Fairy Lake
Water Quality Update Study

June 2021- April 2022

LGL Est. 1971 LIMITED
environmental research associates

TOWN OF HALTON HILLS

Study Goals

The goals of the study were to:

- characterize the current conditions in the lake;
- compare back to the previous study completed in 2008;
- identify the main stressors of water quality in the lake; and,
- identify management activities that could target those stressors to reduce their impact on water quality and recreational use of the lake.

Study Overview

(June 2021-April 2022)

Field Studies

- Surface water (four seasons) & sediment (fall 2021) quality sampling
- Vegetation community mapping, locations of rare and invasive species
- Lake bathymetry
- Goose surveys (habitat assessments, inventories of numbers and nesting activity)

Nutrient Modelling to identify and quantify phosphorus loading to the lake

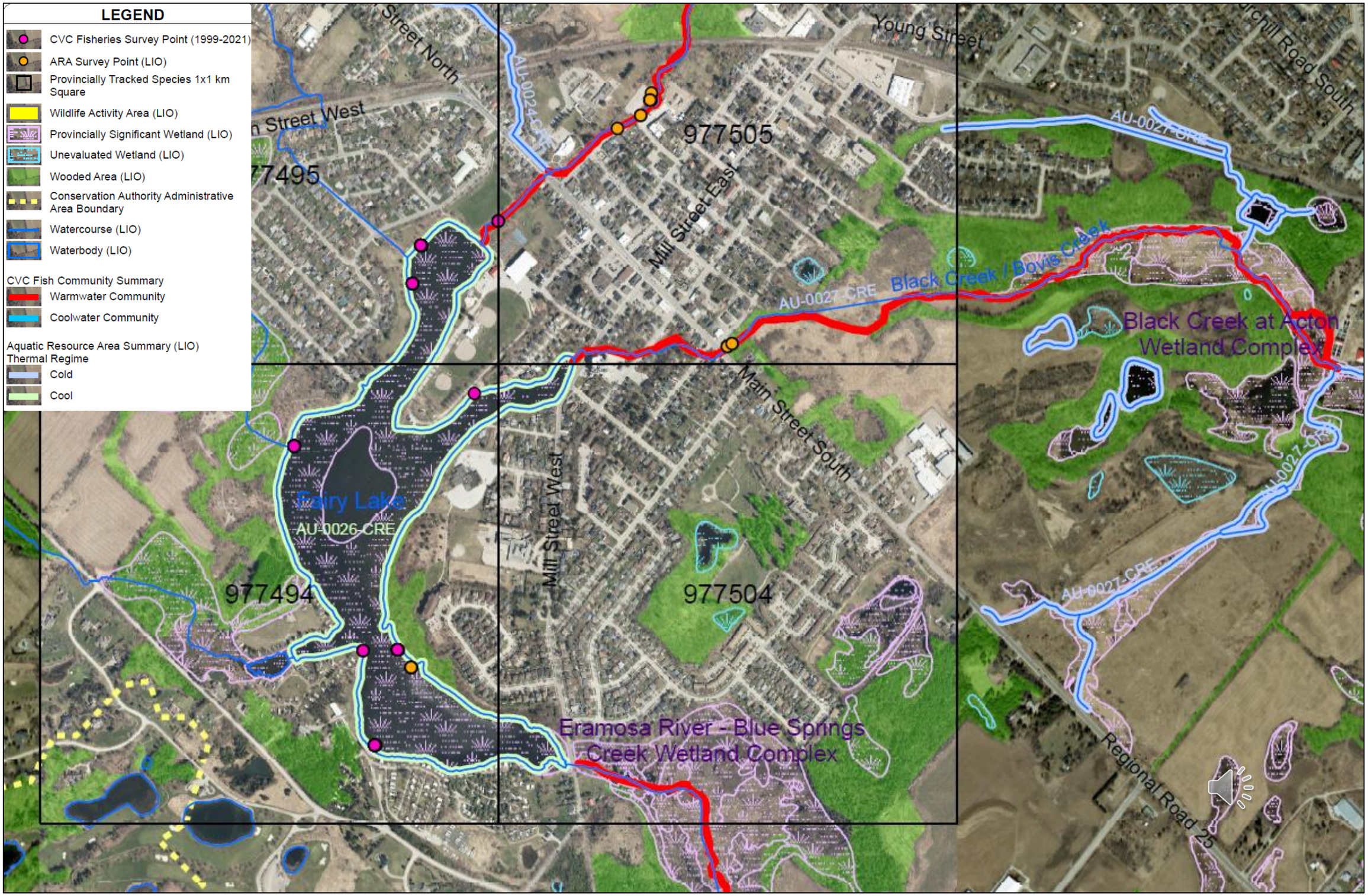
Presentation of Results

- Characterize current conditions within the lake
- Compare current conditions to past conditions and regulatory guidelines
- Identify the stressors for water quality and where additional study is needed
- Recommend lake management to target the water quality stressors identified

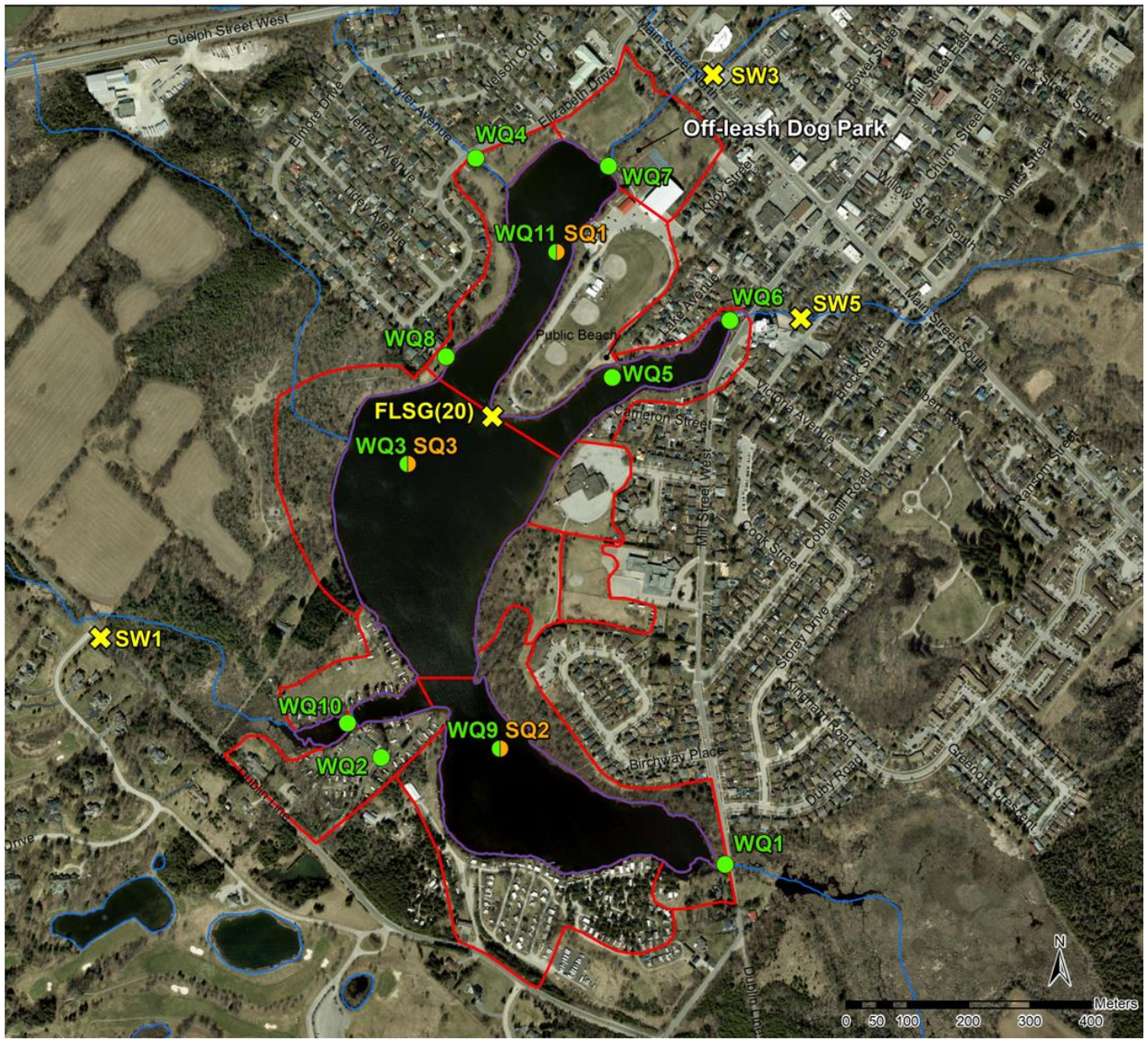
Public Consultation - presentation of results, public input/feedback

Photo Credit: M. O'Halloran

Study Area


LEGEND
CVC Fisheries Survey Point (1999-2021)
ARA Survey Point (LIO)
Provincially Tracked Species 1x1 km Square
Wildlife Activity Area (LIO)
Provincially Significant Wetland (LIO)
Unevaluated Wetland (LIO)
Wooded Area (LIO)
Conservation Authority Administrative Area Boundary
Watercourse (LIO)
Waterbody (LIO)
CVC Fish Community Summary
Warmwater Community
Coolwater Community
Aquatic Resource Area Summary (LIO) Thermal Regime
Cold
Cool
977495
977505
977494
977504
Young Street
Mill Street East
Mill Street West
Main Street South
AU-0027-CRE
Black Creek / Boyle Creek
Black Creek at Acton Wetland Complex
Fairy Lake
AU-0026-CRE
Eramosa River – Blue Springs Creek Wetland Complex
Regional Road 25

Surface Water & Sediment Quality



Water Quality

- Four season sample collection to include under ice, wet and dry weather conditions
- Analyzed for nutrients, bacteria, metals, and chloride

Sediment Quality

- Single sampling event in Fall 2021
- Analyzed for nutrients, total organic carbon and metals

Water / Sediment Quality Station (LGL)

WQ1:	south basin - inlet at Mill St
WQ2:	stormwater inlet at trailer park
WQ3 SQ3:	central basin
WQ4:	stormwater outlet - Tyler Avenue
WQ5:	old beach
WQ6:	Fairy Lake dam
WQ7:	Black Creek inlet
WQ8:	stormwater outlet - Elmore Drive
WQ9 SQ2:	south basin
WQ10:	west inlet
WQ11 SQ1:	northwest basin

Flow Station (Region)

SW1:	Dublin Line
SW3:	library
SW5:	Mill St dam
FLSG(20):	staff gauge

Sediment Quality (SQ) Station (LGL)

Water Quality (WQ) Station (LGL)

Flow Station (Region of Halton)

Goose Monitoring Area

Vegetation & Bathymetry

Vegetation

- aquatic and terrestrial vegetation communities confirmed in the field using the Ecological Land Classification (ELC) for Southern Ontario.
- locations of locally rare species, species at risk and invasive plants were recorded as they were encountered.

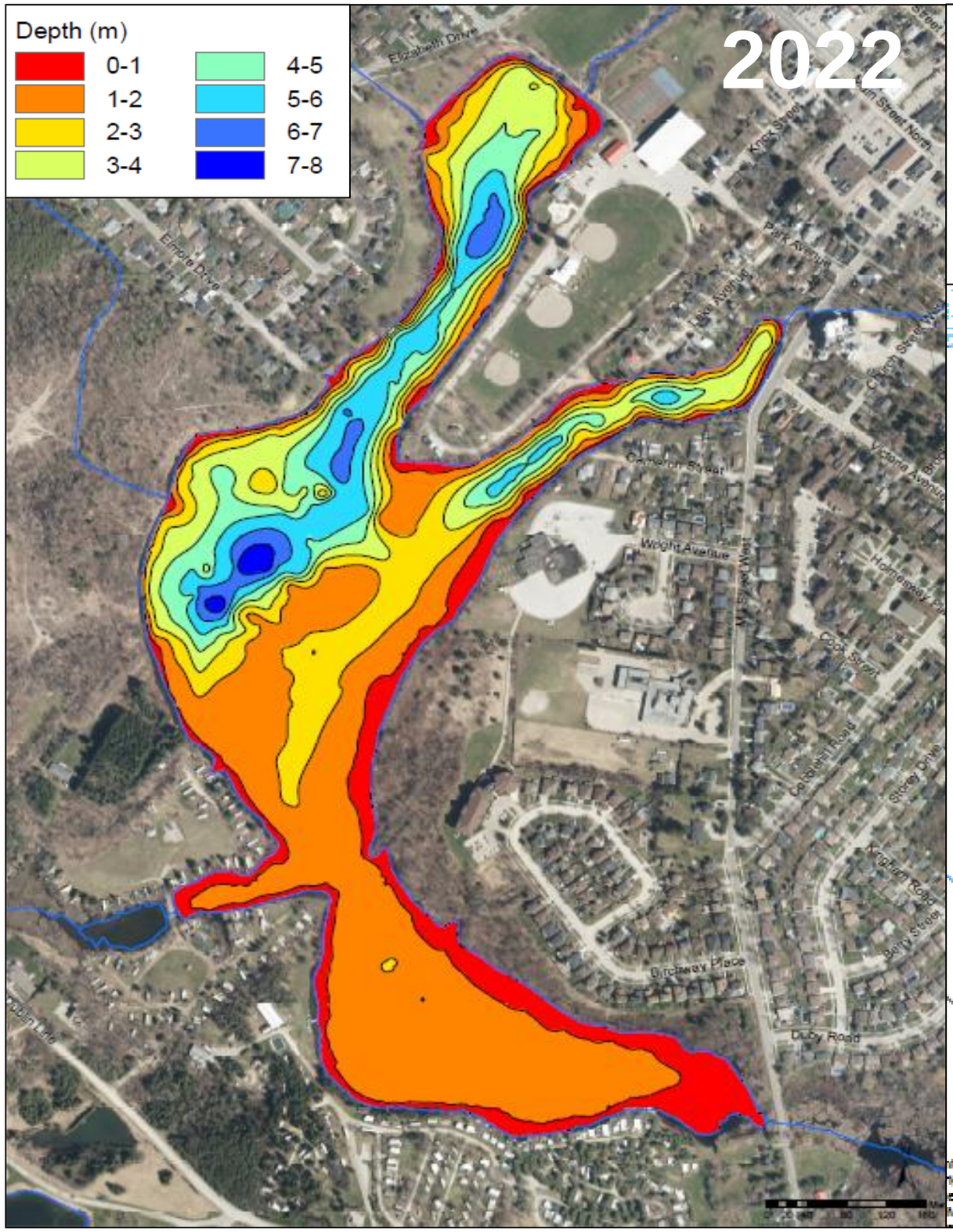
Lake Bathymetry

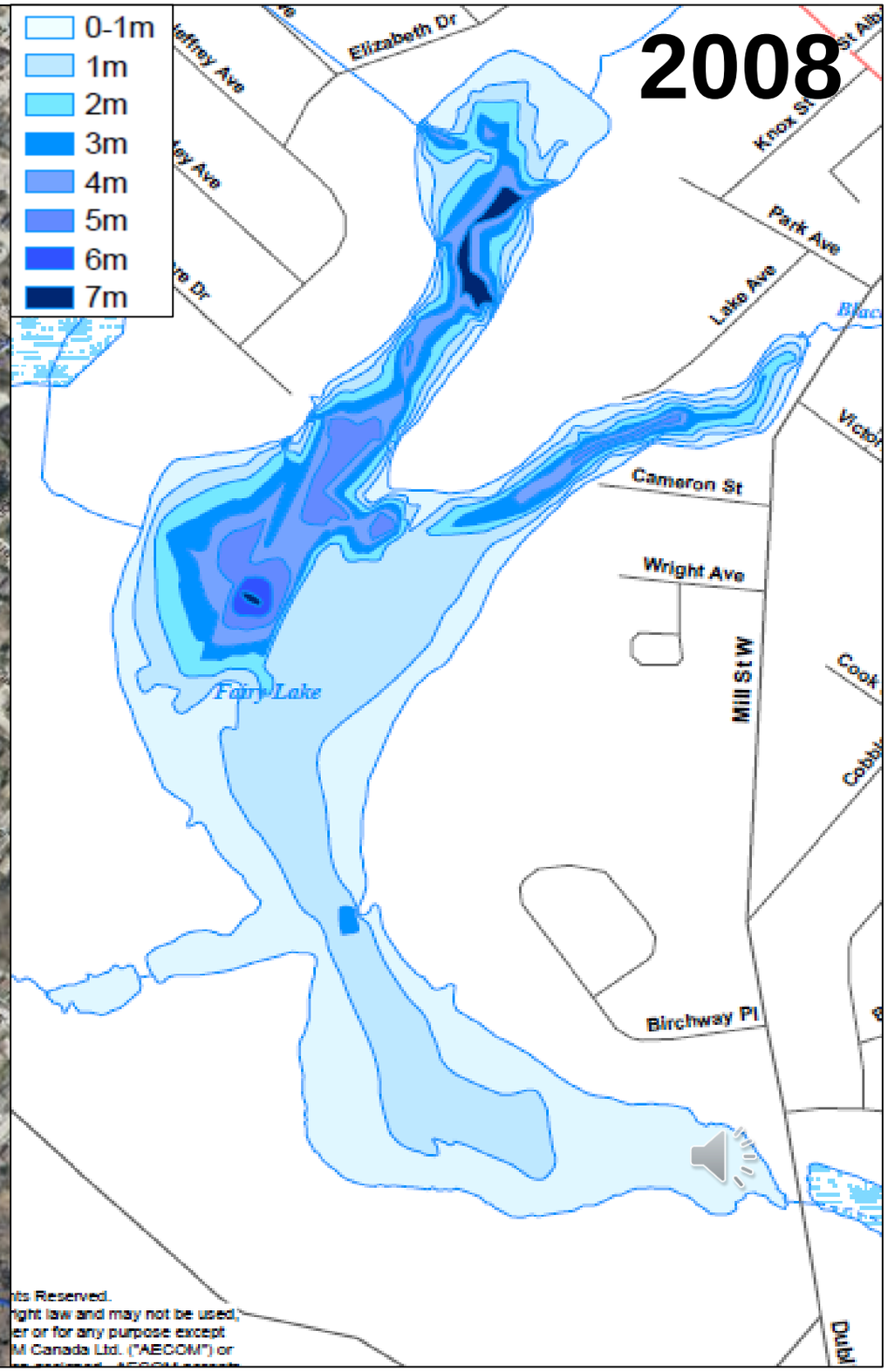
- survey completed April 20, 2022
- data collection included the shoreline and multiple transects across each of the lake basins

Goose Survey

- Habitat Assessment – to assess conditions relevant to geese habitat (e.g., type and height of vegetation, site's proximity to the lake and its accessibility (e.g., sloped manicured lawn vs. retaining wall).
- Goose Presence – data collection for geese activity in and around the lake was collected by LGL biologists and through the community Let's Talk platform (recording date, numbers of individuals, location, and behaviours).
- Nesting Survey – the Town has carried out an egg oiling program for geese for over a decade. An LGL avian biologist participated in the April 2022 surveys of the lake shoreline, the wetland east of Mill Street, and the Fairview Cemetery.

Lake Bathymetry Results





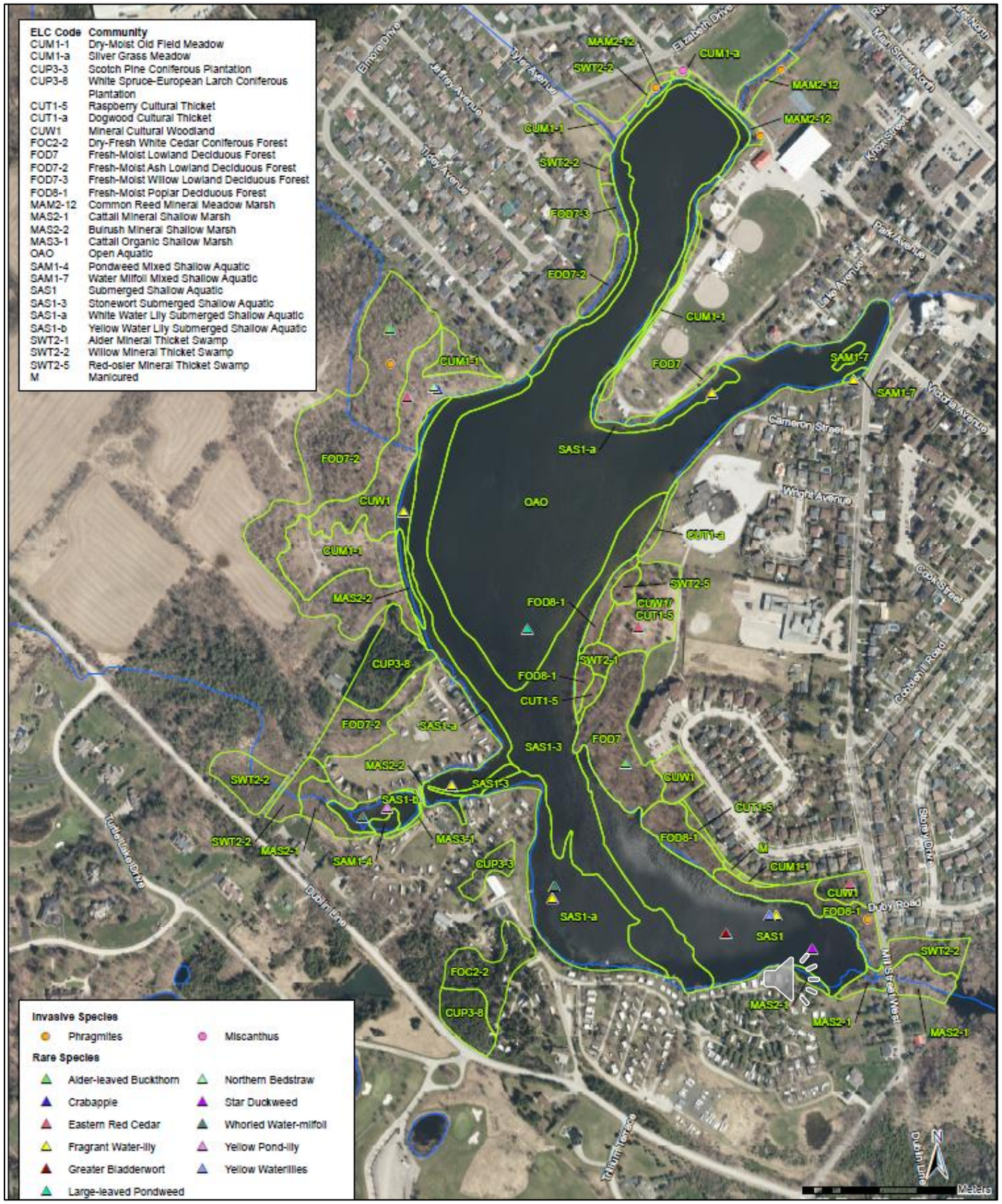
Vegetation Results

North – deepest portion, open water aquatic (lake) habitat

South - shallow with good light penetration and dominated by submerged shallow aquatic vegetation communities (typical of wetland habitat)

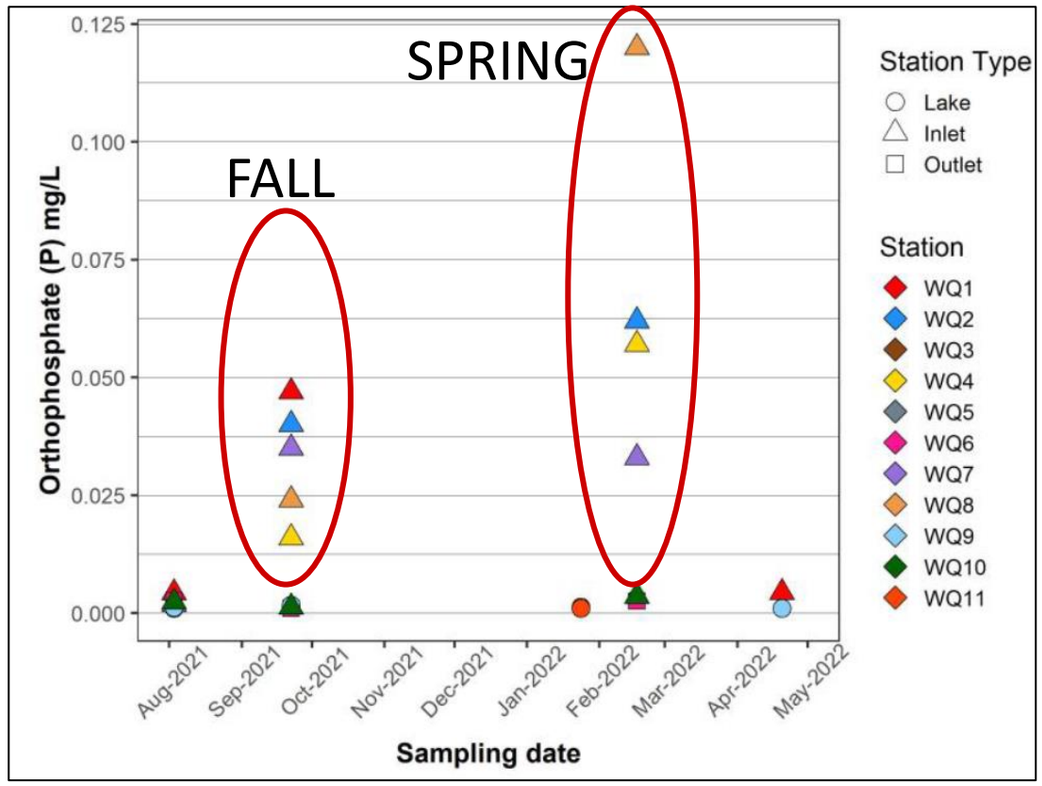
A total of 11 locally rare plants found (7 aquatic and 4 terrestrial)

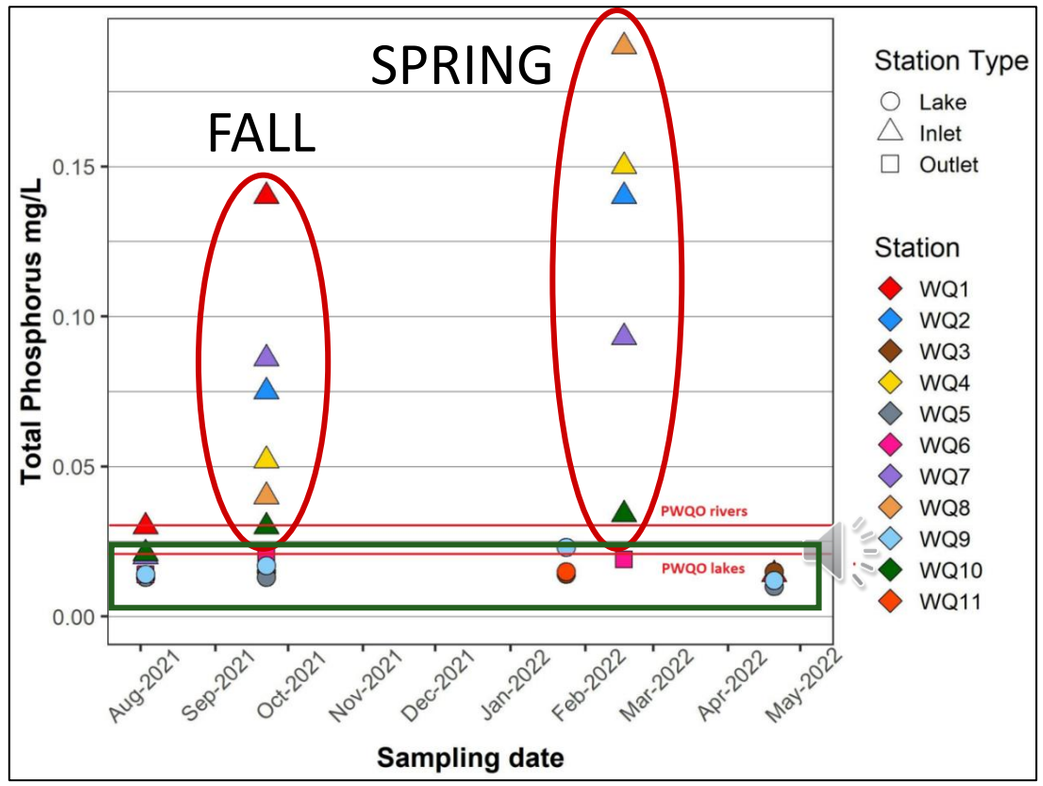
Two invasive plants species in proximity to the shoreline of the lake (*miscanthus* and *phragmites*); if left unchecked they can create monocultures and reduce biodiversity.



Water Quality Results – Phosphorus

- Phosphorus occurs naturally at low levels and is an essential nutrient for all life forms. However, at high concentrations it can affect water quality by overstimulating plant and algae growth.
- Orthophosphate is the form of phosphorus most readily utilized by biota, so it can provide a good estimate of the amount of phosphorus available for algae and aquatic plant growth.
- The highest concentrations of orthophosphate and total phosphorus were found in stormwater flowing into the lake during wet weather events. Results from the same stations were also often above the phosphorus PWQO for the protection of aquatic biota.
- Phosphorus concentrations in water samples collected from lake stations were among the lowest concentrations and mostly below the PWQO.



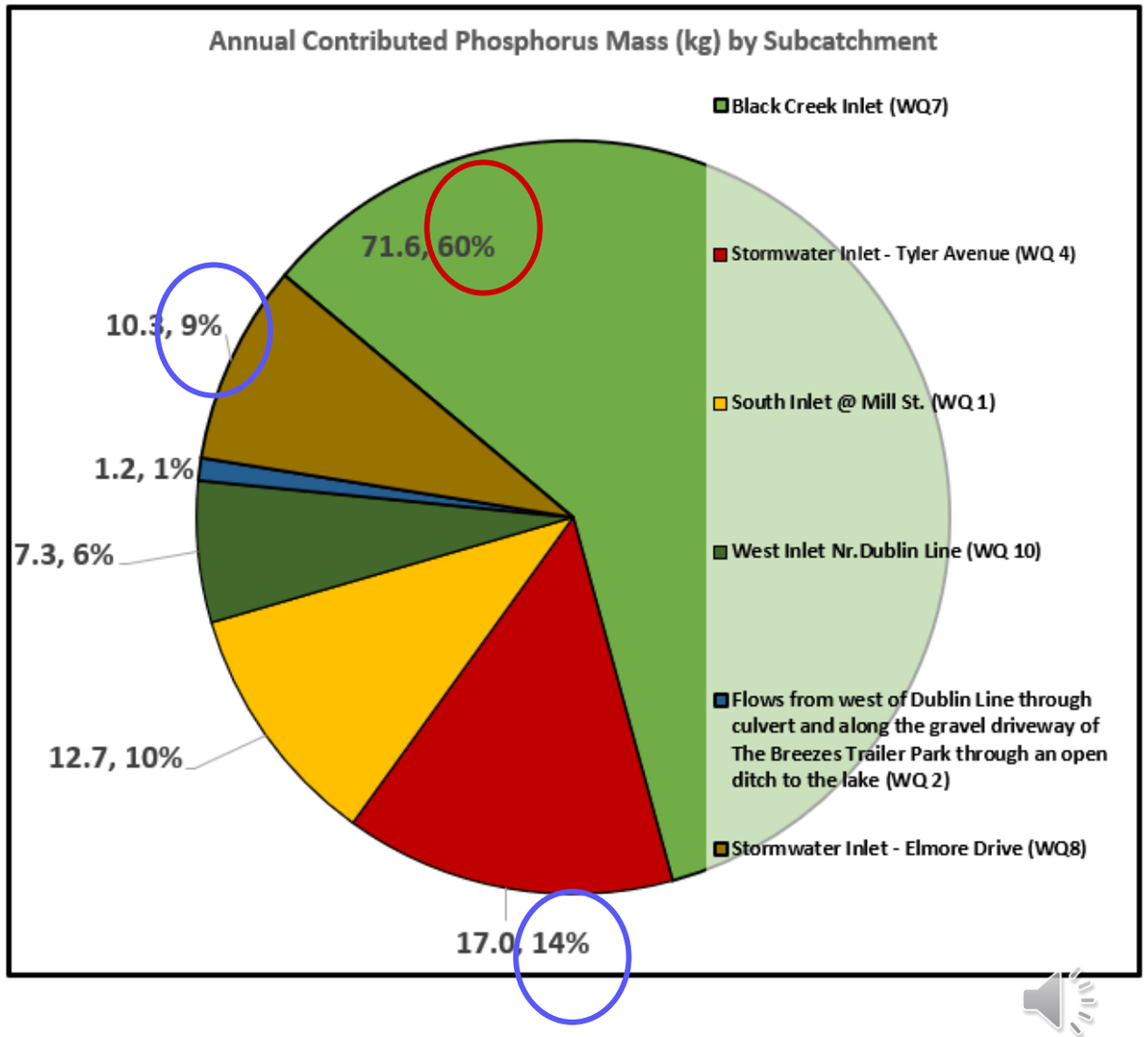


Water Quality Model – Phosphorus

The modeling results demonstrated that stormwater flows are the primary path for phosphorus loading to Fairy Lake.

The relative loading of phosphorus to the lake was determined for each of the inlets monitored as part of the study.

Most of the phosphorus load to the lake was found to be from the Black Creek/Bovis Creek inlet (60% of the total) and the storm sewers at Elmore Drive and Tyler Avenue (23% of the total).

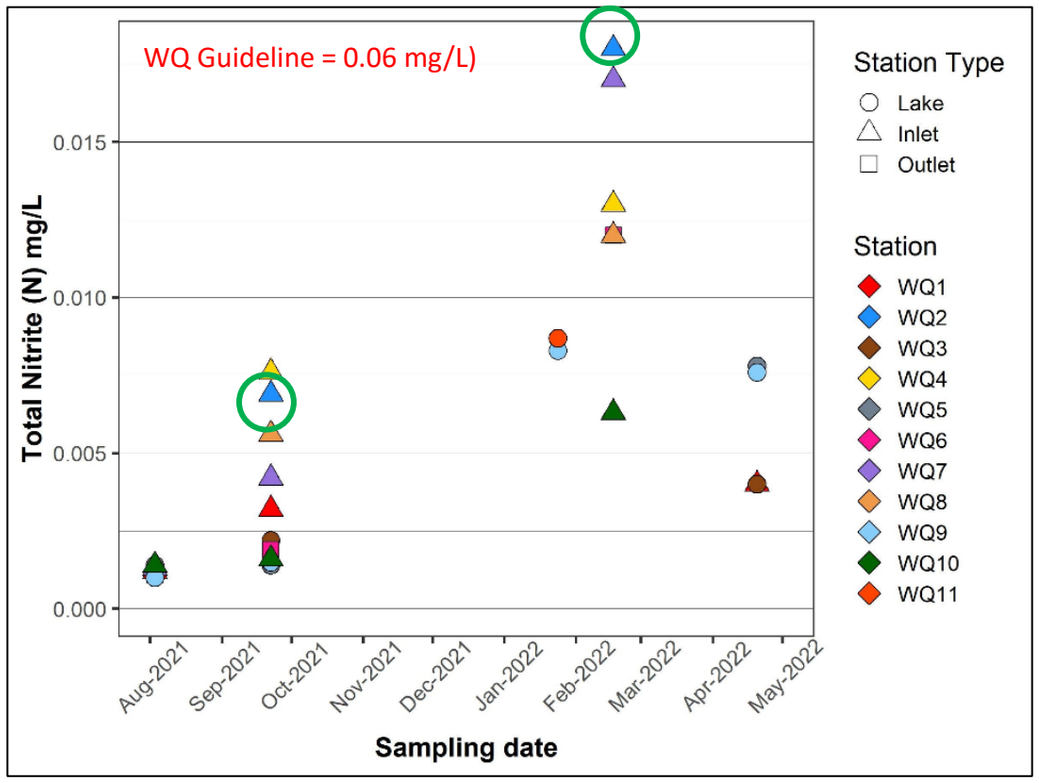


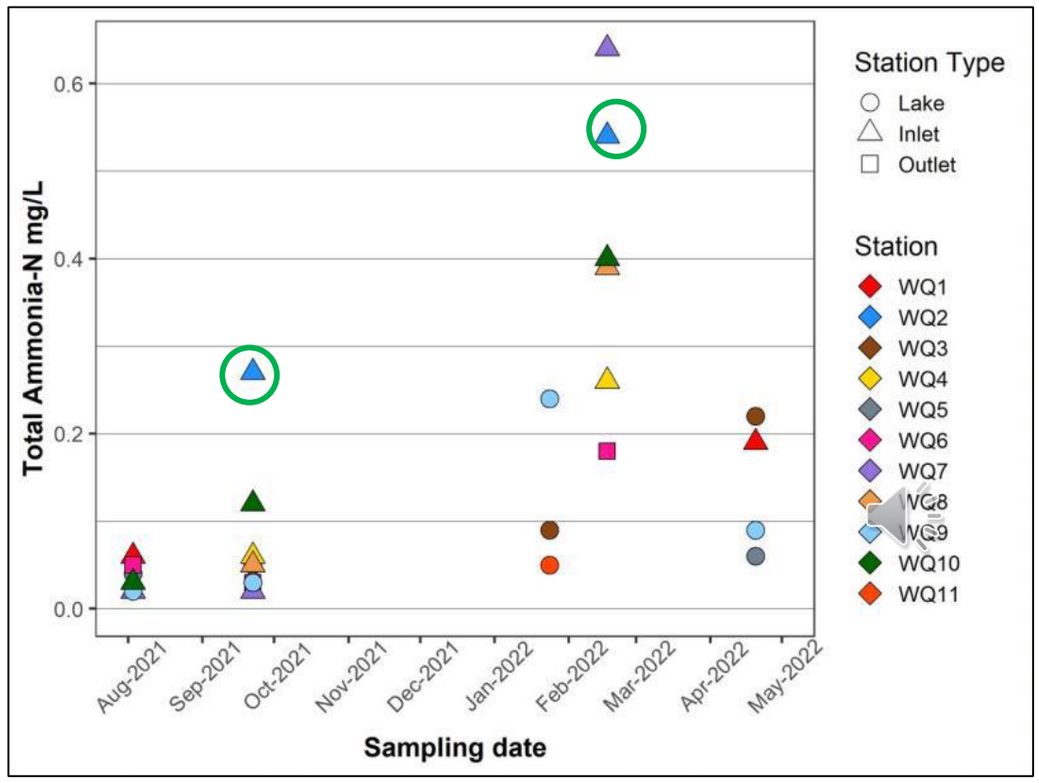
Water Quality Results – Nitrogen

Nitrogen is a critical nutrient in aquatic ecosystems and is naturally abundant, however it is also introduced into surface water through anthropogenic point sources including municipal and industrial wastewater, and non-point sources such as agricultural runoff (animal waste, fertilizer), septic beds, urban runoff, and storm sewer overflow.

Nitrogen containing compounds were found in the highest concentrations in stormwater flows from the creek and storm sewers during wet weather, however most results were below provincial objectives and federal guidelines for protection of aquatic biota.

The WQ2 inlet demonstrated higher concentrations of all forms of nitrogen when compared to other stations monitored in 2021 and compared to the 2008 results at WQ2.

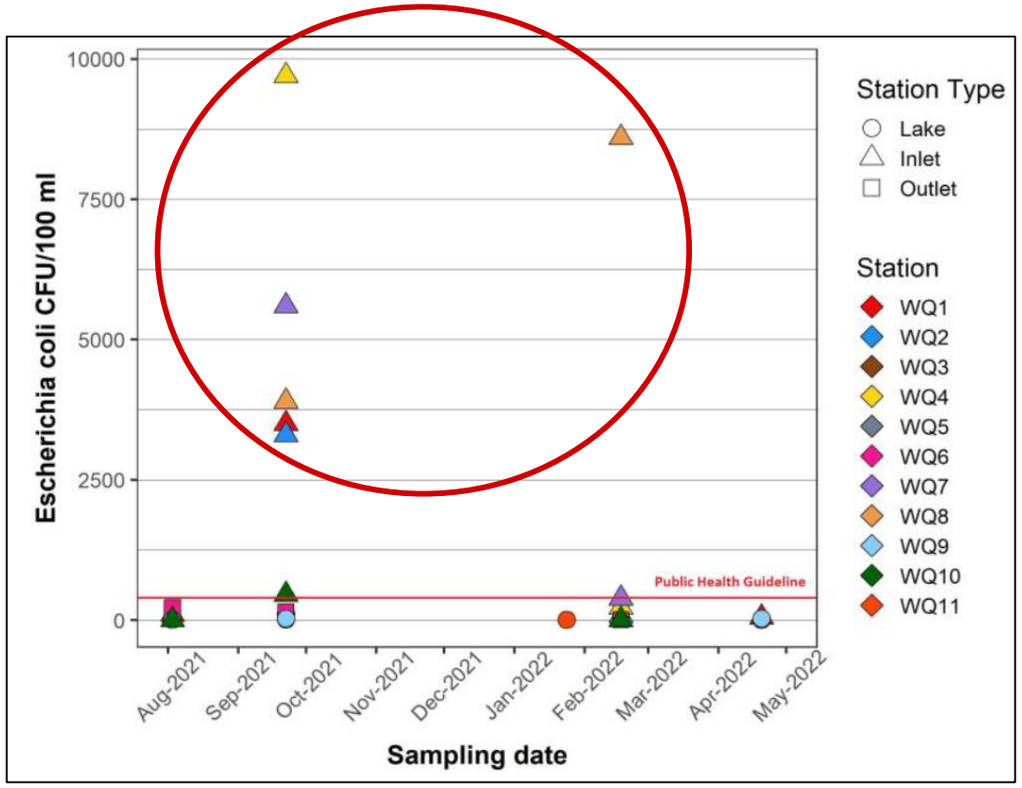




Water Quality Results – Bacteria

Geese feces were observed on the beach in high numbers during the June/July period of frequent beach closures reported by Halton Region Public Health (red shading in table below). This period also **corresponds with the Canada Goose moulting period** when goose were found in high numbers around the lake. Thus, geese activity appears to be driving some of the high bacteria counts at the beach. Nutrient inputs from feces also have the potential to contribute to blue-green algae formation. It is recommended that monitoring of water quality at the beach include documentation of goose activity and the effectiveness of any management mechanisms put in place in future to control geese access.

During the water quality study, very high bacteria counts were observed in stormwater flows from the creek and storm sewers (3,300 - 9,700 counts/100 mL) during wet weather events.

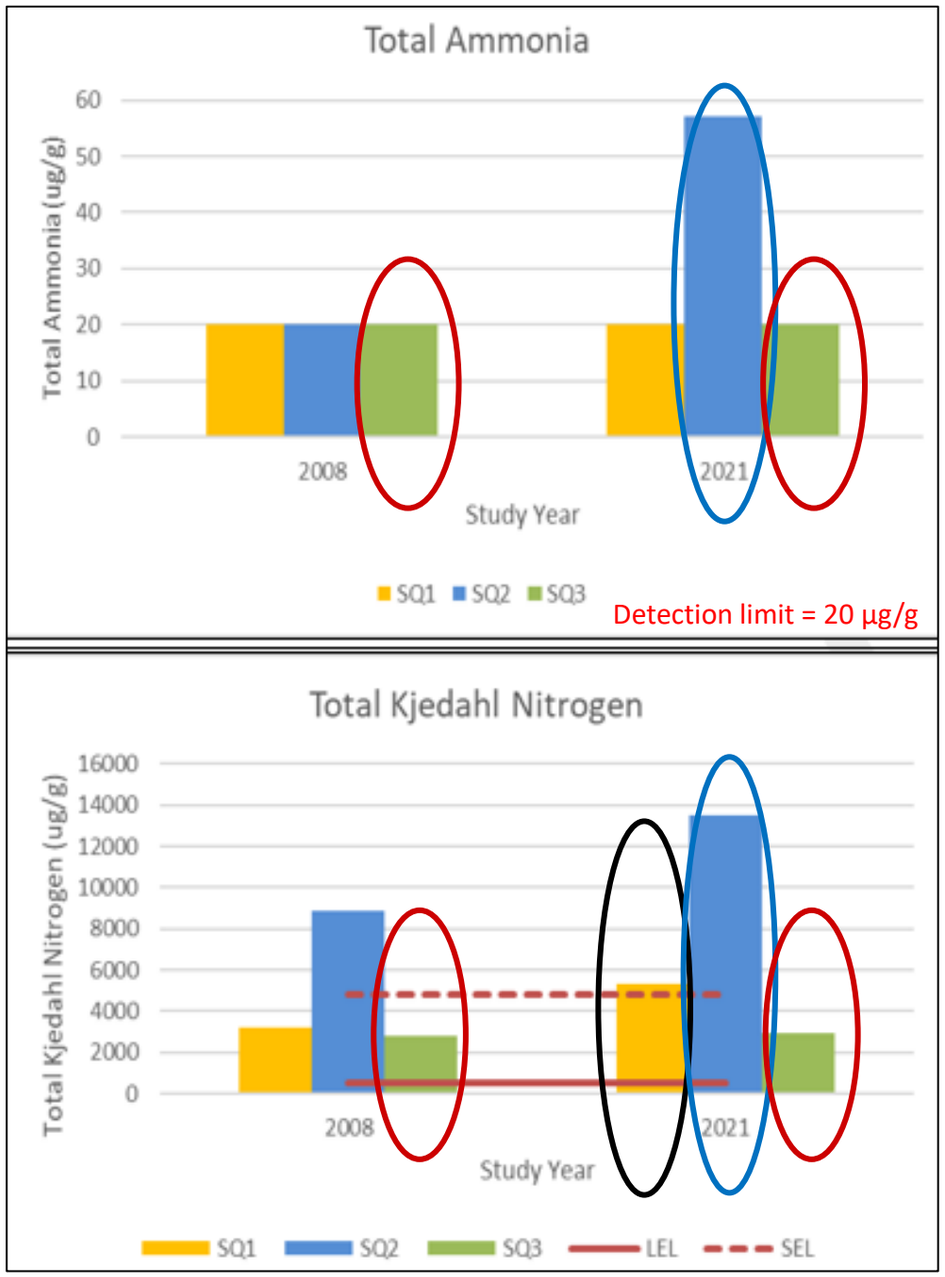


Water Quality Study

	Test 1	Test 2	Test 3	Test 4	Test 5
Date	T1	T2	T3	T4	T5
27-May-21	210	250	330	150	220
~~2-Jun-21~~	~~40~~	~~120~~	~~40~~	~~60~~	~~50~~
9-Jun-21	1000	1000	1000	610	690
16-Jun-21	580	450	490	360	400
23-Jun-21	480	720	1000	1000	1000
29-Jun-21	1000	1000	1000	1000	1000
7-Jul-21	1000	1000	1000	1000	1000
15-Jul-21	820	1000	1000	1000	1000
~~21-Jul-21~~	~~250~~	~~270~~	~~360~~	~~430~~	~~380~~
28-Jul-21	50	480	220	200	160
4-Aug-21	90	120	80	50	105
11-Aug-21	780	700	510	340	450
18-Aug-21	60	20	60	10	30
25-Aug-21	10	10	20	10	20
1-Sep-21	10	10	10	10	10

Beach Public Health Data, 2021

Sediment Quality Results

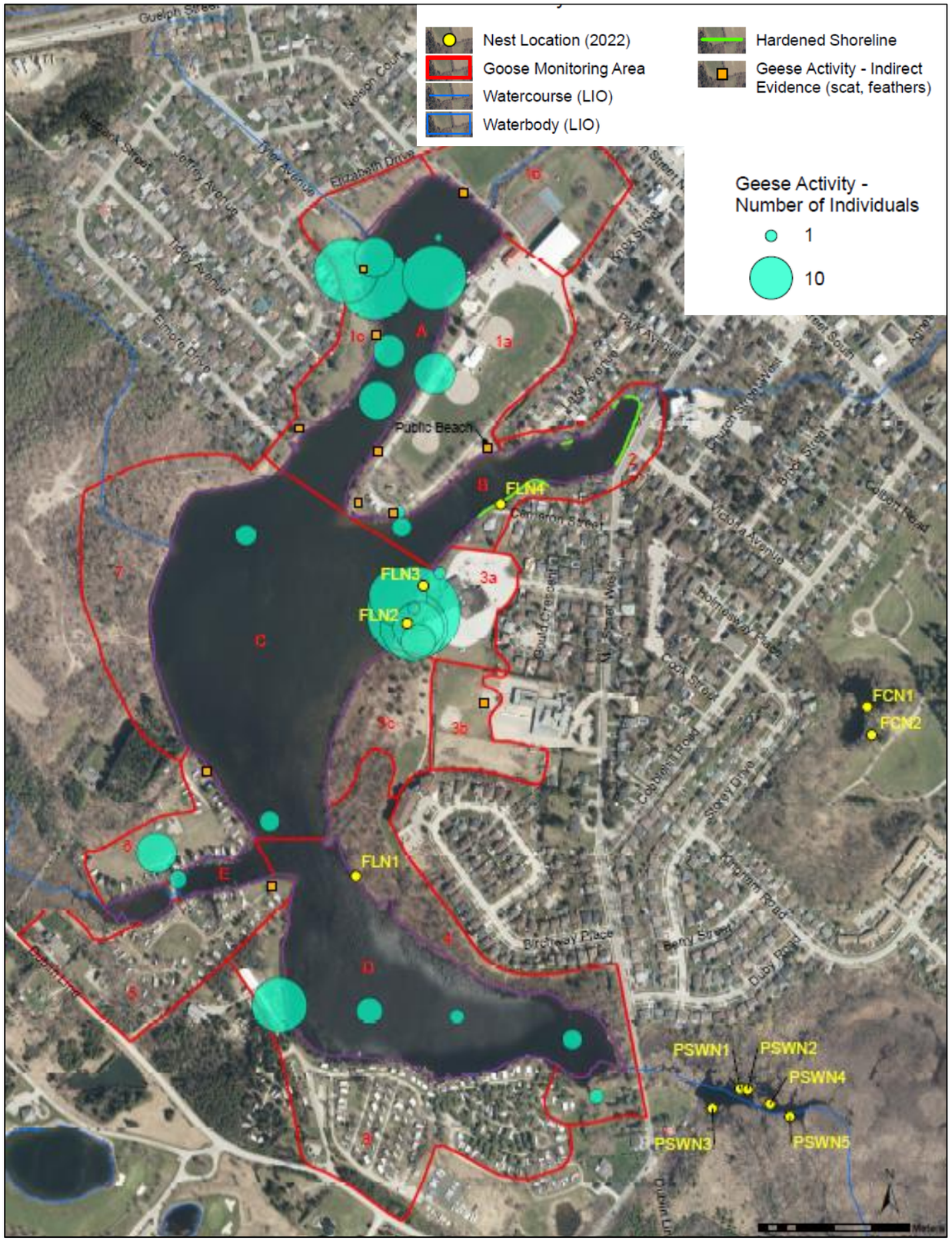


Total ammonia and Total Kjedahl Nitrogen were higher in 2021 SQ2 sediments compared to 2008.

Overall, metal concentrations were lowest at SQ2 with higher concentrations observed at the other two stations, particularly at SQ1 in the north basin where an area of deposition from Black Creek has been noted in past studies. However, all metal concentrations in lake sediments met the provincial sediment quality guidelines for metals.

Additional study is needed to confirm trends in sediment quality. To date, results are based on a one sample collection in 2008 and a single sampling event in 2021.

Goose Survey Results



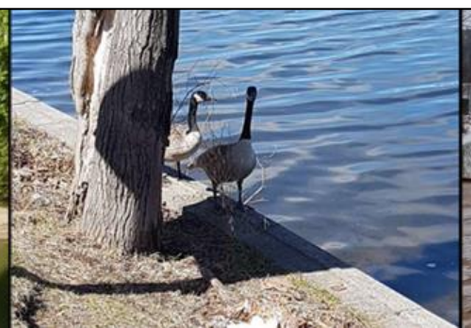
Fairy Lake Stressors

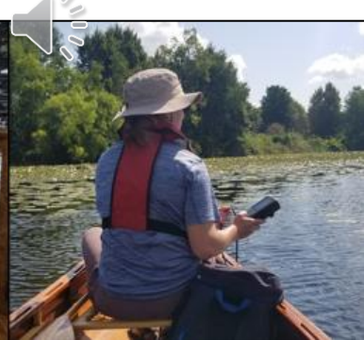
Human activities can negatively impact surface water quality, even when the activity is far removed from a waterbody. These may seem insignificant when viewed separately but can result in **significant cumulative impacts** on aquatic ecosystems when viewed as a whole.

Water quality stressors are identified when impacts are found to affect biological communities or when water quality standards and guidelines are breached. Stressors to Fairy Lake water quality and recreational use of the lake include excessive **nutrients** (particularly, phosphorus and nitrogen containing compounds) and **bacteria**.

Data provided by others (Halton Region Public Health) identify **blue-green algae** as another stressor.

Data analysis identifies stormwater inputs from **urban/residential and agricultural land uses upstream of Fairy Lake** as the main factor negatively impacting water quality. Data also suggest that failing septic systems and wildlife feces may be a local source of contaminants; however, confirmation of this requires some additional study.



Fairy Lake Ecosystem

The open water and wetland habitats present within Fairy Lake are **valued natural assets** that provide a variety of ecological services including the:

- tempering of peak flows in storm events and maintenance of base flow downstream of the lake during low flow periods,
- removal/capture of contaminants and nutrients,
- carbon storage, and
- provision of habitat for vegetation, fish, and wildlife (including rare species and species at risk).

Fairy Lake is also part of a **provincially significant wetland**. Wetlands are unique in their capacity to store carbon compared to other land cover types. Like other natural features, wetlands store carbon in vegetation, in soils below ground, and in decaying biomass. The anoxic (depleted oxygen) conditions within wetlands slow the decomposition of material, resulting in longer term carbon storage. Carbon storage is a key factor in regulating greenhouse gases and **buffering the impacts of climate change**.

Wetlands also **provide habitat for a wide diversity of species** including aquatic invertebrates, fish, migratory and resident birds, frogs, and turtles. In particular, Fairy Lake and the surrounding shoreline support a number of **significant wildlife habitat** types for turtle wintering, candidate bat maternity colonies, turtle nesting, waterfowl nesting, amphibian breeding, marsh breeding birds, and Special Concern and rare wildlife species.

Wood Duck, Photo Credit: M. O'Halloran

Recommendations to Reduce WQ Impacts

Stormwater is identified as a key source of contaminants to Fairy Lake; therefore, **a review of urban and agricultural stormwater quantity and quality controls is needed**.

The most effective contaminant controls are those that follow a multilayer best management practice (BMP) approach to include:

- **pollution prevention** (e.g., public education, planting of vegetative buffers on Town and private property, goose deterrents);
- **source controls** (e.g., beach grooming to remove goose feces, enhanced erosion and sediment controls on construction sites, storm sewer maintenance);
- **on-site treatments** (e.g., use of rain gardens, permeable pavements, grassed channels and swales to reduce flow and increase infiltration of stormwater on site); and,
- **regional treatments** (e.g., stormwater swales, constructed wetlands, and natural channel design to restore the functions of watercourses thereby reducing flows and improving water quality before the runoff reaches the lake.

The Town has control over some of these components, but **interagency, and intergovernmental cooperation and coordination is needed** to implement a comprehensive approach to effectively reduce impacts of stormwater on Fairy Lake water quality. This will be **particularly important as the Town's population and urban footprint continue to grow**.

Summary

The recommended management practices to improve water quality in the lake focus on **reducing the loading of nutrients and sediments to the lake**, and **addressing the overabundance of geese** that foul the lake and shoreline (presumably contributing to local bacteria counts).

Recommendations for management practices need to also consider the form and function of Fairy Lake and the **ecological services** it provides.

Sediment and vegetation removals from the lake are considered intrusive measures that affect ecological functions and habitats within the lake and in the absence of additional BMPs to reduce nutrients at the source, this type of management would be ongoing and costly to the Town. This approach is not recommended at this time. If considered in future, a hydraulic study would be needed to demonstrate its merit.

Some additional study of Fairy Lake is recommended, to include:

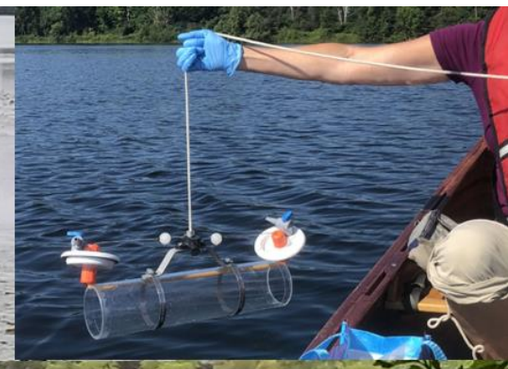
- implementation of a long-term **water and sediment quality monitoring program**
- investigation into the source of flows at **WQ2** where high nutrient inputs were found
- investigation of **potential nutrient storage and cycling** from lakebed sediments
- monitoring of stormwater outfalls at the end of Cameron Street and Wright Avenue
- incorporation of the findings from the University of Guelph HABs study
- a feasibility study to investigate potential hydraulic improvements that could improve water quality in the lake

Next Steps

Public Input – Please review the table that follows detailing recommended management strategies to improve Fairy Lake water quality and go to https://letstalkhaltonhills.ca/fairy-lake to provide your comments and participate in a survey about Fairy Lake.

Next Step: Final Council approval of recommendations will occur after public consultation.

Project Contact: Kevin Okimi, kevino@haltonhills.ca
Director of Parks & Open Space
Recreation and Parks Department
905-873-2600 x2274



Recommendations to Reduce WQ Impacts

Recommendation	Goal/Targeted Stressor	Example
Review agricultural BMPs part of the watershed rural incentives program and introduce new or enhanced BMPs	Reduce nutrient loading to nearby waterbodies as a result of soil disturbance and erosion	No-till or conservation tillage practices, cover crops, vegetative buffers to creeks, nutrient management plans
Storm sewer retrofits	Reduce contaminants in stormwater flows before they reach the lake	Oil grit separators, filters, review adaptive management solutions being investigated for the Region's phosphorus offsetting plan
Low impact development design and retrofits	Reduce contaminants in stormwater flows before they reach the lake	Incorporate LID features in new development – inclusion of green roof, permeable pavement, bioretention/rain gardens, rainwater harvesting, soakaway pits, and infiltration chambers Incorporate LID features into existing neighbourhoods in road right of ways, within residential, industrial or commercial, or public land (e.g., Town owned parks and facilities, schools). Screen ongoing redevelopment and road maintenance/street scaping opportunities for this purpose.
Natural Channel Design	Attenuate stormwater flow rate and quality, moderate water temperature, reduce nutrient loading	Restore the concrete channel of Black Creek/Bovis Creek upstream of Fairy Lake
Constructed Wetlands	Attenuate stormwater flow rate and quality, reduce contaminant loading	At stormwater outfalls and mouth of Black Creek/Bovis Creek at Fairy Lake

Recommendations to Reduce WQ Impacts

Recommendation	Goal/Targeted Stressor	Example
Vegetation Management	Attenuate stormwater flow rate and quality Reduce erosion, increase infiltration, reduce nutrient loading Limit access to the lake shoreline (goose and human activity)	Use of planted riparian buffers with native seed mixes along the lake shoreline and adjacent to Black Creek/Bovis Creek upstream of the lake.
Waterfowl Management	Reduce bacteria source Improve conditions at recreational facilities	Continue egg oiling and associated data collection. Engage owners of other large properties near the lake where geese may be nesting (e.g., golf course) Daily beach grooming Habitat modification - use of landscape design to reduce sightlines to < 9m along the shoreline and impede access Change maintenance practices in grassed areas Use natural applications on grassed areas to deter geese (e.g., garlic based topical solution) Use barriers (retractable fencing) to keep geese from loafing and fouling the beach Consider hazing techniques (dogs or raptors)
Engage local property owners and businesses	Reduce water quality stressors from private properties adjacent to the lake	Promote stewardship through education and incentives (e.g., use of LID design and retrofits, vegetation and waterfowl management)

Recommendations to Reduce WQ Impacts

Recommendation	Goal/Targeted Stressor	Example
Monitor the effectiveness of management activities at meeting targeted goals	Identifying adaptive management to align with changing conditions over time	Implement a routing long-term water quality monitoring program
Coordinate efforts of various stakeholders to align goals and share available resources	Allow for adaptive management to align with changing conditions over time and shifting priorities/goals for the Fairy Lake catchment.	Establish a cross agency and disciplinary technical group that meets regularly to review the results of emerging studies, plan future studies, and develop and prioritize management approaches to align with the collective goals of the group and make the best use of available resources.