SURFACE WATER QUALITY

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6.0 SURFACE WATER QUALITY

High-quality stream water can be defined by the ability to sustain healthy aquatic communities, provide opportunities for recreation and aesthetic enjoyment, and contribute to the protection of drinking water sources. The natural environment (e.g. geology, soils, groundwater, vegetation), land use (e.g. urban, agricultural) and human activities (e.g. spills, illegal dumping) can influence water quality and pose challenges to maintaining good water quality conditions in a watershed.

The degree of urbanization and stormwater management in the Etobicoke and Mimico Creeks watersheds represents a key factor influencing water quality. Urbanization of a watershed leads to increased imperviousness and less opportunity for runoff to infiltrate. Thus, contaminants that accumulate on impervious surfaces during dry weather are washed off and transported to watercourses. As reported in the **Stormwater Management and Streamflow Section** of this Technical Update, urban growth has continued in these watersheds in recent years, as has an evolution of stormwater management practices. The Etobicoke Creek watershed supports three major land uses, including 63 % urban, 22 % rural and 15 % natural cover. Only 33 % of the developed areas in this watershed have stormwater management controls, of which 17 % have quantity, quality and erosion controls (most areas only have quantity controls). The Mimico Creek watershed supports two major land uses, including 88 % urban and 11.5 % natural cover; with only 30 % of the developed areas in this watershed having stormwater management controls. Quantity control is the predominant stormwater management practice, which accounts for approximately 21 % of the urbanized areas.

This **Surface Water Quality Section** provides an updated evaluation of current water quality conditions for routine parameters in Etobicoke and Mimico Creeks, according to targets set out in the previous watershed report card. Water quality samples are routinely collected within the TRCA's jurisdiction as part of the Ministry of the Environment's (MOE) Provincial Water Quality Network (PWQMN) and TRCA's Regional Watershed Monitoring Program (RWMP). Disease-causing substances, pesticides and other contaminants are not part of the routine monitoring program. Information about these parameters from other monitoring programs, such as the *Sport Fish Contaminant Monitoring Program*, City of Toronto's swimming beach monitoring program and wet weather flow monitoring program, and *Toronto Tributary Toxics Assessment* have not been incorporated into this report (see **Appendix 6-A**).

6.1 WATERSHED OBJECTIVES, INDICATORS AND TARGETS

The surface water quality objectives, indicators and targets used in undertaking this Technical Update were taken from *Turning over a new leaf: The Etobicoke and Mimico Creeks Watersheds Report Card* (TRCA, 2006), unless otherwise specified. The objectives, indicators and targets established for surface water quality are shown in **Table 6-1**. The *Greening Our Watersheds: Revitalization Strategies for Etobicoke and Mimico Creeks* report set water quality targets for 2006. As data were not fully available to report on the achievement or failure to meet these targets in the 2006 Report Card, this report notes and addresses those targets as part of the discussion of existing conditions.

Table 6-1: Watershed Objectives, Indicators and Targets

Surface Water Quality
Objective: Water in the creeks is safe for people, fish and wildlife.

Indicator		Water Quality Objective	Targets
Conventional Pollutants	Phosphorus	0.03 mg/L[1]	• By 2025, at least 75% of the samples meet water quality objectives
	Unionized ammonia	0.02 mg/L[1]	
	Nitrates	0.3 mg/L[2] (2.93 mg/L)[3]	
	TSS	25-80 mg/L[4] (30 mg/L)	
	Chloride	250 mg/L[5] (150 mg/L)[6]	
Metals and Organic Contaminants	Copper	5 µg/L[1]	• By 2025, levels of six[7] metals of concern meet the PWQO in at least 75% of the samples • By 2025, priority compounds (the COA Tier 1 list) have been virtually eliminated (e.g., are detected in less than 10% of samples) – *not addressed in this Technical Update* • By 2025, there are no restrictions on eating sport fish due to contaminants - *not addressed in this Technical Update*
	Iron	300 µg/L[1]	
	Zinc	20 µg/L[1]	
	Aluminum	75 µg/L (for clay-free samples)	
	Cadmium	0.5 µg/L1	
	Lead	5 µg/L[1]	
	COA Tier 1 list [8]	Detected in < 10% of samples	
Water Contact Recreation - bacteria	*E coli*	100 CFU/ 100mL[1]	• *By 2025, E. coli* levels meet the PWQO for at least 95% of the swimming season at Lake Ontario beaches – *not addressed in this Technical Update* • *By 2025, E. coli* levels meet the PWQO in at least 75% of the samples for Etobicoke Creek Headwaters and for at least 50% of the samples in the remainder of Etobicoke Creek and Mimico Creek

[1] Provincial Water Quality Objective (PWQO; MOEE 1994)
[2] *Turning over a new leaf: The Etobicoke and Mimico Creeks Watersheds Report Card 2006* (TRCA 2006)
[3] Canadian Water Quality Guideline (CWQG; CCME 2007)
[4] *State of the Watershed Report: Etobicoke and Mimico Creeks Watersheds* (TRCA, 2002)
[5] Partially based on EC and HC 2001
[6] British Columbia Water Quality Guideline (BC MOE , 2003)
[7] Silver dropped from indicator list because this parameters is not monitored by the MOE's PWQMN
[8] EC and MOE 2007

6.2 OBJECTIVES OF TECHNICAL UPDATE

The principle objectives of the Water Quality component of this Technical Update are as follows:

- Summarize current, routine stream water quality data for Etobicoke and Mimico Creeks; and
- Determine if creek water quality is meeting the targets/objectives set out in previous reports.

6.3 DATA SOURCES, MONITORING PROGRAMS AND ANALYSIS

6.3.1 Data Sources

The primary data for this Technical Update were drawn from two monitoring programs:

- Ministry of the Environment (MOE) Provincial Water Quality Monitoring Network (PWQMN) surface water quality data (2003-2007);
- Toronto and Region Conservation Authority (TRCA) Regional Watershed Monitoring Program (RWMP) surface water quality data (2006-2007).

A total of 38 stations (2009) are monitored for surface water quality within the TRCA jurisdiction, under these two programs, of which 3 stations are located in the Etobicoke Creek watershed, and 2 stations are located in the Mimico Creek watershed (see **Figure 6-1)**.

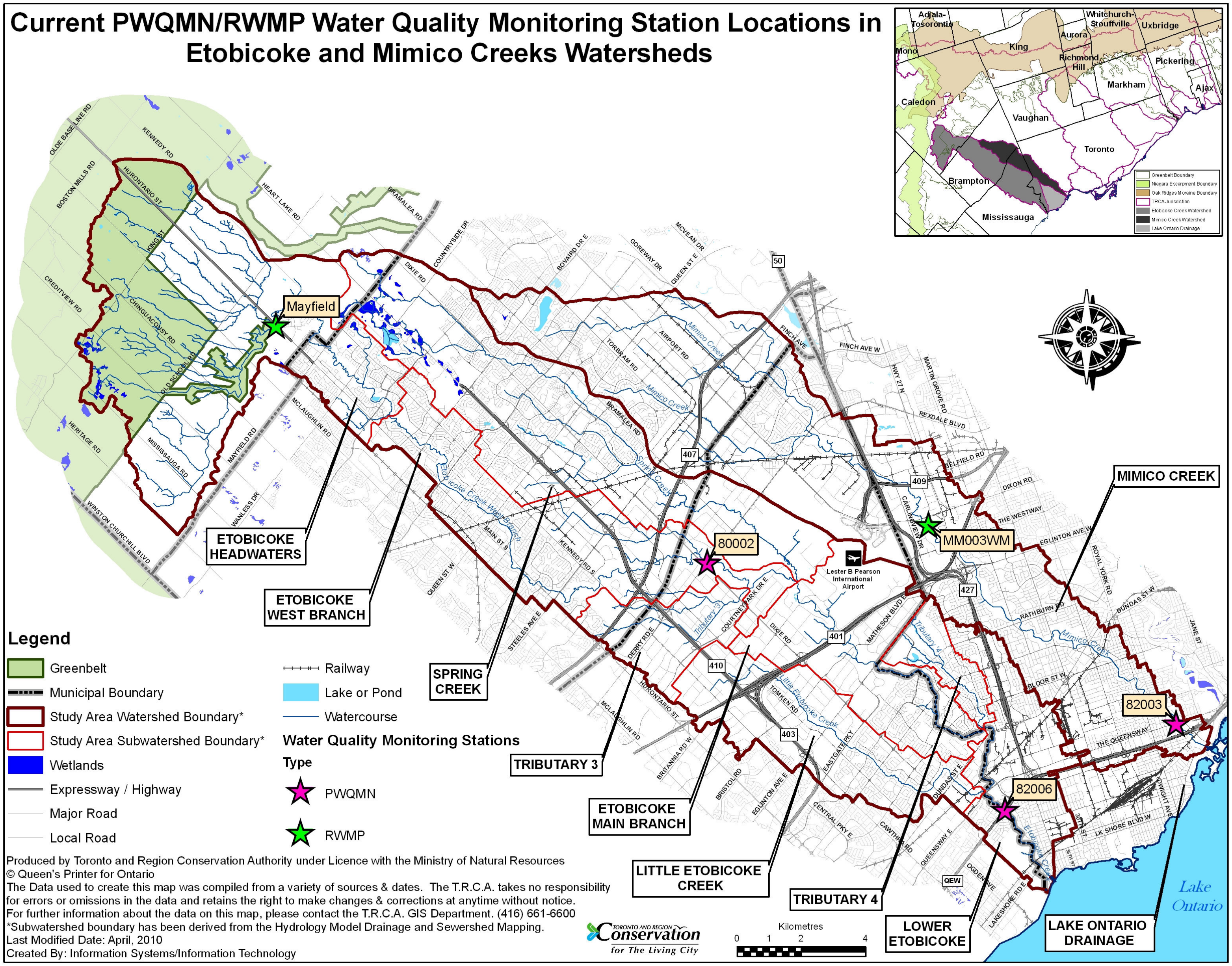
6.3.2 Monitoring Programs

Provincial Water Quality Monitoring Network/Regional Watershed Monitoring Program
Several water quality monitoring programs operate concurrently in the TRCA jurisdiction. These programs include the Provincial Water Quality Monitoring Network (PWQMN) and the Regional Watershed Monitoring Program (RWMP). Currently, there are two PWQMN stations located in the Etobicoke Creek watershed (Stations 0600800602, 0600800202) and one station (Station 06008200302) in the Mimico Creek watershed (see **Figure 6-1** and **Table 6-2**). These stations are sampled monthly during the ice-free period, a total of eight times per year. In addition to the PWQMN stations, TRCA collects water quality samples as part of the RWMP. There is one RWMP station in Etobicoke Creek (Station Mayfield) and one station in Mimico Creek (Station MM003WM). The Etobicoke Creek station was established in May 2002, and Mimico Creek station in January 2006. These sites are sampled for the same standard set of water quality indicators as the PWQMN stations, however are submitted to different laboratories.

In 2004, the RWMP expanded its monthly water quality sampling to be year round. The RWMP samples its sites 12 months per year and samples the PWQMN sites during the 4 months not covered by the MOE. In the spring of 2006, the RWMP began collecting monthly *Escherichia coli* (*E. coli*) samples from all sites (both RWMP and PWQMN) year round, which are analyzed at a private laboratory.

Field Sampling
Monthly grab samples were collected by TRCA in accordance with the PWQMN sampling protocols on set dates, independent of weather conditions, and delivered to a laboratory for analysis usually within 24-hours of sampling (MOE, 2003). Field measurements of water temperature, conductivity, dissolved oxygen, total dissolved solids and pH were taken using hand-held meters. Samples were analyzed at the Ontario Ministry of the Environment Laboratory Services Branch (Rexdale), the City of Toronto Dee Avenue laboratory, and various private laboratories. Samples are analyzed for the parameters listed in **Table 6-3**.

Figure 6-1: Current PWQMN/RWMP Water Quality Monitoring Station Locations in Etobicoke and Mimico Creeks Watersheds



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The Data used to create this map was compiled from a variety of sources & dates. The T.R.C.A. takes no responsibility for errors or omissions in the data and retains the right to make changes & corrections at anytime without notice.
For further information about the data on this map, please contact the T.R.C.A. GIS Department. (416) 661-6600
*Subwatershed boundary has been derived from the Hydrology Model Drainage and Sewershed Mapping.
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Table 6-2: Surface Water Quality Monitoring Station Details

Watershed	Station ID	Type	Subwatershed	Township	Municipality	Description
Etobicoke Creek	0600**80002**02	PWQMN	Etobicoke Creek West Branch	Mississauga	Peel	North-east of Derry Road and Dixie Road
Etobicoke Creek	0600**80006**02	PWQMN	Lower Etobicoke Creek	Toronto	Toronto	South-west of the QEW and Brown's Line, 30 m south (downstream) of QEW bridge
Etobicoke Creek	Mayfield	RWMP	Etobicoke Creek Headwaters	Brampton	Peel	South-east of Mayfield Road and Hwy 10, 5 m south (downstream) of Mayfield Road bridge
Mimico Creek	MM003WM	RWMP	Mimico	Toronto	Toronto	S.-W. of Dixon Rd and Hwy 27 in Royal Woodbine Golf Club, 30 m south (downstream) of bridge located at the south end of the 15th hole
Mimico Creek	0600**82003**02	PWQMN	Mimico	Toronto	Toronto	South-west of Park Lawn Road and The Queensway, under bridge on south (downstream) side

Table 6-3: Standard Suite of Water Quality Parameters Analyzed for Stream Samples

	Parameters			
General Chemistry	Water Temperature	Biochemical Oxygen Demand	Solids, Suspended	Solids, Dissolved
	Conductivity	Hardness	Magnesium	Dissolved Oxygen
	Sodium	Calcium	Chloride	Potassium
	Alkalinity	Turbidity	pH	
Microbiological	*Escherichia coli*			
Metals	Aluminum	Barium	Beryllium	Cadmium
	Chromium	Cobalt	Copper	Iron
	Lead	Manganese	Molybdenum	Nickel
	Silver	Titanium	Vanadium	Zinc
Nutrients	Nitrogen, Total Kjeldahl	Phosphorus, Total	Phosphate	Ammonia, Total
	Nitrate	Nitrite	Ammonia, Unionized	

Note: Additional parameters may be analyzed on a site/project specific basis

6.3.3 Analysis

Water quality results were compared to the Provincial Water Quality Objectives (PWQO) (MOEE, 1994). The PWQO are a set of numerical and narrative criteria which serve as chemical and physical indicators representing a satisfactory level of water quality level for surface waters which will protect all forms of aquatic life and all aspects of the aquatic life cycles during indefinite exposure. There are also some PWQO which are set for the protection of recreational water uses based on public health and aesthetic considerations. When PWQO were not available, other objectives such as the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG) (CCME, 2007) were used.

Statistical analysis was completed using JMP 8.0 (SAS Institute, Carrey, North Carolina). When results were below the laboratory detection limit (trace amounts), these values were set conservatively at the laboratory detection limit for analytical purposes. Only data for the months of April through November were analyzed to make the current results consistent with previous analysis (e.g. 1990-1995). The MOE recommends that for statistical summaries of routine monitoring data a minimum sample size of 30 or greater is required. Stations MM003WM and Mayfield were not included in the analysis due to limited data. Because only samples from the ice-free period were analyzed, historical results presented in this report may be different from previous reports. *E. coli* sampling was initiated in 2006, therefore limited data was available. However, results were analyzed and, where available, analysis included data from January through December.

It is important to note that water quality samples collected as part of the PWQMN/RWMP are collected independent of weather conditions. This means that there is no specific effort placed on monitoring wet-weather events. Samples are collected monthly, and should represent a range of streamflow conditions including snowmelt, runoff from rain events of varying magnitude and baseflow conditions during varying seasons. Winter water quality samples were not included in this analysis, therefore, certain parameters may be biased (e.g. chloride levels may appear low because the highest chloride levels are measured in the winter when road salt is used). Because specific wet-weather events are not targeted, contaminant concentrations presented in this report may be significantly lower than what would be measured during a storm event.

The difference between wet and dry weather contaminant concentrations reflect differences in the source and volume of flow during these two periods. During dry weather periods, flows are small and originate primarily from groundwater which has been filtered by the soil. By contrast, the majority of wet weather flow originates from surface runoff. Urban runoff can contain high concentrations of contaminants (e.g. sediments, nutrients, road salts, heavy metals, petroleum products, bacteria) which are washed off impervious surfaces such as roads and parking lots. Agricultural runoff leaving farm fields because of excessive precipitation, irrigation, or snowmelt, can also contain high levels of contaminants such as sediment, pesticides, nutrients and bacteria.

6.4 EXISTING CONDITIONS AND INTERPRETATION

6.4.1 Conventional Pollutants

The conventional pollutants covered in this report are as follows: total suspended solids, chloride, total phosphorus, nitrates (nitrogen compounds), and ammonia.

Total Suspended Solids (TSS)

A total suspended solids (TSS) value represents the amount of particulate matter (e.g. silt, clay, organic and inorganic matter, soluble organic compounds, plankton, other microscopic organisms) suspended in water. Suspended sediments can act as a transport vector for a wide range of contaminants (e.g. metals are charged particles which can bind with sediment) and can affect aquatic organisms. Direct negative effects to fish include clogging and abrasion of gills, behavioural effects (e.g. movement and migration), blanketing of spawning gravels and other habitat changes, the formation of physical constraints disabling proper egg and fry development, and reduced feeding (CCME, 2002). Effects to benthic invertebrates include physical habitat changes, smothering of benthic communities, clogging of interstices between gravel, cobbles, and boulders affecting invertebrate microhabitat, abrasion of respiratory surfaces, and interference of food intake for filter-feeding invertebrates (CCME, 2002).

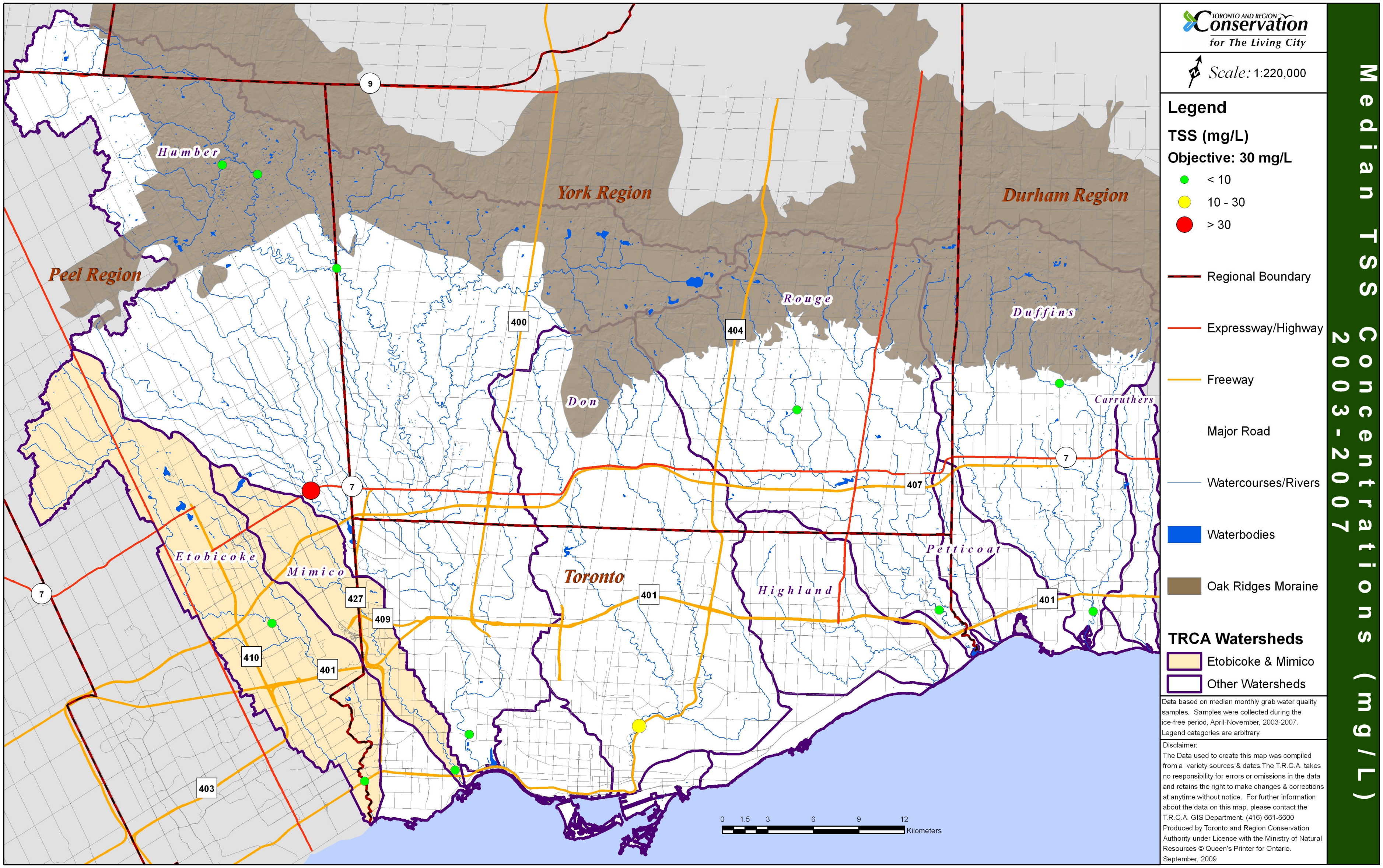
Currently, there is no PWQO for TSS that can be easily applied to stream water quality samples. The Canadian Water Quality Guidelines (CWQG) contain a narrative guideline for TSS which recommends that during periods of “clear flow” water (ambient, baseflow conditions), the maximum increase of TSS should be no more than 25 mg/L from background levels for any short-term exposure (e.g. 24-h period), and only a maximum average increase of 5 mg/L from background levels for longer term exposures (e.g. inputs lasting between 24 h and 30 d). During periods of “high flow” (e.g. after a precipitation event), the guideline recommends a maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L (CCME, 2002).

Previous reports (e.g. TRCA, 2002) have used an objective of 25-80 mg/L for TSS. For the purpose of this Technical Update, an objective of 30 mg/L based on the CWQG was used which assumes an average background TSS concentration of 5 mg/L. **Figure 6-2** shows the median TSS concentrations for Etobicoke and Mimico Creek for 2003-2007 compared to other sampling stations across the TRCA jurisdiction. Median TSS concentrations generally did not exceed the objective of 30 mg/L. In general, median TSS concentrations in Etobicoke and Mimico Creeks are similar, if not lower, than other TRCA watersheds.

The *Greening Our Watersheds: Revitalization Strategies for Etobicoke and Mimico Creeks* report set a target for 2006 of no increase in conventional pollutants over 1990-1995 levels. Median 1990-1995 TSS concentrations for Etobicoke Creek were 6-10 mg/L while median values for 2003-2007 were 5-6 mg/L suggesting that there has been a decrease in TSS concentrations over the last decade. For Mimico Creek, the 1990-1995 median TSS concentration was 6 mg/L measured at a station near the mouth of the creek, and the 2003-2007 median value was 5 mg/L measured approximately 1 km upstream. Therefore, both watersheds met the 2006 target of no increase in TSS over the 1990-1995 concentrations based on available data.

The target set for 2025 is that at least 75 % of the samples should meet the water quality objective for conventional pollutants. TSS samples for 2003-2007 met the 30 mg/L objective for approximately 95 % of the samples in Etobicoke Creek and for 86 % of the samples in Mimico Creek, suggesting that both creeks will meet this objective if conditions remain or improve. However, wet weather is when we expect to see increased TSS and excedences are expected to be higher.

Figure 6-2: Median TSS Concentrations (mg/L) across the TRCA Jurisdiction for the Ice-Free Period (April-November), 2003-2007



Chloride

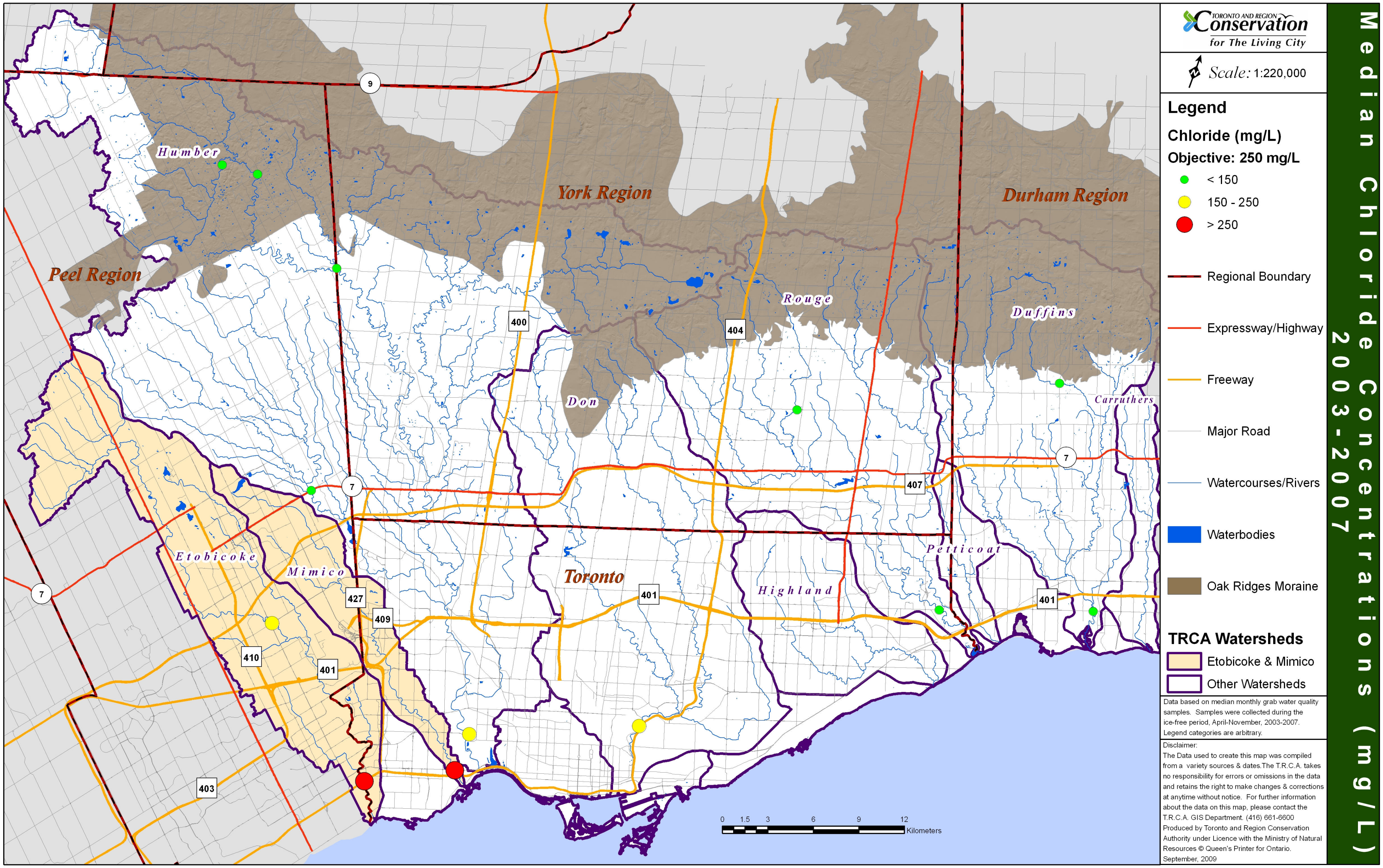
Chloride can be toxic to aquatic organisms with acute effects at high concentrations and chronic effects (e.g. growth, reproduction) at lower concentrations (MOE, 2003). Chloride in our waterways is mainly due to the use of road salts which are used as de-icing and anti-icing agents during winter road maintenance. The predominant chloride salt used in de-icing in North America is sodium chloride, which is composed of about 40 % sodium and 60 % chloride by weight. Trace elements, including trace metals, may represent up to 5 % of the total salt weight. Natural background concentrations of chloride in water are generally no more than a few milligrams per liter, with some local or regional instances of higher natural salinity (EC and HC, 2001).

Chloride is a highly soluble and mobile ion that does not volatilize or easily precipitate or adsorb onto surfaces of particulates. Road salts enter the environment through runoff/melt-water, losses at salt storage and snow disposal sites, or from the release of salts stored in surface soils. There are no major removal mechanisms, such as volatilization, degradation (photodegradation, biodegradation), sorption (to particulates) or oxidation that would remove the salts from surface waters. Because chloride ions are persistent and are entrained in the hydrological cycle, all chloride ions applied to roadways as road salts and/or released from storage yards or snow disposal sites can be expected to be ultimately found in surface water.

Presently, there is no Provincial or Canadian water quality guideline for chloride. A comprehensive five-year scientific assessment by Environment Canada and Health Canada determined that in sufficient concentrations, road salts pose a risk to plants, animals and the aquatic environment (EC and HC, 2001). The report noted that an estimated 5 % of aquatic species would be affected (median lethal concentration) at chloride concentrations of about 210 mg/L, and 10 % of species would be affected at chloride concentrations of about 240 mg/L. The study also noted that changes in populations or community structure can occur at lower concentrations. The British Columbia Ministry of the Environment (BC MOE) has a chloride guideline which states that the average concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L (based on an arithmetic mean computed from five samples collected over a 30-day period) to protect freshwater aquatic life from acute and lethal effects; the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L (BC MOE, 2003). The 150 mg/L value includes a safety factor of five because chronic effects data in the literature is limited and the 600 mg/L acute value includes a safety factor of two because of the relative strength of the data set. Nationally, water quality is summarized as part of the Canadian Environmental Sustainability Indicators (CESI) report series (e.g. EC *et al*., 2008) produced by the Government of Canada (Environment Canada, Statistics Canada, Health Canada). The CESI report authors have interpreted the aforementioned studies and used an objective of 150 mg/L to protect aquatic life (EC, 2005). The Ontario government is currently considering the establishment of a chloride objective for the protection of freshwater aquatic life. In previous TRCA reports (e.g. TRCA, 2002), an objective of 250 mg/L was used.

Median chloride concentrations for the 5-year period of 2003-2007 are presented in **Figure 6-3.** It is important to note that the figure is only for April-November, hence snowmelt events when chloride concentrations are the greatest, have not been accounted for in these survey results. For 1990-1995, the median chloride concentrations did not exceed 250 mg/L at any of the water quality stations monitored in the Etobicoke and Mimico Creeks. The 1990-1995 chloride concentration at Station 82001 near the mouth of Mimico Creek did approach the objective with a median chloride concentration of 247 mg/L. Median chloride concentrations for 2003-2007 exceeded the objective of 250 mg/L at the mouths of both the Etobicoke and Mimico Creeks.

Figure 6-3: Median Chloride Concentrations (mg/L) across the TRCA Jurisdiction for the Ice-Free Period (April-November), 2003-2007



The station located at the mouth of Mimico Creek had the highest median chloride concentration (397 mg/L) in TRCA's jurisdiction. This may be influenced by the geology of the area. Chloride concentrations in the groundwater system across the TRCA jurisdiction are also generally low (below 50 mg/L), except in aquifers close to, or in contact with the marine shales of the Georgian Bay and Queenston shale formations, which is the case in the lower Mimico Creek. The chloride concentrations in these shales can be as high as 30,000 mg/L (Donald Ford, *pers. comm*.). The only way to differentiate the chloride contributions from groundwater/surface water interactions and the application of road salt is to examine the chlorine isotope fractions. Such data are not currently available.

If a 150 mg/L objective was applied to this data, the median chloride concentrations for all sites for both time periods would exceed the 150 mg/L objective. **Table 6-4** shows the percentage of samples which would meet both the 150 mg/L and 250 mg/L objectives.

Table 6-4: Median Chloride Concentrations in Comparison to 150 mg/L and 250 mg/L Objectives.

		1990-1995				2003-2007			
Watershed	**Station**	**N**	**Median**	**% Meet 250 mg/L Objective**	**% Meet 150 mg/L Objective**	**N**	**Median**	**% Meet 250 mg/L Objective**	**% Meet 150 mg/L Objective**
Etobicoke	80001	52	191	73%	35%				
	80002	28	111	100%	71%	38	183	79%	24%
	80003	28	161	79%	39%				
	80004								
	80006					37	362	30%	3%
Mimico	82001	27	247	52%	30%				
	82003					37	397	16%	5%

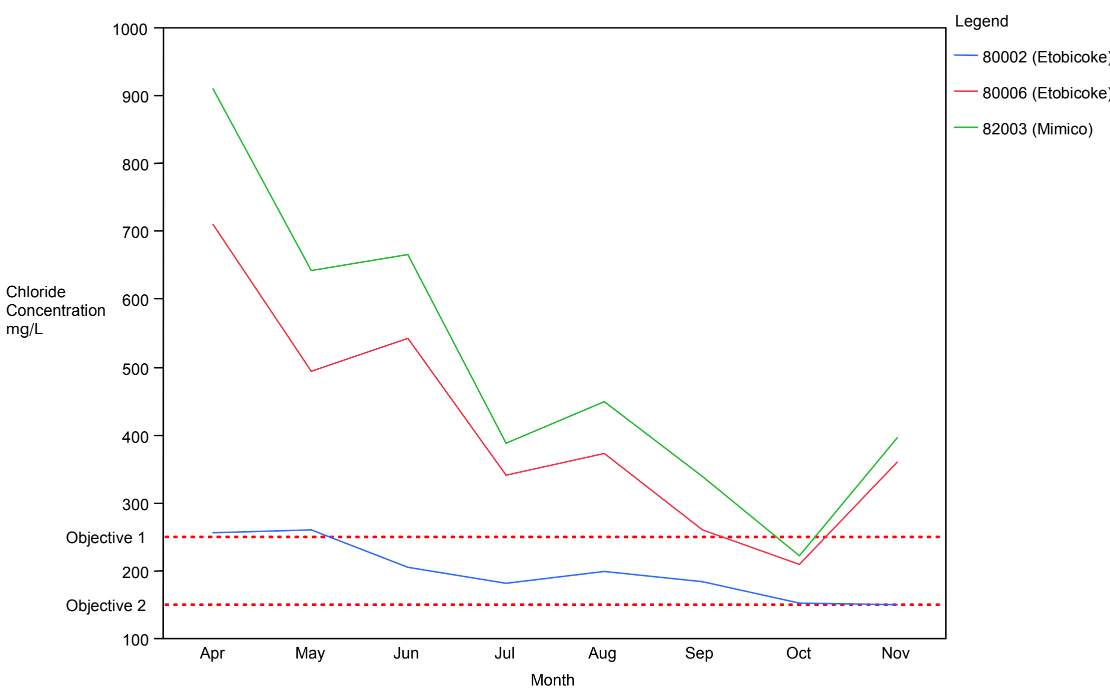
Monthly median chloride concentrations for 2003-2007 are presented in **Figure 6-4.** This figure shows that chloride concentrations are highest in the spring post road salt application and drop over the summer and fall months. Median April concentrations at one Etobicoke Creek station (80006) was greater than 700 mg/L and greater than 900 mg/L in Mimico Creek (82003). These values are more than three times the 250 mg/L objective or five times the 150 mg/L objective.

The *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* set a target for 2006 of no increase in conventional pollutants in Etobicoke and Mimico Creeks over 1990-1995 levels. Median 1990-1995 chloride concentration values for Etobicoke Creek were 111-191 mg/L while median values for 2003-2007 were 183-362 mg/L suggesting an increase in chloride concentrations over the past ten years. Station 80002 located in the middle reaches of Etobicoke Creek was the only station monitored during both time periods. The median concentration for 1990-1995 was 111 mg/L and for 2003-2007 the concentration was 183 mg/L. Yearly median chloride concentrations at this station showed a significant increasing trend when analyzed using the Mann-Kendall non-parametric test ($S=1.789$, $p=0.05$). For Mimico Creek, the 1990-1995 median chloride concentration was 247 mg/L measured at Station 82001 near the mouth of the creek. The 2003-2007 median value was 397 mg/L measured at Station

82003 approximately 1 km upstream. Although chloride concentrations at Station 82001 may have been influenced by dilution from Lake Ontario, an increasing chloride trend has been seen across all of the TRCA's watersheds. Therefore, both Etobicoke and Mimico Creeks watersheds failed to meet their 2006 target.

The target set for 2025 is that at least 75 % of the samples should meet objectives for conventional pollutants. For 2003-2007, chloride concentrations were measured at three stations and the values ranged considerably. Using the 250 mg/L objective, the two stations in Etobicoke Creek met the objective 30-79 % of the samples. In the Mimico Creek watershed, the station located at the mouth of the creek met the objective only 16 % of the samples. It is important to note that results were limited to April to November and may not reflect the highest concentrations of chloride in these streams. These results suggest that both Etobicoke and Mimico Creeks will not meet the 2025 target.

Figure 6-4: 2003-2007 Monthly Median Chloride Concentrations (mg/L) for Two Stations in Etobicoke Creek and One Station in Mimico Creek in Comparison to 150 mg/L Water Quality Objective



Total Phosphorus
Phosphorus is an essential nutrient for all living organisms but in excess, it can have unfavorable effects. Phosphorus is associated with eutrophication – the enrichment of a water body with nutrients.

Additional inputs of phosphorus to an aquatic system can cause increased plant and algal productivity and biomass. Although this may be desirable in some cases, beyond a certain point, further phosphorus additions may cause undesirable effects, such as decreased biodiversity and changes in dominant biota, decline in ecologically sensitive species and increase in tolerant species, increase in plant and animal biomass, increase in turbidity, increase in organic matter leading to high sedimentation, and anoxic conditions (EC, 2004).

When the excessive plant growth includes certain species of cyanobacteria, toxins may be produced, causing increased risk to aquatic life, livestock, and human health (Chambers *et al*., 2001). The potential human quality of life concerns that may relate to eutrophication include difficulties treating potable water which can lead to increased cost, taste or odour problems, decreased aesthetic/ recreational value, excessive macrophyte growth may impede water flow and navigation, and commercial and recreational fish populations may decrease (EC, 2004). Flowing waters are usually less affected than standing waters.

The PWQO for total phosphorus is 0.03 mg/L and this level is intended to control excessive plant growth in rivers and streams. Phosphorus results for 2003-2007 are presented in **Figure 6-5.** The median phosphorus concentration for Station 80006 in Etobicoke Creek was 0.03 mg/L. The median phosphorus concentration for the other site in Etobicoke Creek (80002) and the site in Mimico Creek (82003) both exceeded the PWQO. This is similar to the stations in other jurisdictions with only a few stations in the headwaters of the Humber River and Duffins Creek having median phosphorus concentrations below 0.03 mg/L.

The *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* report set a target for 2006 of no increase in conventional pollutants in Etobicoke and Mimico Creeks over 1990-1995 levels. For 1990-1995, the median total phosphorus concentrations for Etobicoke Creek watershed ranged from 0.03 - 0.15 mg/L and the median concentration of total phosphorus measured near the mouth of the Mimico Creek was 0.06 mg/L. For 2003-2007, the median total phosphorus concentrations ranged from 0.03 - 0.04 mg/L for Etobicoke Creek and 0.05 mg/L for Mimico Creek. The data suggest that both watersheds likely maintained (or slightly decreased) earlier phosphorus concentrations.

The target set for 2025 is that conventional pollutants should meet the PWQO objective of 0.03mg/L for at least 75 % of the samples. For Etobicoke Creek, the 2003-2007 data met the objective for 16-51 % of the samples. Although certain sites in Etobicoke Creek may be able to achieve the target, in general, it seems unlikely that the majority of the sites in Etobicoke Creek will meet the target. For Mimico Creek, the 2003-2007 data met the objective for 11 % of the samples. These results suggest that both Mimico and Etobicoke Creek watersheds will not be able to meet the target.

Nitrogen Compounds

In the majority of water bodies, phosphorus is normally the limiting nutrient for algal growth but nitrogen compounds can also play a role in the eutrophication process. Three nitrogen compounds are analyzed as part of the PWQMN/RWMP: nitrate (NO_3), nitrite (NO_2) and total ammonia (NH_3 + NH_4^+). Anthropogenic discharges of nitrogen can include municipal and industrial wastewaters, septic tanks, agricultural runoff, feedlot discharges, urban runoff, lawn fertilizers, landfill leachate, nitric oxide and nitrogen dioxide from vehicular exhaust, and storm sewer overflow (CCME, 2003). Natural sources of ammonia include the decomposition or breakdown of organic waste matter, gas exchange with the atmosphere, forest fires, animal waste, human breath, discharge of ammonia by biota, and nitrogen fixation processes (CCME, 2003). Nitrate serves as the primary source of nitrogen for aquatic plants in well oxygenated systems, and as nitrate levels increase, there is an increasing risk of algal blooms and eutrophication in surface waters. Nitrite and unionized ammonia can be toxic to fish and other aquatic organisms at relatively low concentrations.

Nitrates (nitrate + nitrite) results are presented in **Figure 6-6**. The 2006 Etobicoke and Mimico Report Card (TRCA, 2006) used an objective of 0.3 mg/L for nitrate. The recent Canadian Environmental Sustainability Indicators (CESI) Initiative report interpreted the interim Canadian Water Quality Guidelines (CWQG) for nitrate as 2.93 mg/L (EC *et al*., 2008). For this Technical Update, an objective of 2.93 mg/L was used for nitrates (since nitrite is only a minor constituent of nitrates, an objective of 2.93 mg/L was applied to the nitrates concentrations). All stations had median water quality values below the 2.93 mg/L objective.

A 2006 target of no increase in conventional pollutants over 1990-1995 levels was set out in the *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* report. For 1990-1995, median nitrates values ranged from 0.35 - 0.75 mg/L in Etobicoke Creek and for 2003-2007, median nitrates concentrations ranged from 0.52 - 0.55. For Mimico Creek, the median nitrates concentration was 0.83 mg/L in Mimico Creek in 1990-1995 and 0.77 mg/L in 2003-2007. The results suggest that both watersheds met the 2006 target of no increase in conventional pollutants. The 2025 target is that conventional pollutants meet water quality objectives for at least 75 % of the samples. For both watersheds, the sites sampled met the objective of 2.93 mg/L 89-100 % of the samples therefore indicating that both watersheds should meet their target.

Figure 6-5: Median Phosphorus Concentrations (mg/L) across the TRCA Jurisdiction for the Ice-Free Period (April-November), 2003-2007

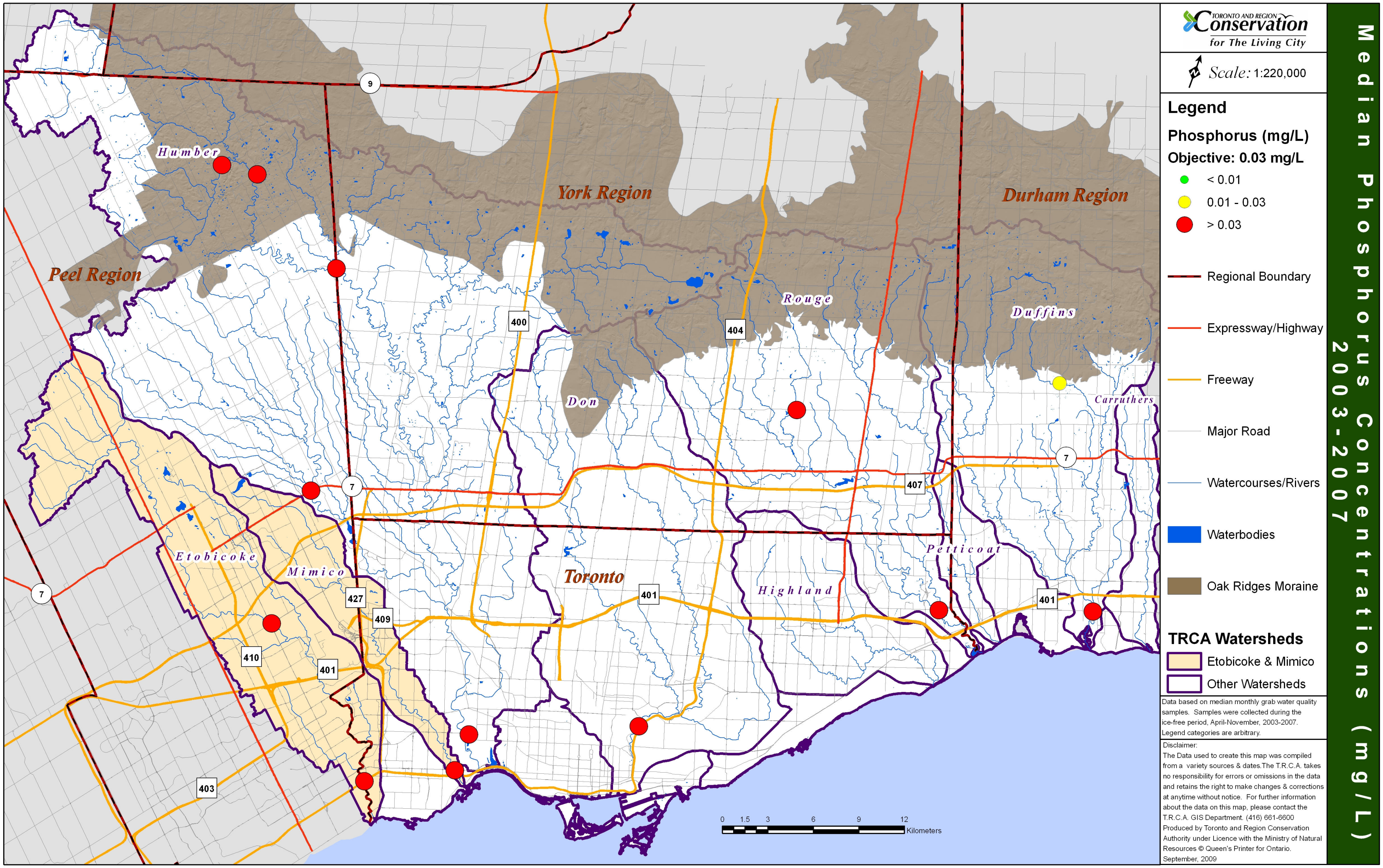
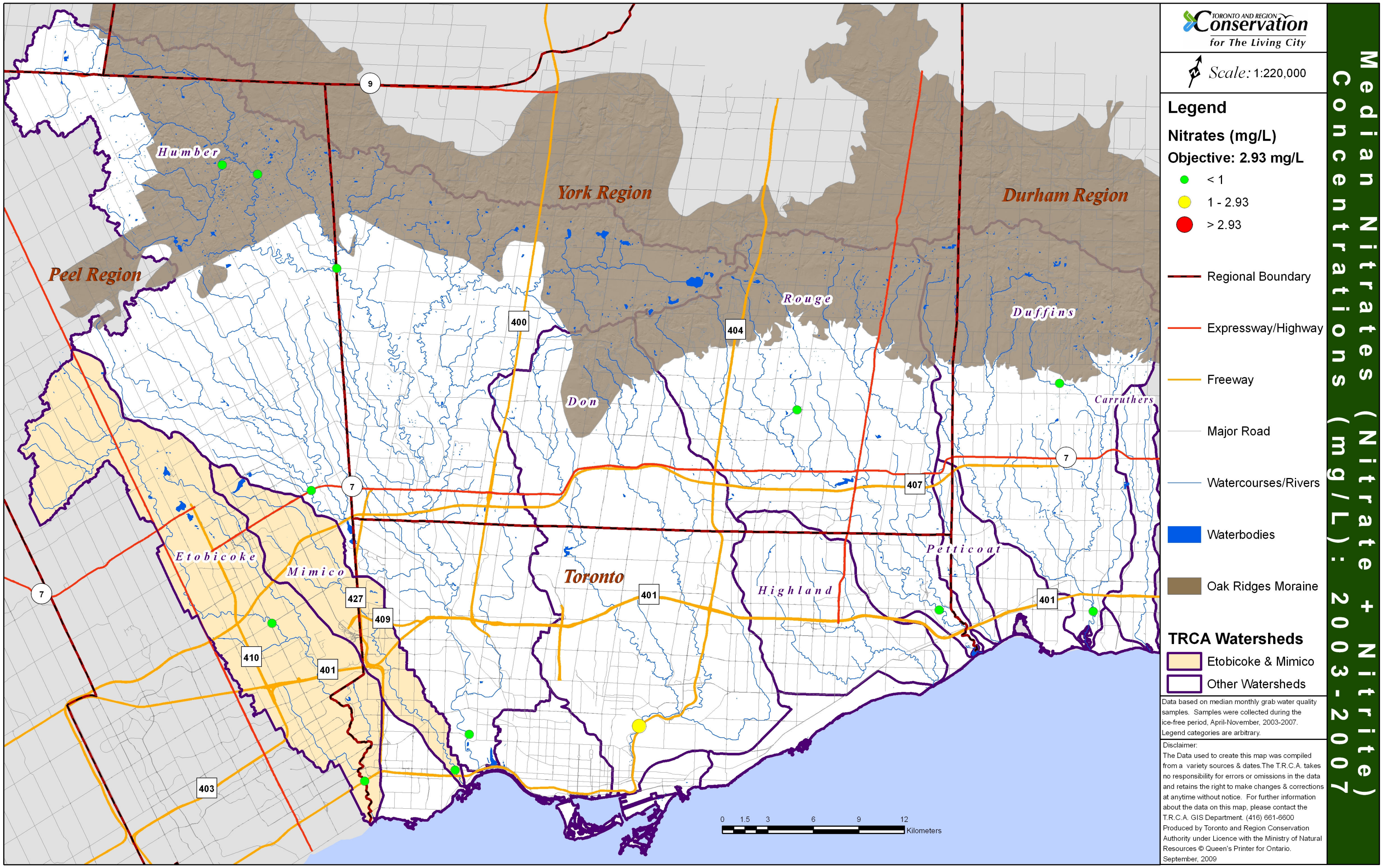


Figure 6-6: Median Nitrates Concentrations (mg/L) across the TRCA Jurisdiction for the Ice-Free Period (April-November), 2003-2007



Unionized ammonia concentrations are presented in **Figure 6-7**. Unionized ammonia values are calculated from total ammonia values and depend on the pH and temperature of the water. Raising pH by one unit can cause the unionized ammonia concentration to increase nearly tenfold, while a 5°C temperature increase can cause an increase of 40-50 % (CCME, 2000). The PWQO for unionized ammonia is 0.02 mg/L. Median concentrations of unionized ammonia for the three water quality stations in 2003-2007 were below the PWQO of 0.02 mg/L. Because unionized ammonia is temperature dependent and water quality samples were collected over many months where the water temperature is low, the median value does not properly describe unionized ammonia concentrations. The 75th percentile of the maximum unionized ammonia concentrations was calculated and did not exceed the PWQO of 0.02 mg/L for 2003-2007.

The *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* target for 2006 was no increase in conventional pollutants in Etobicoke and Mimico Creeks over 1990-1995 levels. For Etobicoke Creek median unionized ammonia concentrations ranged from 0.001 - 0.004 mg/L for 1990-1995 and were 0.001 mg/L for 2003-2007. This suggests that unionized ammonia concentrations may have decreased although this is not certain because Station 80004 which had the highest number of PWQO exceedances in 1990-1995 was not monitored for 2003-2007. For Mimico Creek, the median unionized ammonia concentrations ranged from 0.001 - 0.006 mg/L for 1990-1995 and were 0.002 mg/L for 2003-2007. This suggests that there has been no increase in unionized ammonia in Mimico Creek over the last decade.

6.4.2 Metals

Metals in surface waters originate primarily from urban sources such as automobile use, roof runoff and road surface materials and can be toxic to aquatic life at very low concentrations. The most common metals in urban areas are lead, zinc, chromium, manganese, nickel and cadmium (Paul and Meyer, 2001). In the report *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* copper, iron, zinc, aluminum, cadmium, lead, and silver were listed as indicators. The report *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* set a 2006 target for levels of the seven metals of concern to meet the appropriate PWQO for at least 75 % of the samples. This is now also the long term target for 2025.

<u>Copper</u>

Copper is an essential trace element that can be toxic to aquatic biota at elevated concentrations. It enters aquatic systems through aerial deposition or surface runoff. Sources of copper include the weathering of copper minerals and numerous sources from human activities (e.g. copper pipe, metal alloys, wiring, fungicides and insecticides). Copper strongly adsorbs to particulate matter, such as soil and tends to accumulate in sediments, where a variety of organisms live. Sediments act as an important route of exposure to aquatic organisms (CCME, 1999b). High levels of copper in the aquatic environment are usually found in more urbanized and industrial areas (MOE, 2003).

Copper results are presented in **Figure 6-8**. Median copper concentrations for Etobicoke and Mimico Creeks were less than 4 μg/L which is below the PWQO of 5 μg/L. These results are similar to other watersheds within the TRCA's jurisdiction.

Figure 6-7: Median Un-ionized Ammonia Concentrations (mg/L) across the TRCA Jurisdiction for the Ice-Free Period, 2003-2007

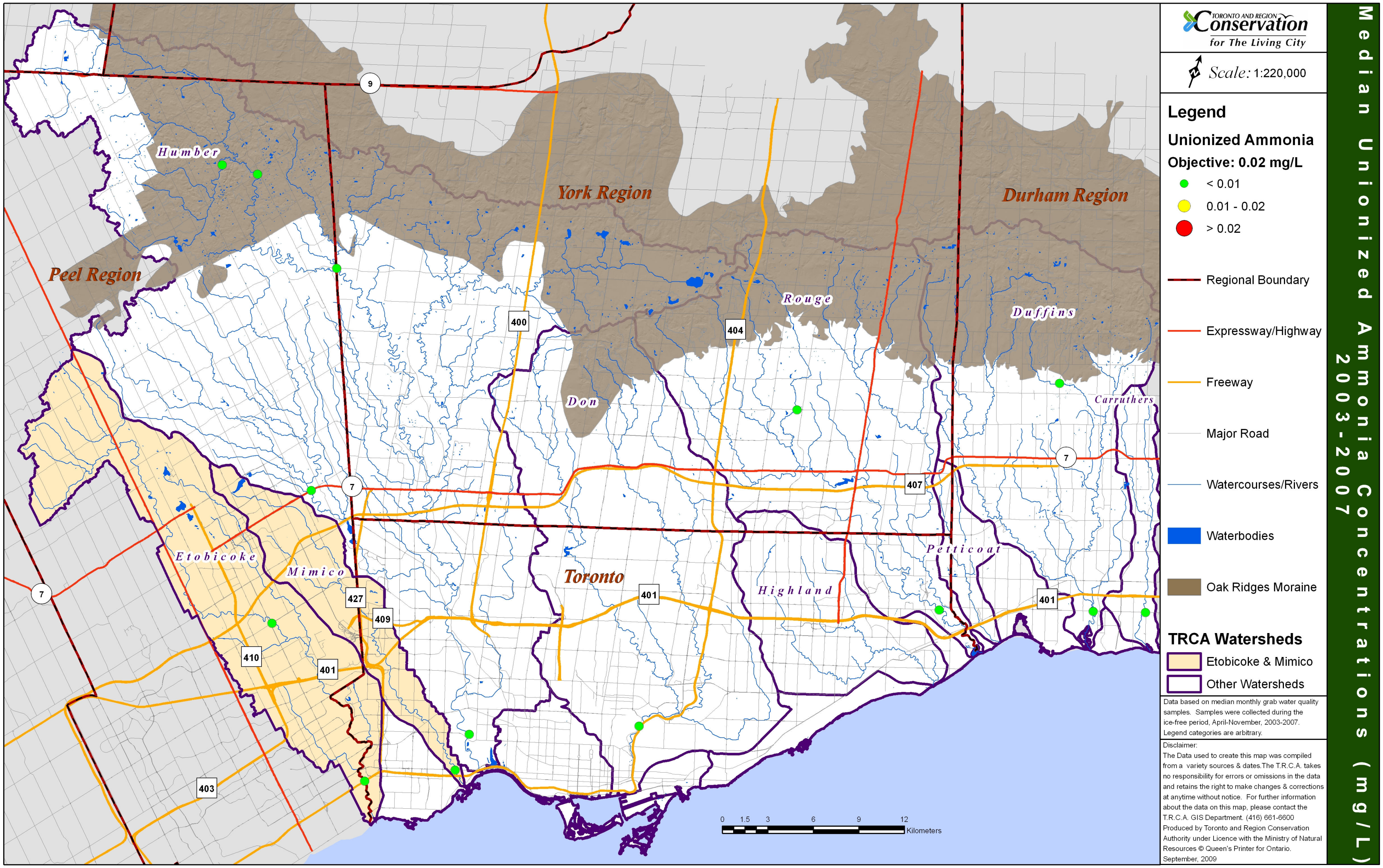
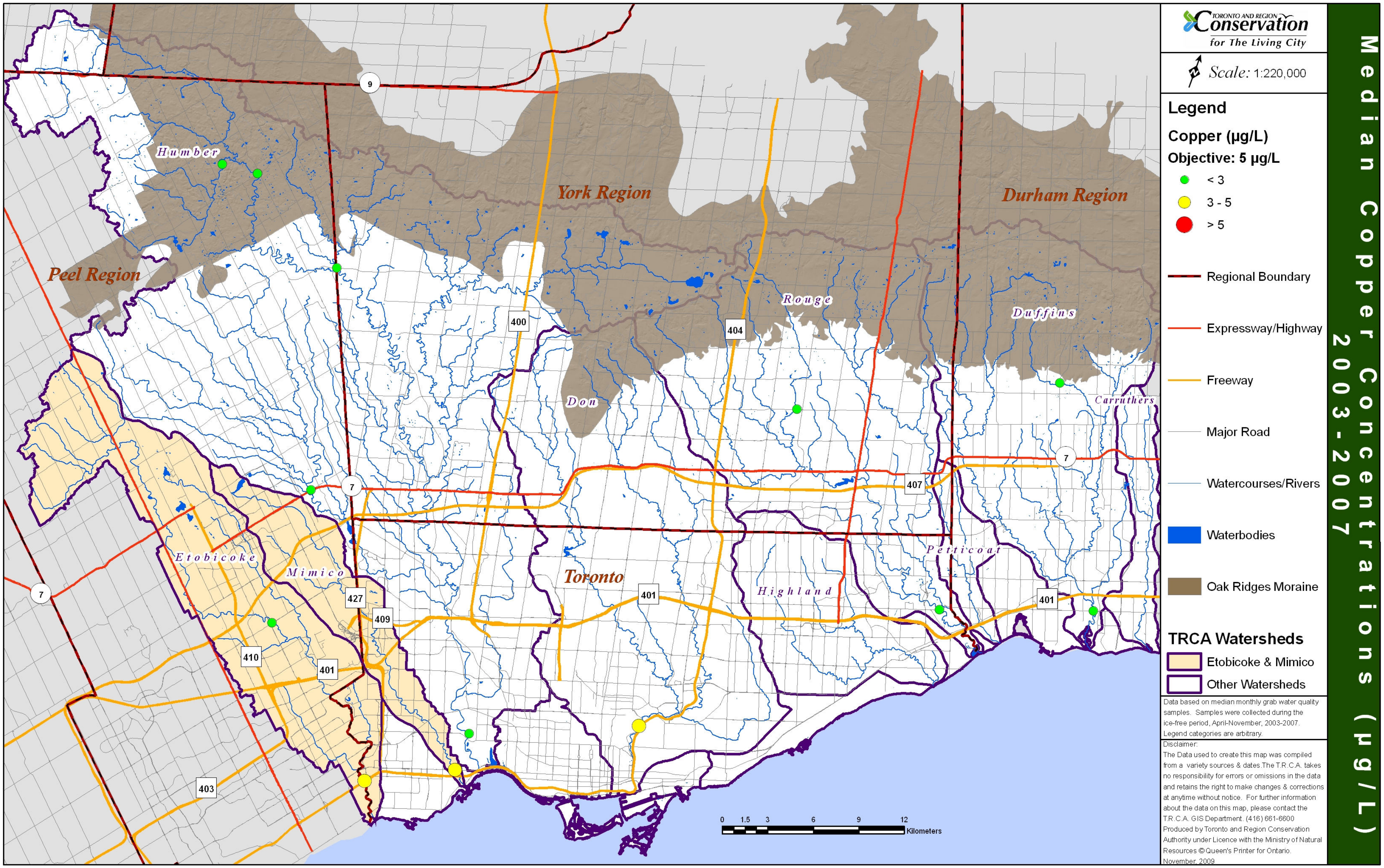


Figure 6-8: Median Copper Concentrations (μg/L) across the TRCA Jurisdiction for the Ice-Free Period, 2003-2007



The target for metals is that they meet the appropriate PWQO for 75 % of the samples. For the 2003-2007 results, copper met the PWQO for 81-92 % of the samples in Etobicoke Creek and for 78% of the samples in Mimico Creek which achieved the 2006 target. If these conditions are maintained or improved, it appears likely that the target will continue to be met by 2025. Further efforts to treat wet weather flows and improve water quality, through proper stormwater treatment infrastructure, riparian plantings, etc. are important to manage metal levels in the Creeks. In addition, some metals naturally occur in soils and are transferred to surface water.

Iron

Iron is the fourth most abundant metal by weight in the earth's crust and is often a major constituent of soils. Examples of anthropogenic sources of iron to surface waters include insecticides, dyeing of cloth, sewage treatment, fertilizer, additive to animal feed (BC MOE, 2008). Iron is a requirement for all forms of life as it plays an important role in metabolic processes (BC MOE, 2008). But, iron can also be toxic to aquatic organisms at high concentrations. The PWQO for iron is 300 μg/L.

Total iron results are presented in **Figure 6-9.** Median iron concentrations for all sites monitored for 2003-2007 were below the PWQO of 300 μg/L. Median 2003-2007 iron concentrations for Etobicoke Creek ranged from 127 – 133 μg/L. The median concentration near the mouth of Mimico Creek was 144 μg/L for the same time period. For both watersheds, there was greater than 78% compliance with the PWQO indicating that the 2006 target was achieved. Given that the samples meet the PWQO in 78-84 % of the samples, it appears the 2025 target of 75 % compliance can be met, if conditions can be maintained or improved.

Zinc

Zinc is an essential trace element that is toxic to aquatic organisms at elevated levels causing increased behavioral changes and mortality as well as decreased benthic invertebrate diversity and abundance (MOE, 2003). Zinc can enter aquatic systems through aerial deposition or surface runoff. The primary use of zinc is for galvanized products for the automotive and construction industry. Sources of anthropogenic zinc include electroplaters, smelting and ore processing, domestic and industrial sewage, combustion of solid wastes and fossil fuels, corrosion of zinc alloy and galvanized surfaces and soil erosion (MOE, 2003). Aquatic organisms are exposed to both particulate and dissolved (bioavailable) forms of zinc. Zinc has a strong affinity for aquatic particles (especially organic matter) and tends to accumulate in bed sediments. A wide variety of organisms live in contact with the sediments of aquatic systems. Sediments therefore act as an important route of exposure to zinc for aquatic organisms (CCME, 1999a).

Zinc results are presented in **Figure 6-10.** All stations monitored in the Etobicoke and Mimico Creeks watersheds had median zinc concentration less than 8 μg/L which is below the PWQO of 20 μg/L. Median zinc concentrations were similar to those monitored throughout TRCA's jurisdiction.

The target for metals is that they meet the appropriate PWQO for 75 % of the samples. For the 2003-2007 results, median zinc concentrations met the PWQO for 81-95 % of the samples in both watersheds which achieved the 2006 target to meet the PWQO for at least 75 % of samples. If conditions are maintained or improved, it appears that this target can continue to be met by 2025.

Aluminum, Cadmium, Lead, Silver

Aluminum, cadmium and lead were not analyzed for this report. These parameters had limited sampling data and should be analyzed in the future when more data is available. Silver is not monitored as part of the MOE's PWQMN, therefore, it has subsequently been dropped from the indicator list.

Figure 6-9: Median Iron Concentrations (µg/L) across the TRCA Jurisdiction for the Ice-Free Period, 2003-2007

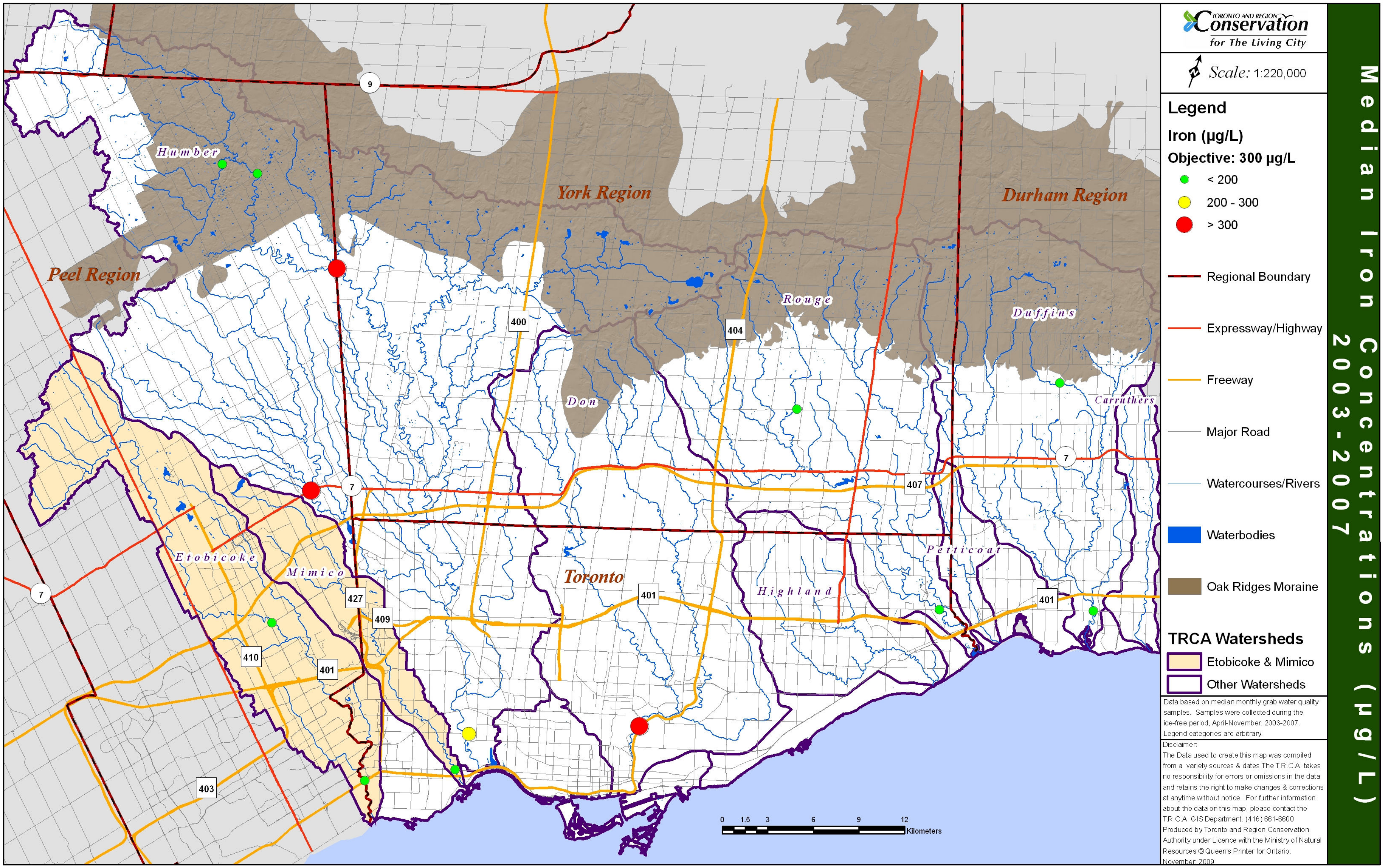
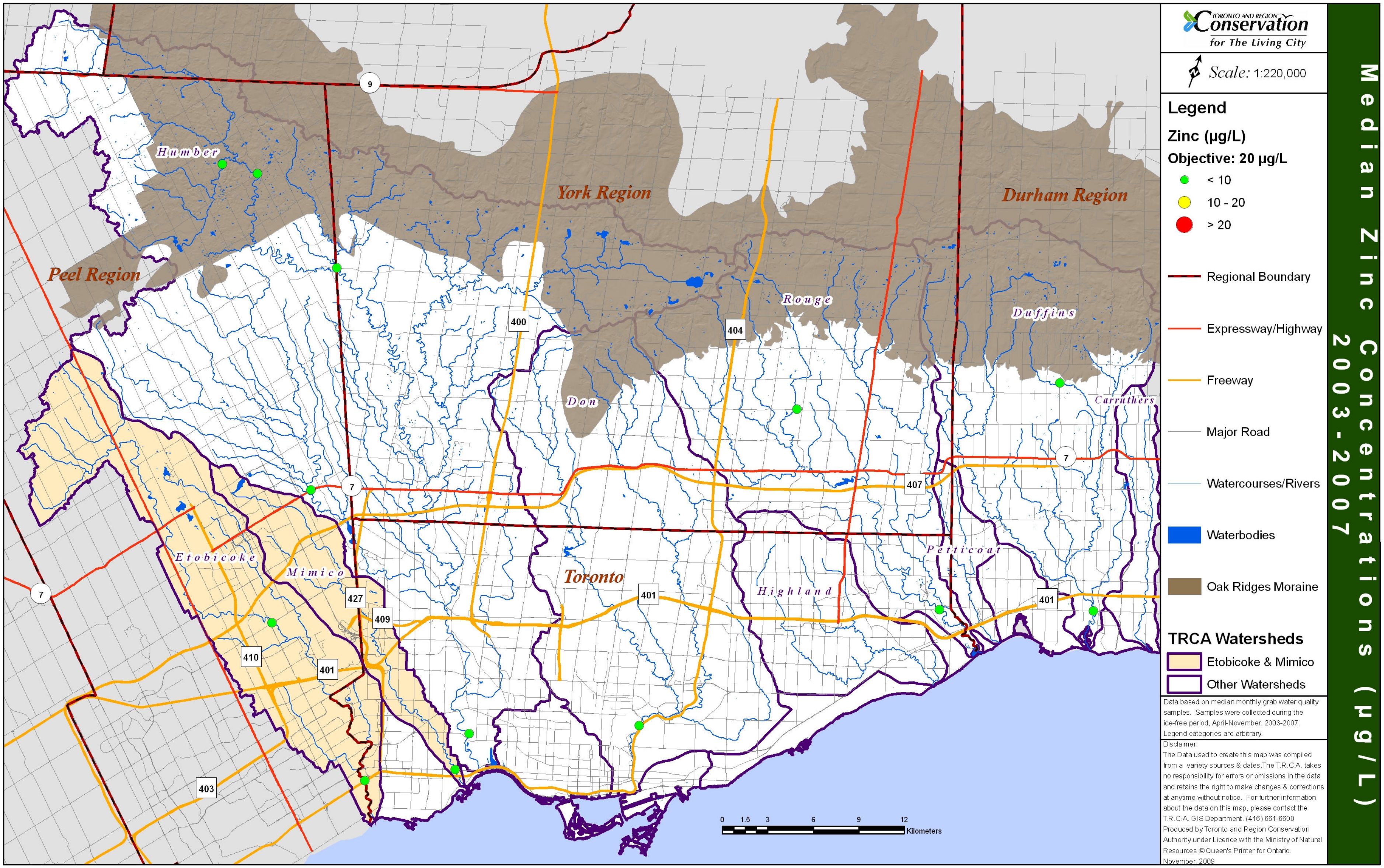


Figure 6-10: Median Zinc Concentrations (µg/L) across the TRCA Jurisdiction for the Ice-Free Period, 2003-2007



6.4.3 Bacteria

<u>*E. coli*</u>

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

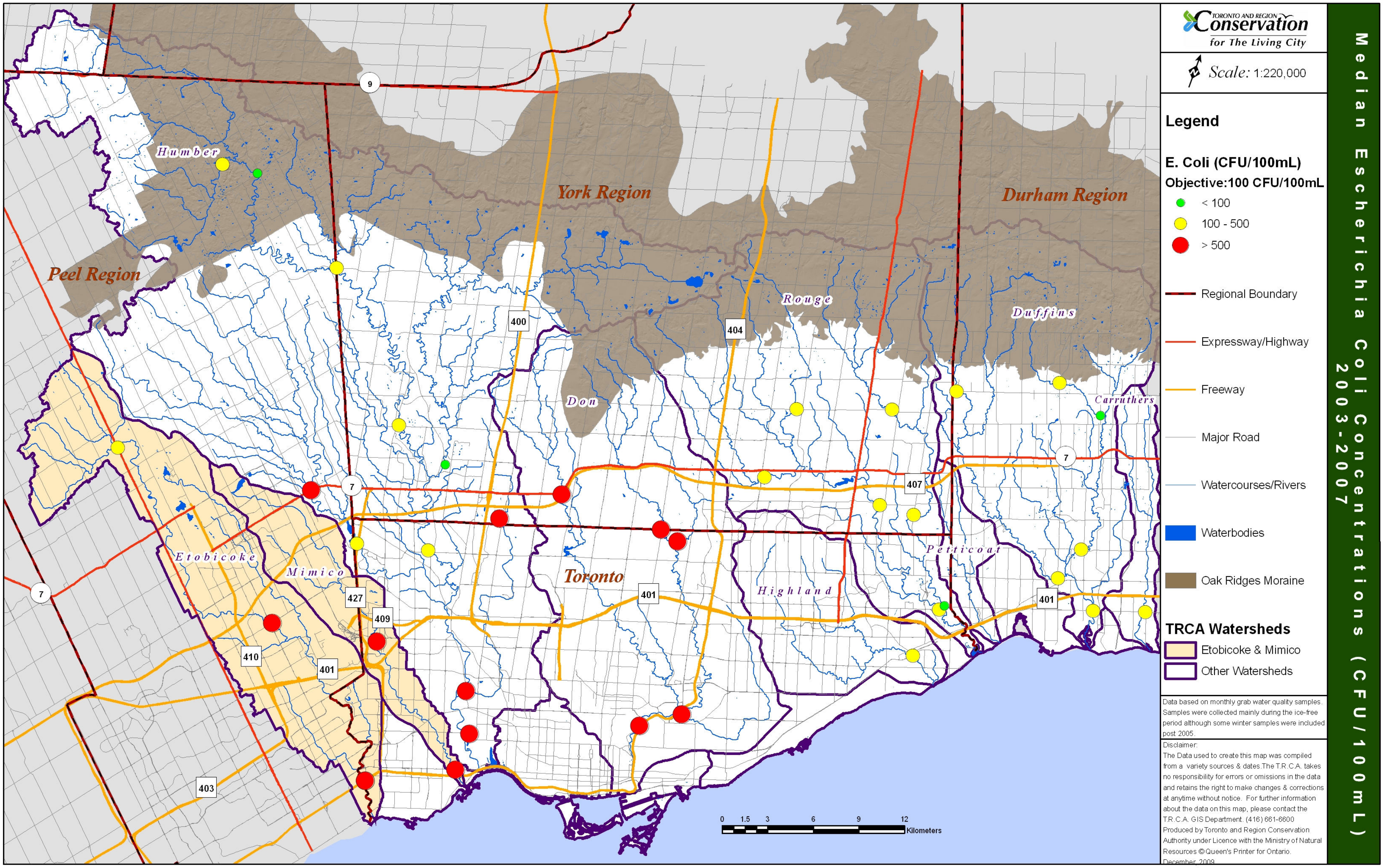
The PWQO for *E. coli* is a recreational water quality guideline for swimming. According to the *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* report, swimming in streams is not a targeted recreational activity but it is recognized that people and their pets often wade into streams. It is also recognized that bacteria levels at Lake Ontario waterfront beaches near the mouths of Etobicoke and Mimico Creeks are influenced by the quality of water discharged from the Creeks. Lake Ontario beach water quality data analysis was not part of this Update. This report focuses on bacteria levels in the creeks.

The PWQO is based upon a geometric mean of at least five samples per site taken within a month period. Only one sample was collected monthly for this program and median results are presented rather than geometric means. Maximum *E. coli* values were capped at 20000 colony forming units (CFU), as this was the maximum value counted by one of the laboratories. This suggests that some sites may have higher median *E. coli* values than what is presented in this report.

E. coli results are presented in **Figure 6-11.** The results represent approximately two years of data (2006-2007). Because there was limited data, the entire dataset, including winter months (December-March) was included in the analysis. The PWQO for *E. coli* is 100 colony forming units (CFU) per 100 mL. In general, *E. coli* concentrations were lowest in the headwaters and increased downstream toward the stream outlets. The median *E. coli* values for all five stations in the Etobicoke and Mimico Creeks watersheds exceeded the PWQO of 100 CFU/100 mL.

The *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* report suggested a target for 2006 of "*lower than 1990-1995 E. coli levels*". Prior to 1995, fecal coliform or total coliform was sampled rather than *E. coli,* therefore there are limited *E. coli* samples from 1990-1995. One station (80001) in the Etobicoke Creek watershed was sporadically monitored for *E. coli* (n=14) and the median concentration was 540 CFU/100 mL. The median *E. coli* values for 2006-2007 for three of four stations in Etobicoke Creek were greater than 540 CFU/100 mL suggesting that current *E. coli* levels are not lower than 1990-1995 levels. One station (Station 80003) monitored in the Etobicoke Creek watershed had a relatively low median *E. coli* value of 150 CFU/100 mL. There were no stations previously monitored for *E. coli* in Mimico Creek for 1990-1995. Two stations were monitored in the Mimico Creek watershed during 2006-2007 and the median *E. coli* values were 880 and 1600 CFU/100 mL, respectively. There are very few *E. coli* data for the 1990-1995 time period, therefore, it is difficult to draw conclusions about the water quality both the Etobicoke and Mimico Creeks watersheds but it is highly likely that neither watershed met the 2002 Greening Our Watersheds target for *E. coli*.

Figure 6-11: Median *E. coli* Concentrations (CFU/100mL) across the TRCA Jurisdiction, 2006-2007



The target for 2025 is for *E. coli* levels to meet PWQO at least 75 % of the samples for the Etobicoke Creek Headwaters and for at least 50% of the samples in the remainder of Etobicoke Creek and Mimico Creek. For 2006-2007, a maximum of 32 % of the samples met the PWQO of 100 CFU/100 mL. Most stations met the objective less than 10 % of the samples. These results suggest that both Etobicoke and Mimico Creeks watersheds will not achieve the 2025 target.

6.4.4 Summary of Findings

A summary of the state of water quality in Etobicoke-Mimico Creeks watersheds in relation to targets set out in previous reports (e.g. TRCA, 2002; TRCA, 2006) is presented in **Table 6-5**.

With the exception of chloride, the conventional pollutants indicators achieved the 2006 targets outlined in the *Greening Our Watershed: Revitalization Strategies for Etobicoke and Mimico Creeks* report. This means that there was no increase in the concentration of conventional water quality parameters for 2003-2007 over those in 1990-1995 results and in many cases there was a decrease in conventional pollutant concentrations. Chloride concentrations were found to be relatively high in both the Etobicoke and Mimico Creeks watersheds, thus did not meet the 2006 target. Both chloride and total phosphorus are not expected to meet the 2025 target. The remaining conventional pollutants are expected to meet the 2025 targets for water quality.

All indicator metals also achieved the 2006 target. It appears that it will be possible to continue to achieve this target in the long term if conditions are maintained or improved.

The bacterial indicator *E. coli* failed to achieve the 2006 target of no increase over 1990-1995. With the exception of one site in Etobicoke Creek, median *E. coli* levels are quite high in both watersheds (>650 CFU/100 mL). Therefore, *E.coli* values are not expected to meet the 2025 target for the Creeks.

A general conclusion regarding water quality in the Etobicoke and Mimico Creeks watersheds is that water quality issues are correlated to the amount of urbanization within a watershed. Non-point sources of contamination from urbanization (e.g. stormwater runoff) continue to be the largest contaminant contributor to surface water quality within these Creeks. Efforts of the GTAA and Partners in Project Green are proactively working to mitigate these pollutant sources. Certain contaminants (e.g. metals, nutrients) have decreased over the past decade, while chloride concentrations show an increasing trend. Continued routine efforts such as the treatment of urban runoff via stormwater best management practices as well as innovative actions are required to maintain and improve the water quality in the Toronto region.

Table 6-5: Summary of Etobicoke and Mimico Creek Water Quality Targets

Parameter	2006 Greening Our Watershed Target	Achieved 2006 Target?		2025 Target	Potential to Achieve 2025 Target?	
		Etobicoke	Mimico		Etobicoke	Mimico
Suspended Solids (TSS)	No increase in conventional pollutants in Etobicoke & Mimico Creeks over 1990-1995 levels	√	√	Meet guidelines & objectives for at least 75% of the samples	√	√
Chloride		X	X		X	X
Phosphorus		√	√		X	X
Nitrates		√	√		√	√
Unionized Ammonia		√	√		√	√
Iron	Levels of metals of concern meet the PWQO for at least 75% of the samples	√	√	Levels of metals of concern meet the PWQO for at least 75% of the samples	√	√
Copper		√	√		√	√
Zinc		√	√		√	√
E. coli	Lower than 1990-1995 *E. coli* levels	X	X	*E. coli* samples meet PWQO for at least 75% of the samples for the Etobicoke Creek Headwaters and for at least 50% of the samples in the remainder of Etobicoke Creek and Mimico Creek	X	X

√ achieved target or potential to achieve future target
X did not achieve target or most likely will not achieve future target

6.5 MANAGEMENT RECOMMENDATIONS

Stormwater Management

- Improve stormwater management in new and existing urban areas (e.g. retrofit older urban areas to have quantity and quality control measures at source, conveyance and end of pipe; reduce runoff through source controls), with particular emphasis on addressing common pollutants (TSS, P and bacteria).
- Improve vegetated buffers around rural waterways. For more detailed recommendations refer to the **Stormwater Management and Streamflow Section.**

Further Research

- Investigate sources of high *E. coli* levels in both Etobicoke and Mimico Creeks;
- Investigate the potential significance of chloride contributions from groundwater sources associated with marine shale formations in the lower Etobicoke and Mimico Creeks by examining chlorine isotype fractions.
- Monitor the effectiveness of salt management plans.
- Promote the adoption of a Provincial chloride objective for the protection of freshwater aquatic life.
- Improve knowledge of wet weather (e.g. during/post precipitation events) water quality.

Completion of Water Quality Analysis

Update the analysis for the non-routine water quality indicators, not addressed in this study, and metals (for which data were not available for this study), including supporting information as part of the next Report Card.
This includes:

- COA Tier I and Tier II contaminants (EC and MOE, 2007);
- Metals, including aluminum, cadmium and lead;
- Water contact *E. coli* levels (e.g. beaches);
- Young of the Year/sport fish contamination data;
- City of Toronto Wet weather flow data (sampling began 2004;
- Spills data.

6.6 REFERENCES

British Columbia Ministry of the Environment (BC MOE). 2008. *Ambient Water Quality Guidelines for Iron*. http://www.env.gov.bc.ca/wat/wq/BCguidelines/iron/iron_tech.pdf. Accessed April 8, 2008.

British Columbia Ministry of the Environment (BC MOE). 2003. *Ambient Water Quality Guidelines for Chloride - Overview Report*. http://www.env.gov.bc.ca/wat/wq/BCguidelines/chloride/chloride.html. Accessed March 30, 2008.

Canadian Council of Ministers of the Environment (CCME). 1999a. *Canadian sediment quality guidelines for the protection of aquatic life: Lead*. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 1999b. *Canadian sediment quality guidelines for the protection of aquatic life: Zinc*. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2000. *Canadian water quality guidelines for the protection of aquatic life: Ammonia*. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2002. *Canadian water quality guidelines for the protection of aquatic life: Total particulate matter*. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2003. *Canadian water quality guidelines for the protection of aquatic life: Nitrate Ion*. In: Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2007. *Summary of Canadian water quality guidelines for the protection of aquatic life*. In: Canadian Environmental Quality Guidelines, 2007, Canadian Council of Ministers of the Environment, Winnipeg.

Center for Disease Control (CDC). 2008. U.S. Centre for Disease Control and Prevention. Atlanta, GA. http://www.cdc.gov/nczved/dfbmd/disease_listing/stec_gi.html. Accessed April 2, 2009.

Chambers, P. A., R. Kent, M. N. Charlton, M. Guy, C. Gagnon, E. Roberts, E. Grove, and N. Foster. 2001. Nutrients and their impact on the Canadian environment. Environment Canada. 241 pp

Environment Canada and Health Canada (EC and HC). 2001. *Priority Substances List Assessment Report: Road Salts*. Ottawa, ON.

Environment Canada & Health Canada (EC and HC). 2001. *Priority Substance List Assessment Report: Ammonia in the Aquatic Environment*. ISBN: 0-662-29192-1.

Environment Canada, Health Canada, Statistics Canada (EC, HC, SC). 2008. *Canadian Environmental Sustainability Indicators 2007: Freshwater Quality Indicator Data Sources and Methods*. Ottawa, ON.

Environment Canada (EC). 2004. Canadian *Guidance Framework for the management of phosphorus in freshwater systems*. Scientific Supporting Document, National Guidelines and Standards Office, Water Policy and Coordination Directorate, Environment Canada, Ottawa, ON.

Environment Canada (EC). 2005. *Recommended Water Quality Guidelines for the Protection of Aquatic Life for Use in the 2005 National Water Quality Indicators under the Canadian Environmental Sustainability Indicators (CESI) Initiative* [draft]. National Guidelines and Standards Office, Environment Canada, Gatineau, Quebec. June 23, 2005.

Environment Canada and Ontario Ministry of the Environment (EC and MOE). 2007. Canada-Ontario Agreement: Respecting the Great Lakes Ecosystem Basin 2007. Toronto, ON. Queen's Printer for Ontario. ISBN 978-1-4249-4709-6 (PDF).

Toronto and Region Conservation Authority (TRCA). 2002. *Greening Our Watersheds: Revitalization Strategies for Etobicoke and Mimico Creeks*. Toronto, ON.

Toronto and Region Conservation Authority (TRCA). 2006. *Turning over a New Leaf: The Etobicoke and Mimico Creeks Watersheds Report Card 2006*. Toronto, ON.

Ontario Ministry of the Environment (MOE). 2003. *Water Sampling and Data Analysis Manual for Partners in the Ontario Provincial Water Quality Monitoring Network*.

Ontario Ministry Environment and Energy (MOEE). 1994. *Policies Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy*. Queen's Printer for Ontario. Toronto, ON.

Paul M.J. and Meyer J.L. 2001. *Streams in the urban landscape*. Annual Review of Ecology and Systematics 32:333–365.

6.7 APPENDIX 6-A: OTHER WATER QUALITY MONITORING PROGRAMS

Sport Fish Contaminant Monitoring Program

The MOE, in co-operation with the MNR, conducts the Sport Fish Contaminant Monitoring Program and the Young-of-the-year Fish Biomonitoring Program. These programs monitor contaminant levels in both water and fish tissue for contaminants of concern such as mercury, PCBs, and organic pesticides. Samples are collected from Lake Ontario as well as sites from streams within the Toronto region Areas of Concern (AOC). The information from these programs is used to update the Guide to Eating Ontario Sport Fish on a bi-annual basis.

City of Toronto's Swimming Beach Monitoring Program

The City of Toronto and Peel Region undertake bacterial monitoring for beaches along Lake Ontario. Throughout the summer, the health departments conduct bacteriological tests to determine if these beaches are safe for swimming. Marie Curtis Park East Beach is situated on the banks of the Etobicoke Creek in Toronto where it flows into Lake Ontario (http://www.toronto.ca/parks/parks_gardens/mariecurtis2.htm). The park has a supervised beach (July-August) but does not have a Blue Flag designation. The City of Toronto has been participating in the Blue Flag program which is a highly respected and recognized international eco-label. Blue Flags are awarded to beaches that meet strict criteria that cover everything from water quality to environmental programs. The Lakefront Promenade Park in Peel Region is located west of the Etobicoke Creek outlet. The swimming area is inland but is fed by water from Lake Ontario.

Wet Weather Flow Master Plan

The City of Toronto has developed the Wet Weather Flow Master Plan which uses various control strategies to manage combined sewer overflows and stormwater discharges. The City is undertaking a 25-year monitoring program by installing and operating 14 automated wet-weather flow monitoring stations throughout the City of Toronto. This includes one station at the mouth of Etobicoke Creek and one at the mouth of Mimico Creek. The equipment was installed in 2008 and water quality sampling began in 2009.