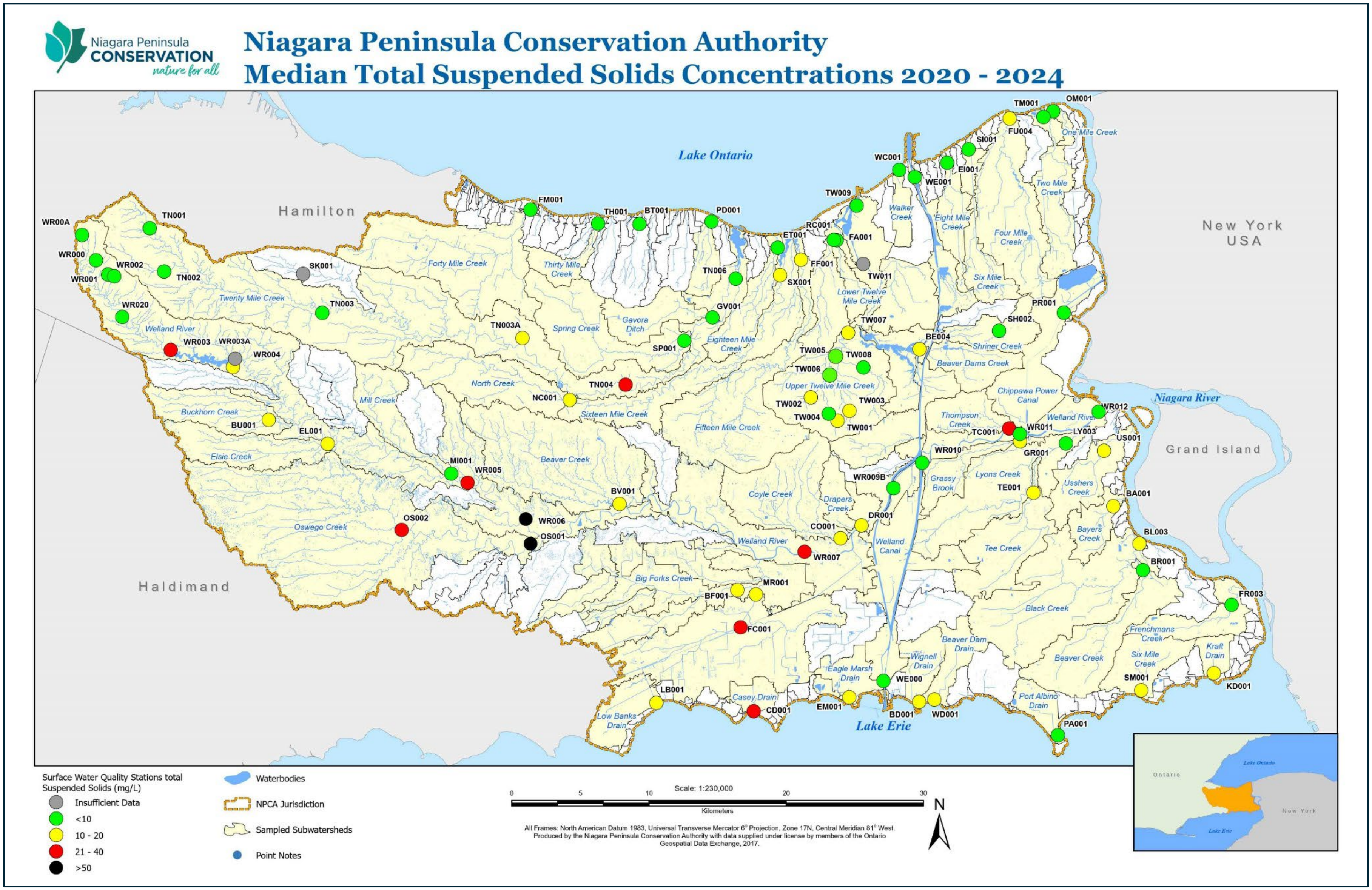

Twelve Mile Creek Watershed Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
500
200
100
50
20
10
5
PWQO
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

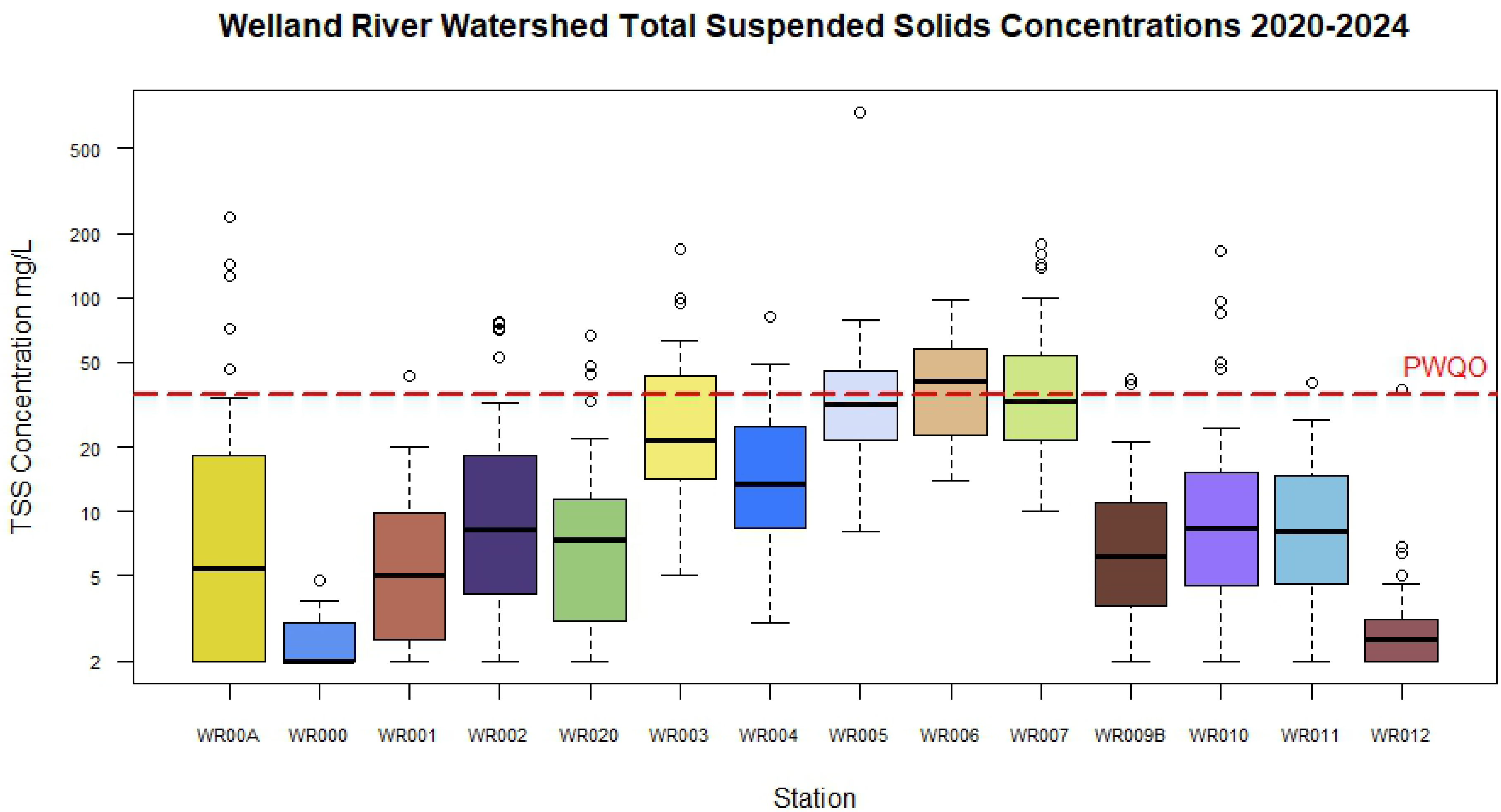

Lake Erie North Shore Tributaries Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
1000
500
200
100
50
20
10
5
2
PWQO
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

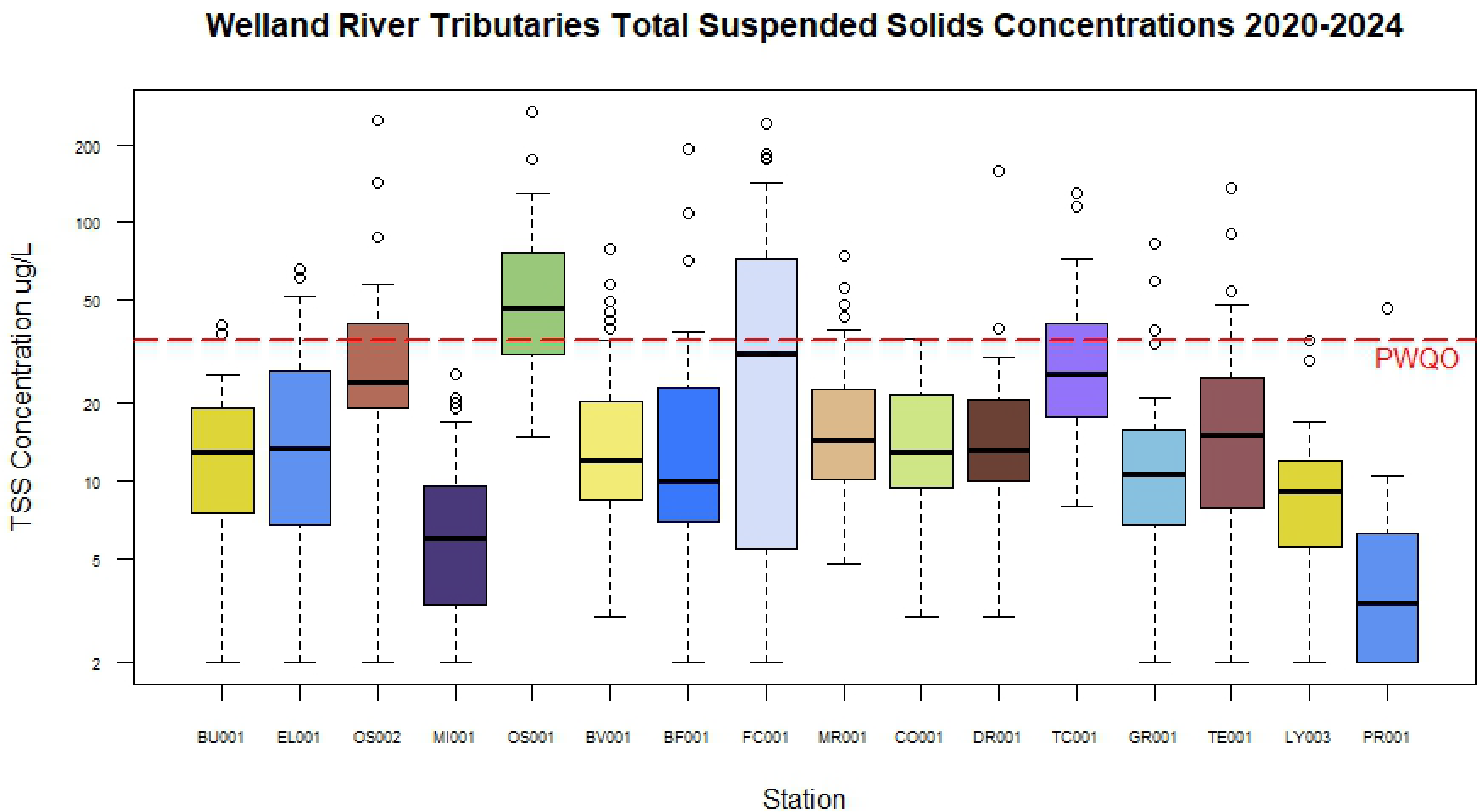

Niagara River Tributaries Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
1000
500
200
100
50
20
PWQO
BA001
BL003
BR001
FR003
US001
Station

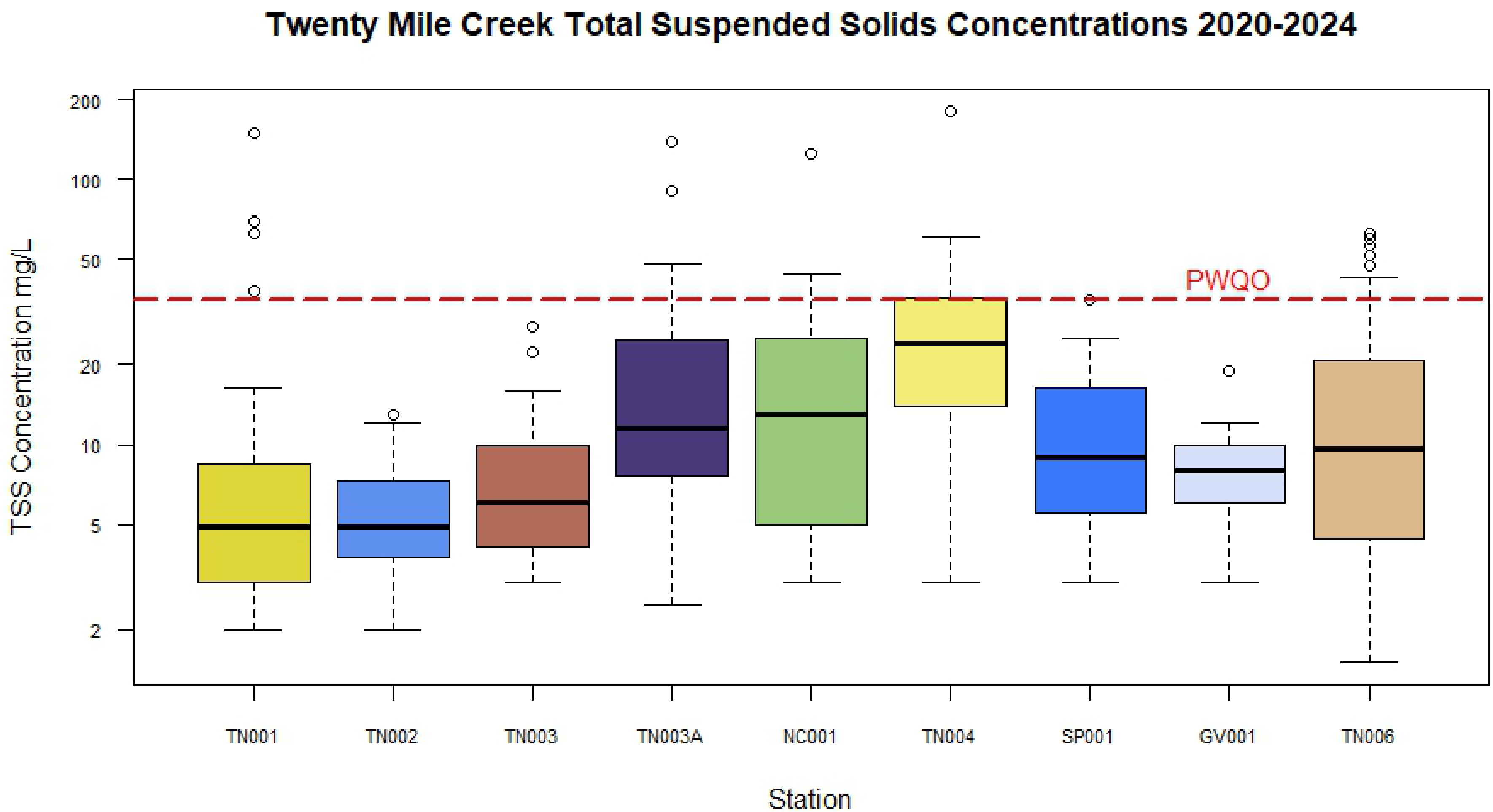

Conservation Area Total Phosphorus Concentrations 2020-2024
TP Concentration ug/L
500
200
100
50
20
10
5
2
PWQO
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

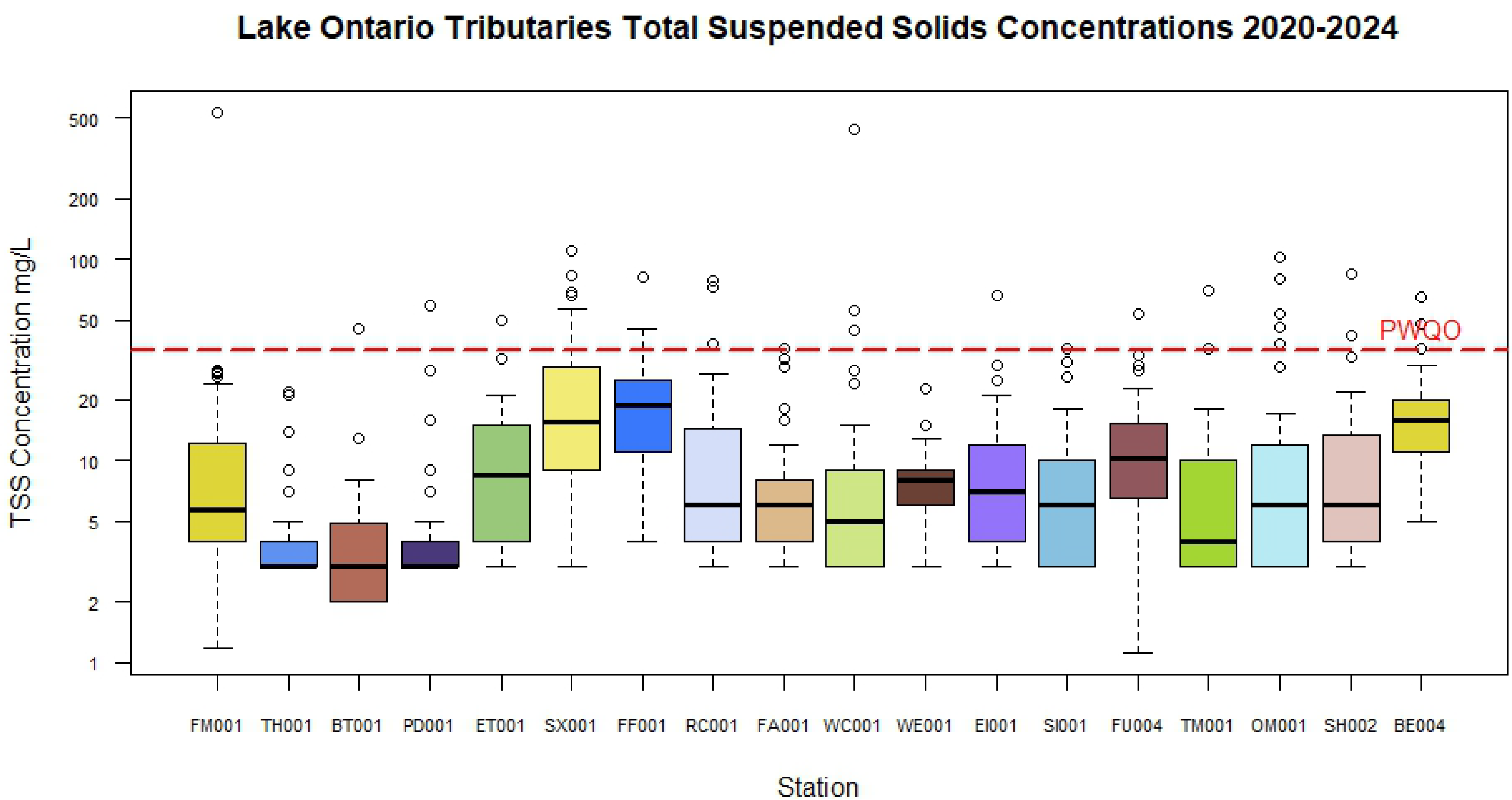
Appendix I: 2020-2024 Median Total Suspended Solid Concentrations and Summary Boxplots

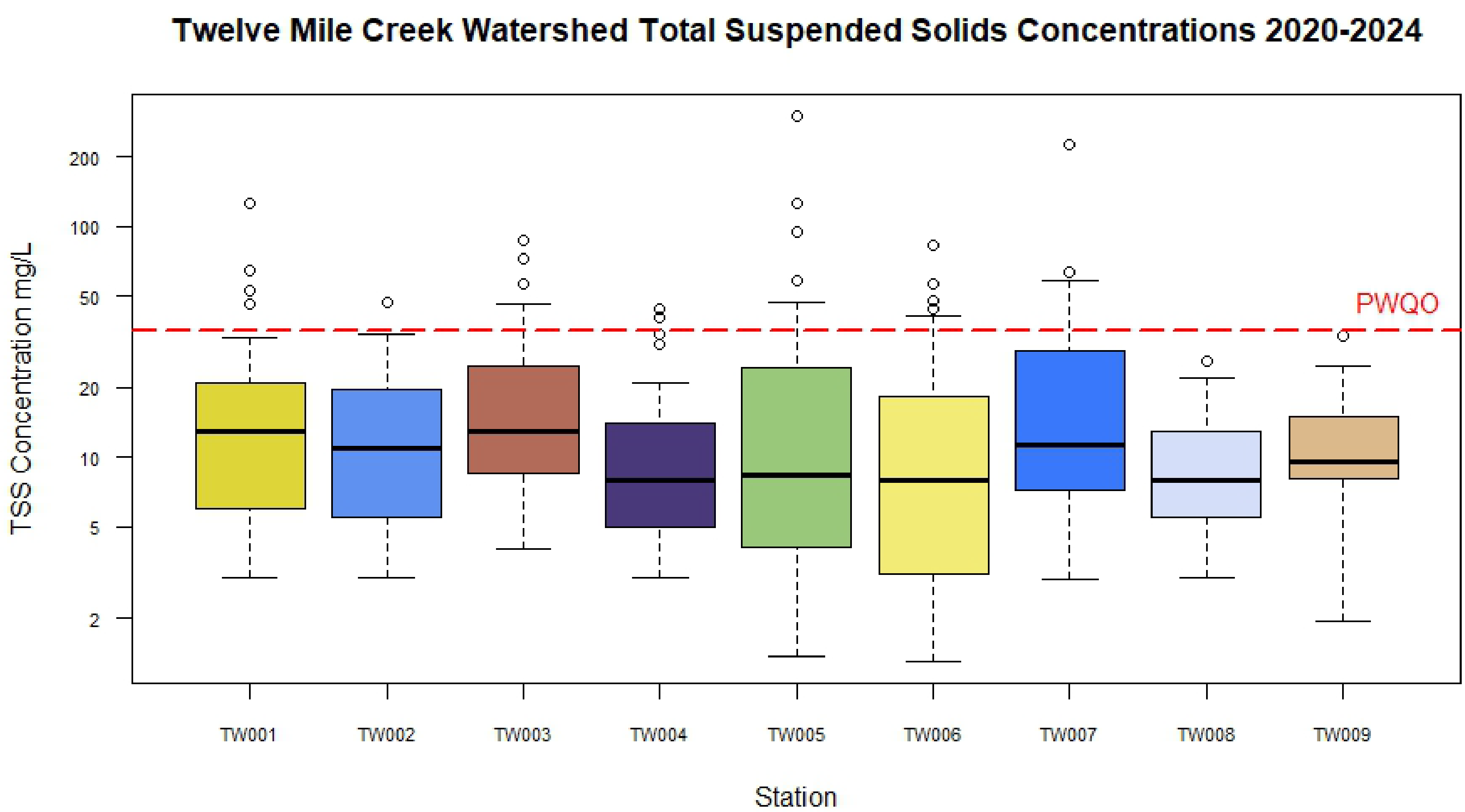

Niagara Peninsula Conservation Authority
Median Total Suspended Solids Concentrations 2020 - 2024
Lake Ontario
Lake Erie
Hamilton
Haldimand
New York USA
Grand Island
Niagara River
Welland River
Welland Canal
Twenty Mile Creek
Sixteen Mile Creek
Fifteen Mile Creek
Beaver Creek
Oswego Creek
Big Forks Creek
Coyle Creek
Surface Water Quality Stations total Suspended Solids (mg/L)
Insufficient Data
<10
10 - 20
21 - 40
>50
Waterbodies
NPCA Jurisdiction
Sampled Subwatersheds
Point Notes
Scale: 1:230,000
Kilometers
All Frames: North American Datum 1983, Universal Transverse Mercator 6° Projection, Zone 17N, Central Meridian 81° West.
Produced by the Niagara Peninsula Conservation Authority with data supplied under license by members of the Ontario Geospatial Data Exchange, 2017.

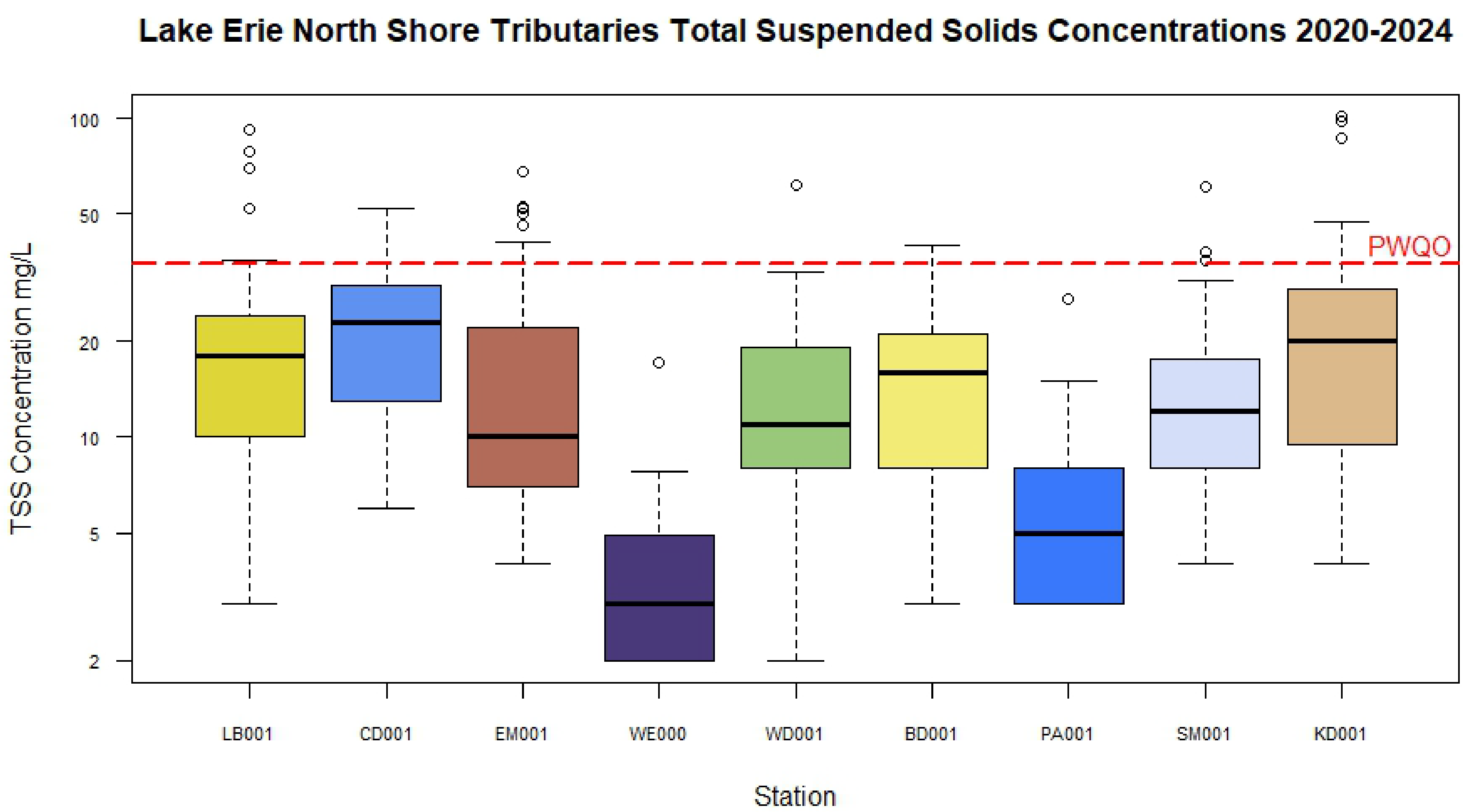

Welland River Watershed Total Suspended Solids Concentrations 2020-2024
TSS Concentration mg/L
500
200
100
50
20
10
5
2
PWQO
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

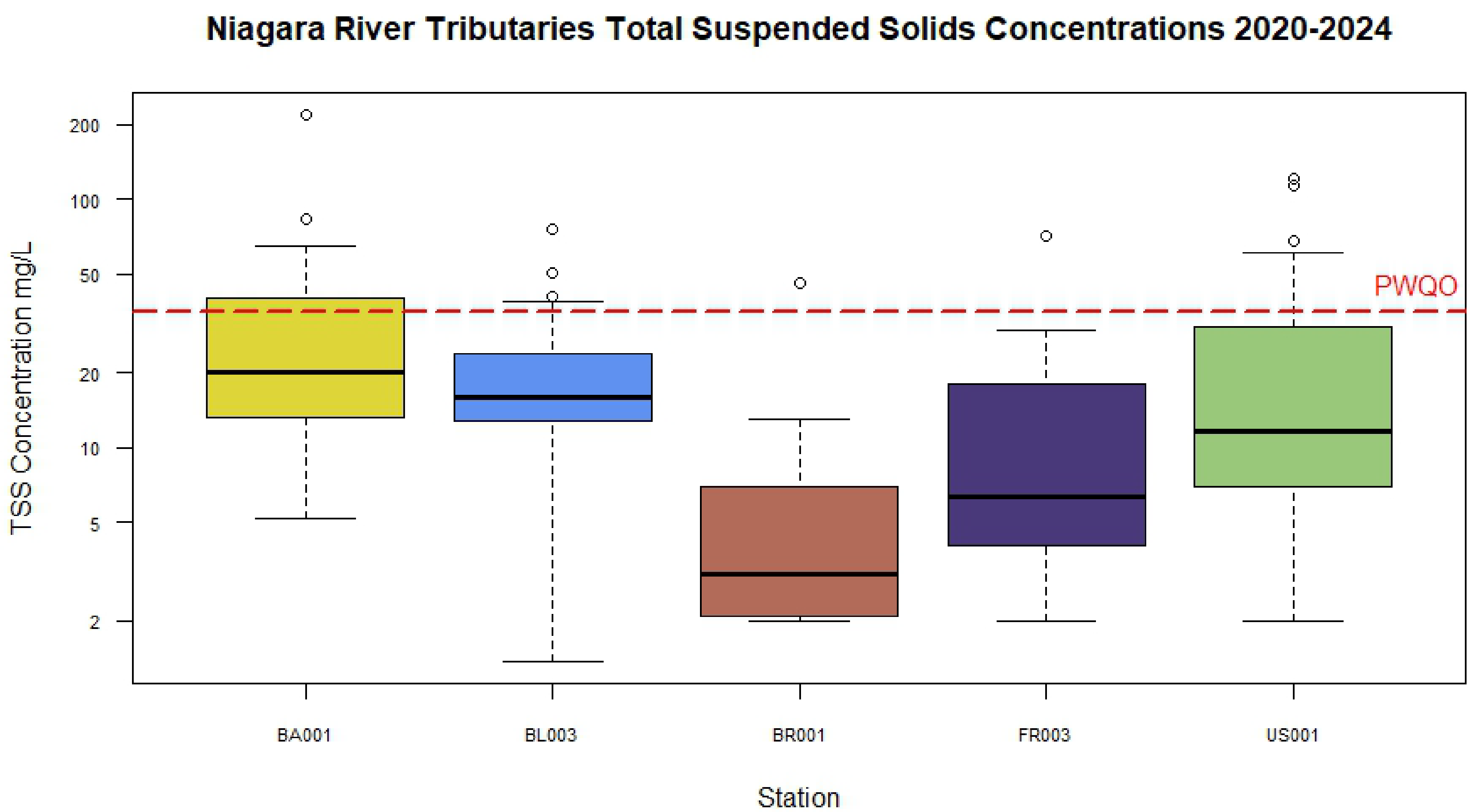

Welland River Tributaries Total Suspended Solids Concentrations 2020-2024
TSS Concentration ug/L
200
100
50
20
10
5
2
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

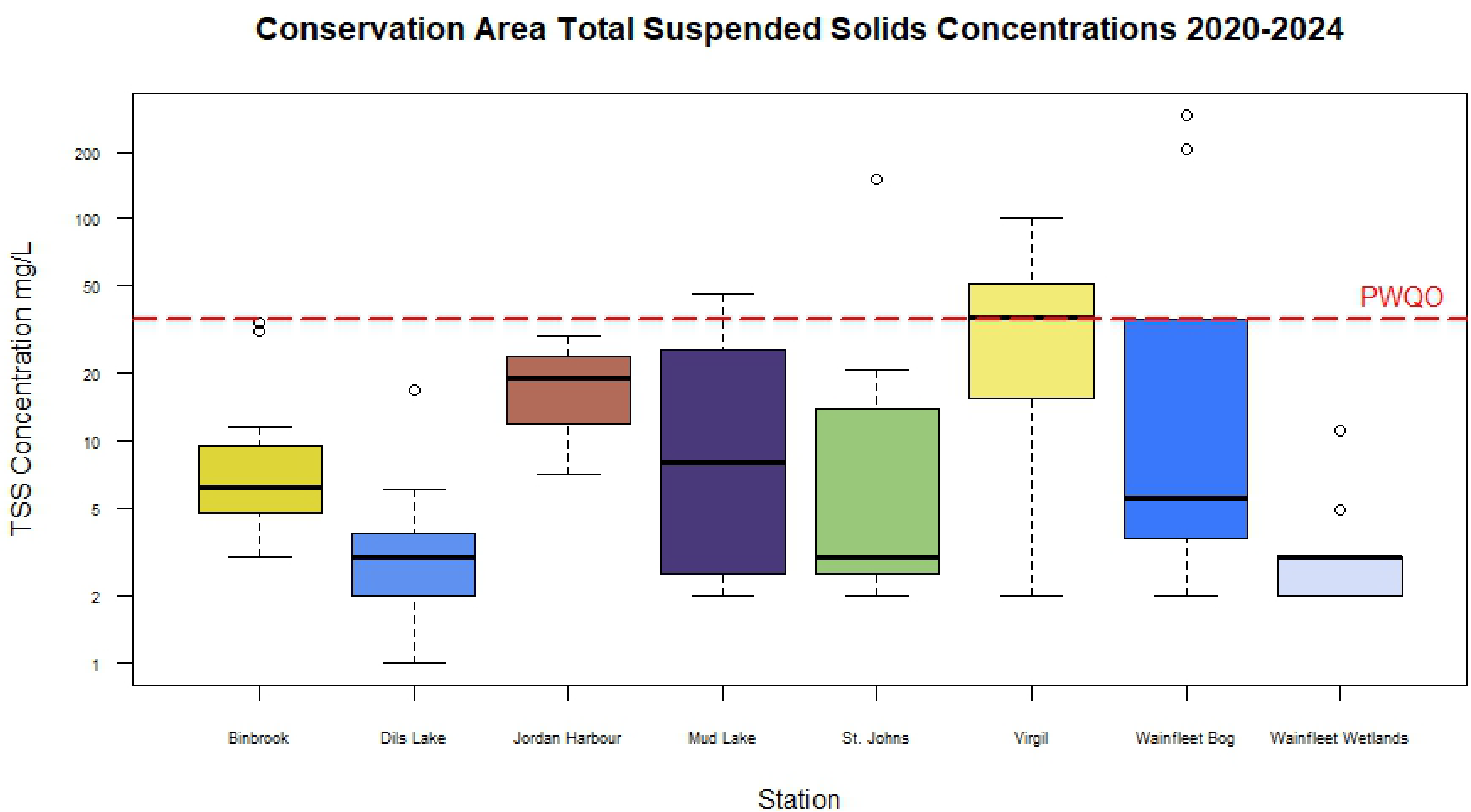

Twenty Mile Creek Total Suspended Solids Concentrations 2020-2024
TSS Concentration mg/L
200
100
50
20
10
5
2
PWQO
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station


Lake Ontario Tributaries Total Suspended Solids Concentrations 2020-2024
TSS Concentration mg/L
500
200
100
50
20
10
5
2
1
PWQO
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station


Twelve Mile Creek Watershed Total Suspended Solids Concentrations 2020-2024
TSS Concentration mg/L
200
100
50
20
10
5
2
PWQO
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station

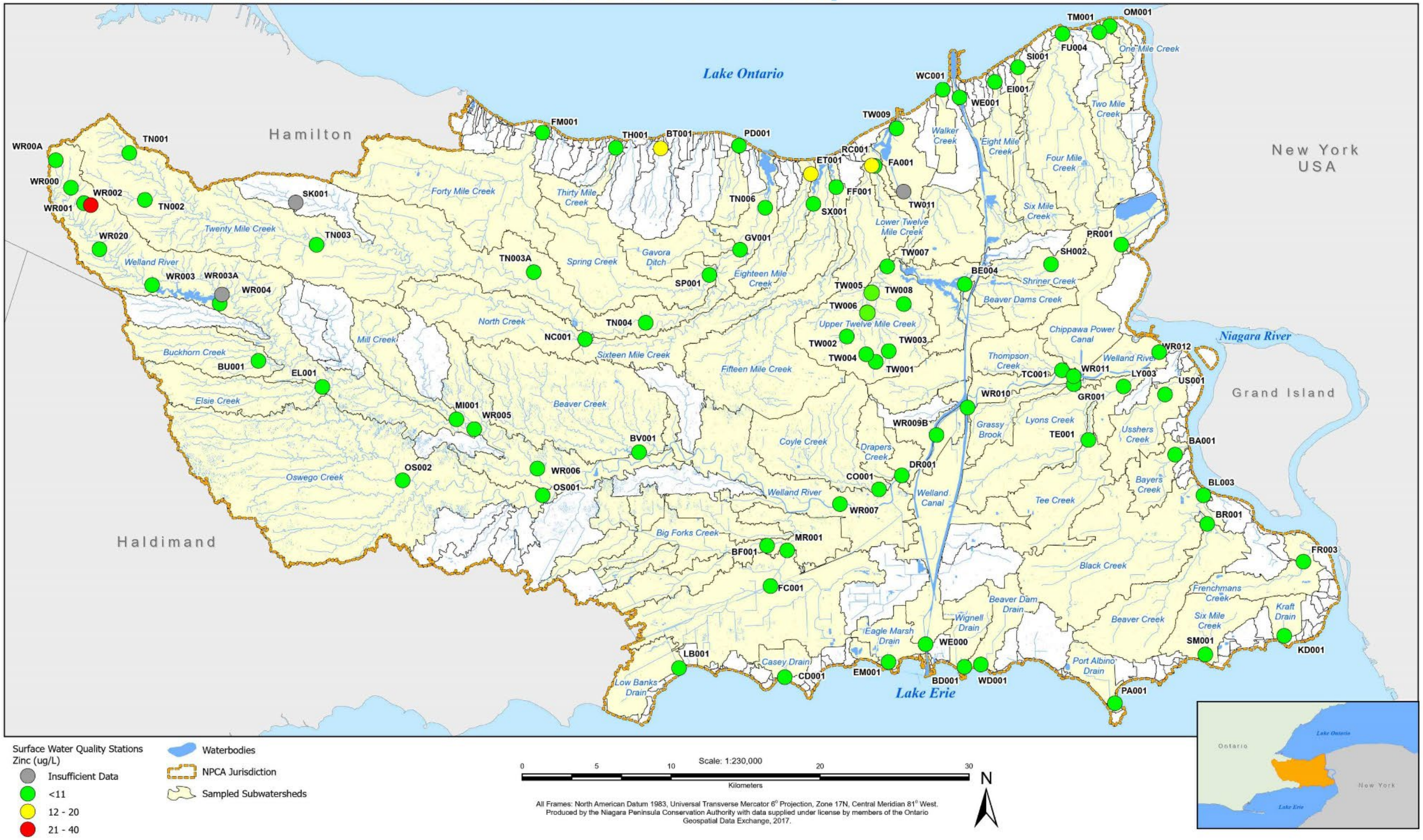

Lake Erie North Shore Tributaries Total Suspended Solids Concentrations 2020-2024
100
50
20
10
5
2
TSS Concentration mg/L
PWQO
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station

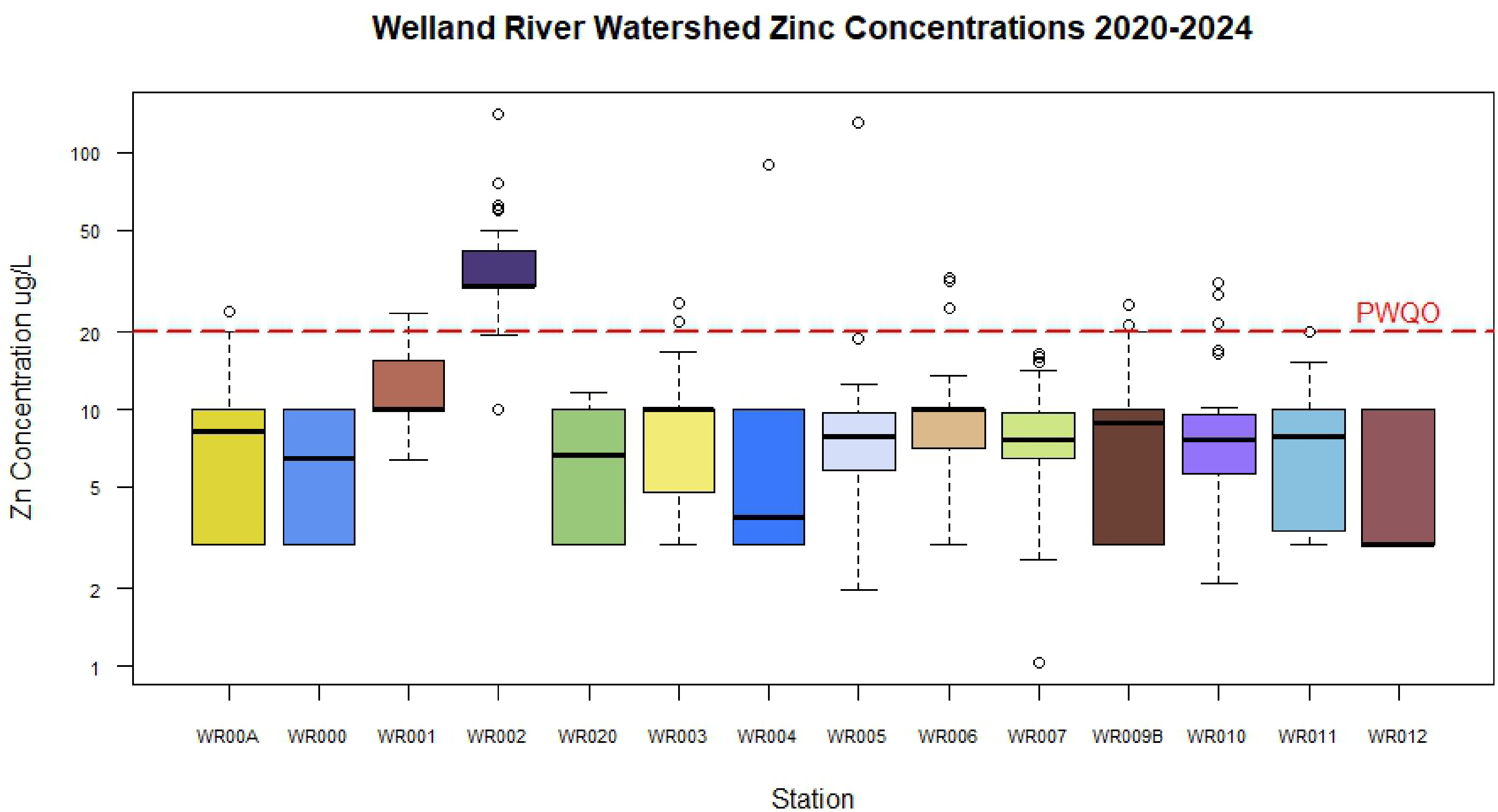

Niagara River Tributaries Total Suspended Solids Concentrations 2020-2024
TSS Concentration mg/L
200
100
50
20
10
5
2
PWQO
BA001
BL003
BR001
FR003
US001
Station

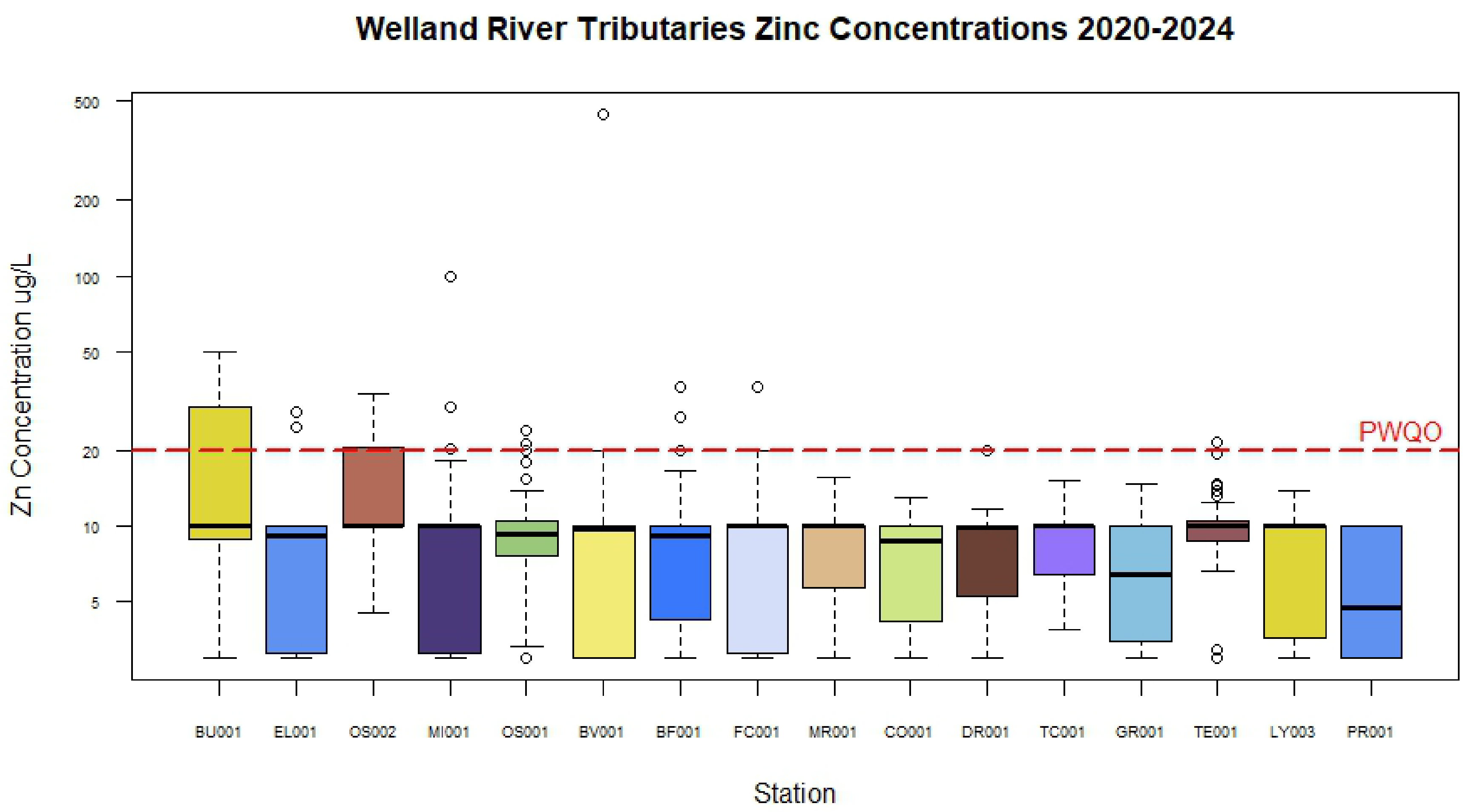

Conservation Area Total Suspended Solids Concentrations 2020-2024
TSS Concentration mg/L
200
100
50
20
10
5
2
1
PWQO
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

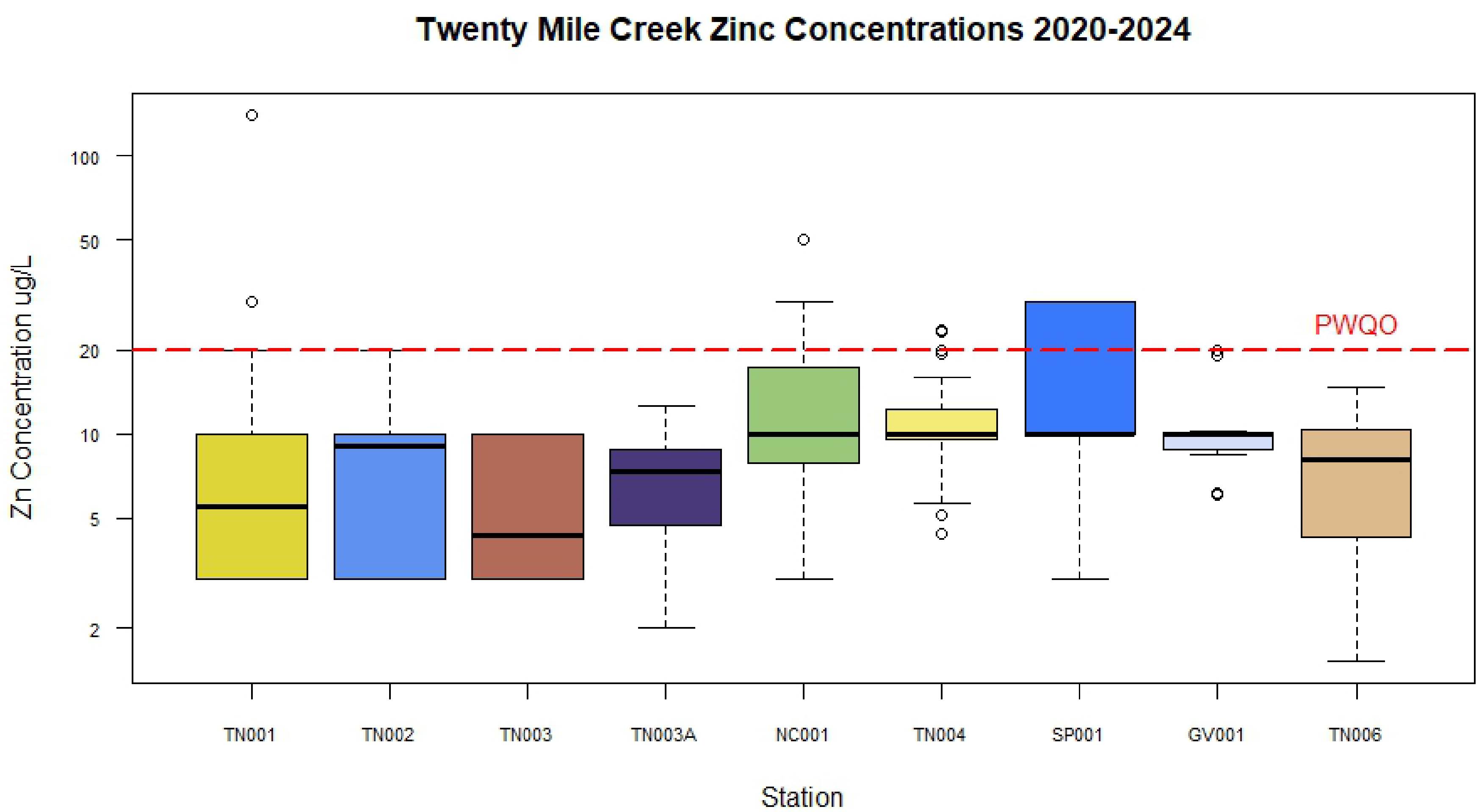
Appendix J: 2020-2024 Median Zinc Concentrations and Summary Boxplots

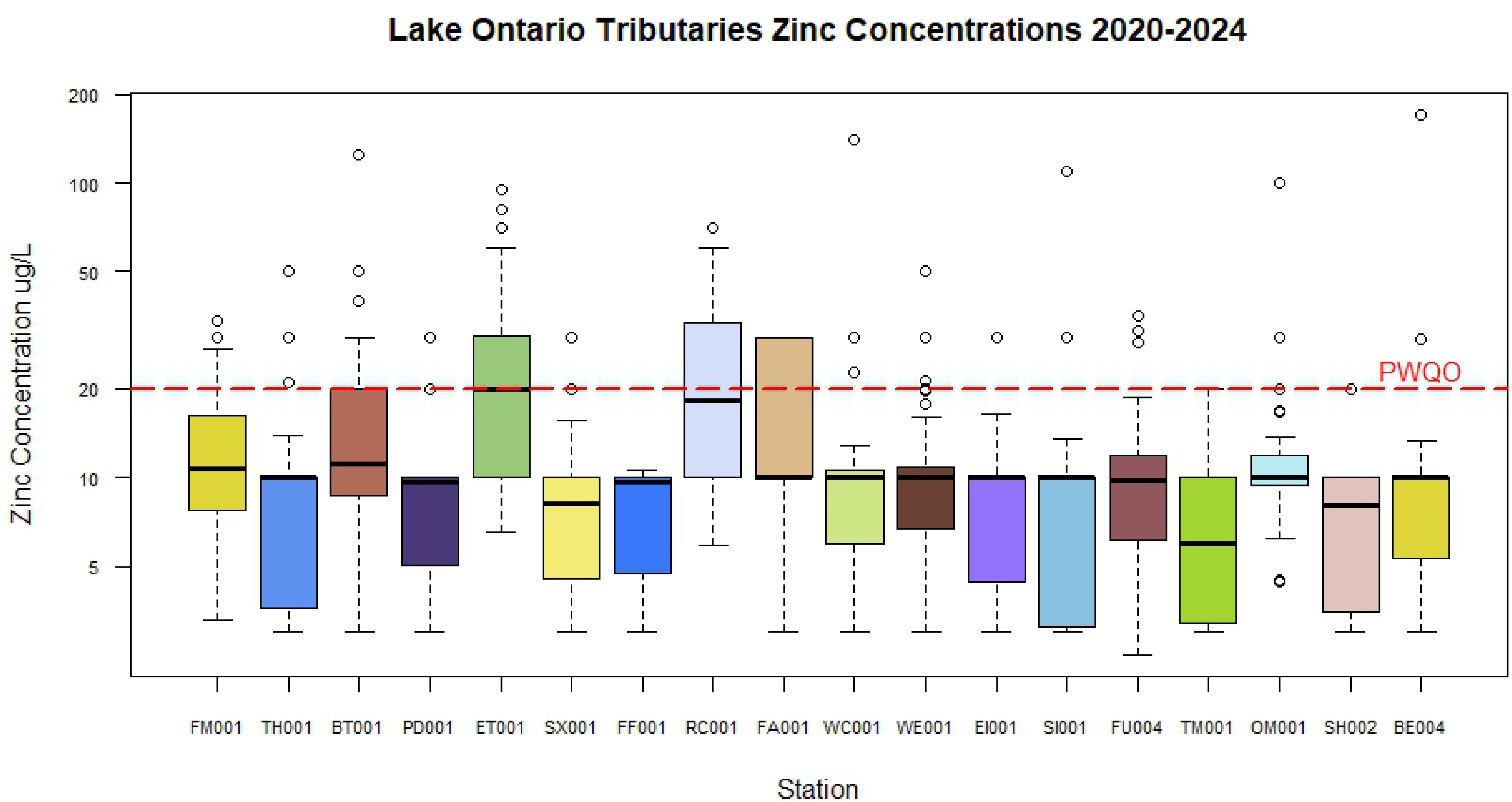
Niagara Peninsula Conservation Authority Median Zinc Concentrations 2020 - 2024

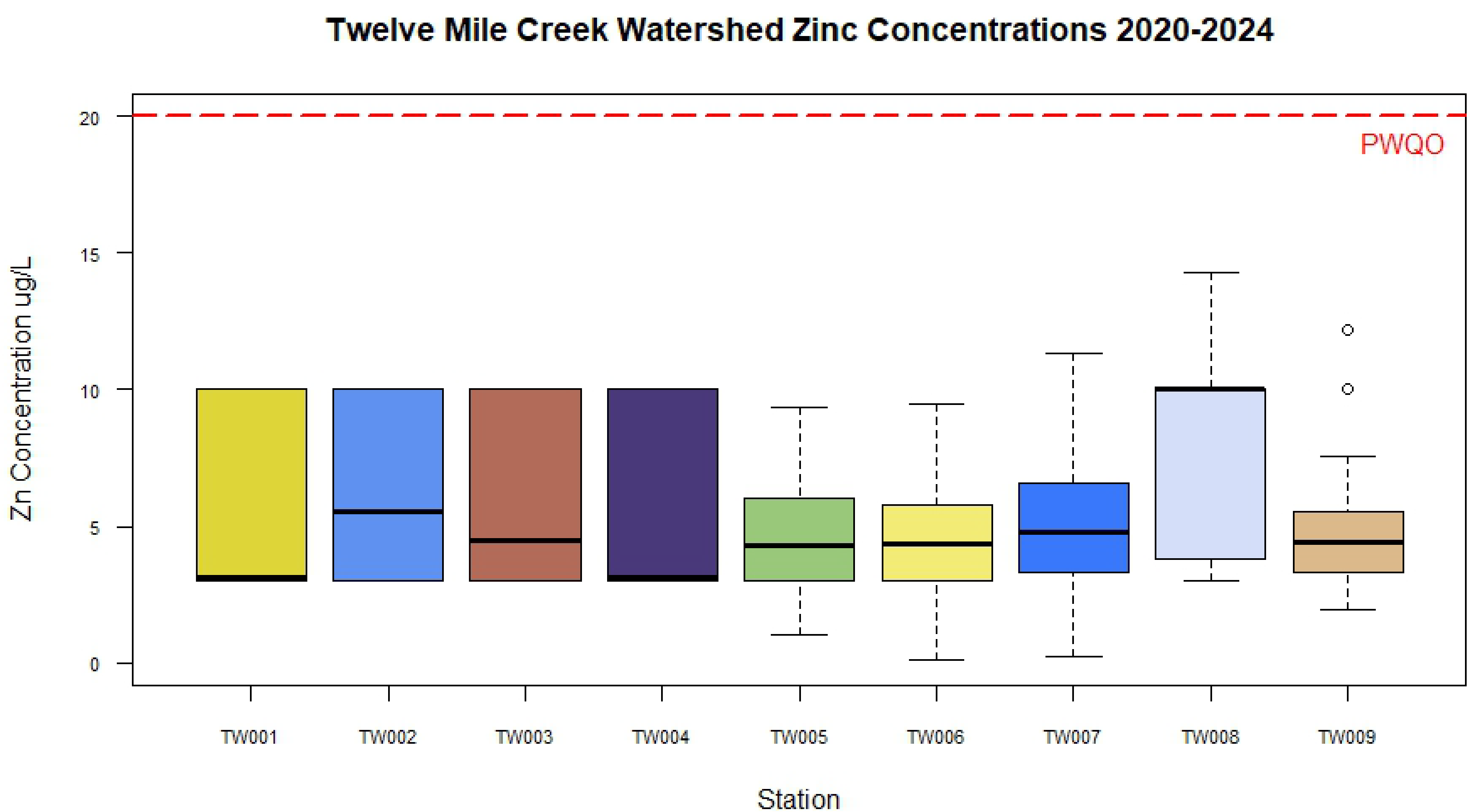


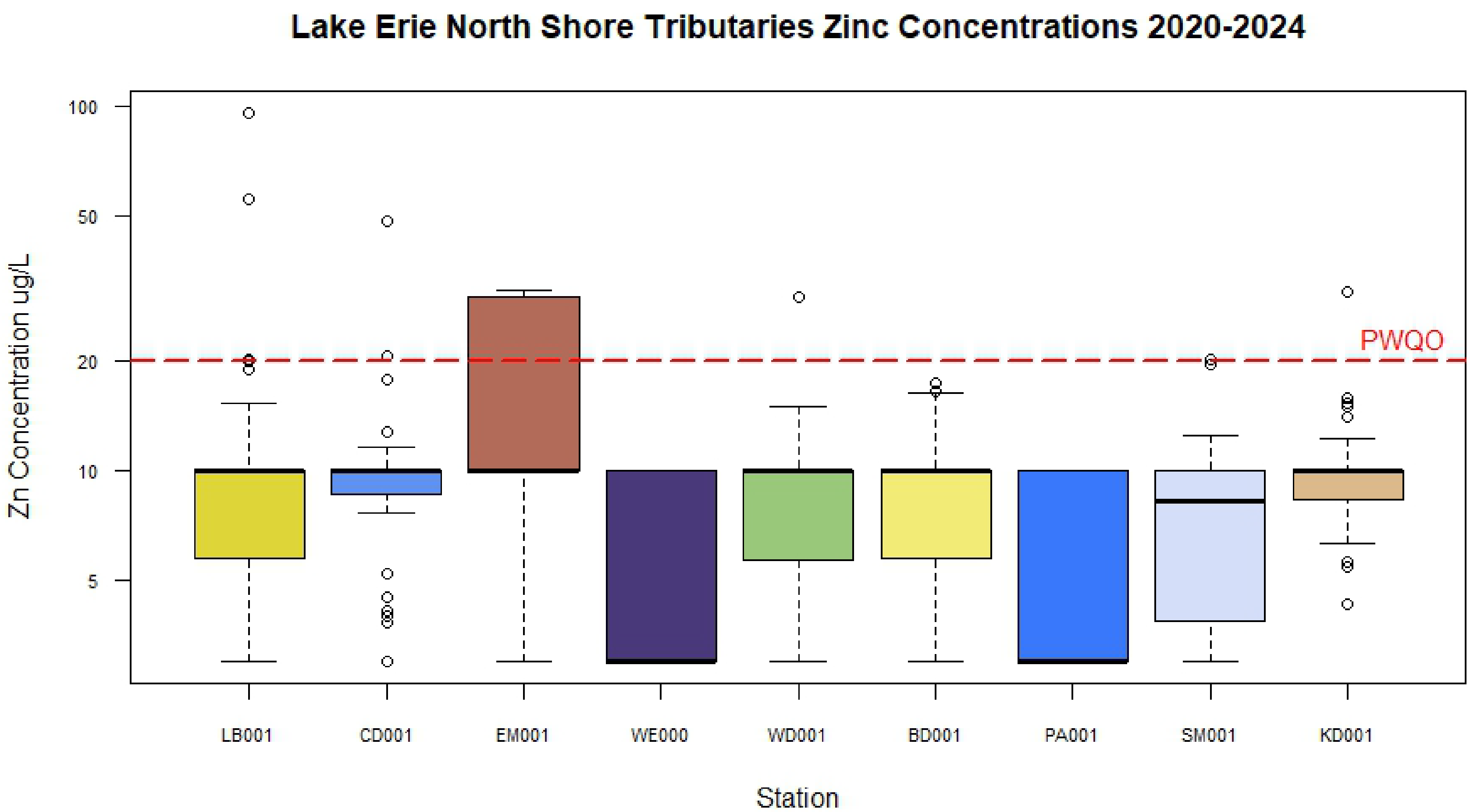

Welland River Watershed Zinc Concentrations 2020-2024
Zn Concentration ug/L
100
50
20
10
5
2
1
PWQO
WR00A
WR000
WR001
WR002
WR020
WR003
WR004
WR005
WR006
WR007
WR009B
WR010
WR011
WR012
Station

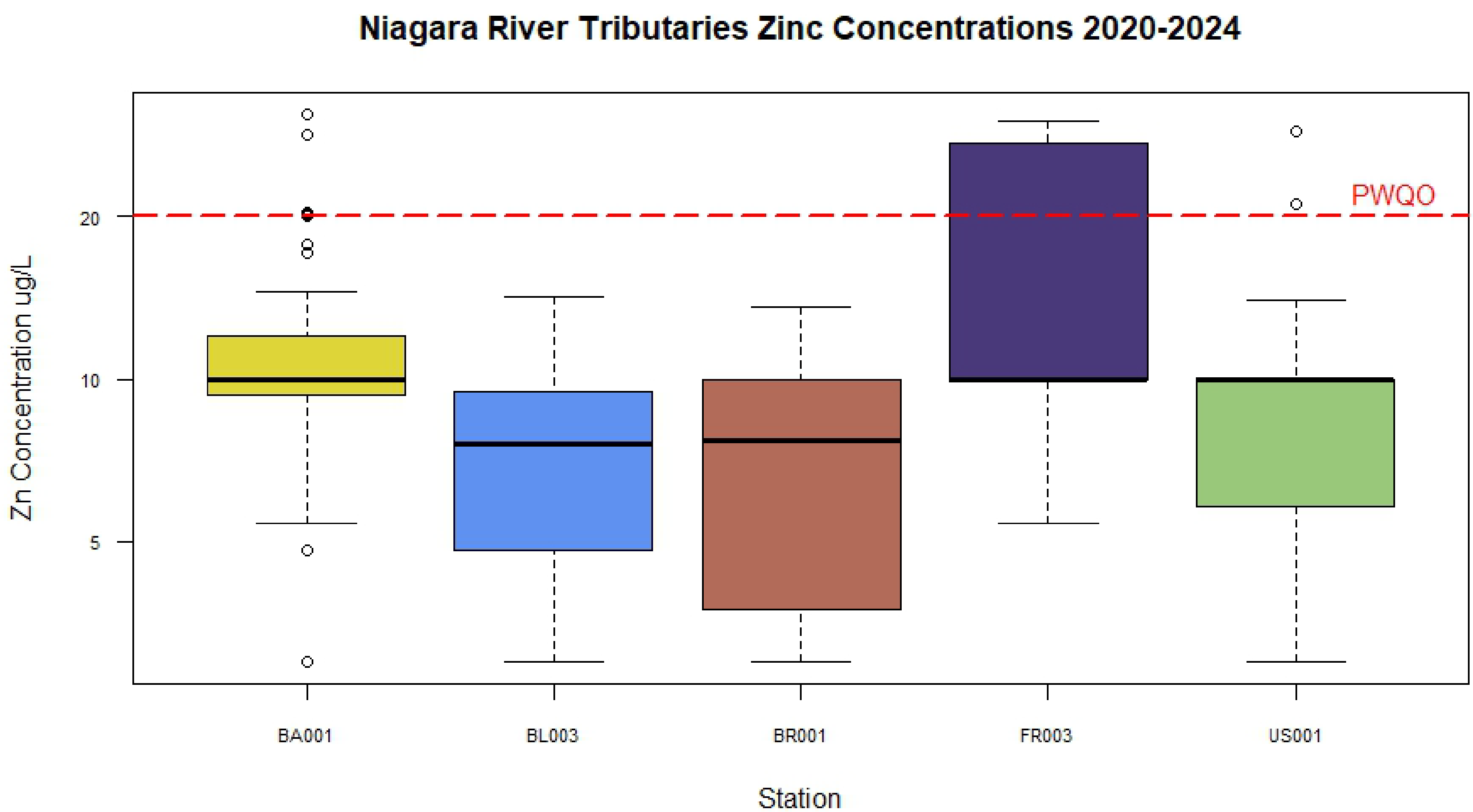

Welland River Tributaries Zinc Concentrations 2020-2024
Zn Concentration ug/L
500
200
100
50
20
10
5
PWQO
BU001
EL001
OS002
MI001
OS001
BV001
BF001
FC001
MR001
CO001
DR001
TC001
GR001
TE001
LY003
PR001
Station

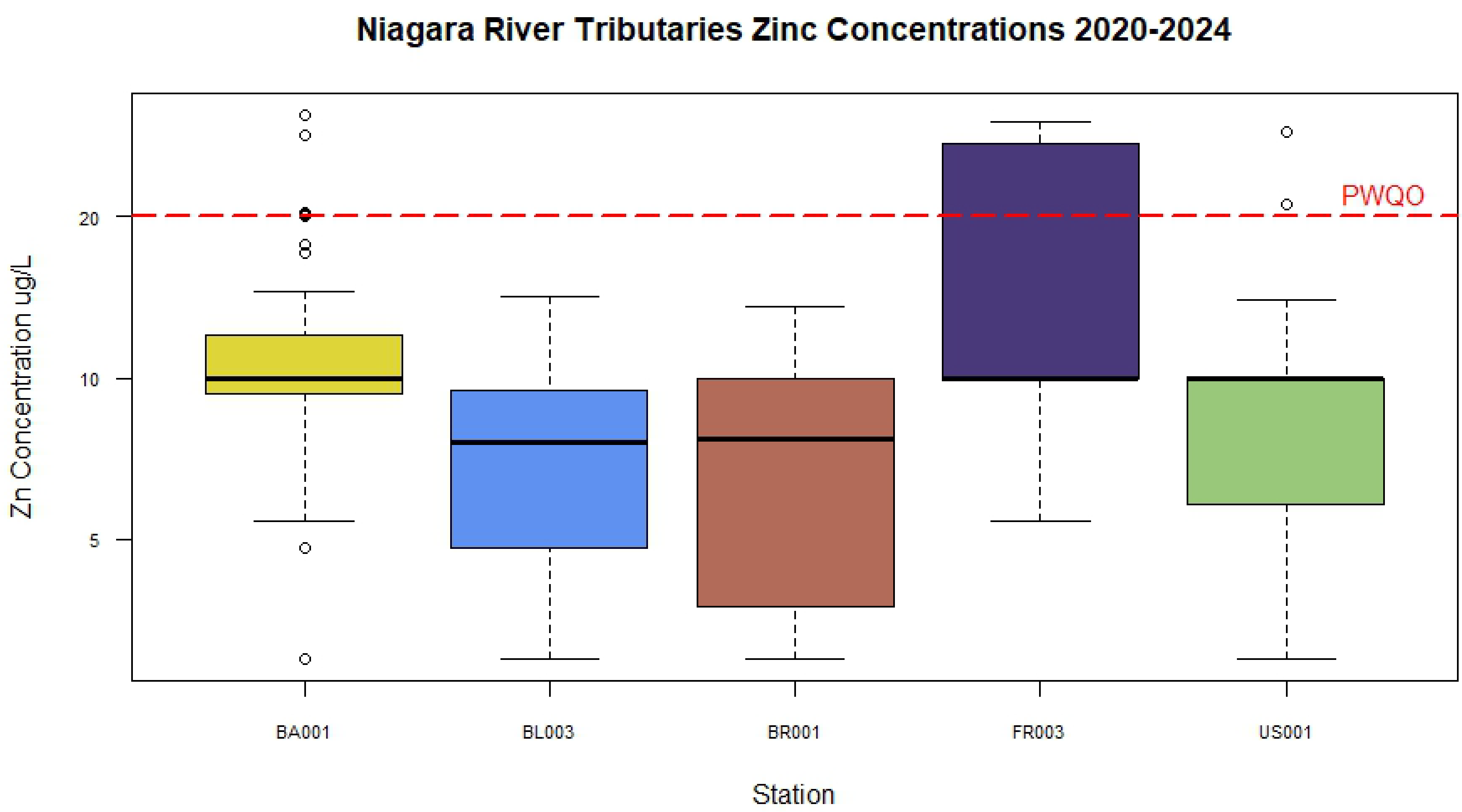

Twenty Mile Creek Zinc Concentrations 2020-2024
Zn Concentration ug/L
100
50
20
10
5
2
PWQO
TN001
TN002
TN003
TN003A
NC001
TN004
SP001
GV001
TN006
Station

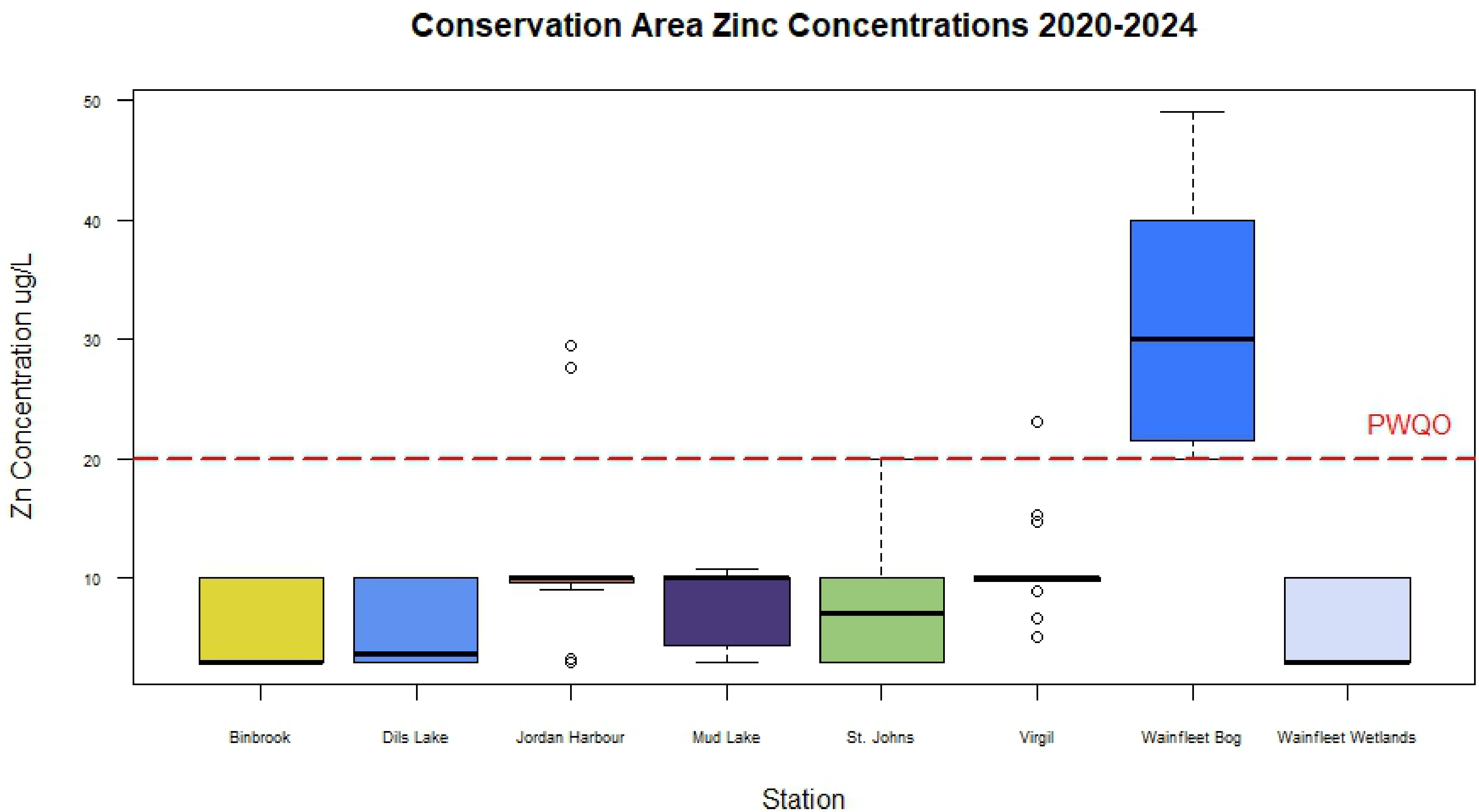

Lake Ontario Tributaries Zinc Concentrations 2020-2024
Zinc Concentration ug/L
200
100
50
20
10
5
PWQO
FM001
TH001
BT001
PD001
ET001
SX001
FF001
RC001
FA001
WC001
WE001
EI001
SI001
FU004
TM001
OM001
SH002
BE004
Station


Twelve Mile Creek Watershed Zinc Concentrations 2020-2024
PWQO
Zn Concentration ug/L
20
15
10
5
0
TW001
TW002
TW003
TW004
TW005
TW006
TW007
TW008
TW009
Station


Lake Erie North Shore Tributaries Zinc Concentrations 2020-2024
Zn Concentration ug/L
100
50
20
10
5
PWQO
LB001
CD001
EM001
WE000
WD001
BD001
PA001
SM001
KD001
Station


Niagara River Tributaries Zinc Concentrations 2020-2024
PWQO
20
10
5
Zn Concentration ug/L
BA001
BL003
BR001
FR003
US001
Station


Niagara River Tributaries Zinc Concentrations 2020-2024
Zn Concentration ug/L
20
10
5
PWQO
BA001
BL003
BR001
FR003
US001
Station


Conservation Area Zinc Concentrations 2020-2024
Zn Concentration ug/L
50
40
30
20
10
PWQO
Binbrook
Dils Lake
Jordan Harbour
Mud Lake
St. Johns
Virgil
Wainfleet Bog
Wainfleet Wetlands
Station

Niagara Peninsula Conservation Authority
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