



BI-ANNUAL WQ TRENDING REVIEW

JANUARY 2023

PREPARED BY: TERRI WILLERT

PUBLIC WORKS
HAMILTON WATER

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- Conclusion of Review, Action Items & Next Steps

*Note: Areas of Interest (AOI's) based on observations, charts and conversations with multiple Parties. Limitations with guidelines, objectives and/or statistical analysis due to SWQP Integrative Program limitations and/or minimal samples to designate baseline or threshold trends.
Not all Parties sample and/or trend for same WQ Parameters.

- Introduction

- Where are we?

- Workload:

- Monthly Sampling, CSO SR's, MOUs & Data Sharing and Trending
 - MOUs are signed

- Internal & External Data Sharing / Power BI Development

- On-going

SWQP Bi-Annual Review / SAR / SWQP Annual Report to Council, June 2023

- Bi-Annual Review - Parameters for Review

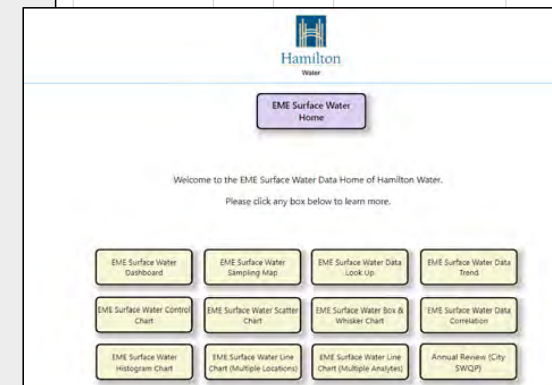
- City SWQP – WQT reviews these regularly on Power BI

- Standard Deviation, Mean and Trendlines: to be added to Power BI dashboard.

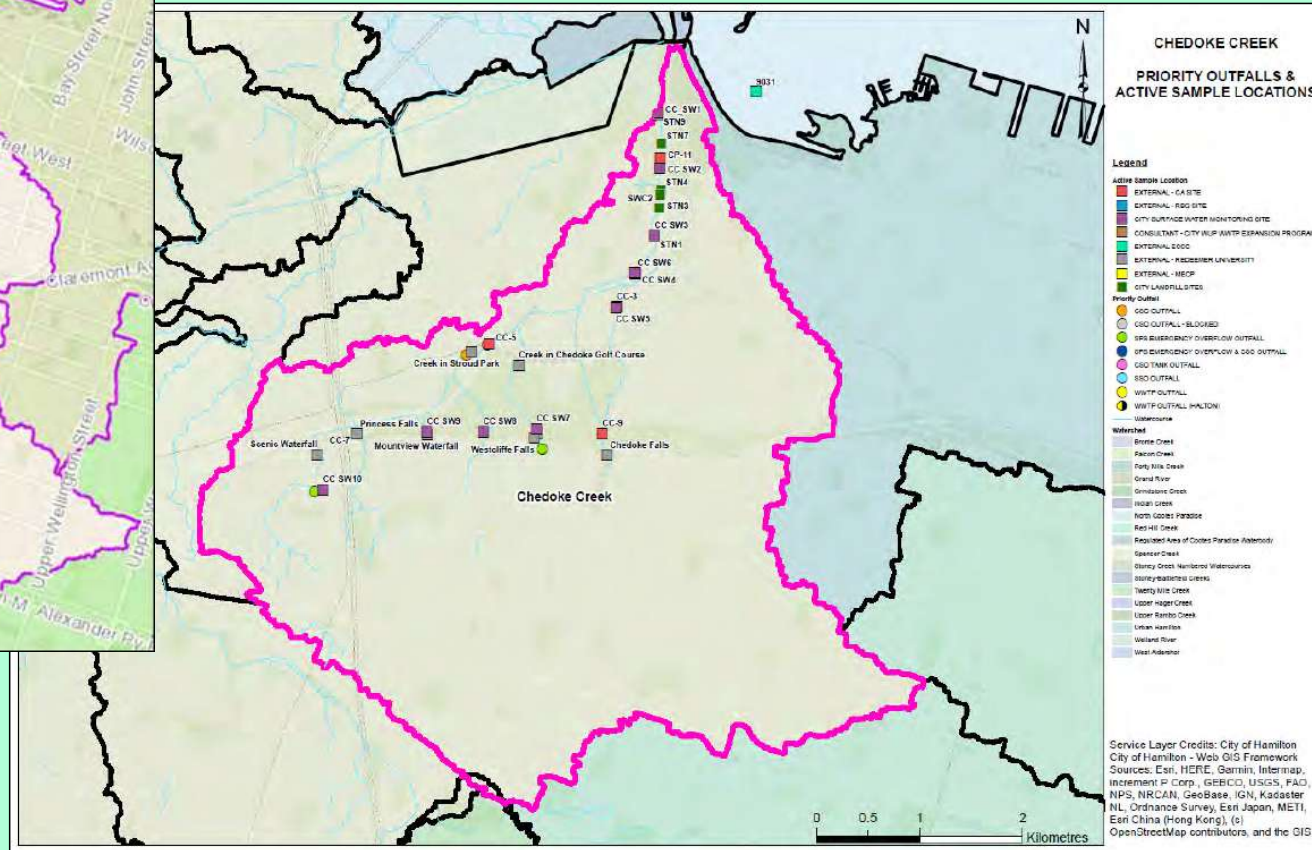
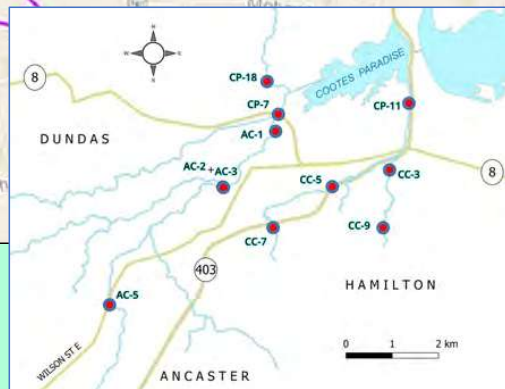
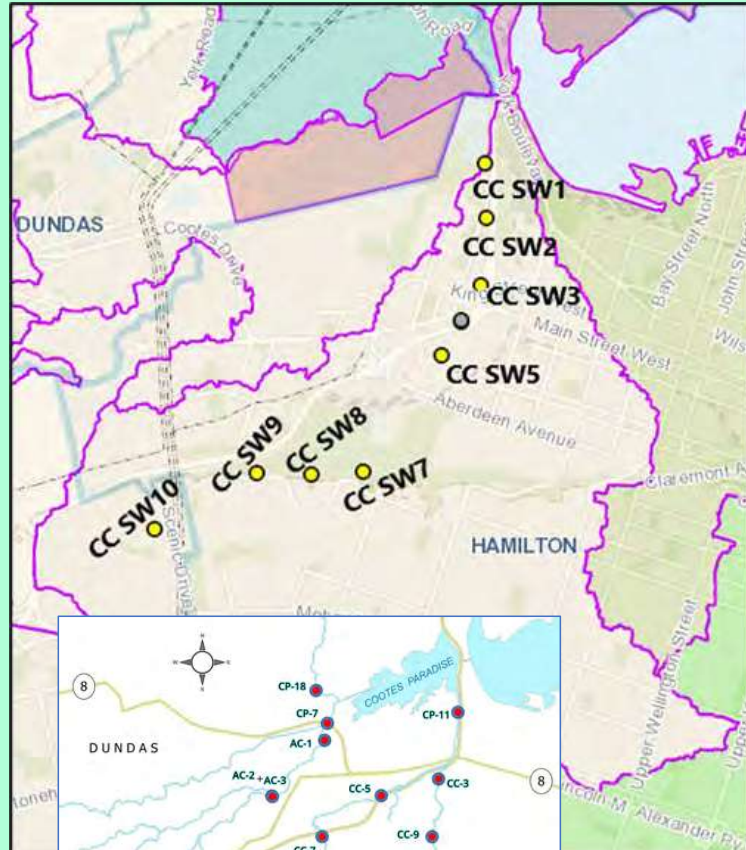
- Other Data: DFO, ECCC, MECP, CH, HCA, NPCA, RBG, Redeemer, WUP – noted trends, areas of interest, etc.

- Excluded: Landfills (except West Hamilton) due to duplicate sample names

PARAMETER LIST		
Field Parameters	Chemical Parameters	METALS
1 Conductivity	1 Ammonia as N	1 Aluminium
2 Dissolved Oxygen	2 Carbonaceous Biochemical Oxygen Demand	2 Antimony
3 pH	3 Chloride	3 Arsenic
4 Temperature	4 Bromide	4 Barium
	5 Escherichia coli (E. coli) bacteria	5 Beryllium
	6 Hardness	6 Bismuth
	7 Nitrate	7 Boron
	8 Nitrite	8 Cadmium
	9 O-Phosphate	9 Calcium
	10 Total Kjeldahl Nitrogen (TKN)	10 Chromium
	11 Total Phosphorus (TP)	11 Cobalt
	12 Total Suspended Solids (TSS)	12 Copper
	Un-ionized Ammonia	13 Iron
		14 Lead
		15 Lithium
		16 Magnesium
		17 Manganese
		18 Molybdenum
		19 Nickel
		20 Potassium
		21 Selenium
		22 Silicon
		23 Silver
		24 Sodium
		25 Strontium
		26 Thallium
		27 Tin
		28 Titanium
		29 Tungsten
		30 Uranium
		31 Vanadium
		32 Zinc
		33 Zirconium

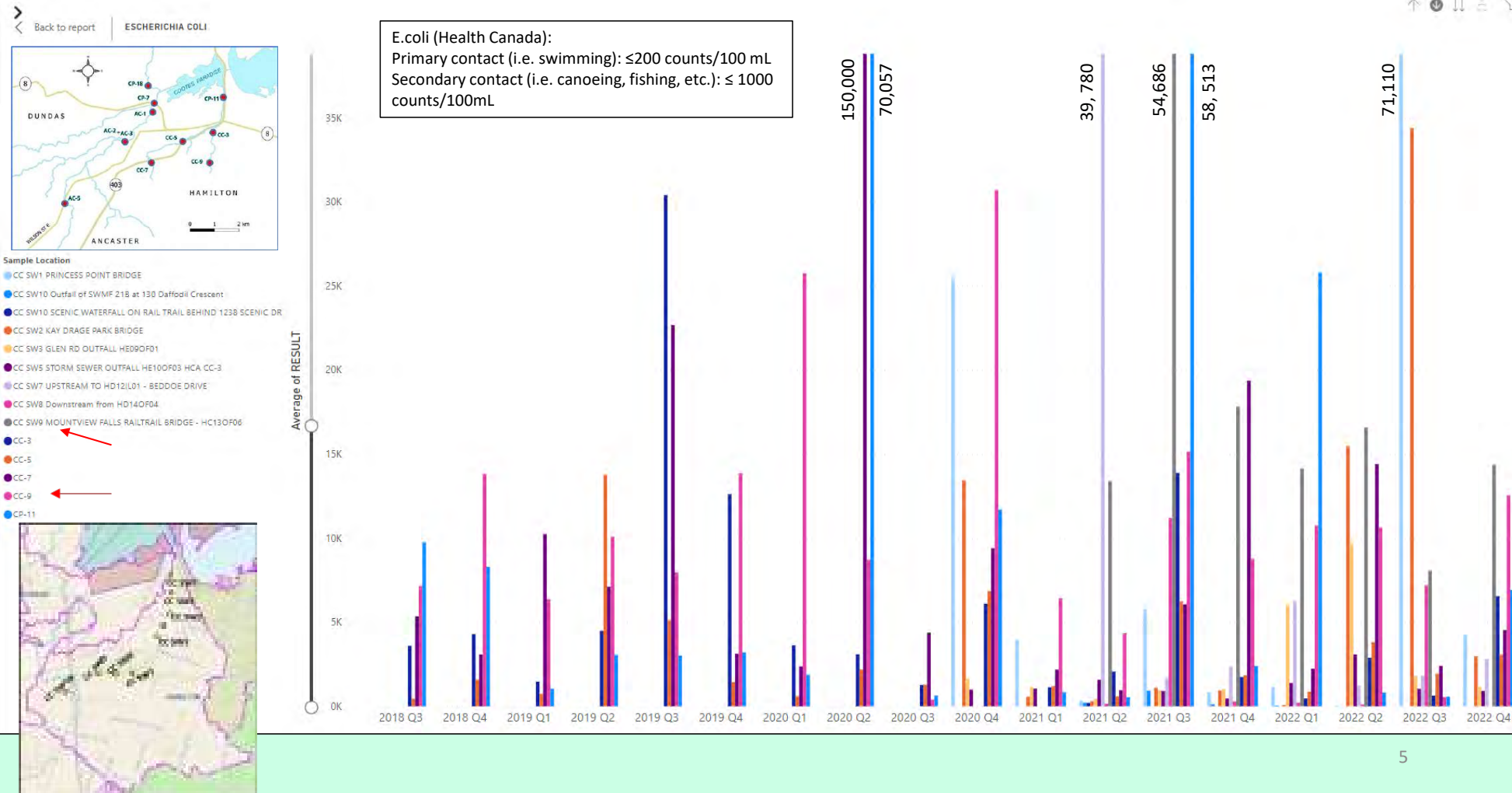


Chedoke Creek



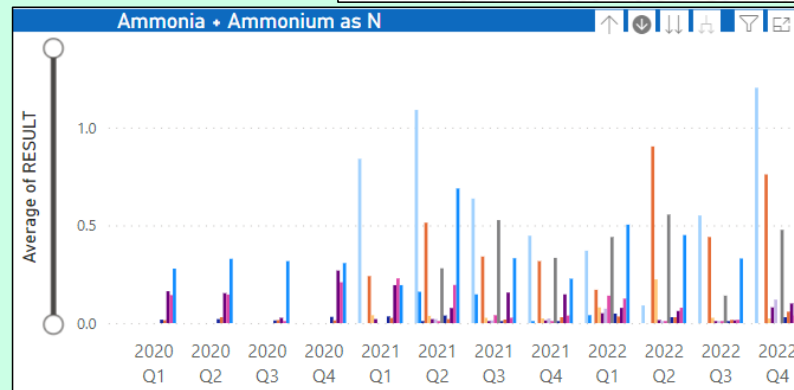
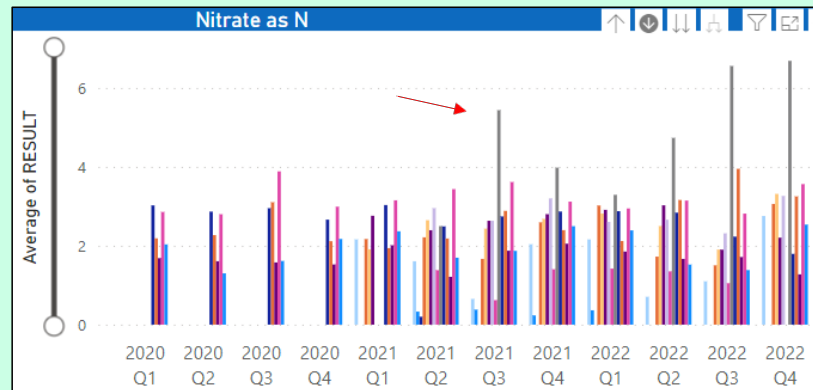
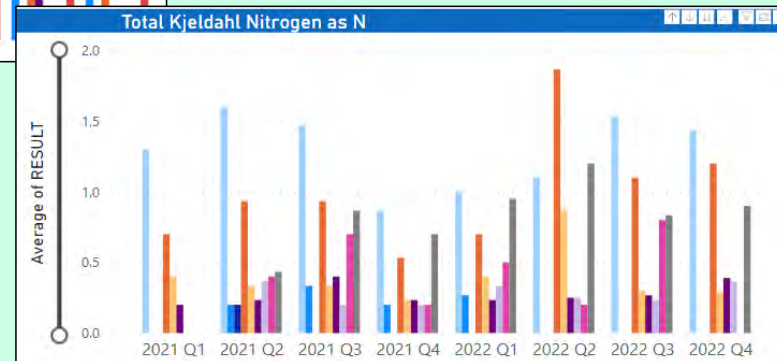
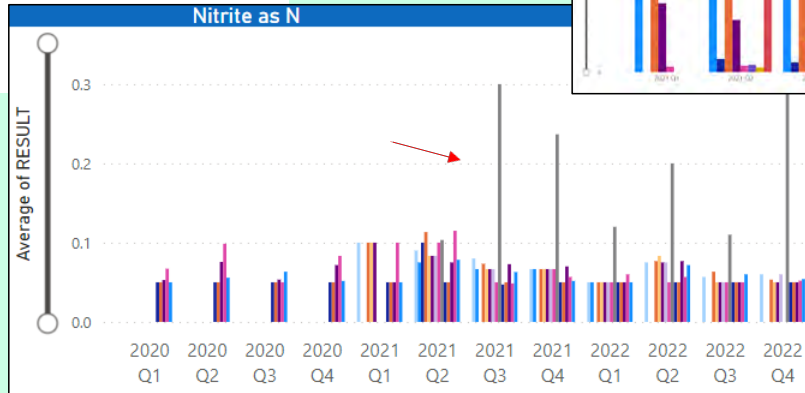
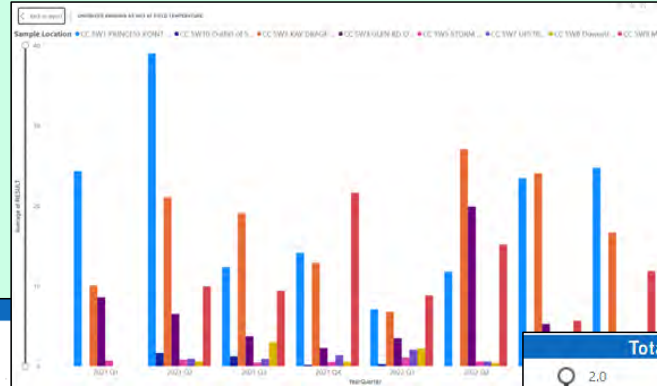
Service Layer Credits: City of Hamilton
City of Hamilton - Web GIS Framework
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS

Chedoke Creek – Quarterly E. coli Results

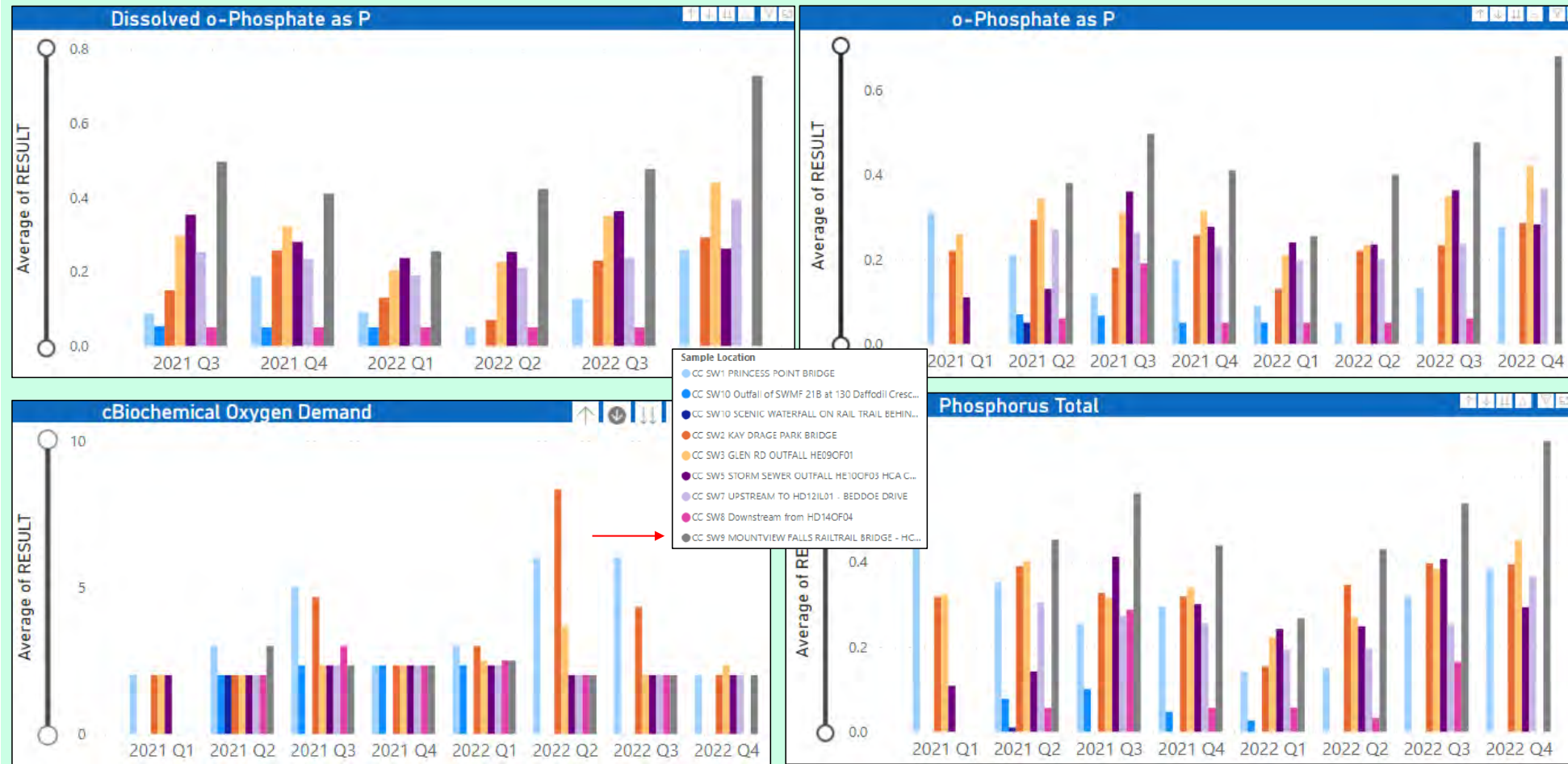


Chedoke Creek – Average Nutrient Results

- Sample Location**
- CC SW1 PRINCESS POINT BRIDGE
 - CC SW10 Outfall of SWMF 21B at 130 Daffodil Crescent
 - CC SW10 SCENIC WATERFALL ON RAIL TRAIL BEHIND 1338 SCENIC DR
 - CC SW2 KAY DRAGE PARK BRIDGE
 - CC SW3 GLEN RD OUTFALL HE090F01
 - CC SW3 STORM SEWER OUTFALL HE100F03 HCA CC-3
 - CC SW7 UPSTREAM TO HD121L01 - BEDDOE DRIVE
 - CC SW8 Downstream from HD140F04
 - CC SW9 MOUNTVIEW FALLS RAILTRAIL BRIDGE - HC130F06
 - CC-3
 - CC-5
 - CC-7
 - CC-9
 - CC-11

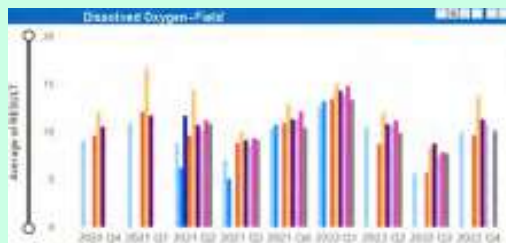
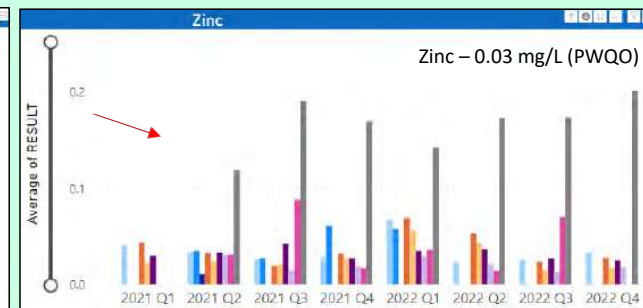
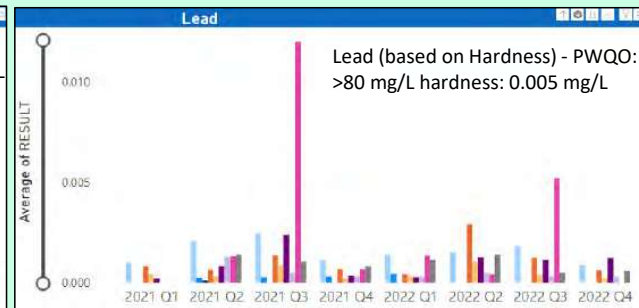
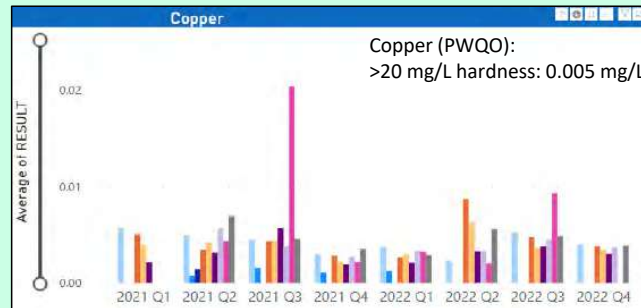


Chedoke Creek – Average Nutrient Results – Cont'd

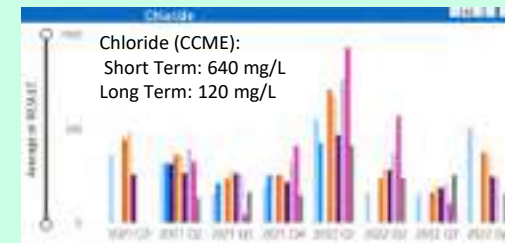


WD dosing of ortho phos. = 3.1mg/L

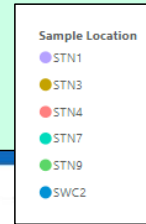
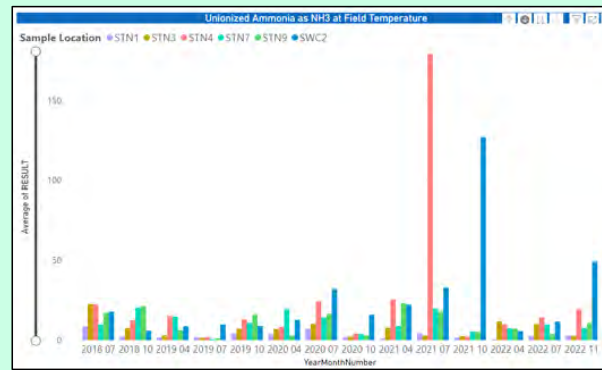
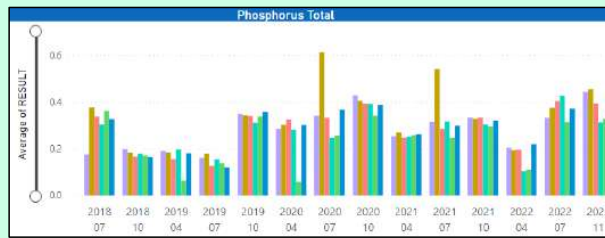
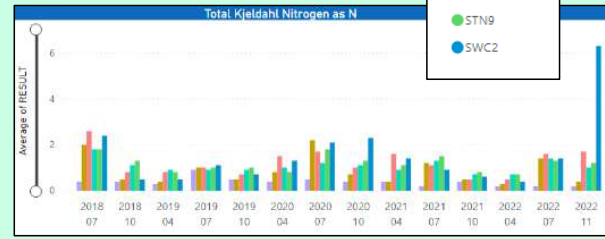
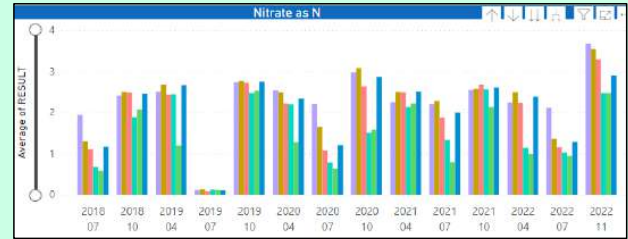
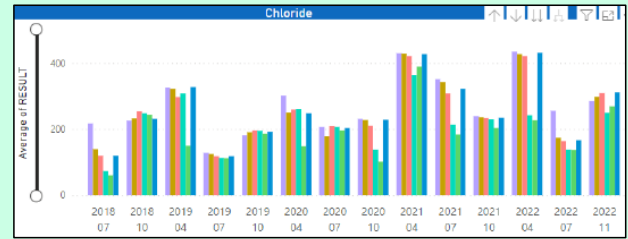
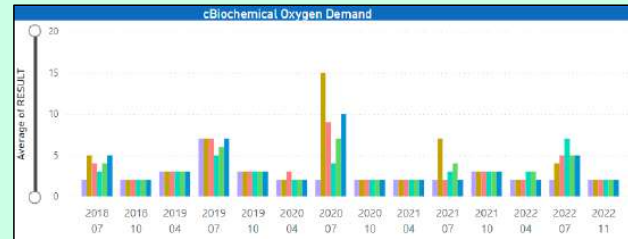
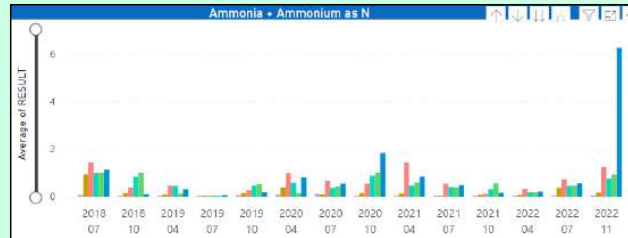
Chedoke Creek – Quarterly Results



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 - CC SW2 KAY DRAGE PARK BRIDGE
 - CC SW3 GLEN RD OUTFALL HE090F01
 - CC SWS STORM SEWER OUTFALL HE100F03 HCA C...
 - CC SW7 UPSTREAM TO HD12IL01 - BEDDIE DRIVE
 - CC SW8 Downstream from HD140F04
 - CC SW9 MCUNTVIEW FALLS RAILTRAIL BRIDGE - HC...



Chedoke Creek – Landfills Results

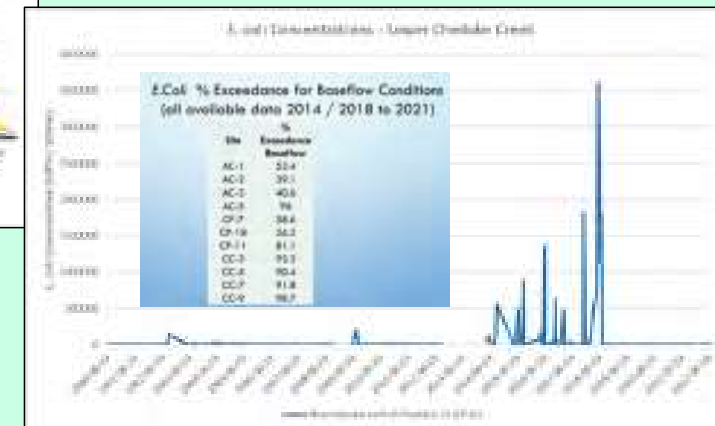
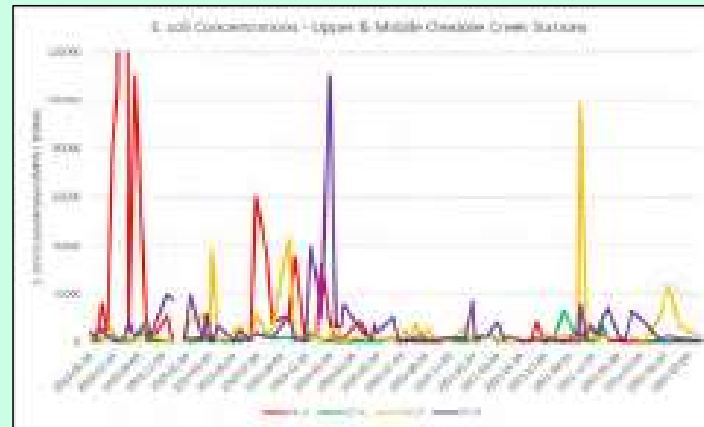


Chedoke Creek - HCA Data:

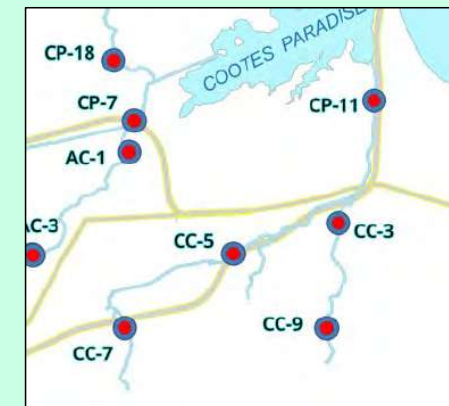
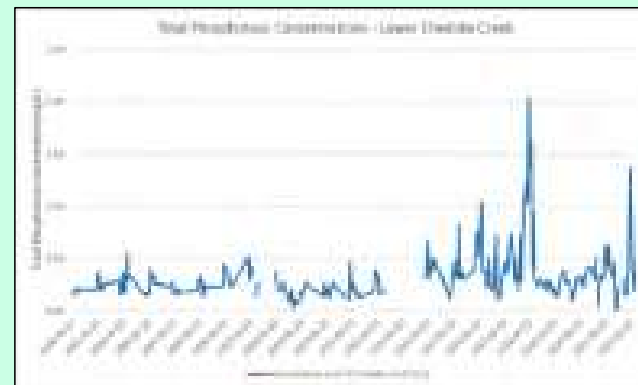
Chedoke Creek sites experienced the highest values for both E.coli and TP.

ALL the upstream Chedoke Creek sites have a 100% exceedance rate for TP

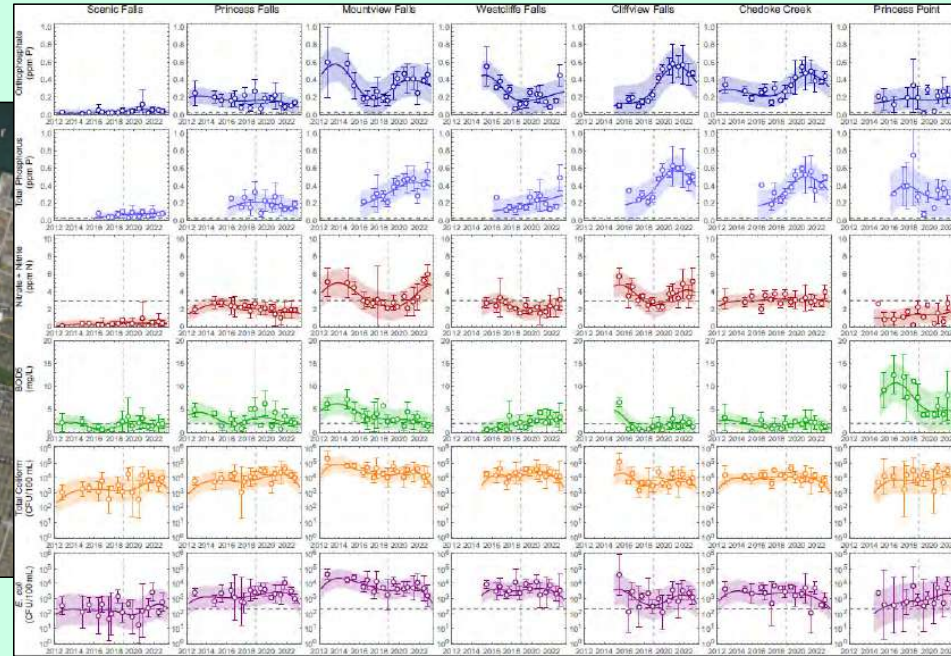
The furthest upstream site at Chedoke Falls (CC-9), experiences the highest average TP and E.coli geomean.



Site	% Exceedance
AC-1	33.8
AC-2	25.6
AC-3	38.3
AC-5	64.5
CP-7	77.3
CP-11	96.9
CP-18	73.8
CC-3	100
CC-5	100
CC-7	100
CC-9	100



Chedoke Creek Redeemer Data:



Highlight – Fall 2022:

- 1) Mountview Falls (CC SW9) –Nitrate, Phosphate
- 2) Westcliffe (CC SW7) – Phosphate, Bacterial, BOD
- 3) Cliffview Falls (CC SW7) –Nitrate, Phosphate
- 4) Chedoke Creek/Falls (HCA's CC-9) – Phosphate
- 5) Princess Point (CC SW1) - BOD

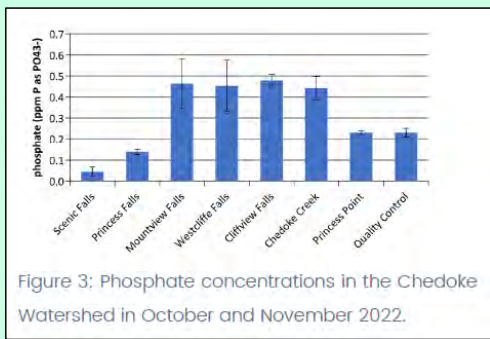


Figure 3: Phosphate concentrations in the Chedoke Watershed in October and November 2022.

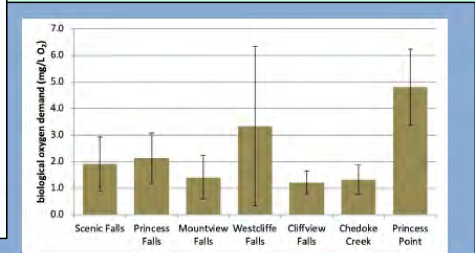


Figure 4. Biological Oxygen Demand in the Chedoke Watershed in October and November 2022.

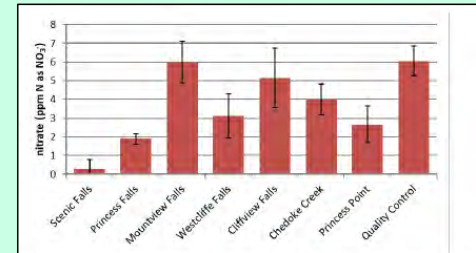


Figure 2: Nitrate concentrations in the Chedoke Watershed in October and November 2022.

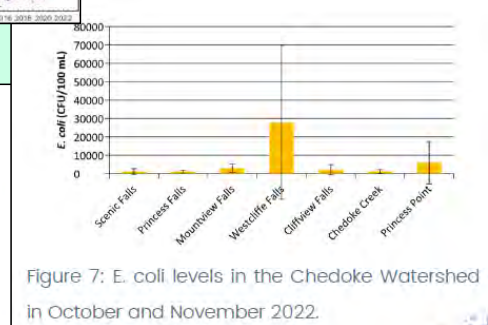


Figure 7: E. coli levels in the Chedoke Watershed in October and November 2022.

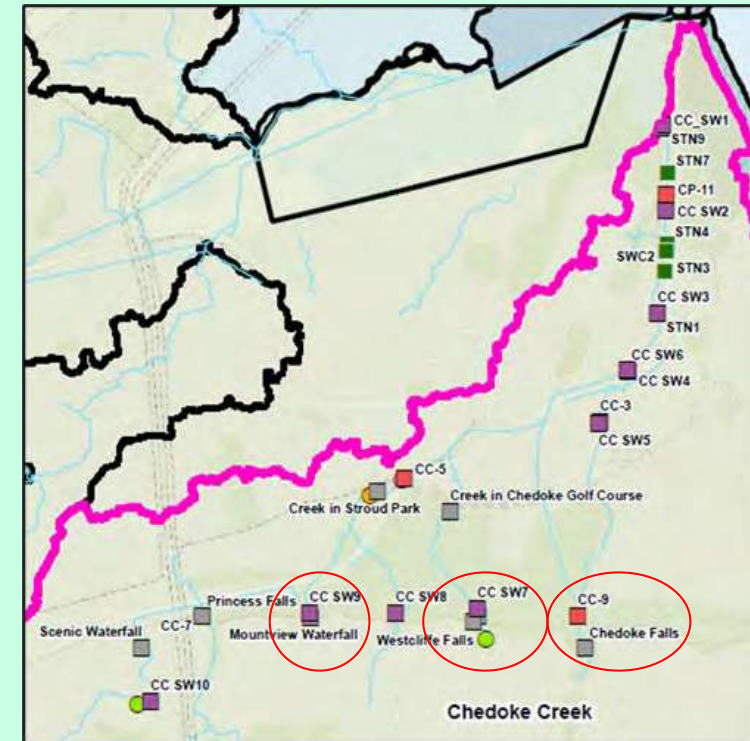
Chedoke Creek Summary of Findings:

Areas of Interest (AOI)

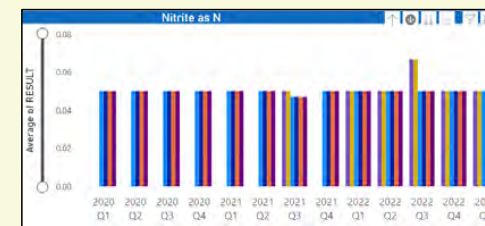
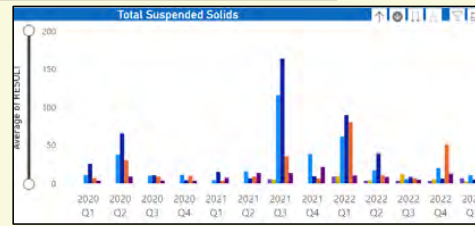
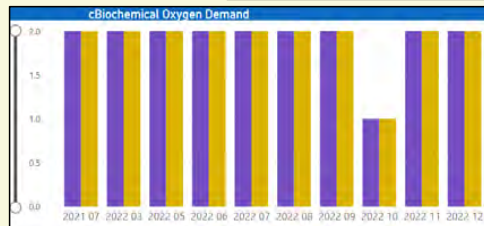
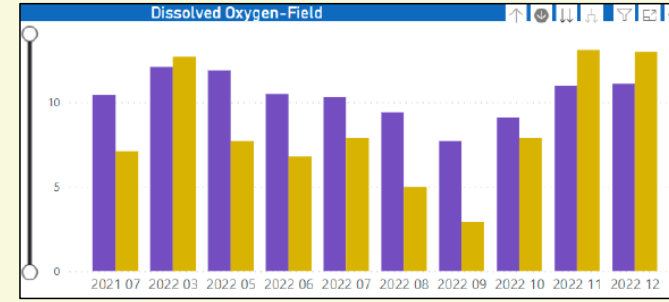
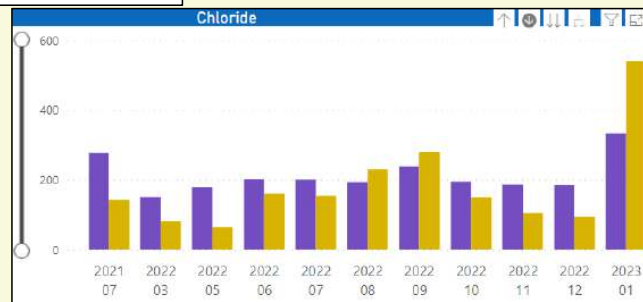
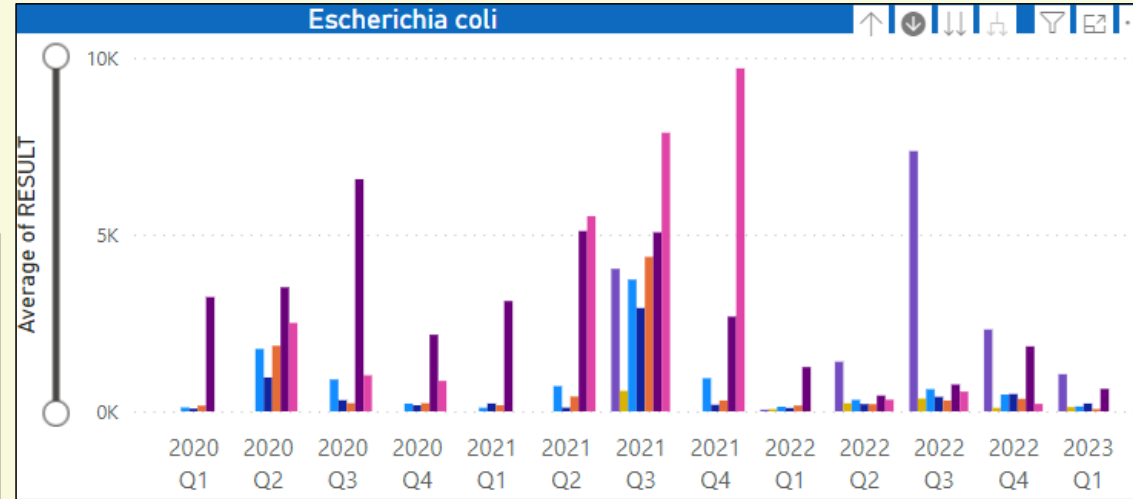
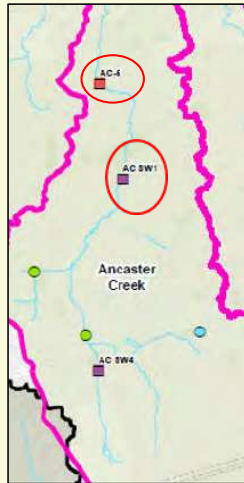
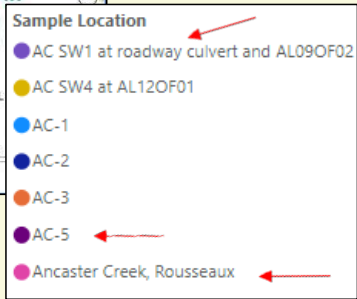
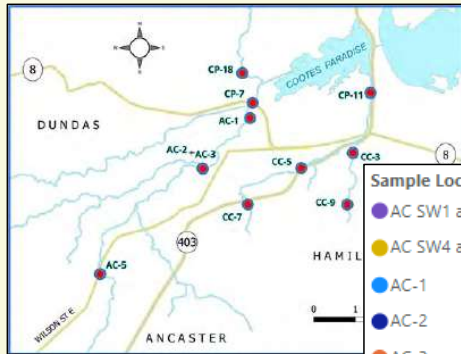
- Upper Chedoke
 - HCA's CC-9 & Redeemer's Chedoke Creek/Falls (Chedoke Falls)
 - City's SWQP CC SW9 (Redeemer's Mountview Falls)
 - City SWQP CC SW8
 - High Total Metals: Aluminum, Copper, Lead, Zinc
 - This location does not flow during dry weather, indicating it is mainly road run off during snow melt/wet weather events.
 - City's SWQP CC SW7 (Redeemer's Cliffview Falls)
- Lower Chedoke – multiple parameters/locations are of interest (Landfills, HCA, Redeemer, City SWQP)



Landfill update:

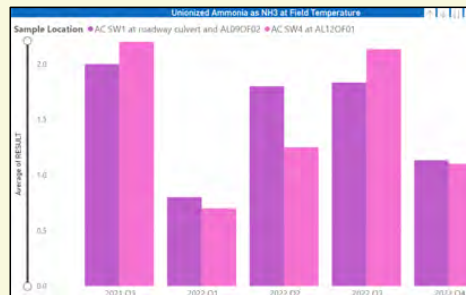
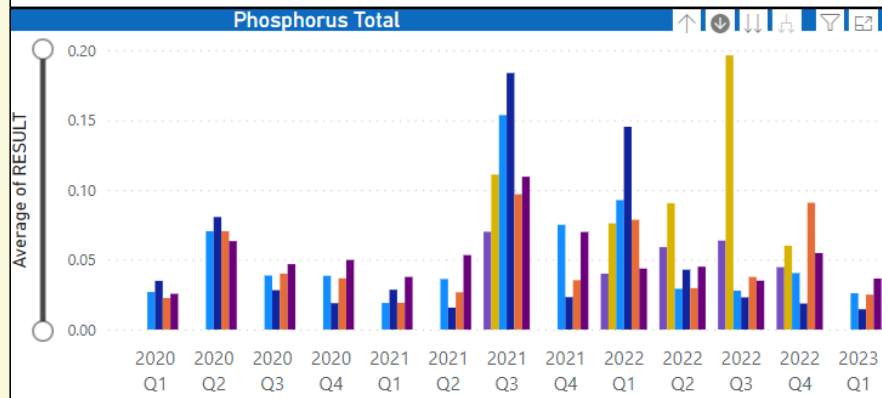
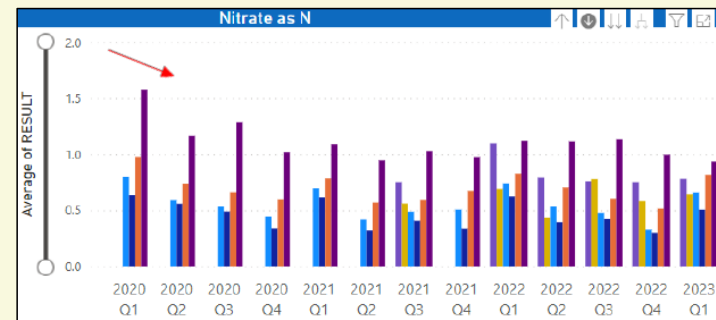
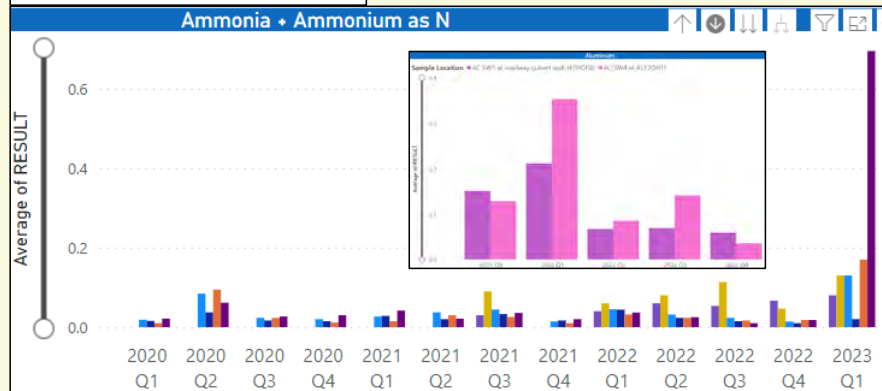
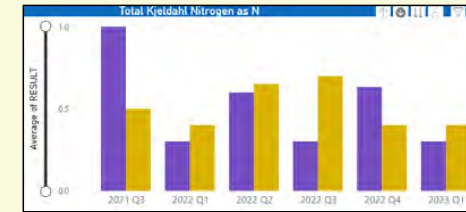
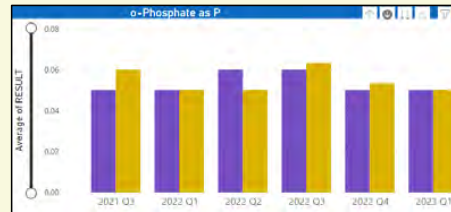
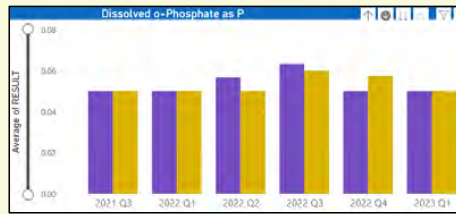


Ancaster Creek - Average Results

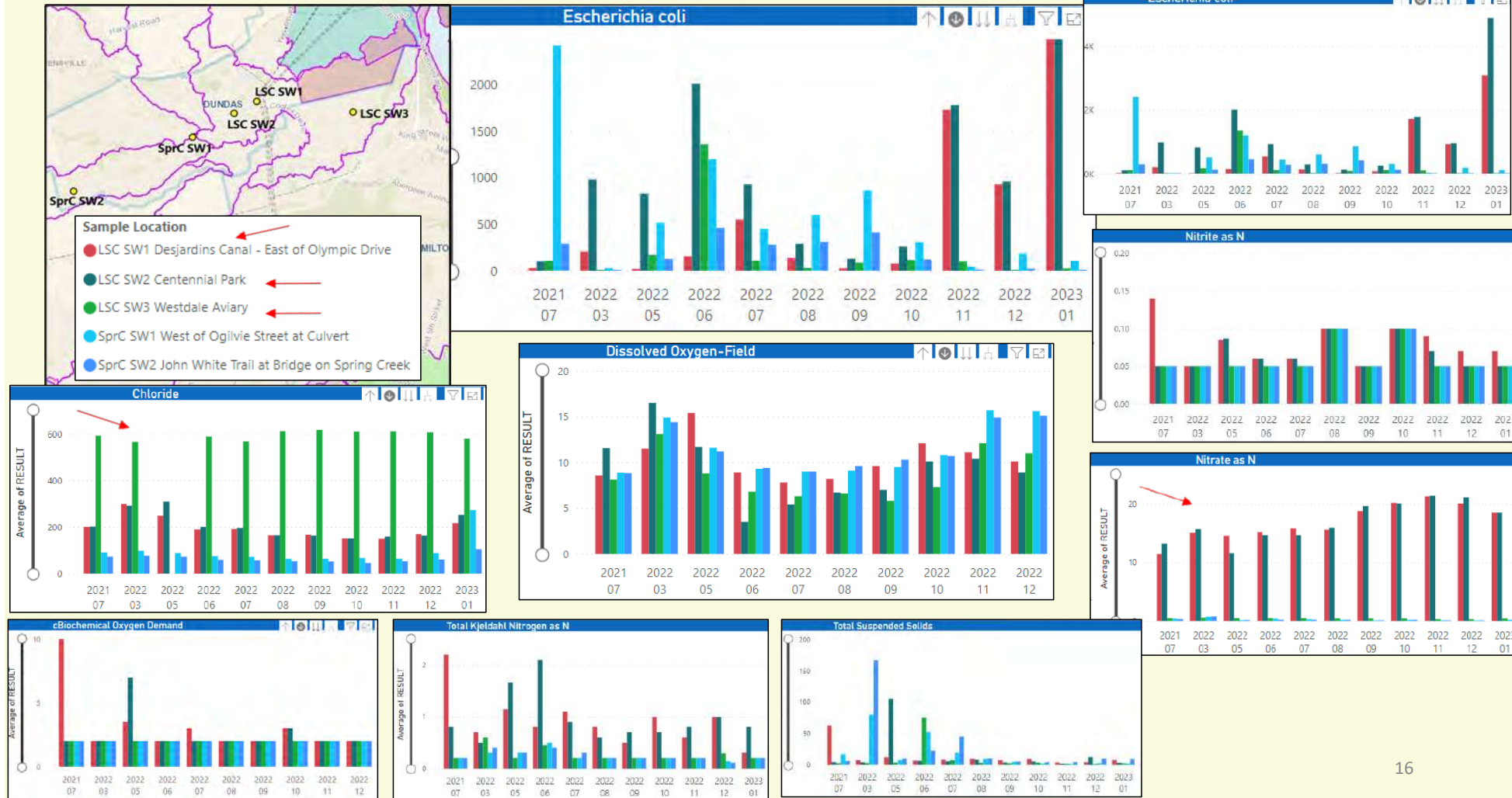


Ancaster Creek– Average Results

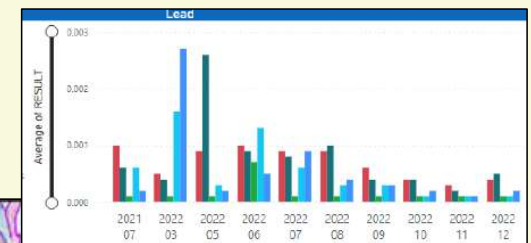
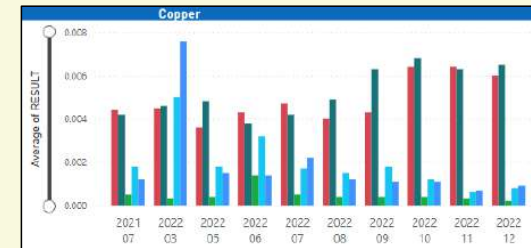
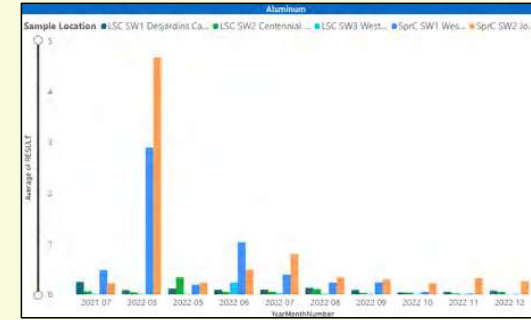
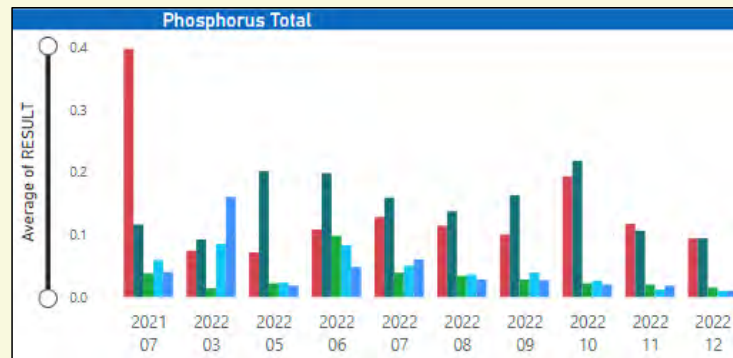
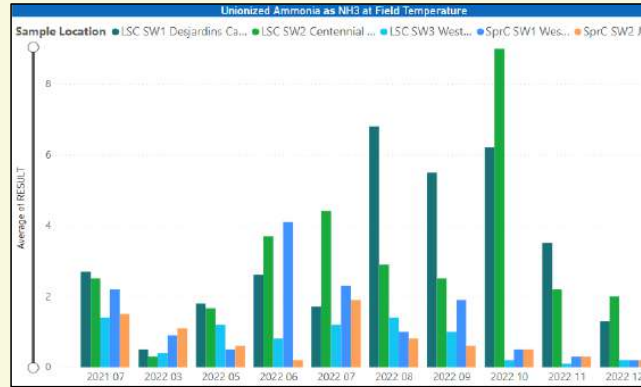
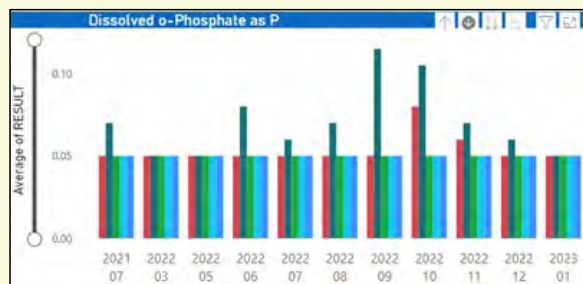
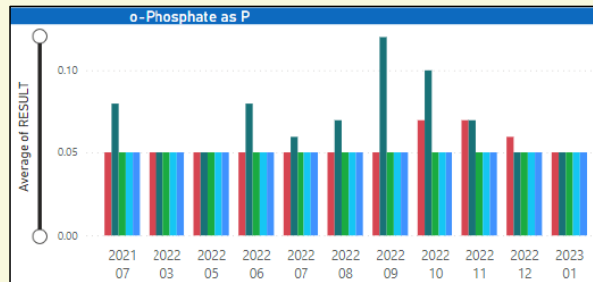
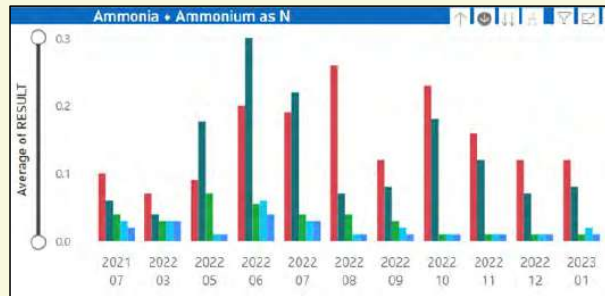
- Sample Location**
- AC SW1 at roadway culvert and AL09OF02
 - AC SW4 at AL12OF01
 - AC-1
 - AC-2
 - AC-3
 - AC-5



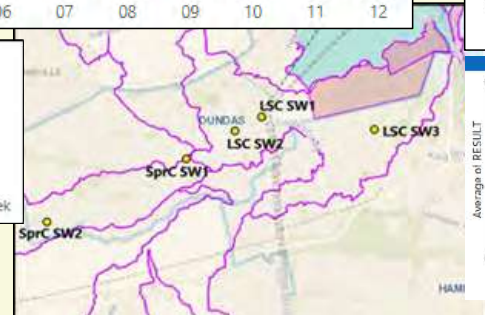
Spencer Creek (Spring & Lower Spencer Creeks):



Spencer Creek (Spring & Lower Spencer Creeks) – Con't:



- Sample Location**
- LSC SW1 Desjardins Canal - East of Olympic Drive
 - LSC SW2 Centennial Park
 - LSC SW3 Westdale Aviary
 - SprC SW1 West of Ogilvie Street at Culvert
 - SprC SW2 John White Trail at Bridge on Spring Creek



HCA Spencer & Ancaster Creek E. Coli & Total Phos. Data:

HCA Summary of Trends in Ancaster Creek

Ancaster Creek sites have experienced a slight decreasing trend in E.coli and Total Phosphorus values for baseflow events with the exception of AC-5 the most upstream of sites which only has four years of data

The **downstream Ancaster Creek sites routinely see the best water quality** out of all monitoring sites

AC-5 located the furthest upstream routinely experiences high values of E.coli with an exceedance rate of 96%.

HCA Summary of Trends in Spencer and Borers Creeks

The **Spencer Creek E.coli is trending downwards since 2014** for baseflow conditions

Borers Creek experiences the lowest rate of exceedances for E.coli at 26%

Spencer Creek also has just over half of baseflow samples experiencing exceedances (58%)

Total Phosphorus in Spencer Creek remains relatively stable

RBG – Cootes Paradise WQ Data

Water quality parameters (mean values) measured during the entire 2022 field season (May 4th to September 28th); Values highlighted in bold exceed targets/guidelines.

Parameters	HHRAP Targets Cootes/Grindstone		Guidelines	Cootes Sampling Stations				
	Initial	Proposed Final		1	2	5	16	20
Secchi (m)	>1.5/>1			0.37	0.32	0.34	0.45	0.34
Temperature (°C)				21.07	19.73	20.50	20.51	20.23
pH				8.52	8.38	8.98	8.11	8.60
Chl a (µg/l)	<20			-	-	-	-	-
Turbidity (NTU)		<4 / <8		22.10	23.14	6.94	12.31	20.98
DO (mg/L)	>5	>5 for 80% of samples and >3 for 95% of samples		9.21	10.24	15.49	7.40	8.55
TP (µg/L)	60 – 70		<30 ^{1,3}	134.29	142.36	124.72	140.83	140.12
Nitrate-N (mg/L)			<3.0 ¹	-	0.19	6.5	-	-
Nitrite-N (mg/L)	< 0.06			-	0.02	0.11	-	-
Unionized Ammonia (mg/L)	<0.02	<0.02	<0.02 ³	0.004	0.002	0.0081	0.0006	-
TSS (mg/L)	<25	<10 / <14		29.84	34.23	12.66	19.25	-
ISS (mg/L)				20.47	23.93	6.40	10.38	-
<i>E. coli</i> (#/100 mL)			<1000 ²	20	81	6.51	33	-
Number of samples				11	19	8	11	10

1 Canadian Council of Ministers of the Environment Guideline
2 Federal Secondary Contact for Recreation Guideline
3 Provincial Water Quality Objective
NOTE: * five samples secchi is equal to water depth.
GC1, CP20 samples were not collected beyond September 7th
CP5 samples were not collected beyond August 10th

Eutrophication (excess algae) is the principal challenge.

- Algae blooms occur in all seasons due to the ongoing supply of excess nutrients, from CSOs, treated wastewater, and surface runoff.
 - These issues are tied to the urban areas.
 - Upper watersheds provide surface water flows, but largely dry up each summer, leading to downstream concentration of water quality impairments.

Habitat loss of established vegetation in recent years.

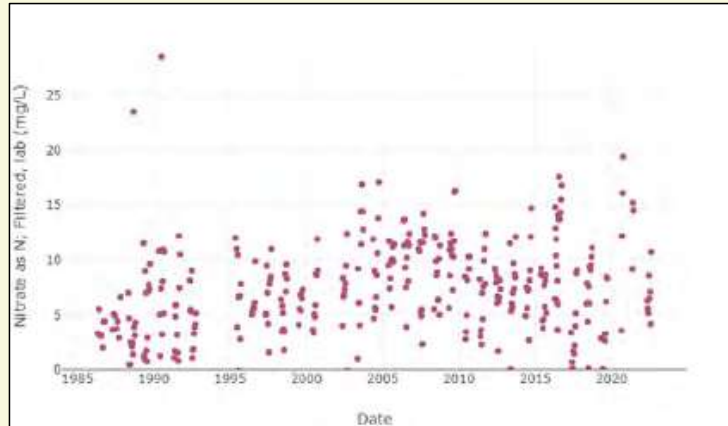
- Widespread loss of submergent and some emergent marsh vegetation following the Main King CSO malfunctions.
- Lake level regulation leading to emergent plant loss during elevated water levels and subsequent wave action.
- Loss of water lilies in two marsh locations (West Pond and Long Pond). Cause still unknown.

Potential impacts of phosphorus additions to city drinking water are unknown and require analysis.

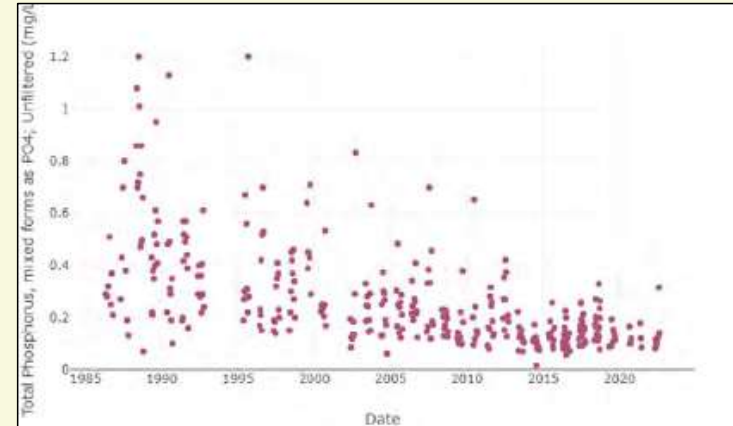
Two Cootes Paradise sites with unique issues:

- Westdale Inlet** was an early success story of the HHRAP process moving from extremely degraded at the outset, to steadily improving with areas of healthy habitat.
 - This trend reversed in 2016 and the inlet is again substantially degraded.
 - The inlets water sources are a spring feed creeks and combined sewer overflows from the Sterling Avenue CSO.
 - The sewer line associated with the Sterling Avenue CSO is also used for the excess sewage waters from the towns of Dundas and Waterdown.
- West Pond** inlet area is a driver of Cootes Paradise **algae issues** as well as a **unique issue with elevated nitrate levels**
 - West Pond area is a 1.5 km long inlet of West Cootes Paradise Marsh; acting as the **mixing zone for the DWWTP** before it joins with Spencer Creek.
 - The tertiary plant water in combination with the lack of water dilution by another water source creates elevated levels of nitrates and phosphorus.
 - The **very high nitrate levels are product of the denitrification process** at the WWTP which eliminates elevated ammonia levels.
 - The pond has very limited aquatic life likely associated with the **extreme dissolved oxygen swings** from anoxia to supersaturation, **elevated nitrate levels**, and impacts from a slurry of man-made substances not removed at the WWTP including but not limited to **pharmaceuticals, personal care products and pesticide compounds**.
 - The pond generally has clear water as it is **not impacted by sediment associated with erosion and runoff** from the watershed.
 - Habitat is dominated by algae and until recently, white water lily.

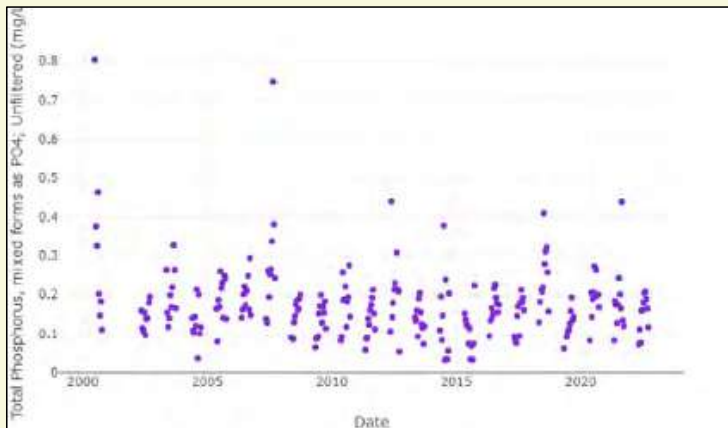
RBG – Cootes Paradise WQ Data – Cont'd



Nitrate levels in West Pond from 1986 to 2022. Data extracted from DataStream. Nitrate levels are considered toxic to amphibians at levels exceeding 5 mg/l. Nitrates in natural water ways rarely exceed 0.5 mg/l.



Total Phosphorus levels in West Pond from 1986 to 2022. Data extracted from DataStream. Eutrophication, and associated excessive algae blooms and impaired dissolved oxygens levels, occur at levels above 0.03 mg/l (30 ug/l).



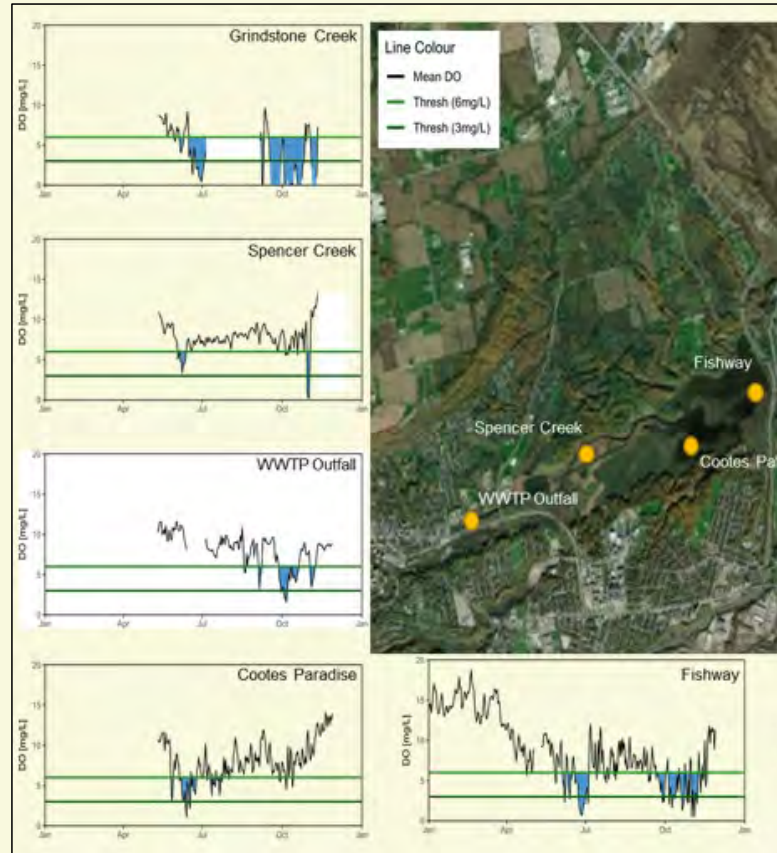
Total Phosphorus levels in Westdale from 2001 to 2022. Data extracted from DataStream. Eutrophication, and associated excessive algae blooms and impaired dissolved oxygens levels, occur at levels above 0.03 mg/l (30 ug/l).

Photograph of West Pond on June 20, 2022



DFO Cootes Paradise DO/Temp (DOT) Data:

Average daily bottom dissolved oxygen concentrations and exceedances in 2017



The two horizontal lines represent two different thresholds

Blue area represents time periods when the DO concentration dropped below 6 mg/L.

These thresholds were selected based on work examining dissolved oxygen suitability curves for freshwater fish.

- Sensitive fish species would likely exhibit stress when dissolved oxygen drops below 6 mg/L.
- More tolerant fish species would likely exhibit stress when dissolved oxygen drops below 3 mg/L.

Stress could present as avoidant behaviour, respiratory distress, and eventually death

NOTE: these two thresholds are not species specific, and DO stress is affected both by the duration for which unsuitable DO conditions persist as well as individual species tolerance.

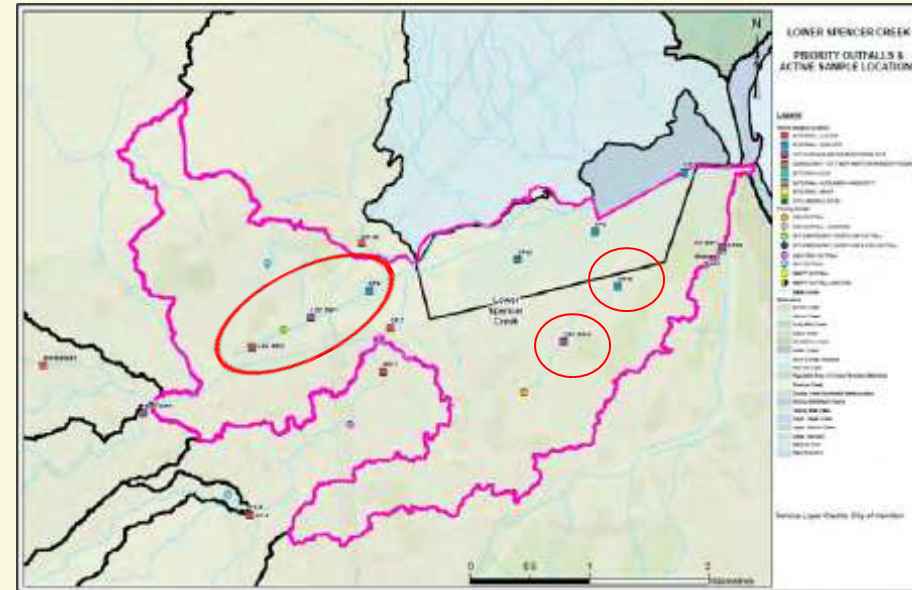
Spencer Creek, Ancaster Creek & RBG Summary of Findings

Areas of Interest

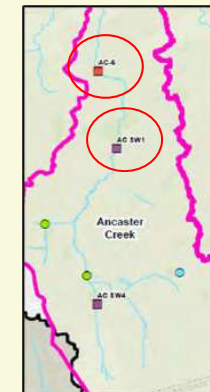
- HCA's AC-5 (Rousseaux)
- City SWQP AC SW1
- City SWQP LSC SW1
- City SWQP LSC SW2
- City SWQP LSC SW3
- RBG's CP-5 (West Pond)
- RBGs Westdale Inlet – Sterling CSO (City's LSC SW3)

*Total Phos. = problematic at all sample locations

Extreme DO (high and low) recorded within CP



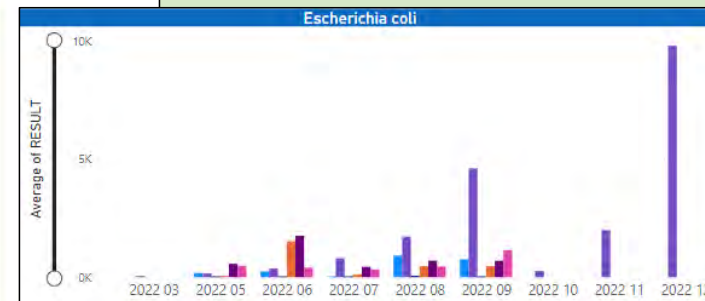
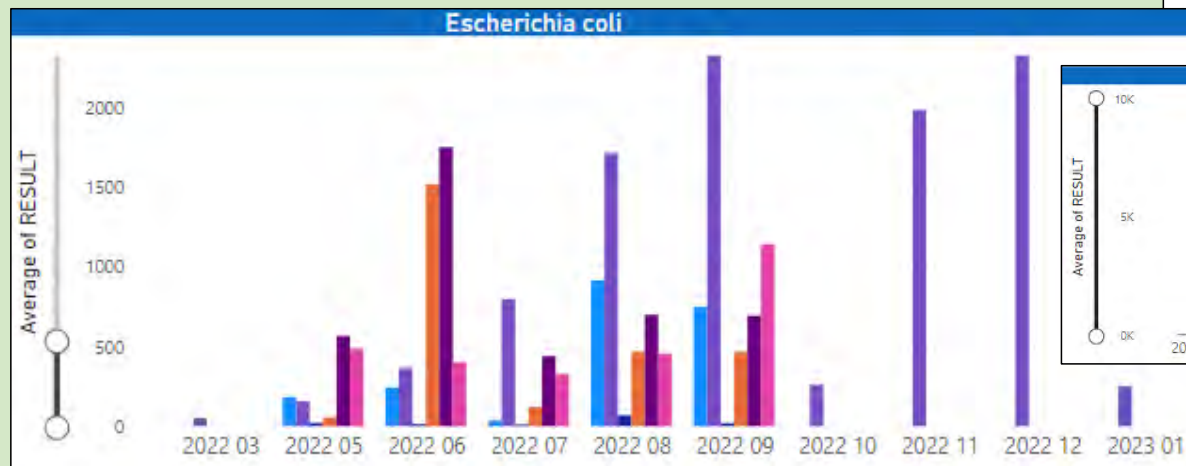
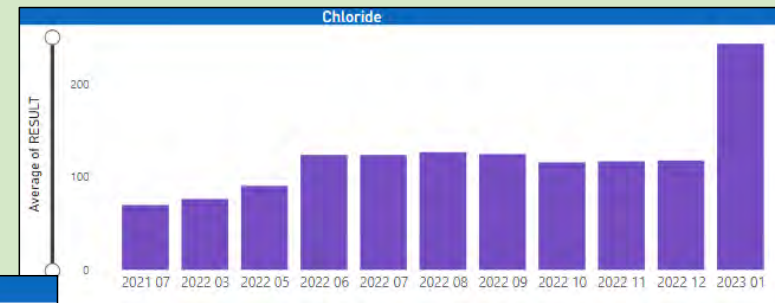
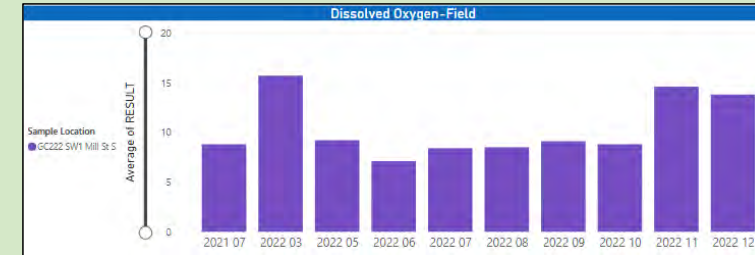
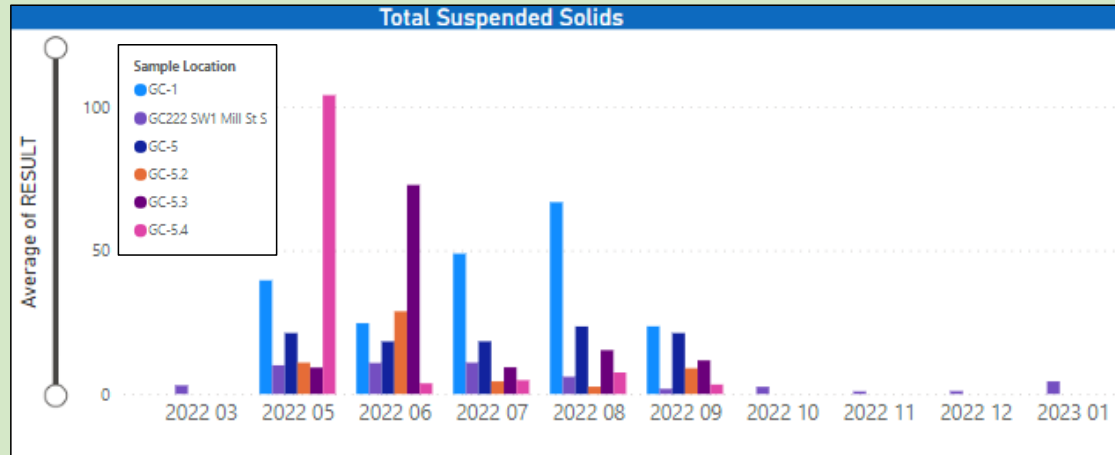
RBG comment: Ancaster Creek upper (unassumed SWMF 157) area –is the source of the Ancaster Creek general erosion down through the Dundas Valley (and perhaps other things).



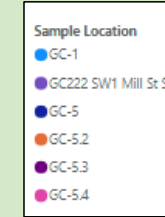
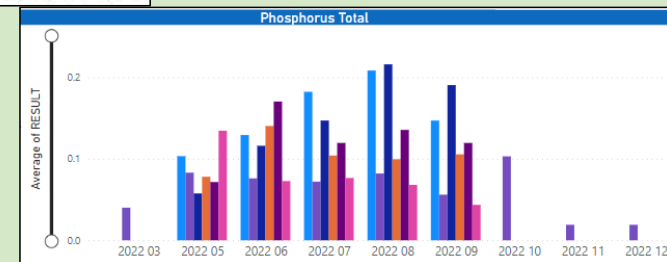
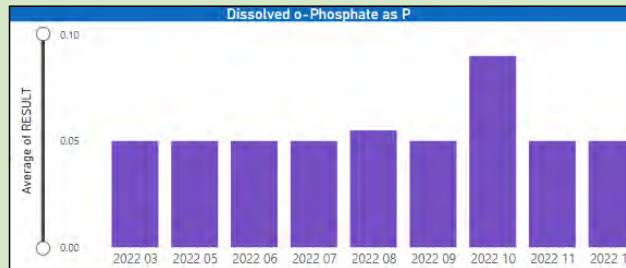
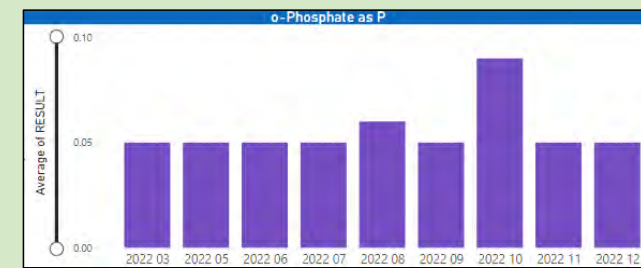
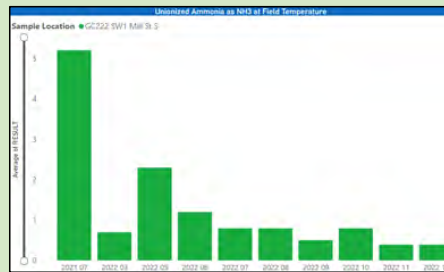
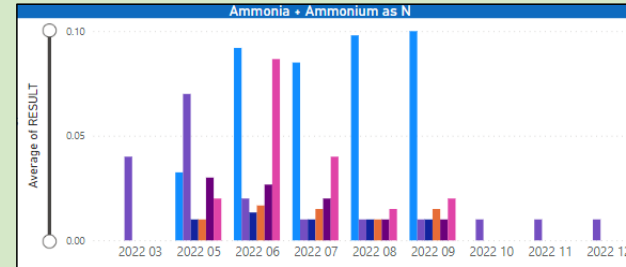
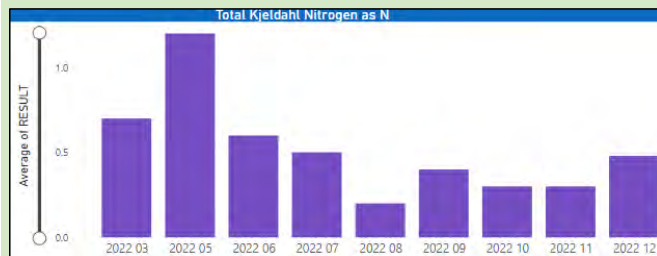
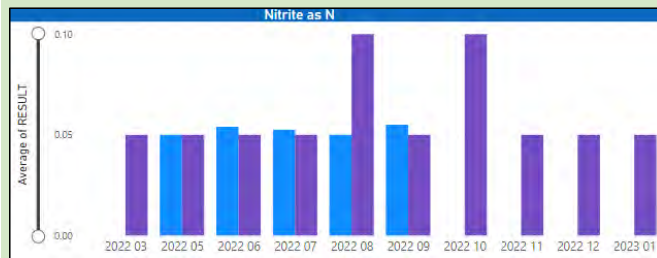
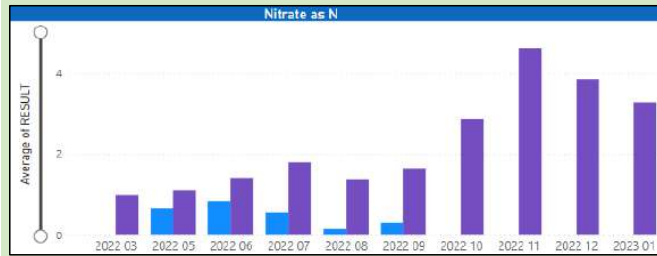
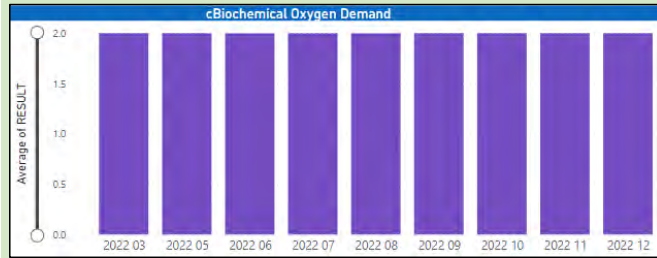
Grindstone Creek



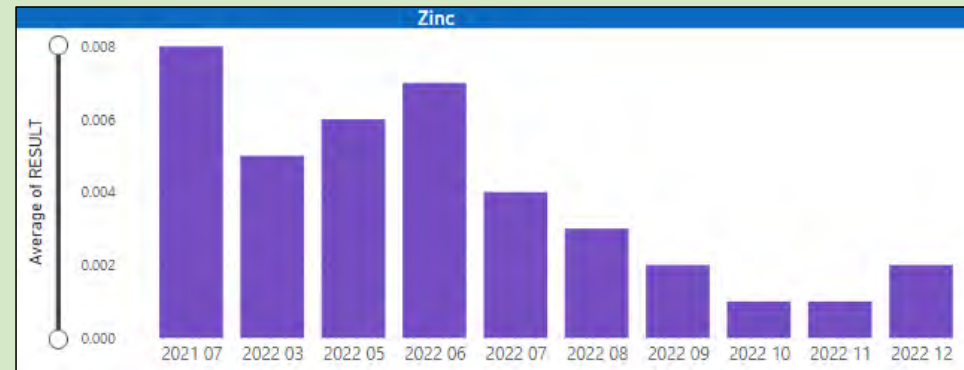
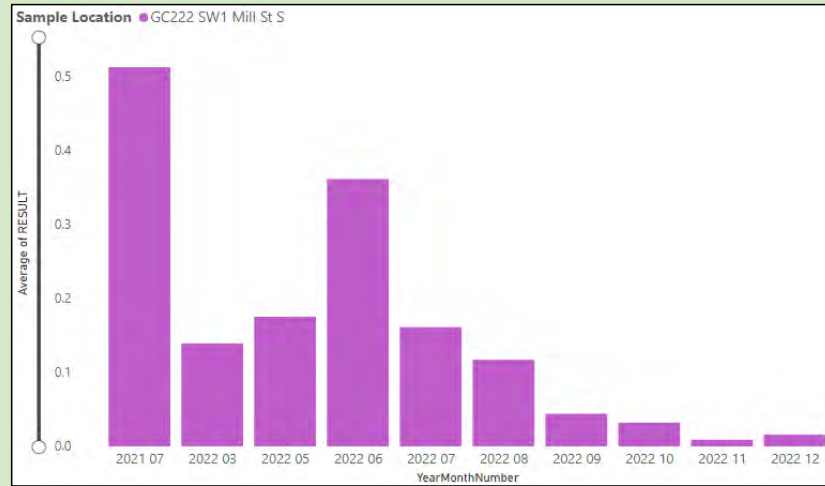
Grindstone Creek – Average E. coli, TSS, Dissolved Oxygen & Chloride Results



Grindstone Creek – Average Nutrient Results



Grindstone Creek – Metals Results



Grindstone Creek – RBG

Water quality parameters (mean values) measured during the entire 2022 field season (May 4th to September 28th)

Parameters	HHRAP Targets Cootes/Grindstone		Guidelines	Grindstone Sampling Stations	
	Initial	Proposed Final		1	5
Secchi (m)	>1.5/>1			0.29*	0.36
Temperature (°C)				21.59	21.54
pH				8.33	8.04
Chl a (µg/l)	<20			-	-
Turbidity (NTU)		<4 / <8		28.27	22.92
DO (mg/L)	>5	>5 for 80% of samples and >3 for 95% of samples		9.38	6.30
TP (µg/L)	60 – 70		<30 ^{1,3}	146.08	128.21
Nitrate-N (mg/L)			<3.0 ¹	0.31	-
Nitrite-N (mg/L)	< 0.06			0.03	-
Unionized Ammonia (mg/L)	<0.02	<0.02	<0.02 ³	0.004	0.0004
TSS (mg/L)	<25	<10 / <14		35.86	19.44
ISS (mg/L)				25.79	11.81
<i>E. coli</i> (#/100 mL)			<1000 ²	106	13.59
Number of samples				22	11

¹ Canadian Council of Ministers of the Environment Guideline

² Federal Secondary Contact for Recreation Guideline

³ Provincial Water Quality Objective

NOTE: * five samples secchi is equal to water depth.

GC1, CP20 samples were not collected beyond September 7th

CP5 samples were not collected beyond August 10th

Water quality parameters for Long Pond tributaries (GC5.2, GC5.3, and GC5.4) collected from May 4th 2022 to September 21st 2022 .

Parameter	GC5.2	GC5.3	GC5.4
TP (µg/l)	105.0	118.0	68.8
Turbidity (NTU)	4.67	7.84	7.00
<i>E. Coli</i> (#/100ml)	228	413	417

Eutrophication = excessive algae growth. Principal challenge in marsh restoration.

Algal blooms occur during all seasons

- On-going supply of excessive nutrients from CSOs, wastewater effluent, and surface runoff.
 - Water volume is greatly reduced during the hot summer months. This leads to a downstream concentration of water quality impairments during the summer.

Habitat loss of established vegetation.

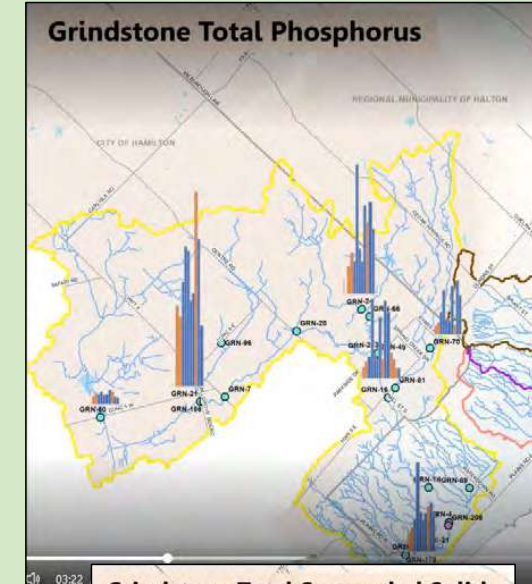
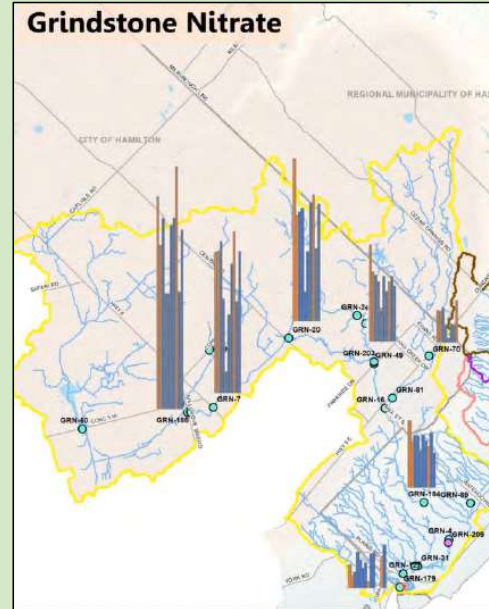
- Lake level regulation leading to emergent plant loss during elevated water levels and subsequent wave action.
- Loss of water lilies in two marsh locations (West Pond and Long Pond). Cause still unknown.

Grindstone Creek Conservation Halton Summary 2014 vs 2021

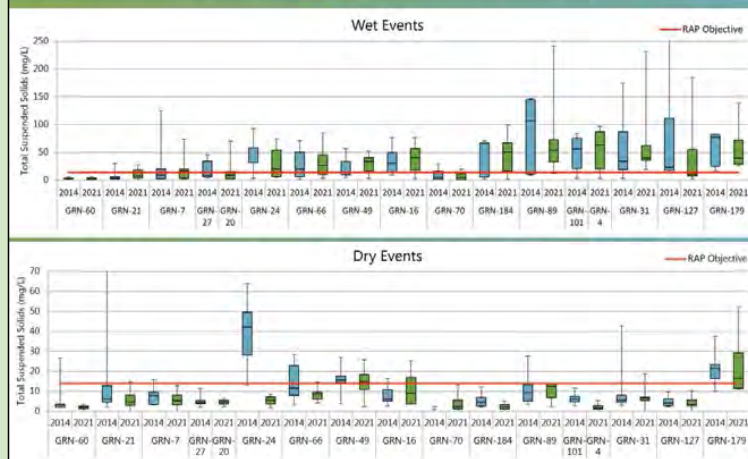
- 20 monitoring locations in Grindstone Creek, 5 in Indian Creek
- Sampled bi-weekly June through November
- Analyzed for Total Phosphorus, Total Suspended Solids, Nitrate
- Captured 8 wet events and 6 dry events

Grindstone

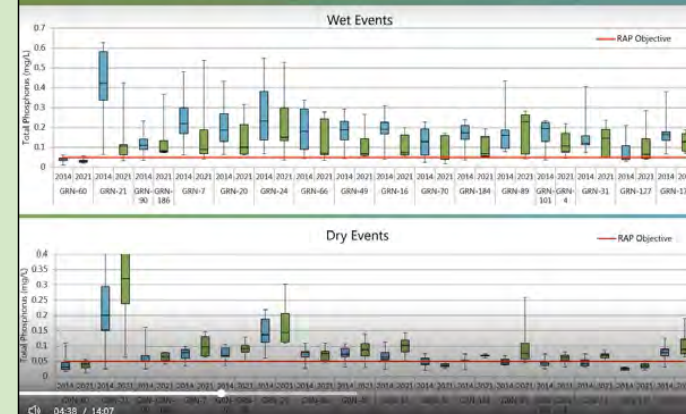
- TP continues to be problematic
- Nitrate concentrations from the 6th Concession tributary are concerning
- TSS during rain events from the escarpment streams is high



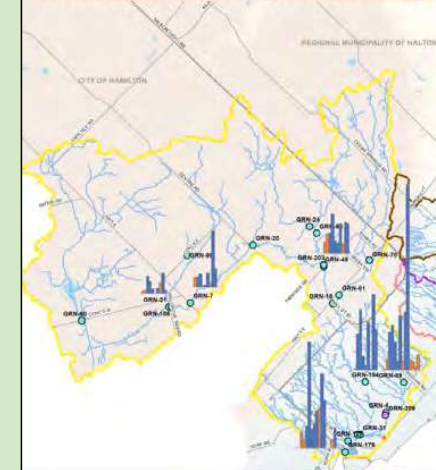
Grindstone Total Suspended Solids: 2014 vs 2021



Grindstone Total Phosphorus: 2014 vs 2021



Grindstone Total Suspended Solids



Grindstone Creek Summary of Findings:

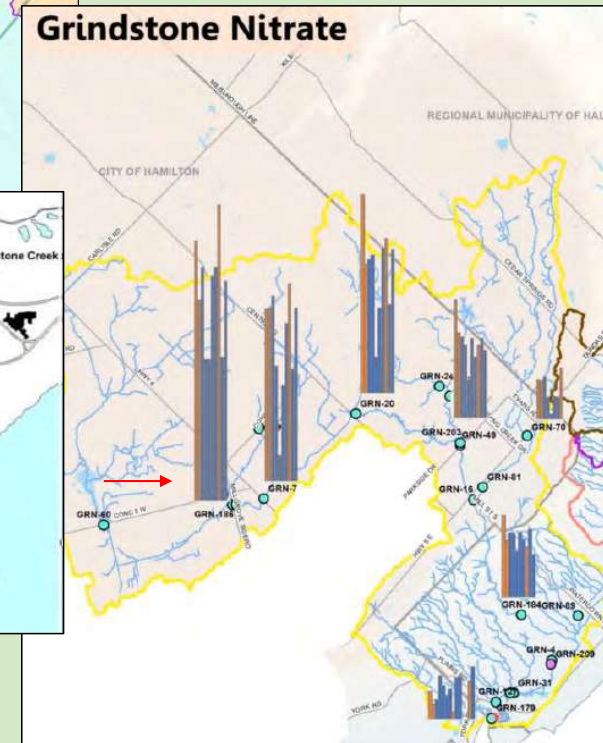
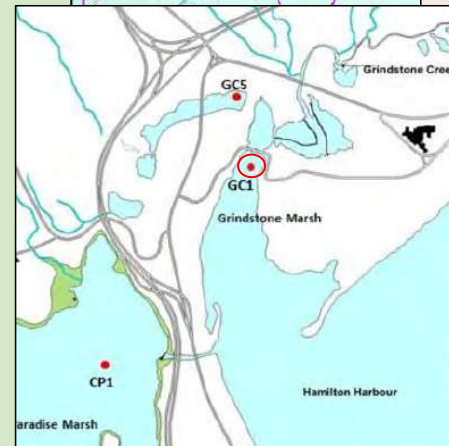
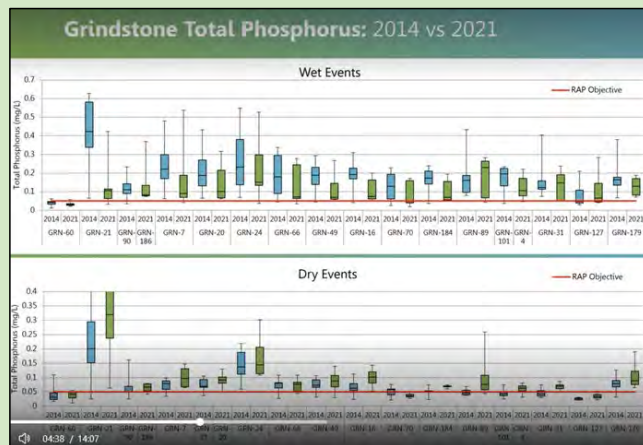
Areas of Interest (AOI)

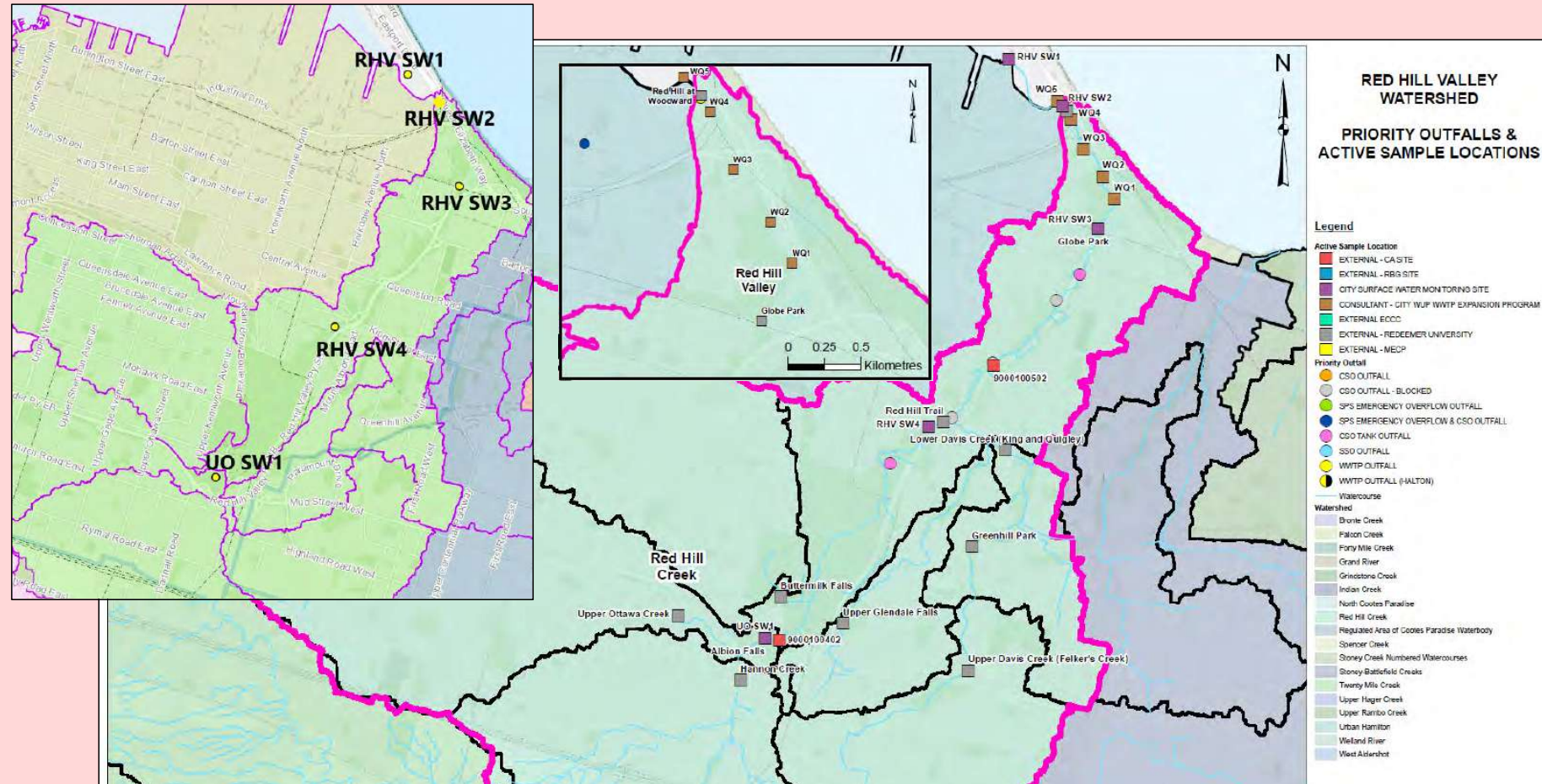
- RBG - lower Grindstone Creek
- TP, TSS & Turbidity

Conservation Halton WQ Summary of the Watershed:

Grindstone

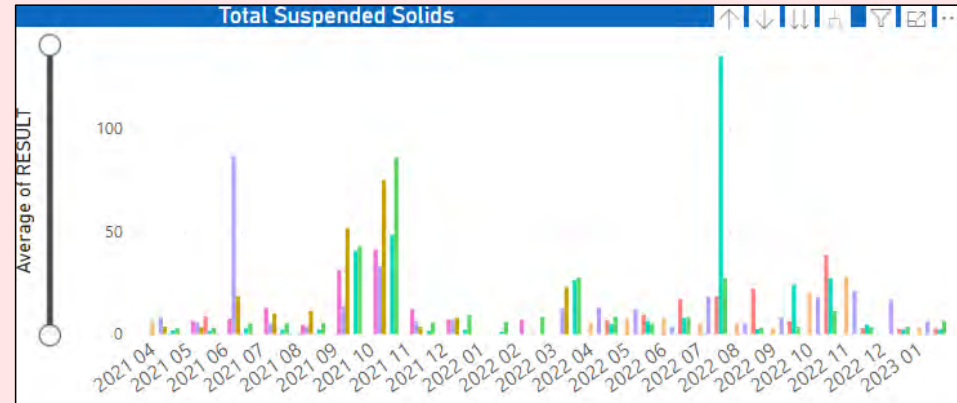
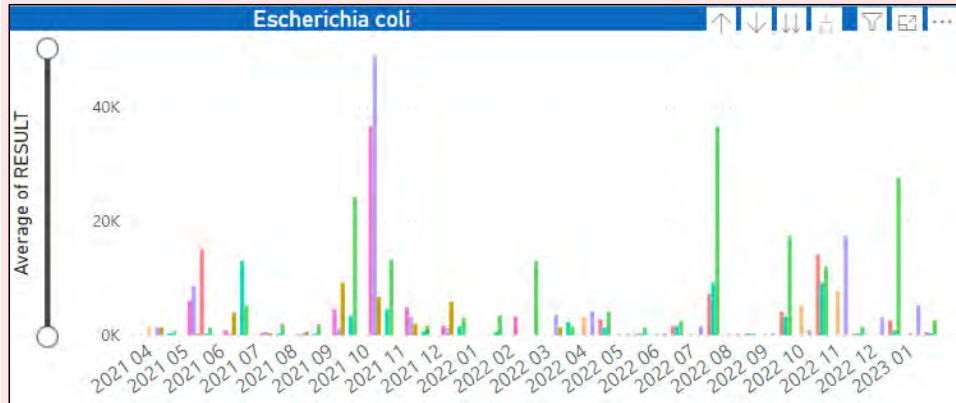
- TP continues to be problematic
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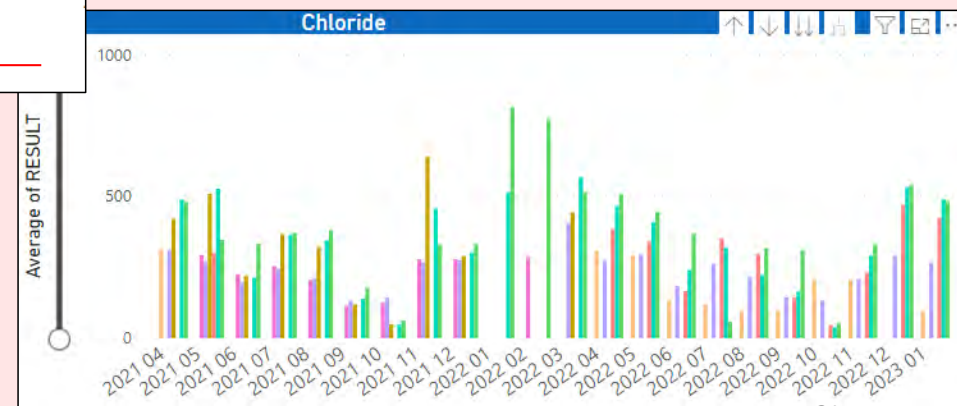
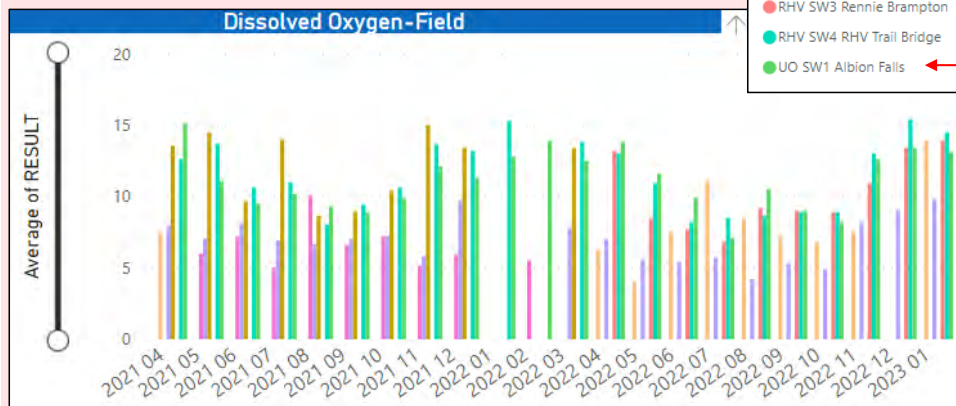


Red Hill Valley

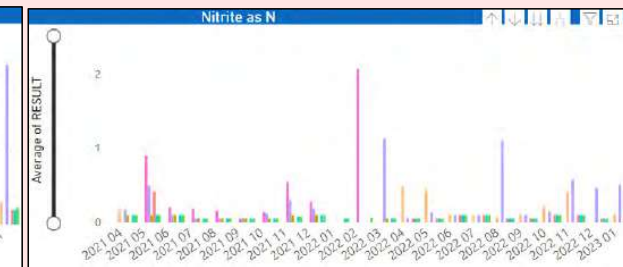
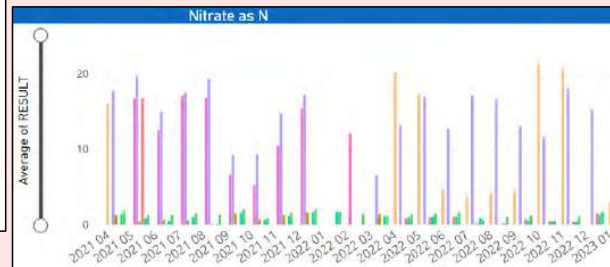
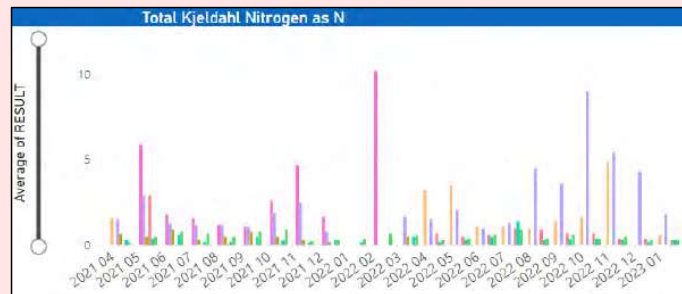
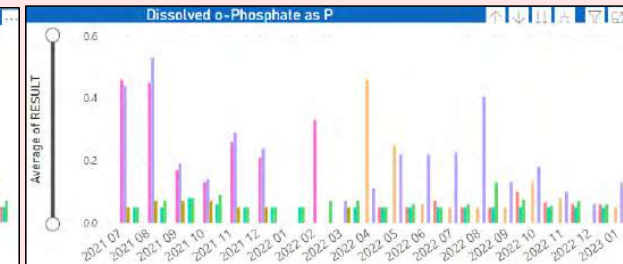
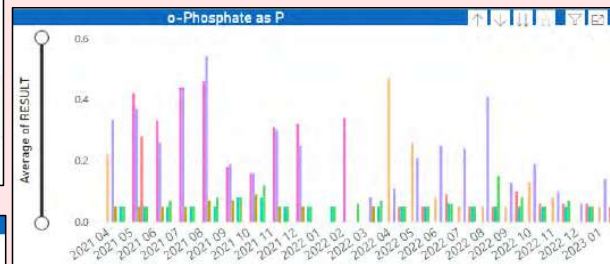
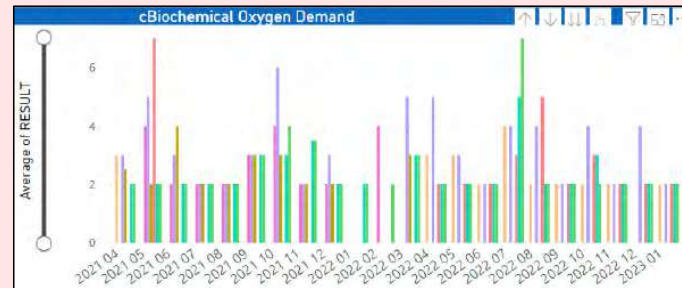
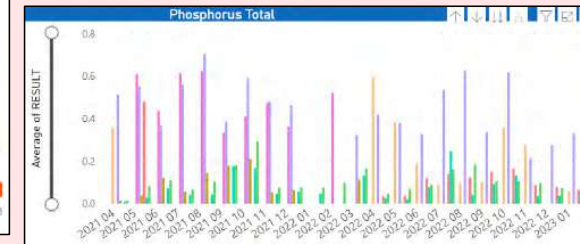
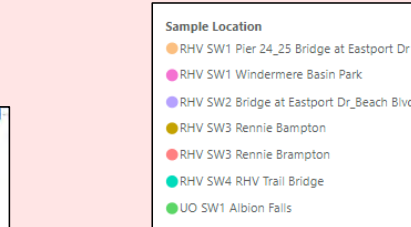
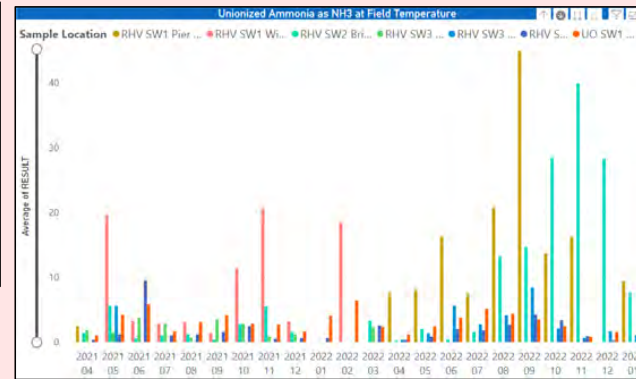
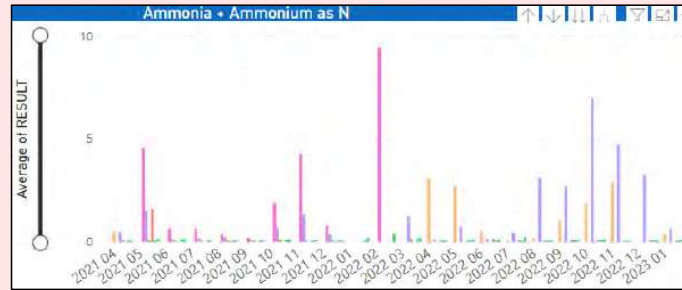
Red Hill Valley – Average E. coli, TSS, Dissolved Oxygen & Chloride



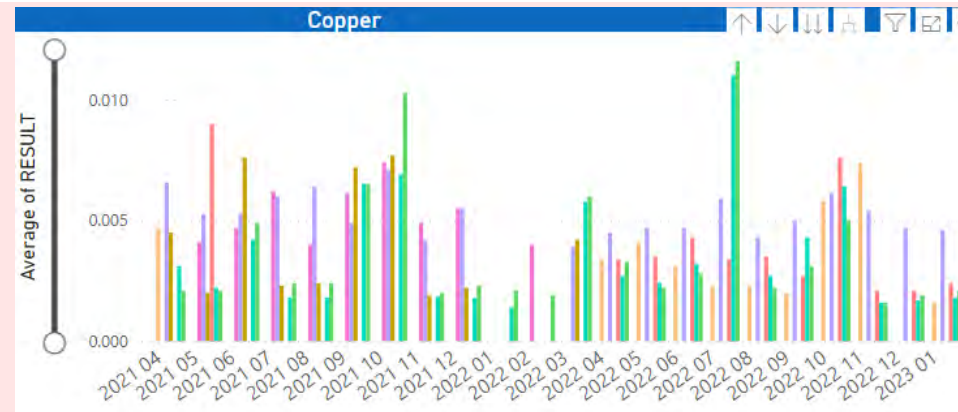
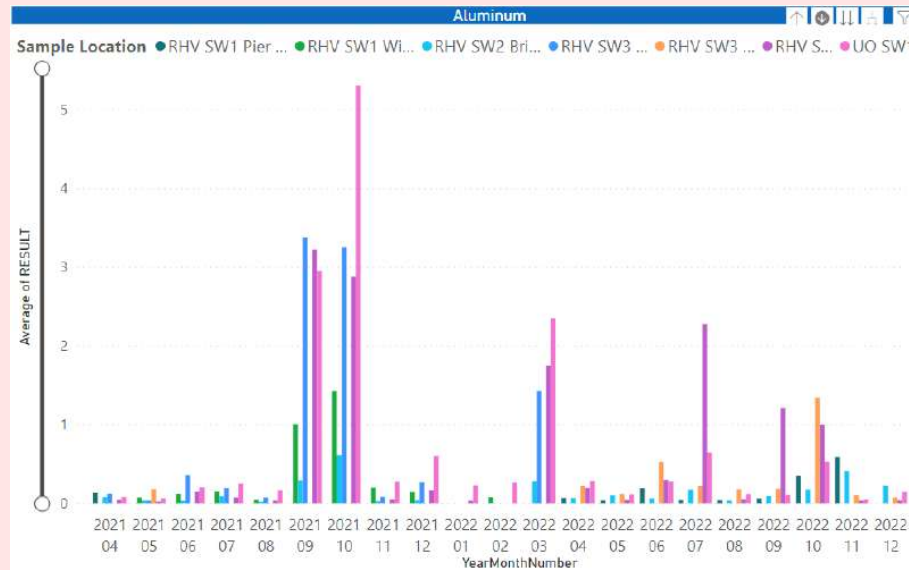
- Sample Location**
- RHV SW1 Pier 24_25 Bridge at Eastport Dr
 - RHV SW1 Windermere Basin Park
 - RHV SW2 Bridge at Eastport Dr_Beach Blvd
 - RHV SW3 Rennie Brampton
 - RHV SW3 Rennie Brampton
 - RHV SW4 RHV Trail Bridge
 - UO SW1 Albion Falls



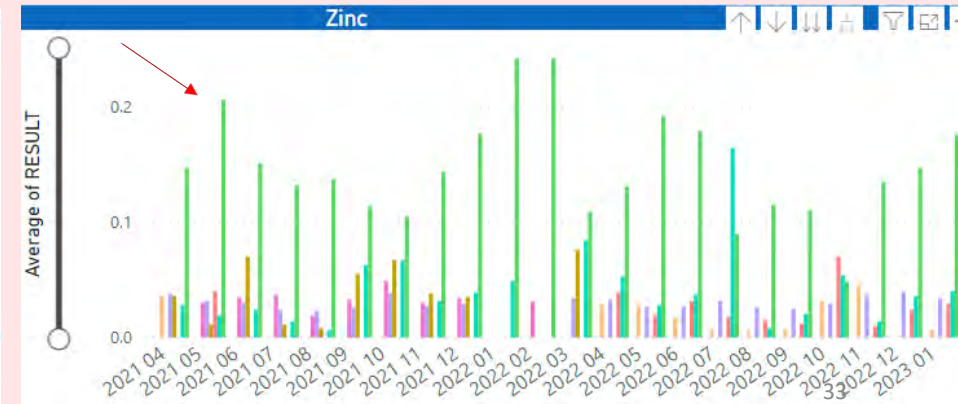
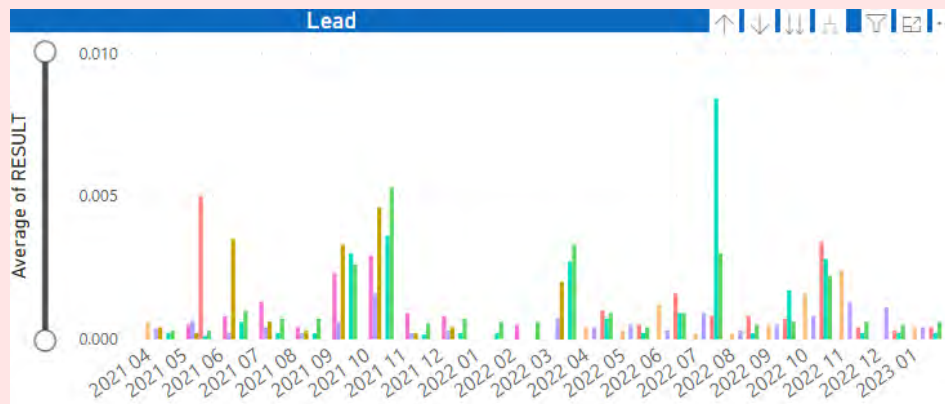
Red Hill Valley – Average Nutrient Results



Red Hill Valley – Average Metals Results



- Sample Location**
- RHV SW1 Pier 24_25 Bridge at Eastport Dr
 - RHV SW1 Windermere Basin Park
 - RHV SW2 Bridge at Eastport Dr_Beach Blvd
 - RHV SW3 Rennie Brampton
 - RHV SW3 Rennie Brampton
 - RHV SW4 RHV Trail Bridge
 - UO SW1 Albion Falls



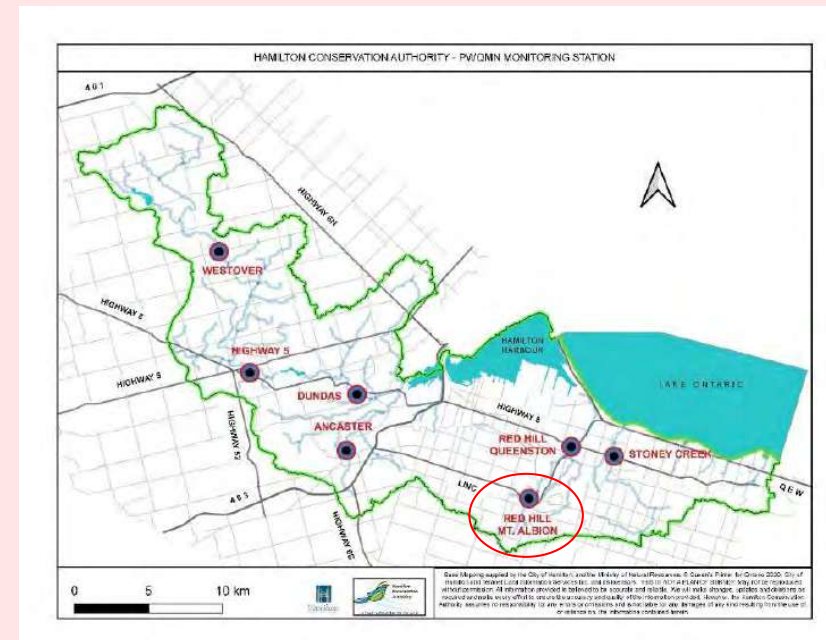
Red Hill Creek – HCA PWQMN (E.Coli Only) Data

HCA Summary of E. Coli Trends in Red Hill Creek

- Red Hill Creek at **Mt. Albion exceeded every sample event.**
- Red Hill Creek at **Queenston Road exceeded on 3/8 samples**, with quite a large variance between exceedance and compliance concentrations.
- Mt. Albion and Queenston sample locations tend to behave in a similar fashion year-to-year.
 - Their annual pattern of highs and lows are very much alike.

HCA's analysis **suggests** that a **steady source for E. coli** within this creek is located near the **Mt. Albion** location.

- **Downstream** at Queenston, concentrations suggest there is **dilution/buffering** effect occurring.
 - Analysis **suggests** the location is **susceptible to instances of concerning high E. coli** concentrations.

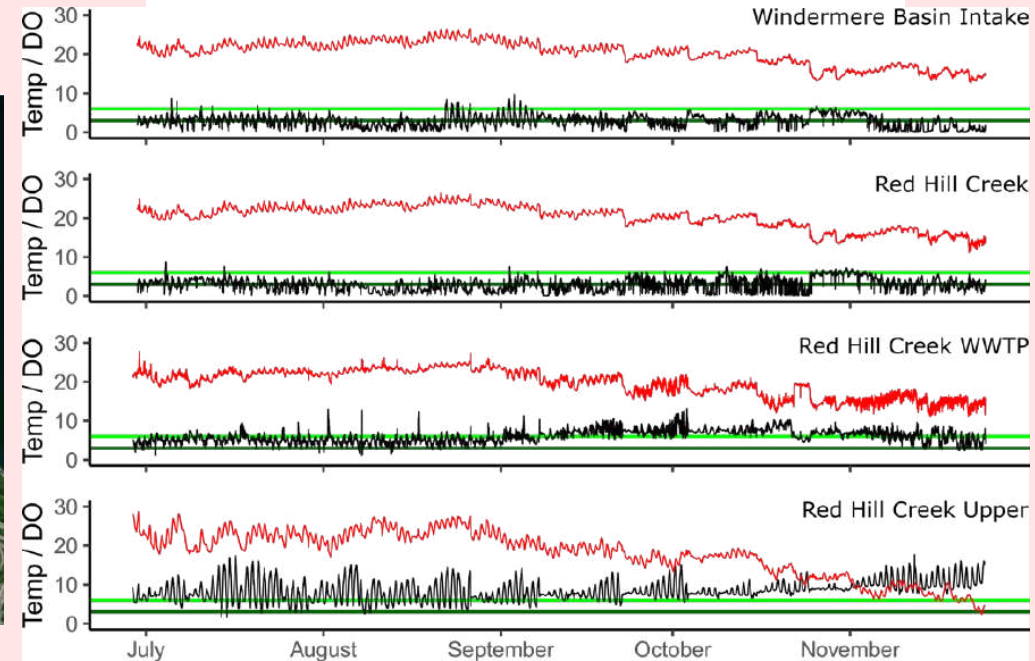


Lower Red Hill Valley – DFO Dissolved Oxygen & Temperature (DOT) Analysis Summary:

Analysis Suggests:
 HWWTP discharge disrupts the natural dissolved oxygen signal in Red Hill Creek



Variation in temperature and dissolved oxygen in 2020

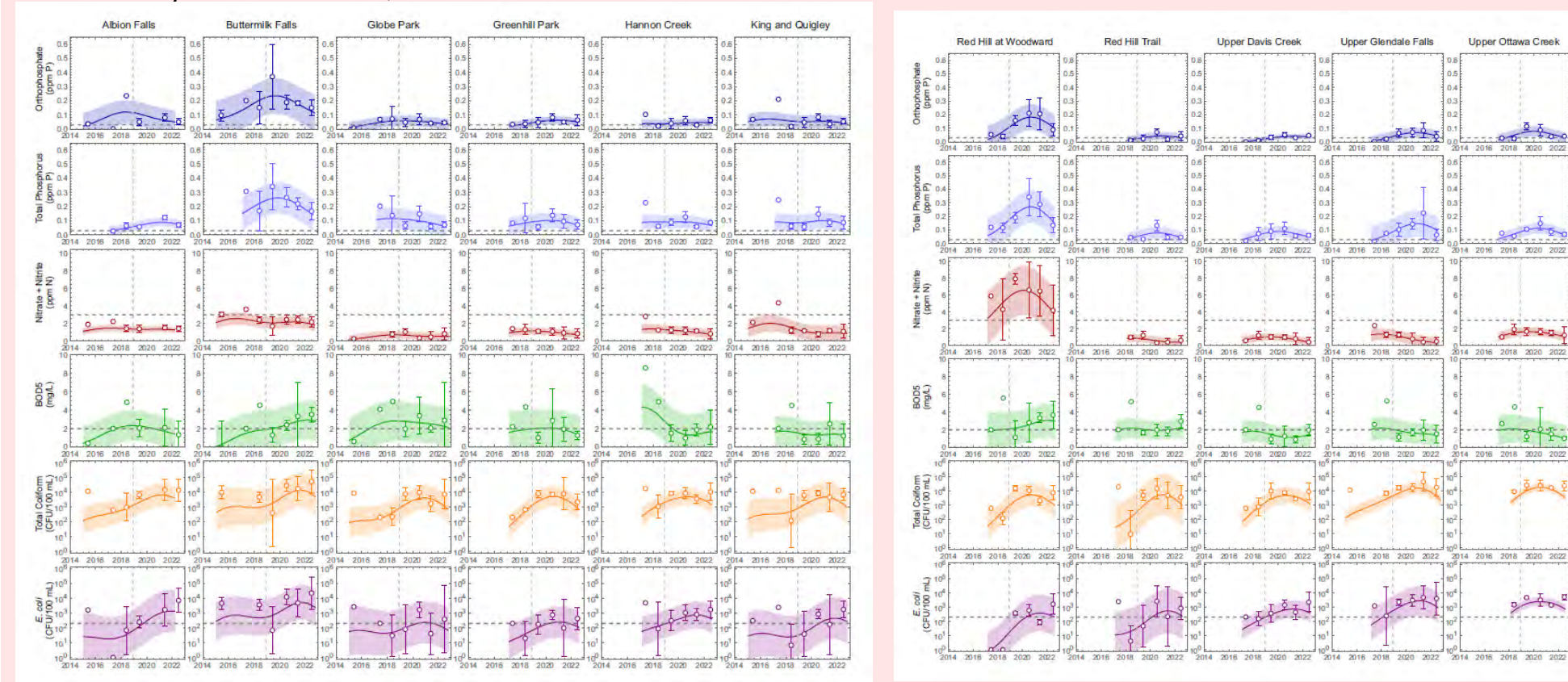


To understand how Red Hill Creek is influenced by human activity, **4 loggers were placed** moving from the less impacted upstream site (Red Hill Creek Upstream) to more impacted (most downstream site being Windermere Basin Intake).

As **water flows downstream** (move from bottom to top in the graphs) you can see that the **natural cycle in dissolved oxygen disappears**. In addition, the amount of time that the dissolved oxygen falls below the two DO thresholds depicted increases, reducing the quality of nearby fish habitat.

These **changes in DO are likely the result of WWTP effluent disrupting the natural dynamics** (changes in temperature and DO, as well as changes to water chemistry that affect stream biota, i.e. phytoplankton and bacterial communities that contribute to DO). As this creek water is being directly pumped into Windermere Basin, Red Hill Creek water quality will have a direct effect on the water quality within the basin.

Red Hill Valley – Redeemer WQ Data



Highlight:

- 1) Buttermilk Falls – Memo sent to CoH July 12, 2022. Upstream of Buttermilk Falls, an overflow pipe appears to be an **important source of bacterial and nutrient contamination**. Redeemer has sampled this location three times in June/July 2022; it is consistently the most contaminated within the RHC Watershed. It is possible that, as in the Chedoke Creek Watershed, upstream cross connections are a source of these contaminants
- 2) Upper Glendale – Although not on this chart, high concentrations of **Chloride** measured at this location.

Red Hill Valley Summary of Findings

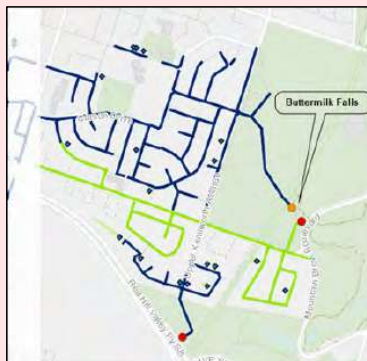
Areas of Interest (AOI)

- HCA's Mt. Albion (UO SW1)
- City SWQP RHV SW1 (WUPS WQ5)
- City SWQP RHC SW2 (WUPS WQ 4)

Redeemer:

Upstream of Buttermilk Falls, an overflow pipe appears to be an important source of bacterial and nutrient contamination.

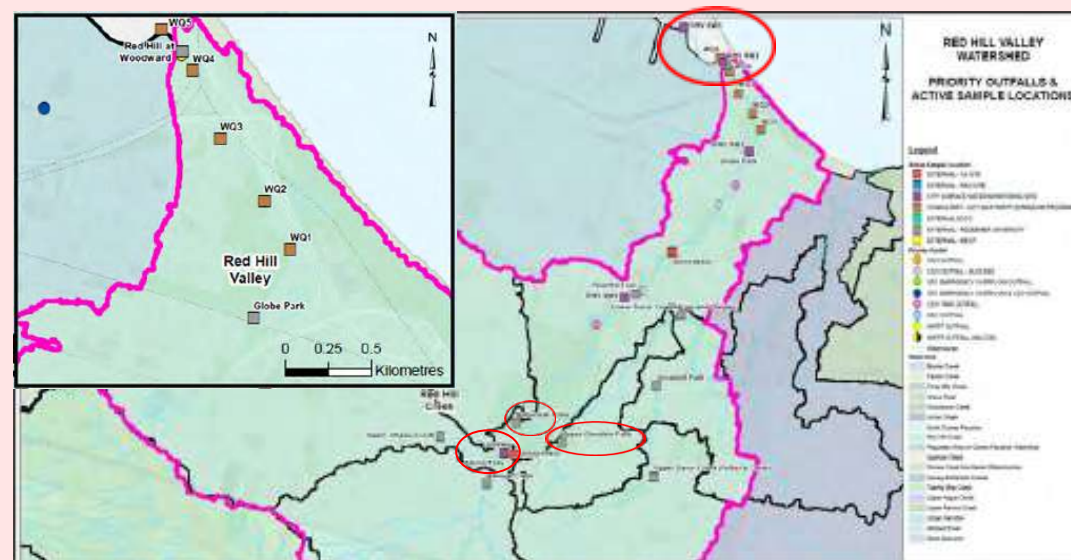
Upper Glendale – Although not on this chart, high concentrations of Chloride measured at this location.

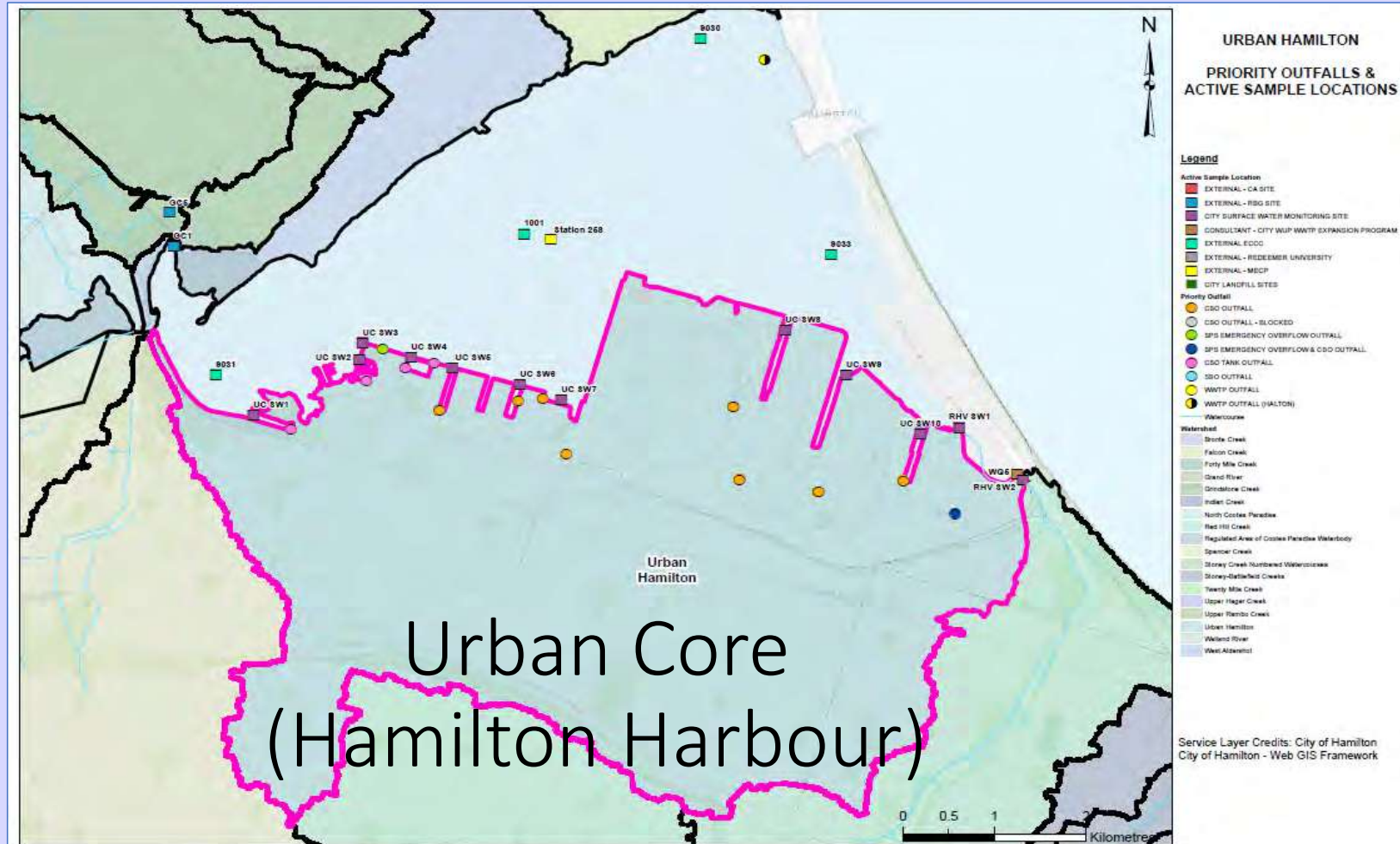


DFO Dissolved Oxygen & Temperature Summary:

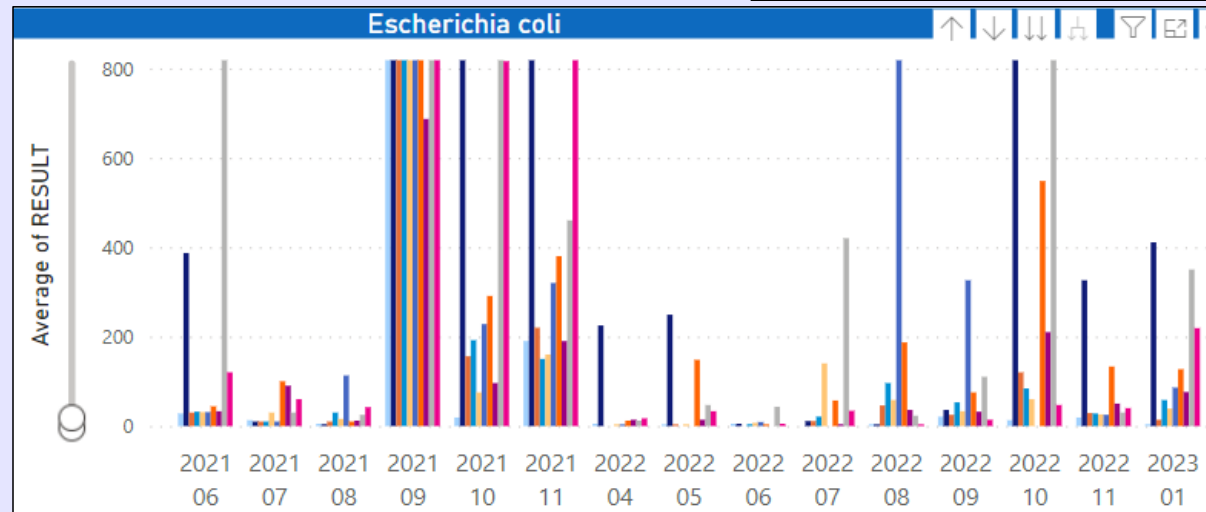
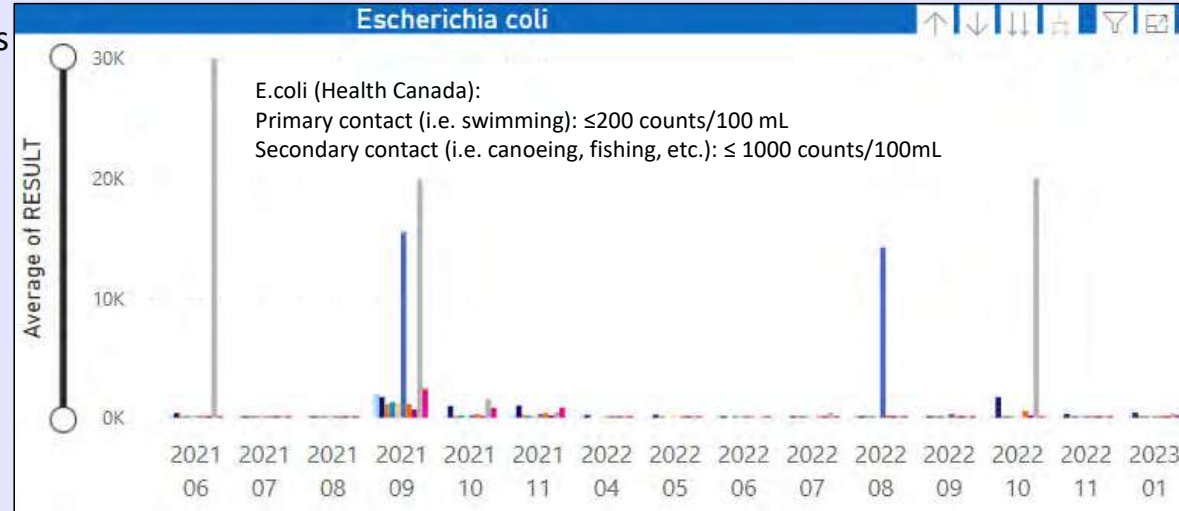
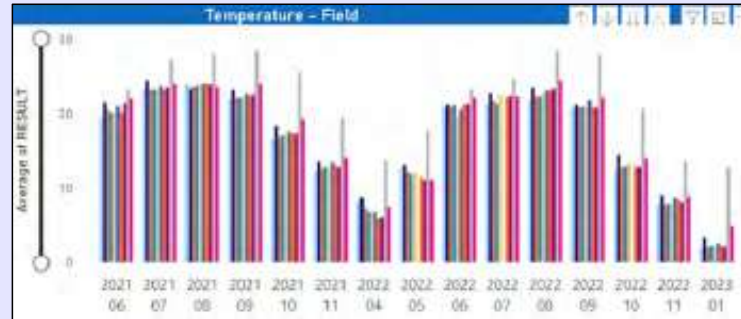
As water flows downstream from Red Hill Creek Upper (City SWQP RVH SW3), you can see that the natural cycle in dissolved oxygen disappears downstream of the HWWTP.

Changes in DO are likely the result of WWTP effluent disrupting the natural dynamics (changes in temperature and DO, as well as changes to water chemistry that affect stream biota, i.e. phytoplankton and bacterial communities that contribute to DO).



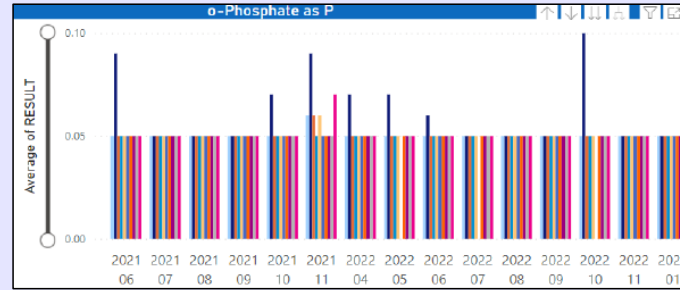
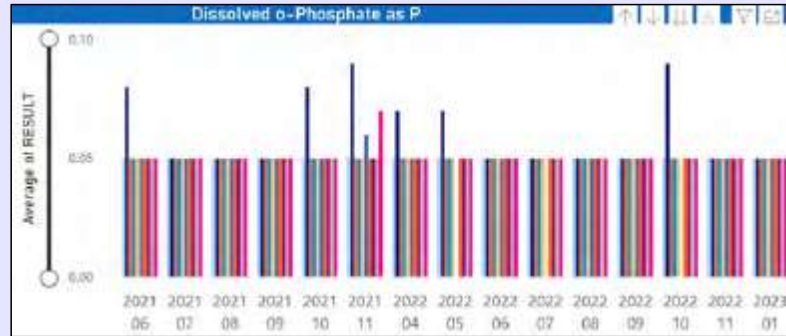


Urban Core – Average Monthly E. coli Results

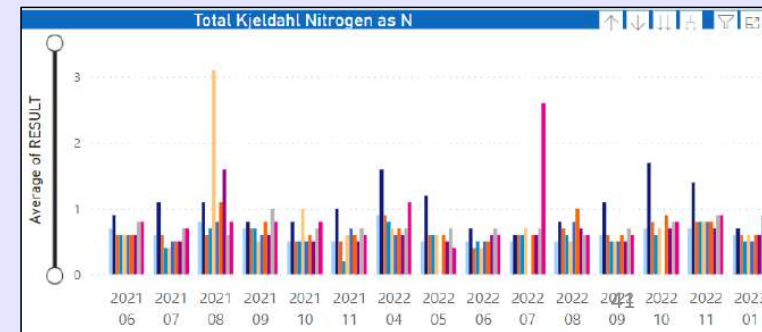
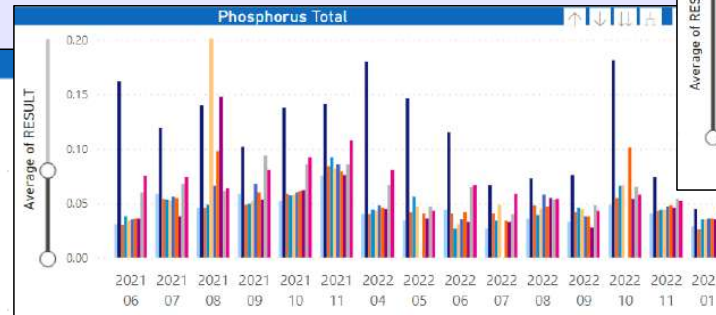
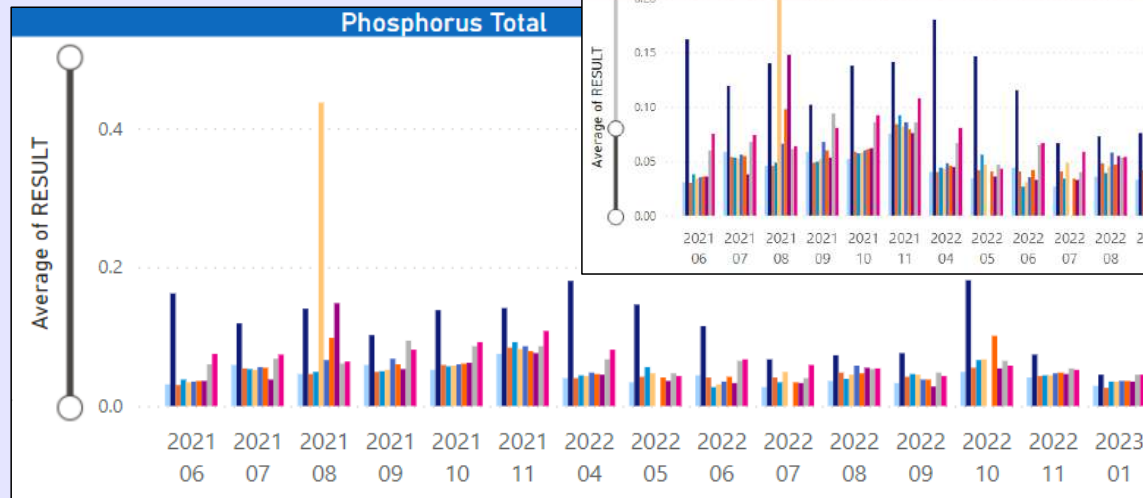


- Sample Location**
- UC SW1 BAYFRONT PARK
 - UC SW10 STRATHEARNE AVE
 - UC SW2 WILLIAMS SOUTH
 - UC SW3 WILLIAMS NORTH
 - UC SW4 EASPORT CATHARINE
 - UC SW5 WELLINGTON ST N
 - UC SW6 WENTWORTH ST N
 - UC SW7 HILLYARD BIRCH SHERMAN
 - UC SW8 GAGE OTTAWA STIPES INLET
 - UC SW9 KENILWORTH AVE N

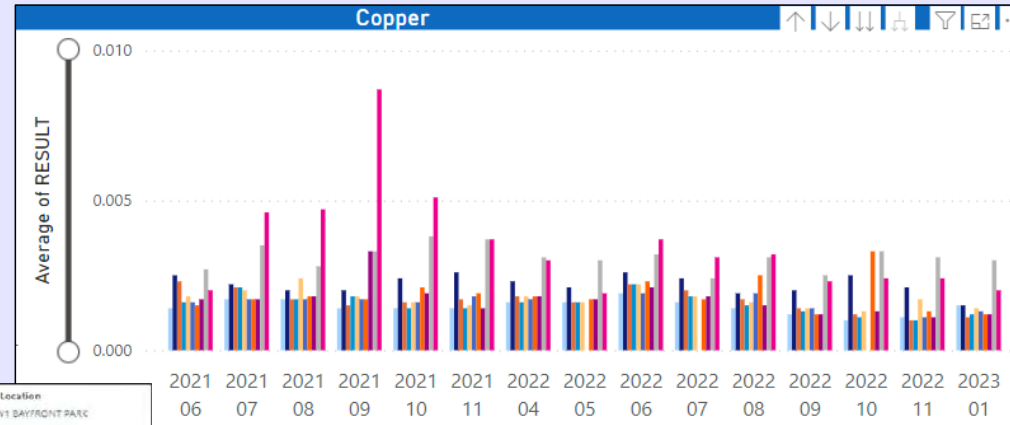
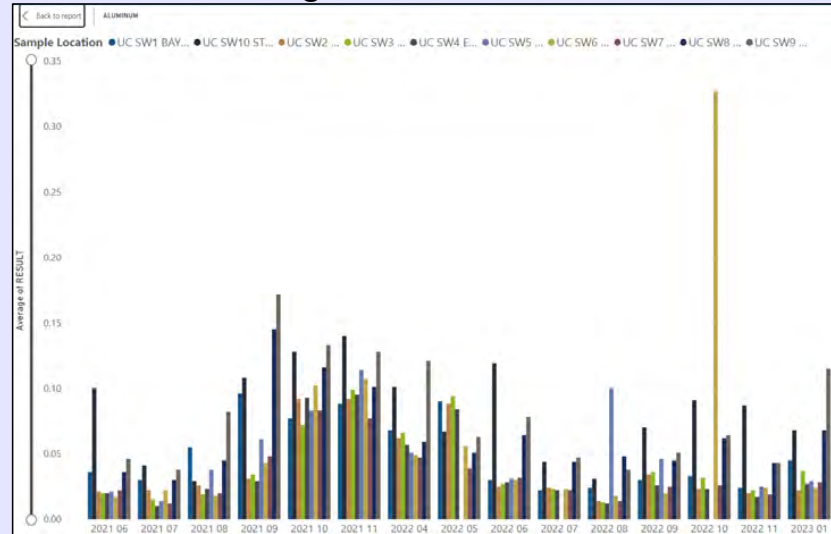
Urban Core – Average Nutrient Results



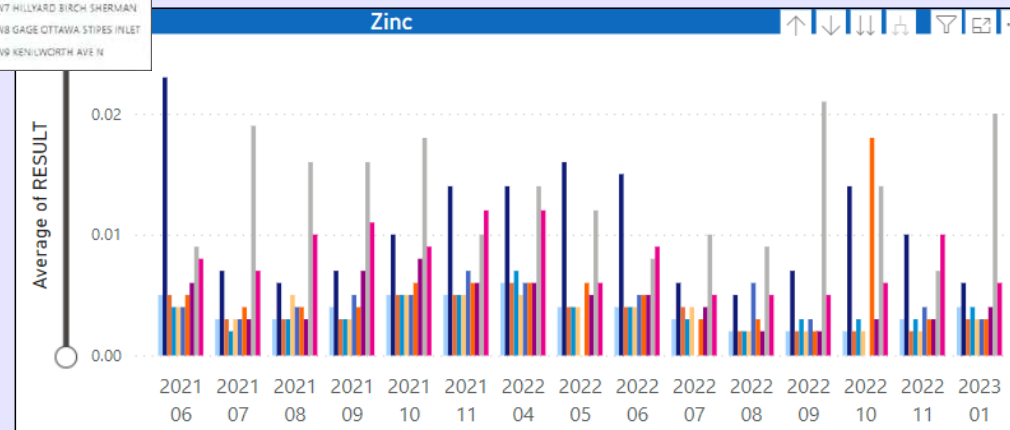
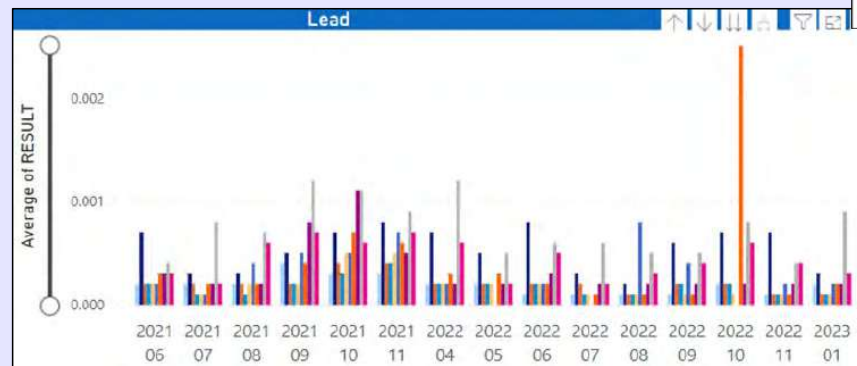
- Sample Location
- UC SW 33 STREET/STARS AVE
 - UC SW 2 WILLIAMS SOUTH
 - UC SW 3 WILLIAMS NORTH
 - UC SW EXPORT CATHARINE
 - UC SW 33 WILLINGTON ST N
 - UC SW 33 WILLIAMS ST N
 - UC SW 33 WILKIE BUSH OVERPASS
 - UC SW 33 WOODSTOCK ST/STEELE BLVD
 - UC SW 33 WOODSTOCK AVE N



Urban Core – Average Metals Results



- Sample Location
- UC SW1 BAYFRONT PARK
 - UC SW10 STRATHHEARNE AVE
 - UC SW2 WILLIAMS SOUTH
 - UC SW3 WILLIAMS NORTH
 - UC SW4 AIRPORT CATHARINE
 - UC SW6 WELLINGTON ST N
 - UC SW8 WENTWORTH ST N
 - UC SW7 HILLYARD BIRCH SHERMAN
 - UC SW8 GAGE OTTAWA STIPES INLET
 - UC SW9 KENILWORTH AVE N



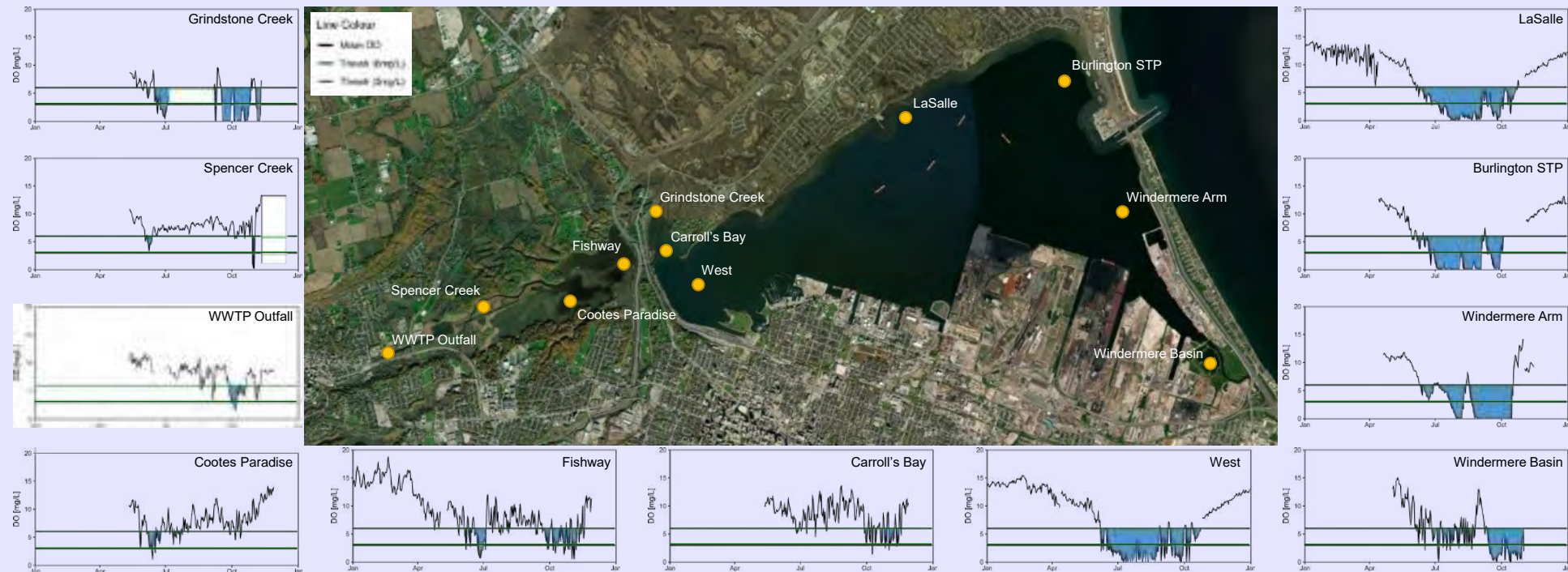
DFO DOT Data Summary

Hamilton Harbour area **faces significant periods of hypoxia, and even anoxia**. Our temporal work (not plotted) indicates that **these periods are increasing during the summer**.

DO concentrations are becoming much **more variable during the winter**, and **hypoxia is occurring earlier in the summer** than historical records would suggest.

Hamilton Harbour experiences long periods of anoxia during the summer and increased variability in dissolved oxygen concentrations during winter.

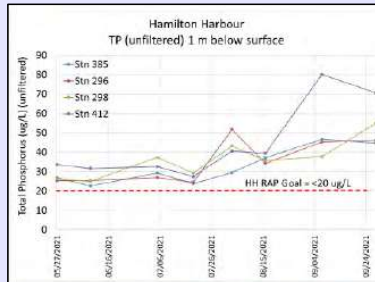
Average daily bottom dissolved oxygen concentrations and exceedances in 2017



Urban Core- MECP/ECCC HHRAP Data

Summary

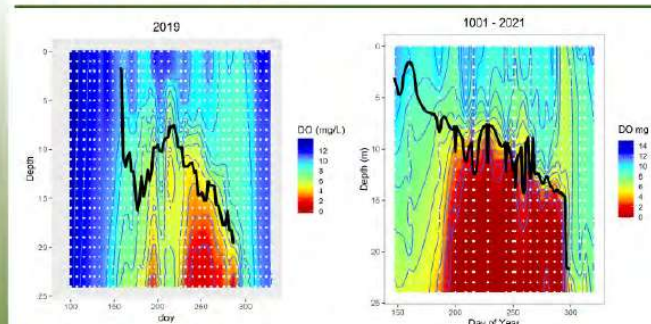
- TP, chlorophyll a and secchi depth did not meet HH RAP targets in 2021, similar to previous years data
- Un-ionized ammonia met HH RAP goal in 2021
- Severe and sustained DO depletion in 2021
- Sediments continue to leak P



Total P – 1 m 2021 Spatial Variability

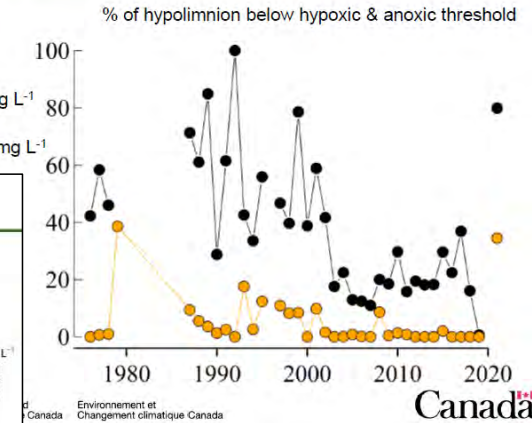
- Increasing trend through 2021 monitoring season at some stations
- Similar trends among stations, except for higher TP at Station 412 in September
- All 4 stations demonstrated similar non-attainment with HH RAP goal of <20 ug/L

Dissolved Oxygen

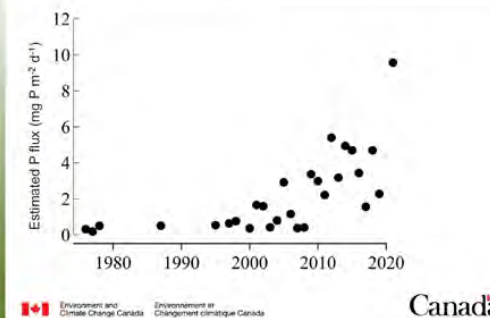


- DO conditions in 2021 considerably worse than 2000-2019 period
- Sustained hypoxia for ~ 115 d

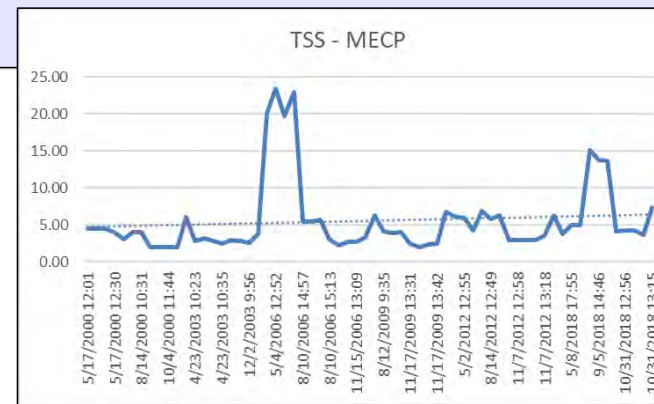
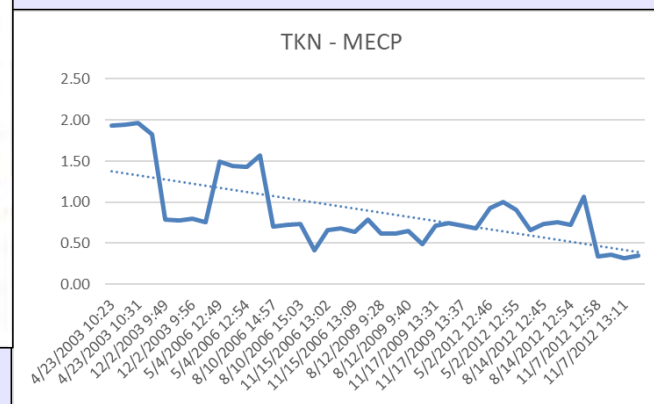
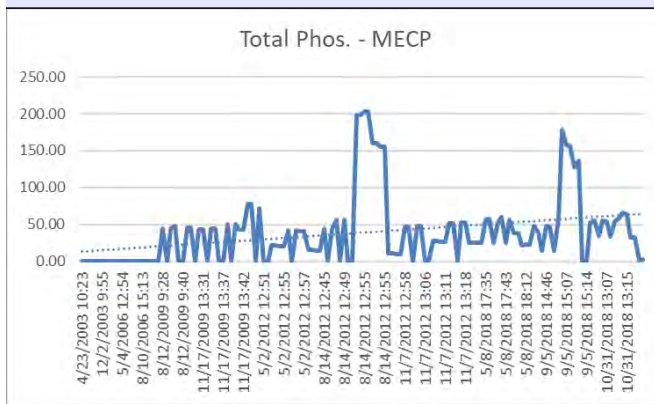
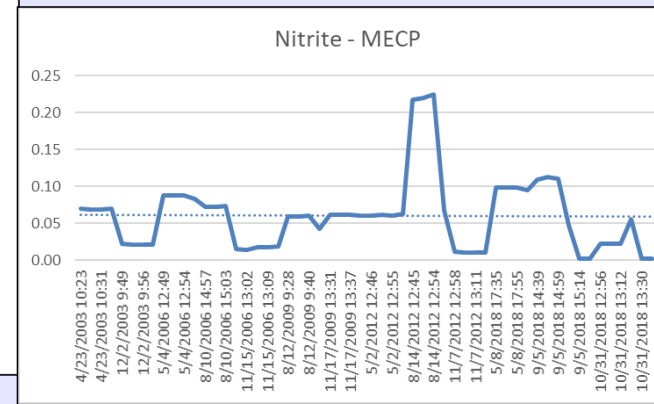
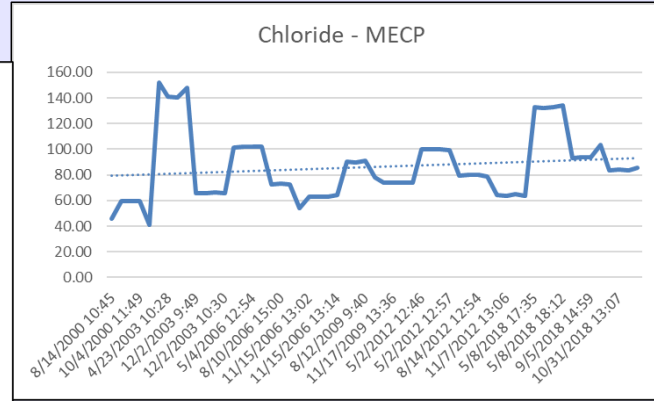
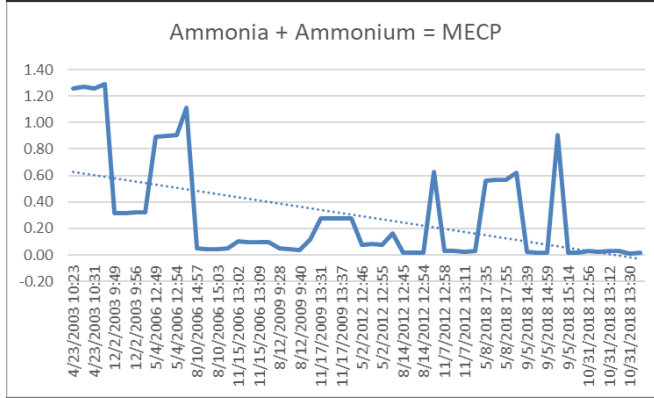
Dissolved Oxygen



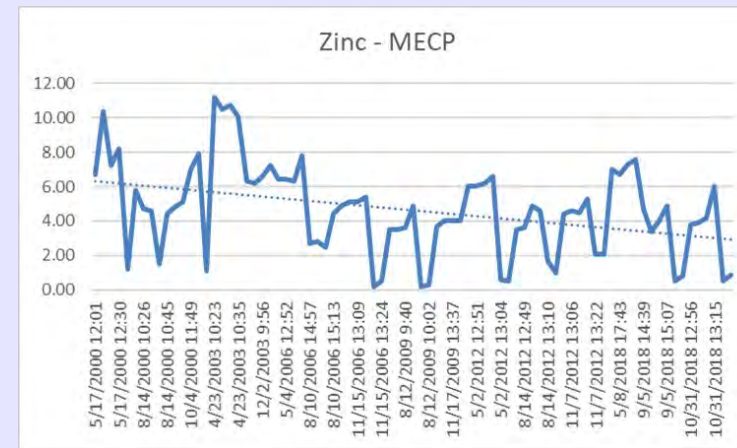
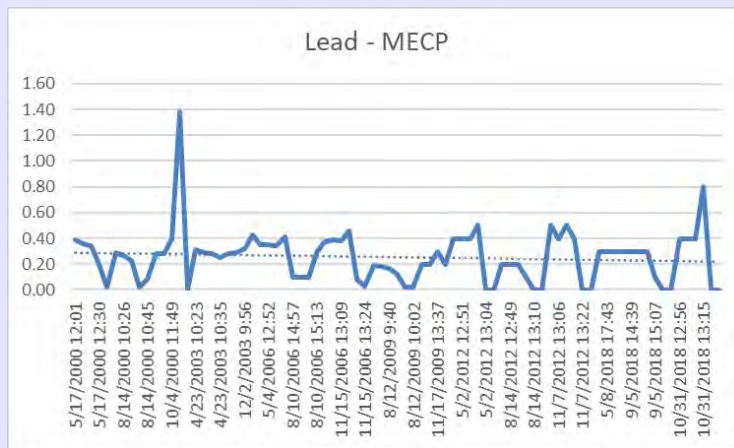
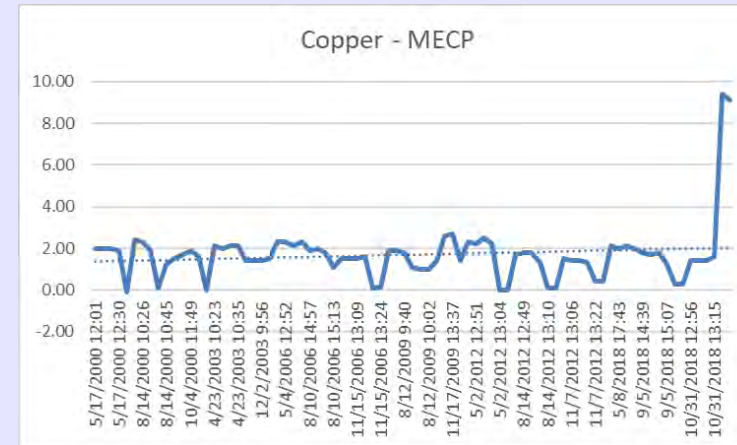
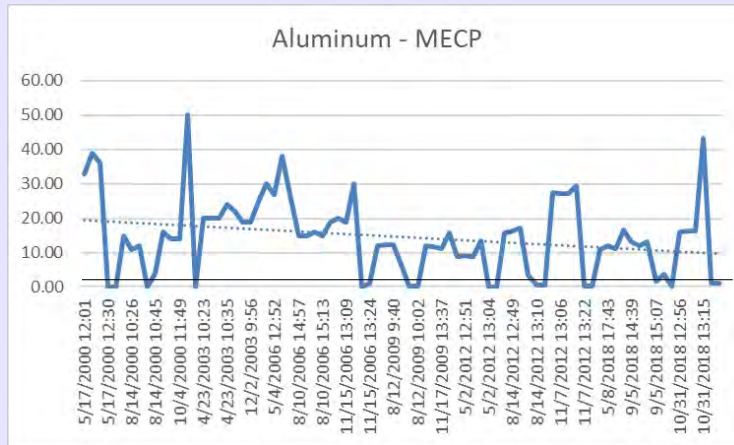
Sediment P release

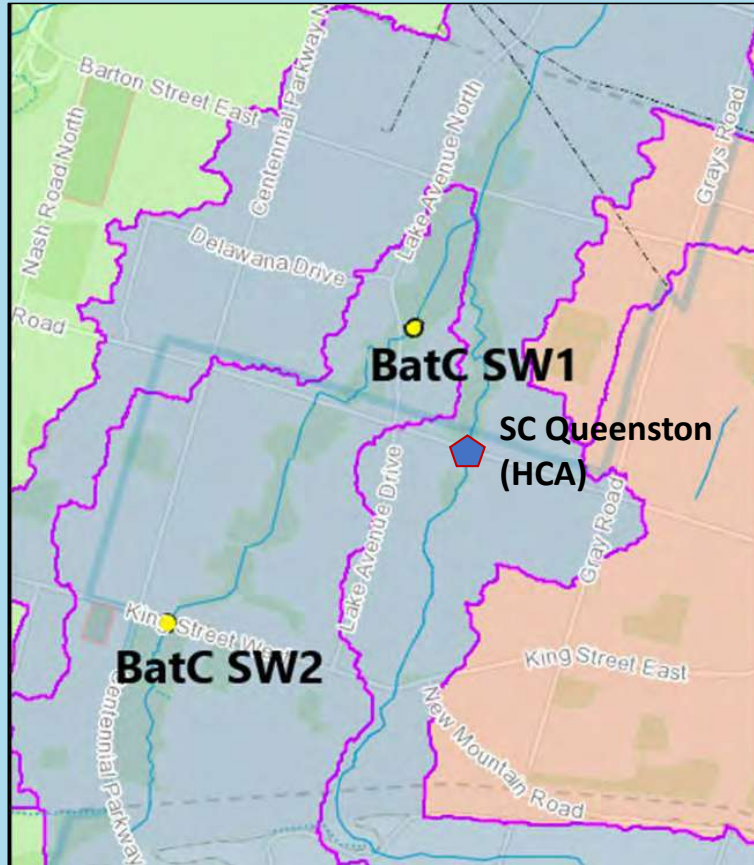


MECP (Centre Station) Results:



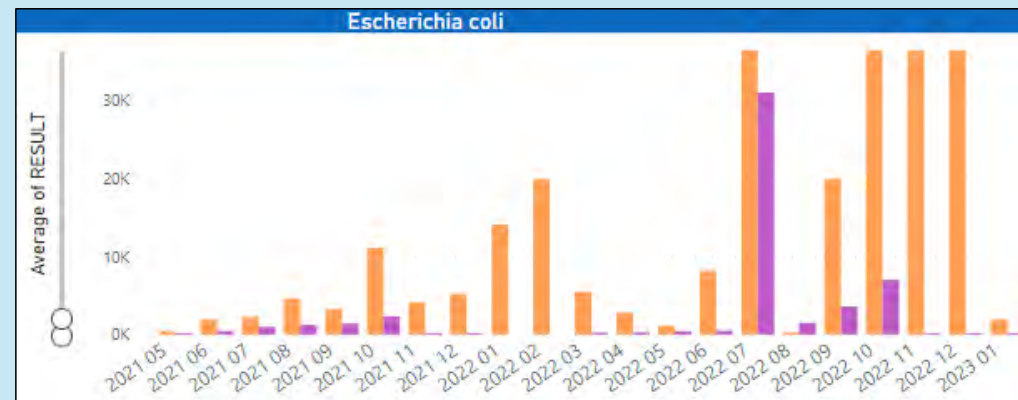
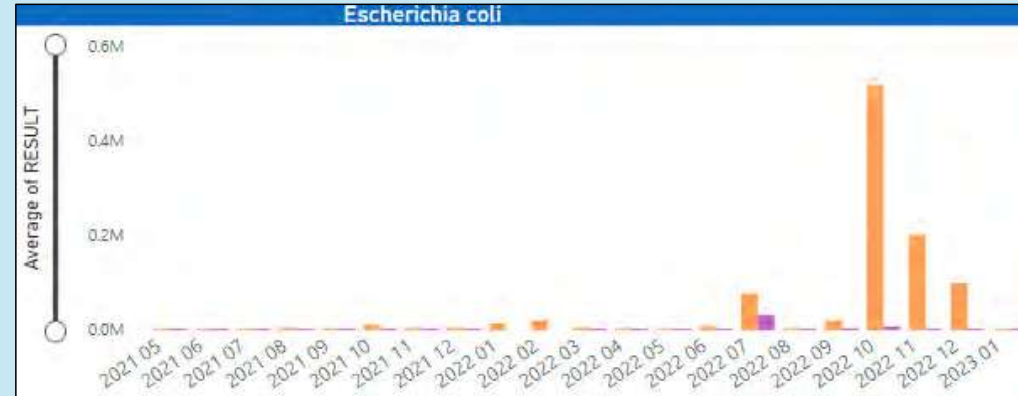
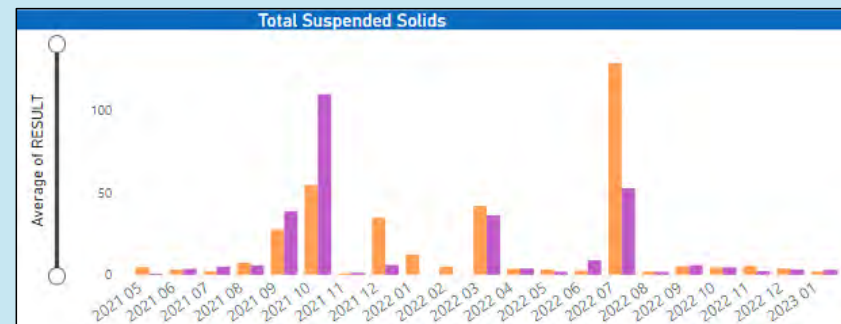
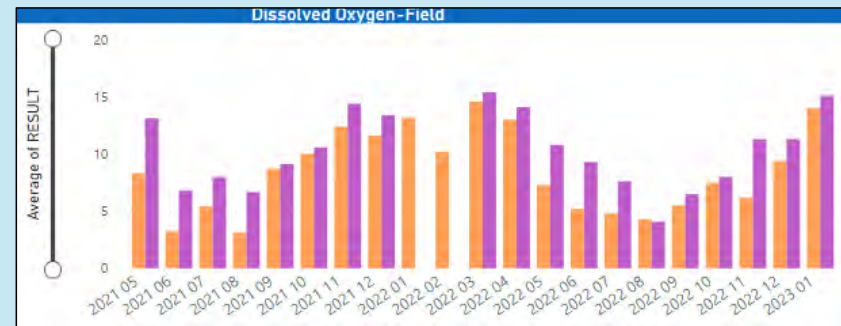
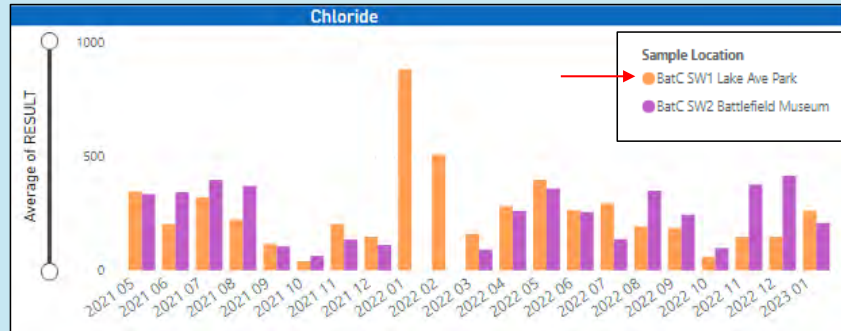
MECP (Centre Station) Results – Cont'd:



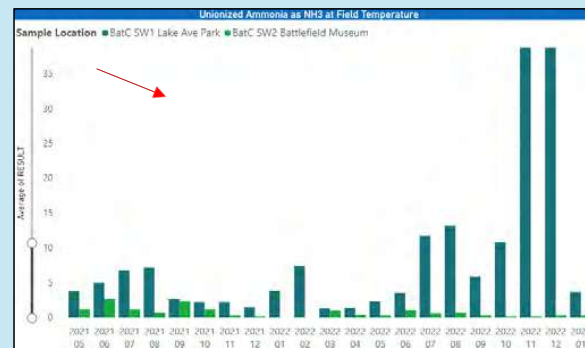
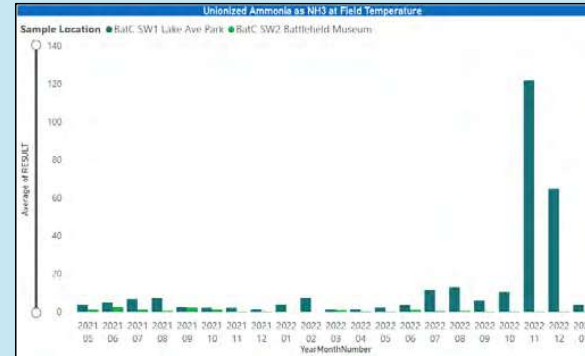
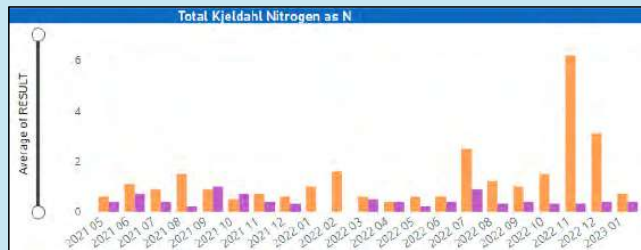
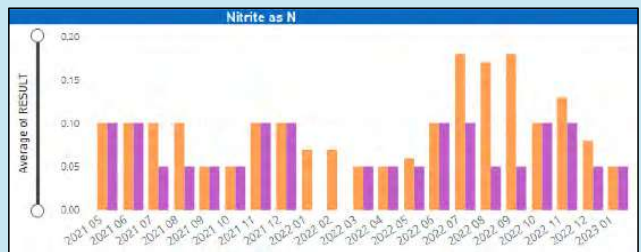
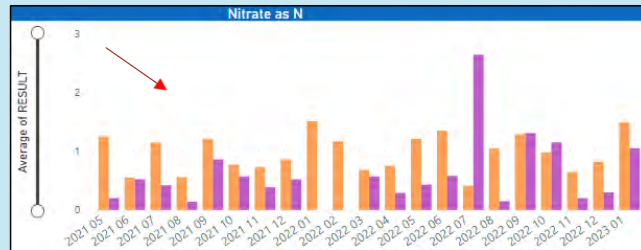
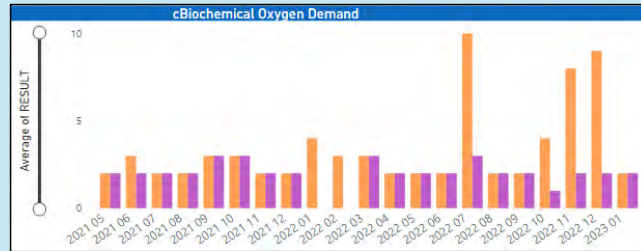


Stoney - Battlefield Creeks

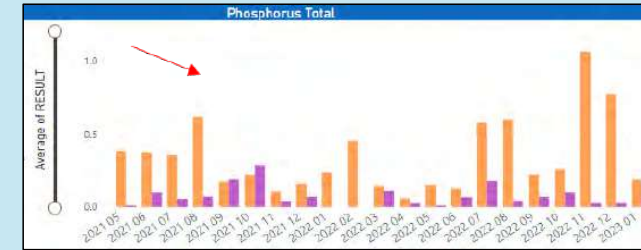
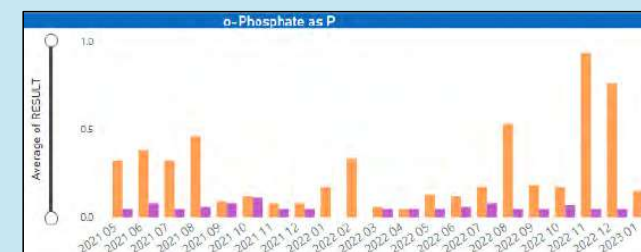
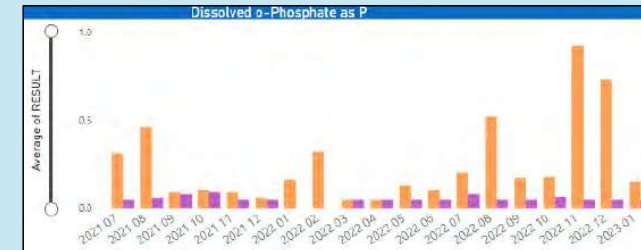
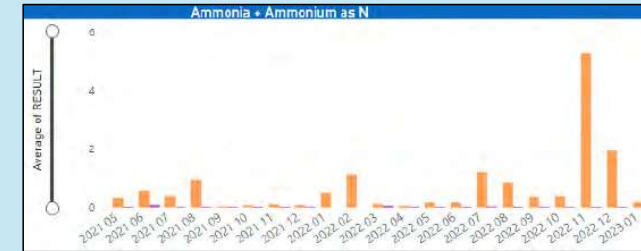
Stoney - Battlefield Creeks – Average Monthly Results



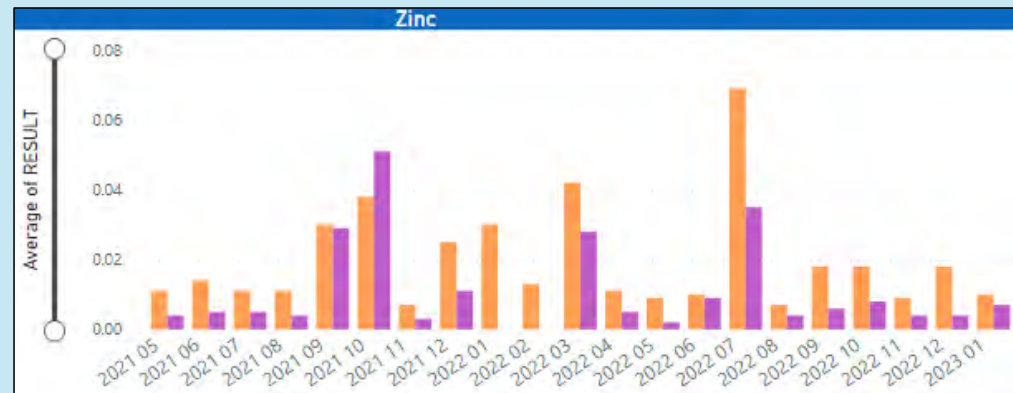
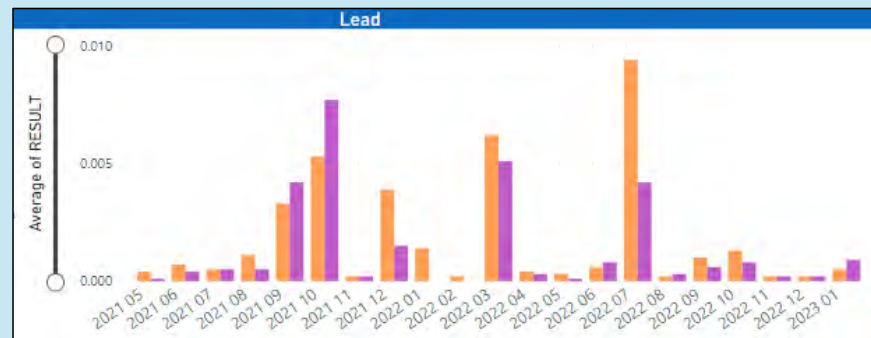
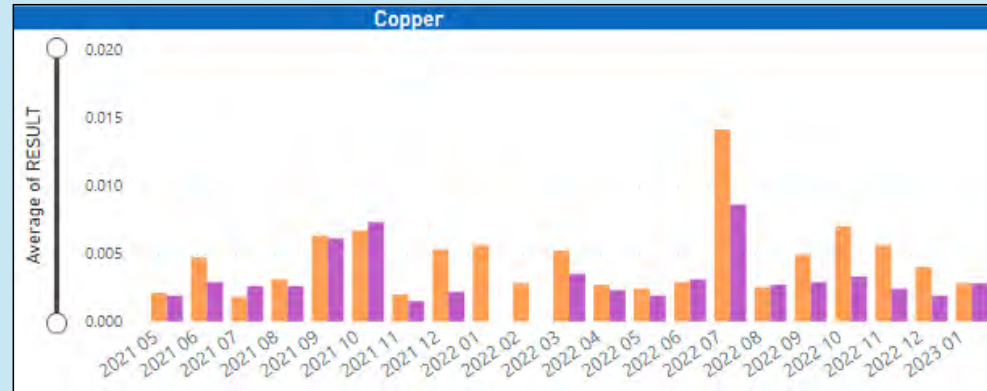
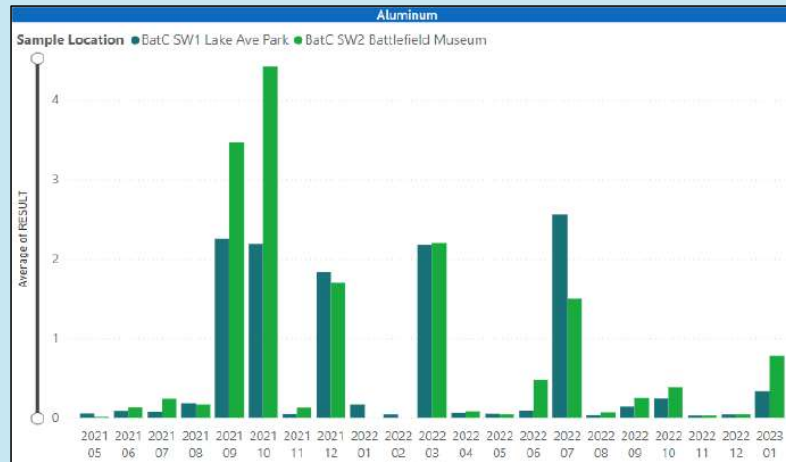
Stoney - Battlefield Creek – Average Monthly Nutrient Results



Sample Location
● BatC SW1 Lake Ave Park
● BatC SW2 Battlefield Museum



Stoney - Battlefield Creek Average Monthly Metals Results:



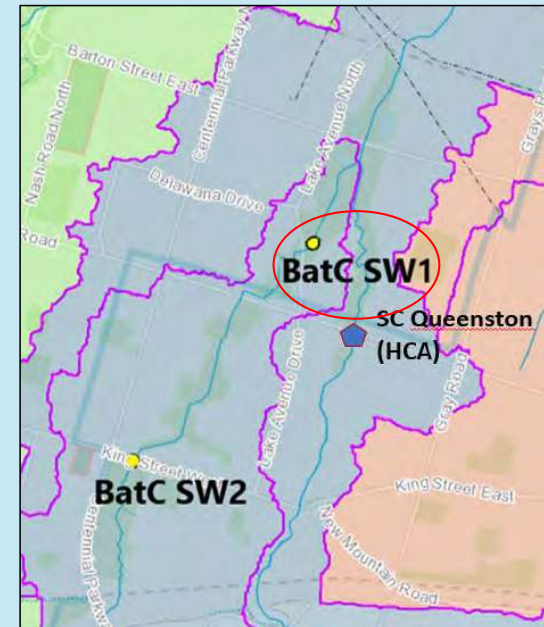
Stoney - Battlefield Creek Summary of Findings:

Areas of Interest (AOI)

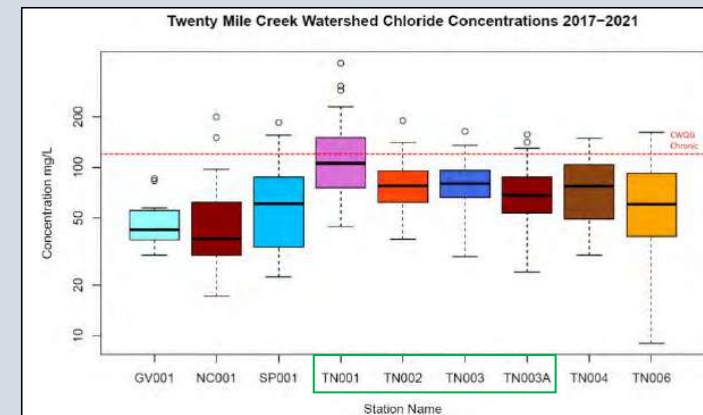
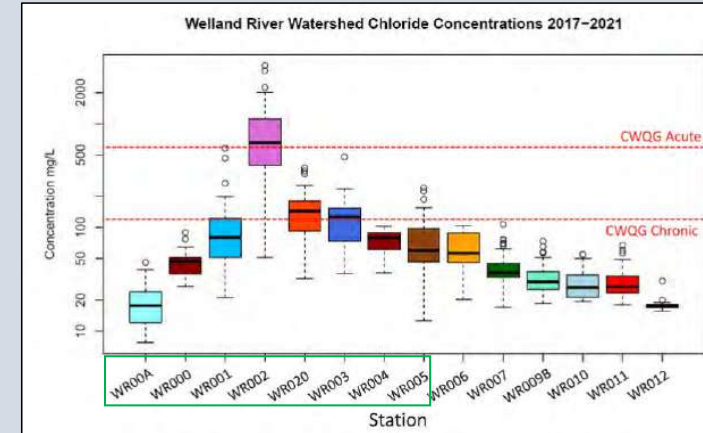
For select parameters, there is an observed trend of WQ degradation and/or changes in WQ Chemistry between the up- (BatC SW2) and down- (BatC SW1) stream location.

- AquaSignum will be putting sensors into these two (2) locations to study for GLPI Funding
- City SWQP BatC SW1 (Lake Ave. Park)
- City SWQP BatC SW2 (Battlefield Museum)
- SC Queeston

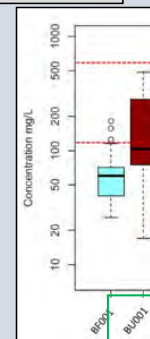
*Upstream to BatC SW1 at SD07OF01 = Observed a plunge pool with a steady flow of water, SAN debris comprised of broken-down tissue, and heavy film on water just downstream. Algae/high nutrient evidence on the stream sediment. Notified CC of the location.



Niagara Peninsula Report:



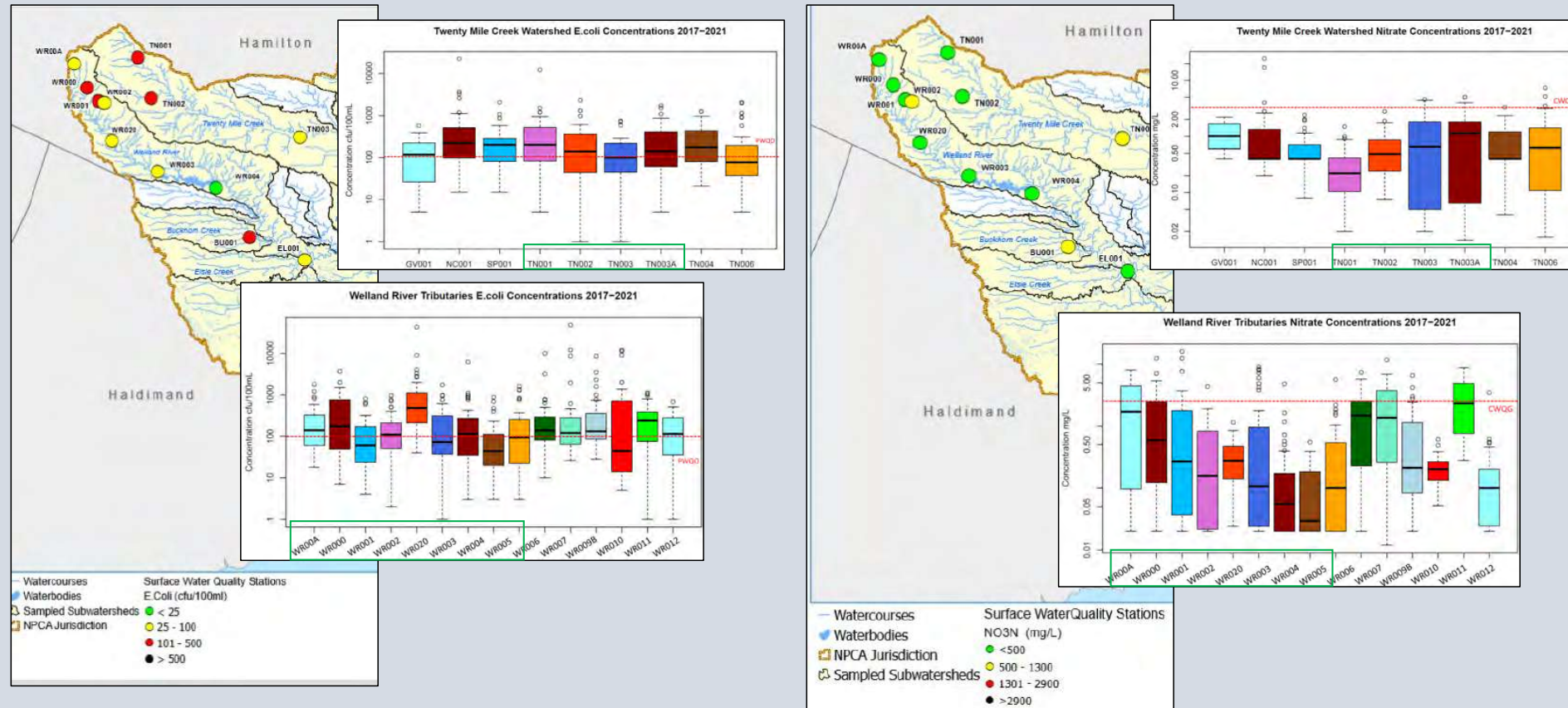
Chloride: Airport.



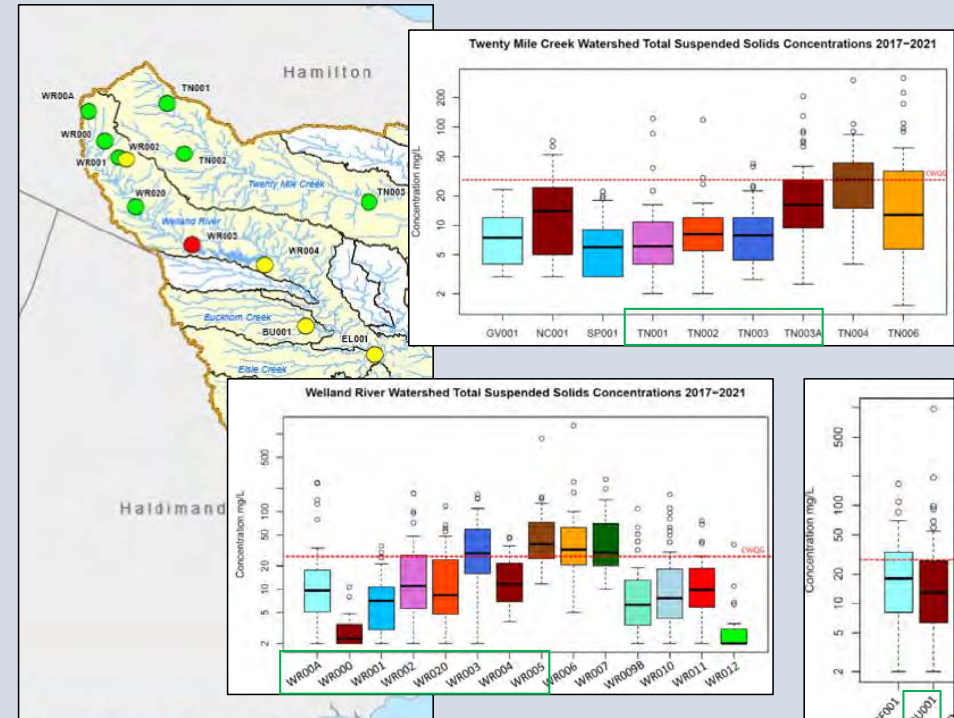
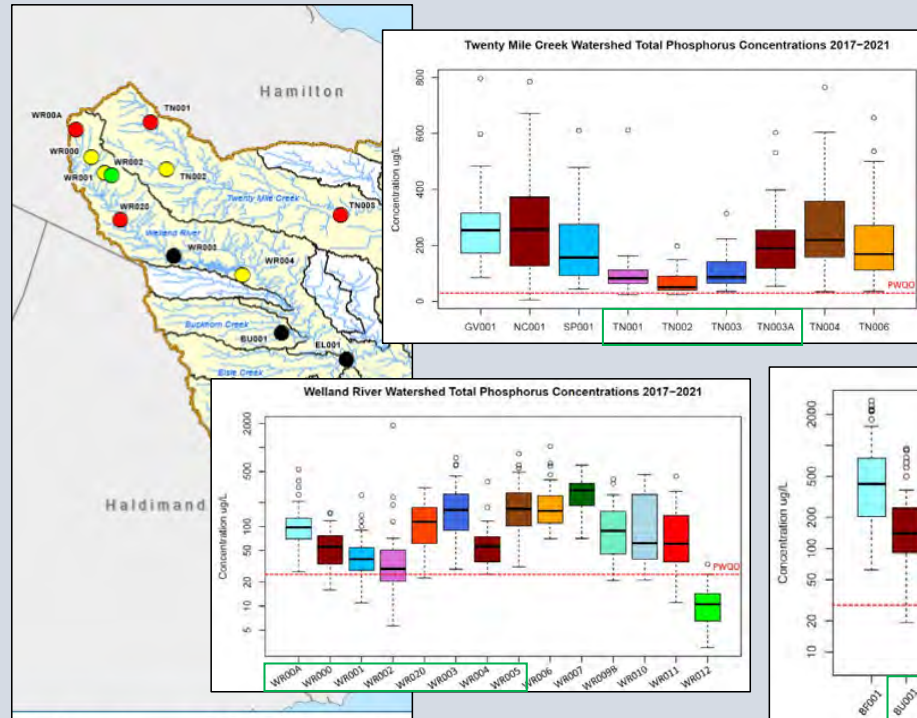
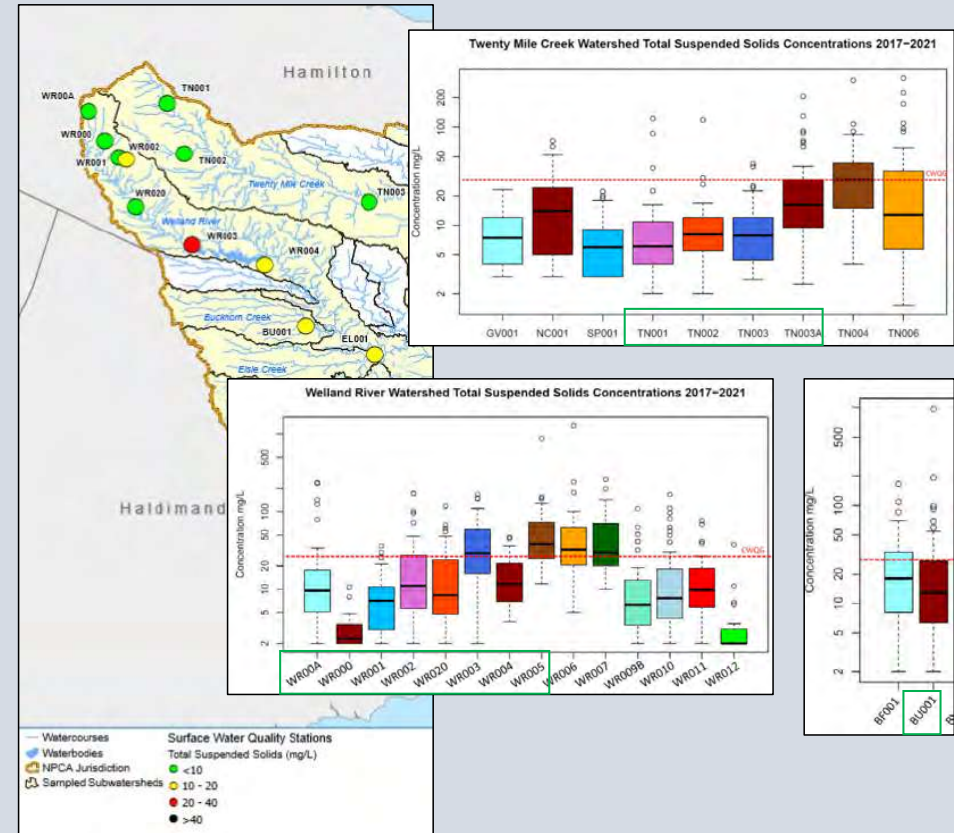
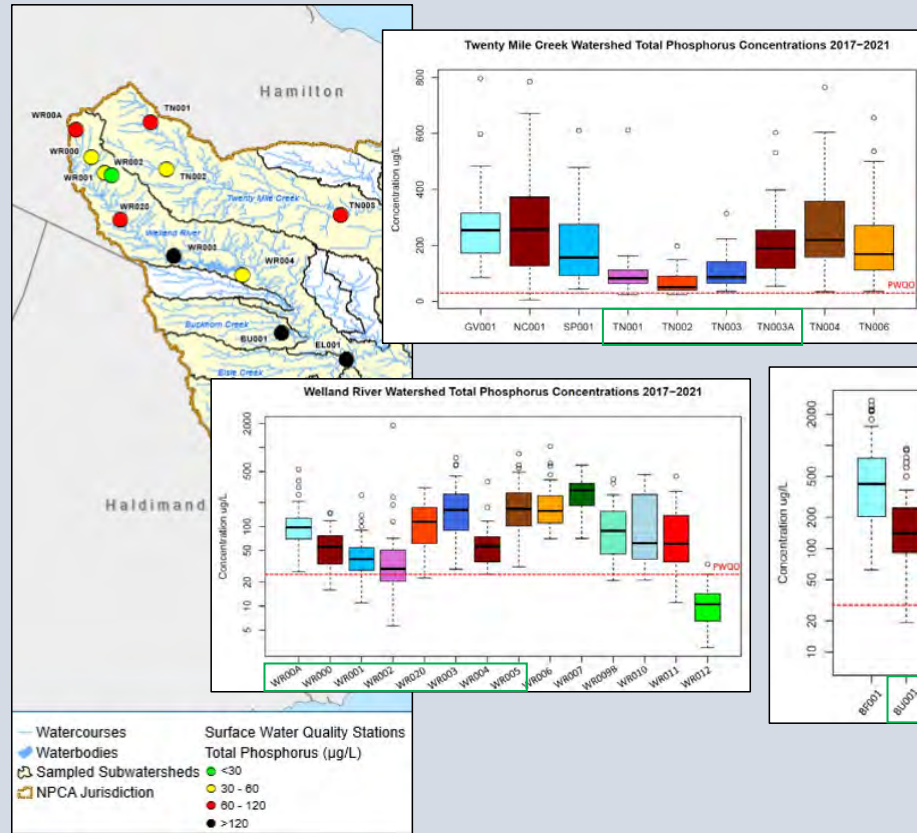
https://npca.ca/images/uploads/common/Water_Quality_Report_2021.pdf

https://npca.ca/images/uploads/common/Water_Quality_Monitoring_Program_Summary_Report_of_the_Year_2021_web.pdf

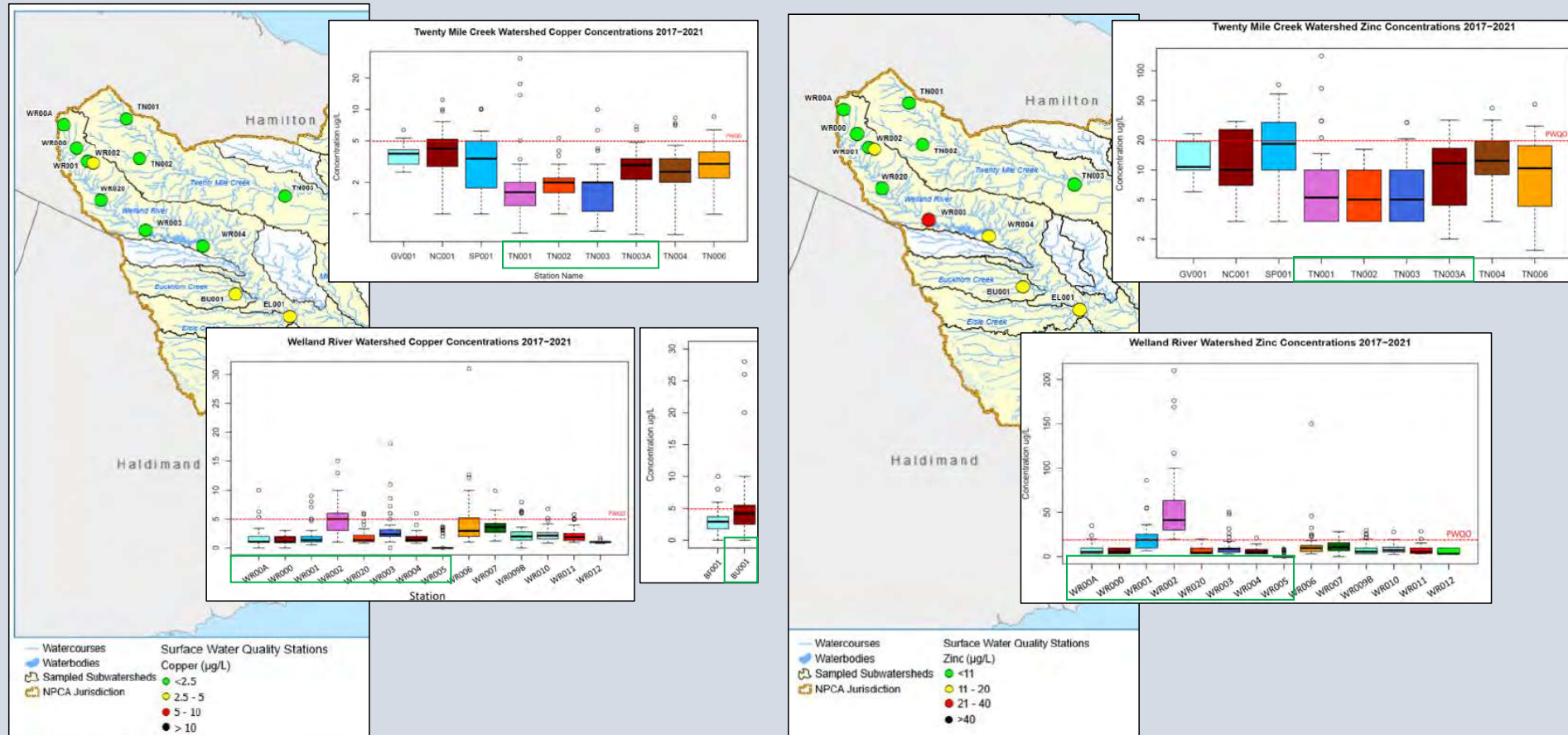
Niagara Peninsula Report:



Niagara Peninsula Report:



Niagara Peninsula Report:



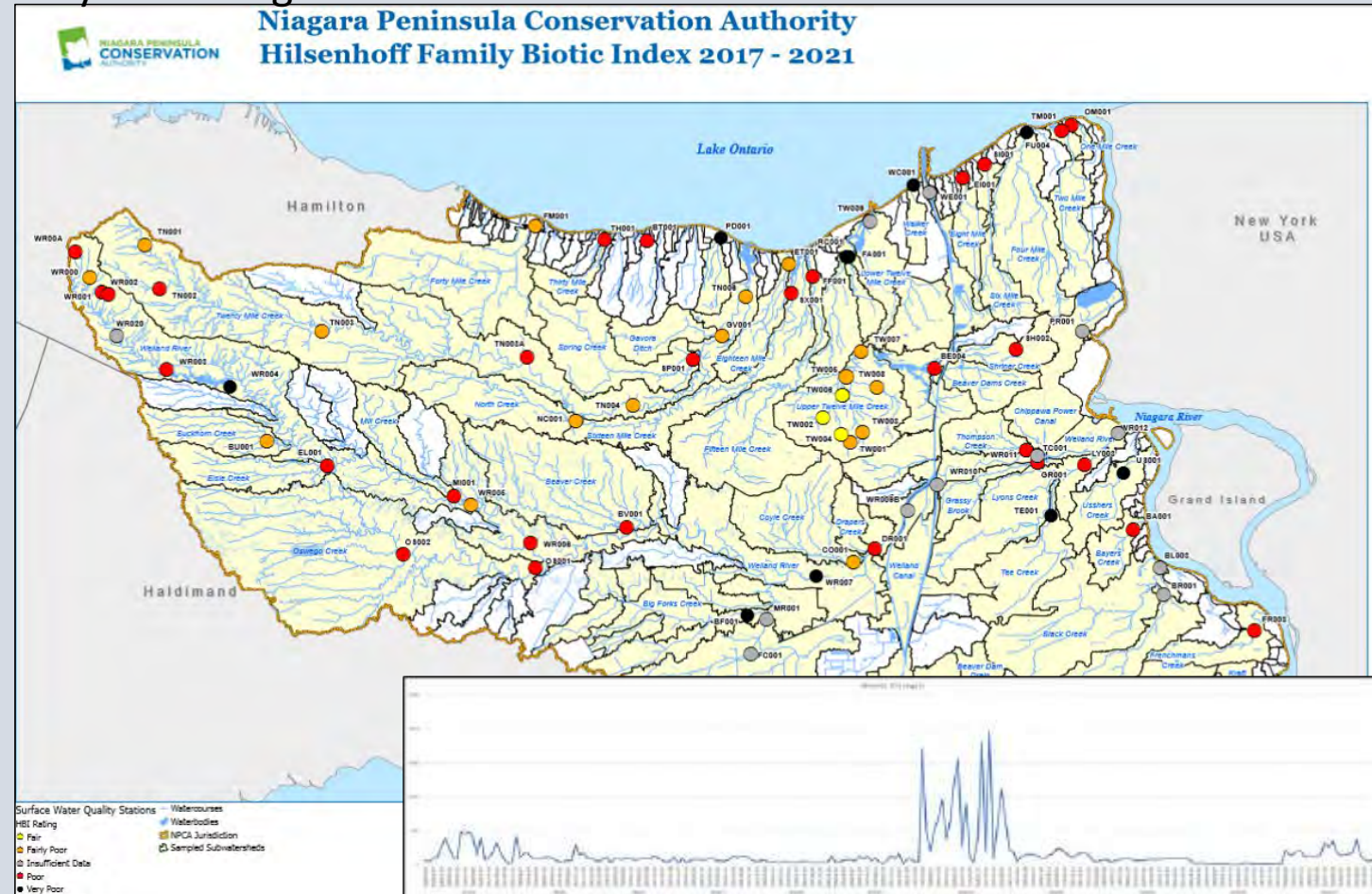
Niagara Peninsula Summary of Findings:

Areas of Interest (AOI)

NPCA indicates that the overall trend throughout their Watersheds include Total Phos. & E.coli exceedances, causing concern.

Chloride* downstream from the airport is noticeably high. See chart below.

- Provide NOCA with update on Airport Chloride Response
- Provide the NPCA with an update regarding Hamilton Airport PFAS contamination issue if one is available.
 - NPCA had a few meetings with Transport Canada in 2022 regarding their Risk Assessment release and how it pertains to our Binbrook Conservation Area.
 - There was quite a bit of press surrounding this issue and the public is concerned (fisheries, hunting, swimming, well contamination etc.).
 - NPCA currently attempting to reach out to Transport Canada again to determine the status of a communications webpage/site.
 - TC mentioned specifically that were trying to connect with the City to get their input.



Conclusion of Review, Action Items & Next Steps

Suspected cross connections observed in the field:

- Ancaster Creek - Between AC-5 (HCA) & City's AC SW1
- Battlefield / Stoney Creek – upstream to BatC SW1
 - SD07OF01 - Observed a plunge pool with a steady flow of water, SAN debris comprised of broken-down tissue and heavy film on water just downstream, as well as algae/high nutrient evidence on the stream sediment
- Buttermilk Falls

On-going Communication:

Landfills – Kay Drage / Chedoke

Red Hill (U of T) Nutrient Inputs study

AquaSignum – Battlefield Creek

Next Steps:

FRAMEWORK Review and Modifications for 2023

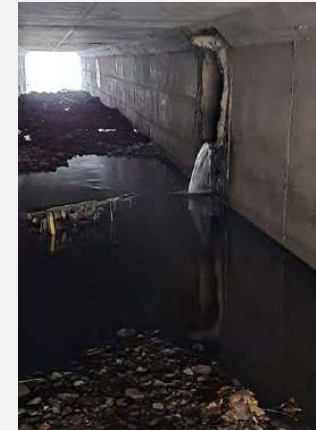
- SWOT Review.
 - CSG to review Priority outfall assets, which now also includes RESERVOIRS

Current/Known modifications:

- Dissolved O-Phos to be field filtered (instead of lab filtered)

Suggestion for consideration

- Harbour Locations – introduce a horizontal sampler to sample below surface at a specific depth.
 - Example: UC SW1 – at surface and at 2m below surface (work with MECP & ECCC to determine best method)
 - Place buoys at select Priority outfalls in harbour (con: ship traffic) *ECCC asked for sponsors/partners to help purchase last year (perhaps looking again this year?)



Limitations of the SWQP WQ Trending

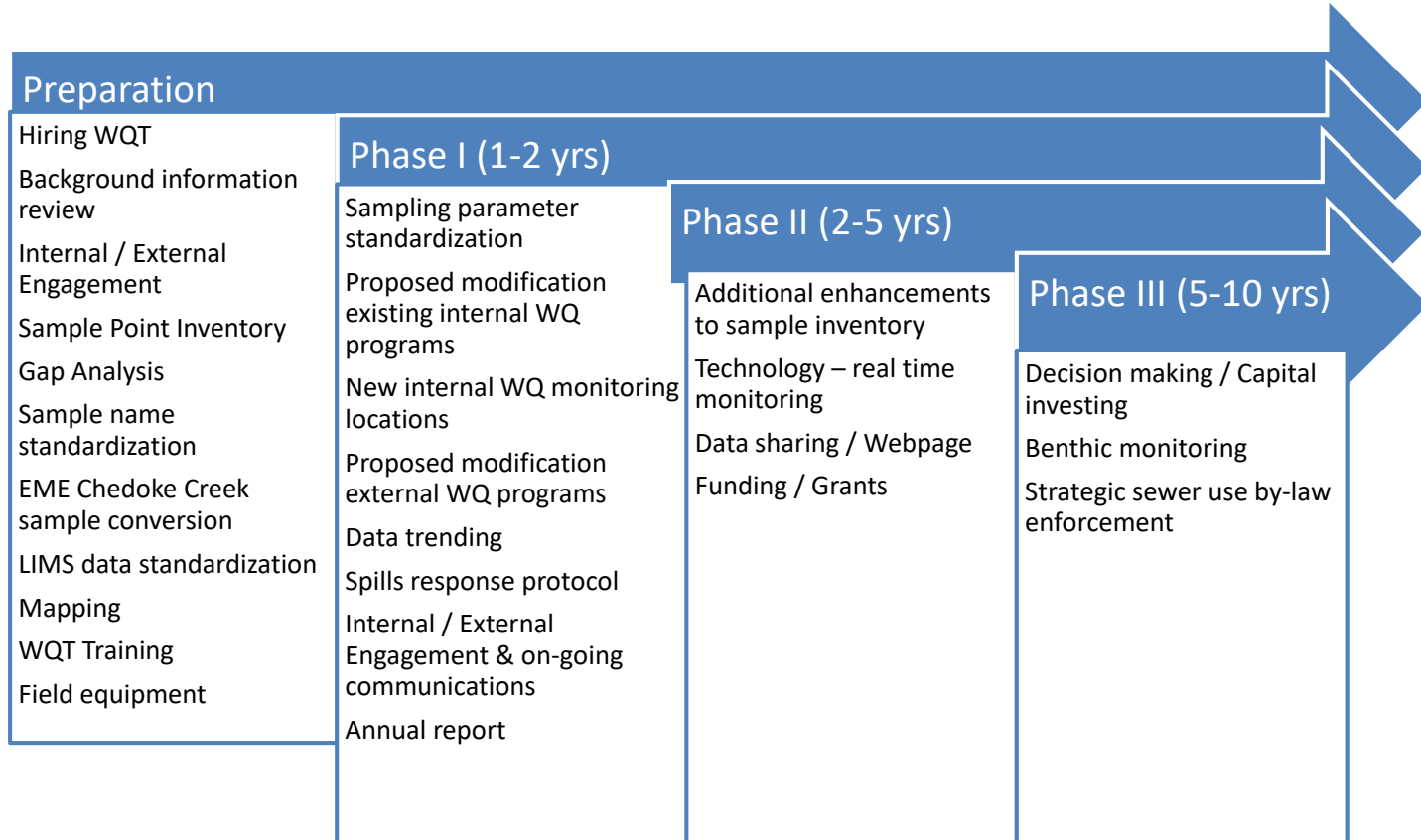
- Resources and/or Funding (BI Trending is supported by internal colleague)
 - Consultant/Corporate and/or Ham Water internal resource to build an Integrative Dashboard (2023)?
 - Not all Parties sample or trend 16 WQ parameters
 - Plan required to assist 3rd Party Parameter lists
 - Request Parties to begin trending additional parameters in their own sampling program
- Develop SW Tributary Baselines & Thresholds (HHRAP)
- 5-10 yrs of data needed to create location 'thresholds' to trigger Spill Response/Inspection
 - Develop method with Parties, validated by HHRAP, to ensure consistency.



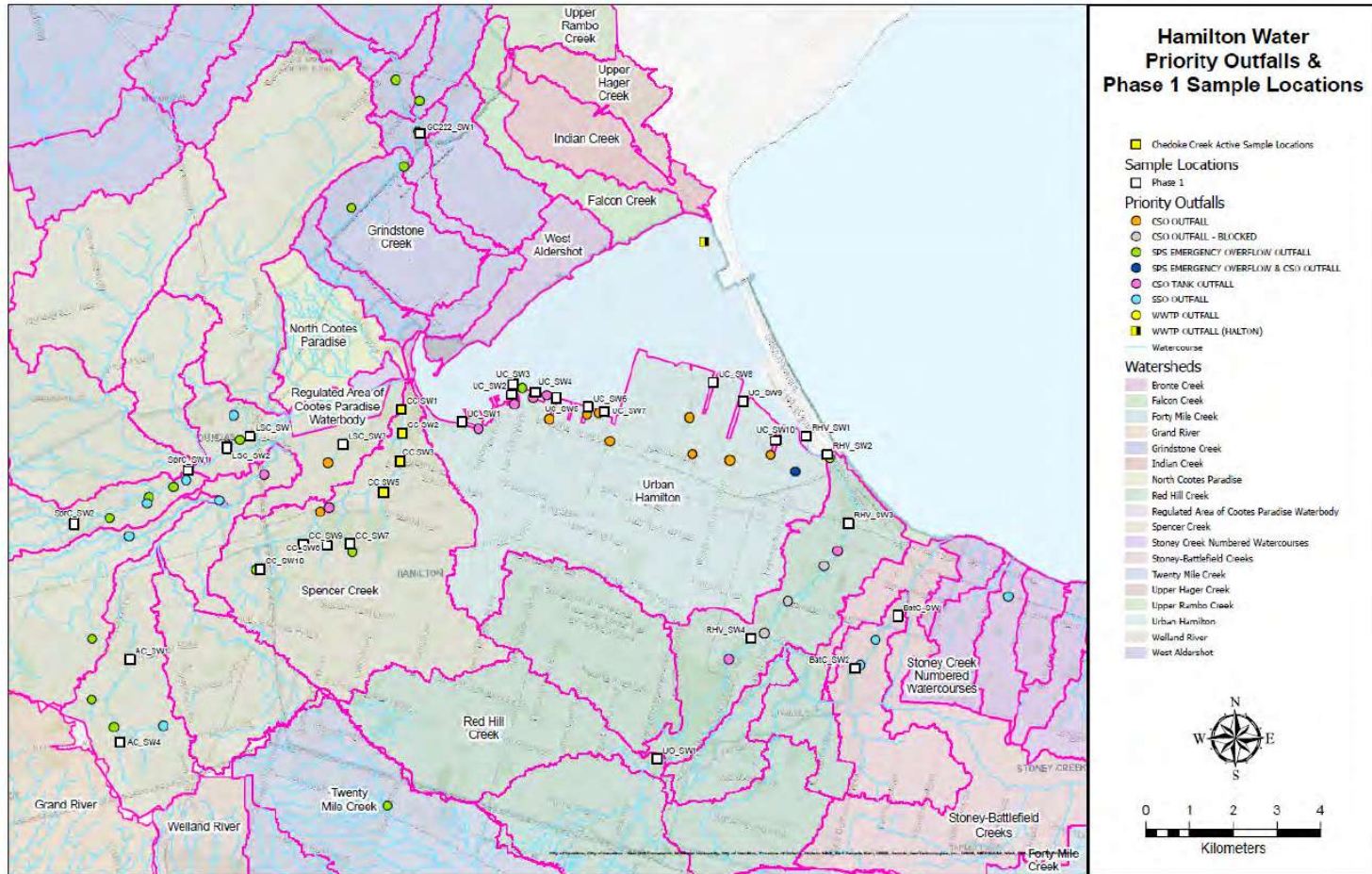
City of Hamilton's Surface Water Quality Program

Update JULY 2023

Surface Water Quality Program - Framework



Surface Water Quality Program – Sample Locations



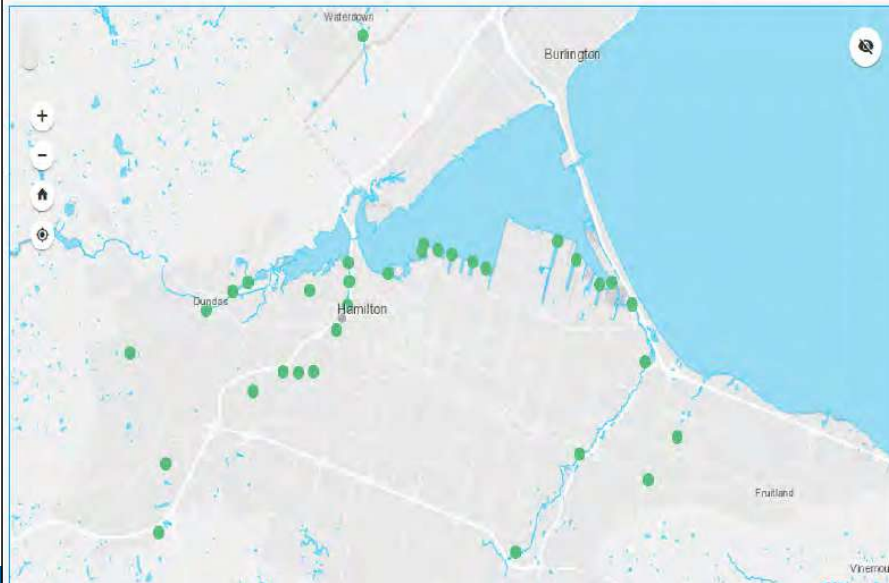
Website and Data Sharing

The City of Hamilton's Water Division developed a Surface Water Quality Program (SWQP) that samples surface water locations monthly, throughout the City's waterways. The purpose of this program is to work with and alongside internal and external Stakeholders to develop and monitor baseline surface water quality conditions.

Data on the Surface Water Sample Locations is provided through the Open Hamilton Data Portal which is a public-facing resource for up-to-date, easy and transparent data for surface water quality general knowledge, trending, review and research purposes.

SURFACE WATER SAMPLE LOCATIONS

The surface water data is exported from the City Laboratory nightly, providing up-to-date surface water quality data through the Open Hamilton Data Portal. Select any sample location on the map to access the data. Once selected, click the 'Download' icon near the top left of the Open Hamilton page to access the full dataset through the 'Download Options'.



i) Integrate existing Chedoke Creek Surface Waters Monitoring Program

- Complete

ii) – Integrate new City of Hamilton Surface Waters Quality Program locations and revised parameter monitoring list – as per SWQP Framework.

- Complete

iii)– Integrate external party sampling locations and monitoring data.

- Next Step / On-going
 - Dashboard development

iv) – On demand data trending and analysis.

- TBD

MOUs / Partnership
Agreements have been signed

Surface Water Quality Program: Semi-Annual Review



PARAMETER LIST		
Field Parameters	Chemical Parameters	METALS
1 Conductivity	1 Ammonia as N	1 Aluminum
2 Dissolved Oxygen	2 Carbonaceous Biochemical Oxygen Demand	2 Antimony
3 pH	3 Chloride	3 Arsenic
4 Temperature	4 Bromide	4 Barium
	5 Escherichia coli (E. coli) bacteria	5 Beryllium
	6 Hardness	6 Bismuth
	7 Nitrate	7 Boron
	8 Nitrite	8 Cadmium
	9 O-Phosphate	9 Calcium
	10 Total Kjeldahl Nitrogen (TKN)	10 Chromium
	11 Total Phosphorus (TP)	11 Cobalt
	12 Total Suspended Solids (TSS)	12 Copper
	13 Un-ionized Ammonia	13 Iron
		14 Lead
		15 Lithium
		16 Magnesium
		17 Manganese
		18 Molybdenum
		19 Nickel
		20 Potassium
		21 Selenium
		22 Silicon
		23 Silver
		24 Sodium
		25 Strontium
		26 Thallium
		27 Tin
		28 Titanium
		29 Tungsten
		30 Uranium
		31 Vanadium
		32 Zinc
		33 Zirconium

Areas of Interest (AOI's) based on observations, charts and conversations with multiple Parties.

Current limitations with the SWQP Integrative Dashboard.

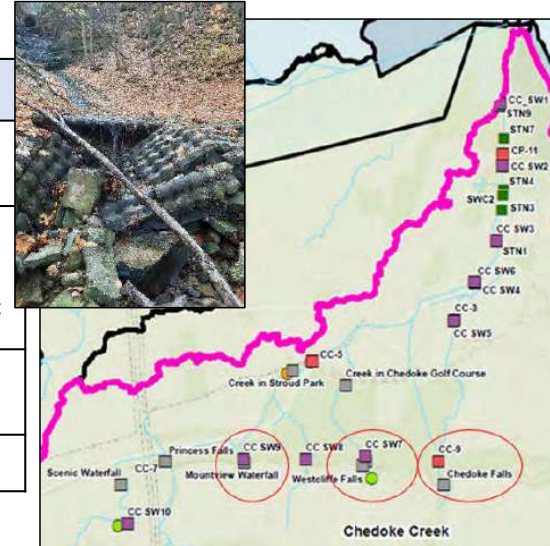
Designate baseline and critical thresholds.

Not all Parties sample and/or trend for same WQ Parameters.

Chedoke Creek – Areas of Interest

Upper Chedoke

LOCATION	PARAMETER OF CONCERN	OTHER INFORMATION
SWQP CC SW9 Redeemer's Mountview Falls	Ammonia, E. coli, nitrates/nitrites, TKN, phosphorus (incl. ortho), zinc	
SWQP CC SW8 (Sanatorium Falls)	Total metals (Al, Cu, Pb, Zn)	No flow during dry weather, suggesting primarily road run off during snow melt/wet weather events
SWQP CC SW7 (Beddoe Drive) Redeemer's Westcliffe & Cliffview Falls	E. coli	
HCA's CC-9 (Chedoke Falls) Redeemer's Chedoke Falls	E. coli, phosphorus	

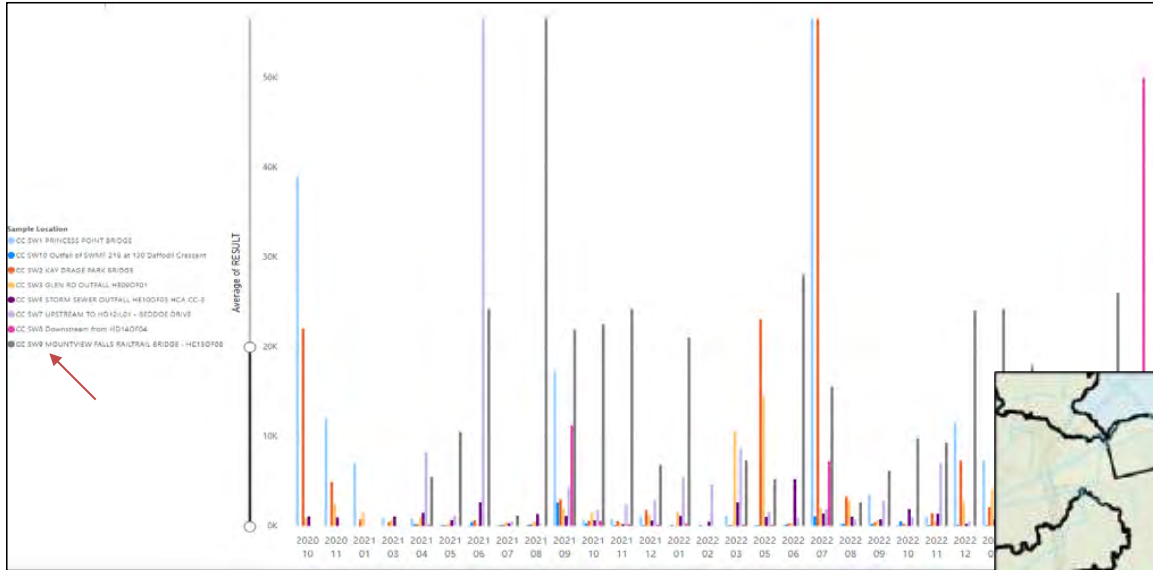


Lower Chedoke

LOCATION	PARAMETER OF CONCERN	OTHER INFORMATION
Multiple along lower Chedoke Creek Locations	Multiple Parameters	Dredging on-going.
Kay Dredge Park	NA	Recycling & Waste Department working with contractors to CCTV drainage pipes within closed landfill and along lower CC.



Note 1: Kay Dredge Park Storm Pipe

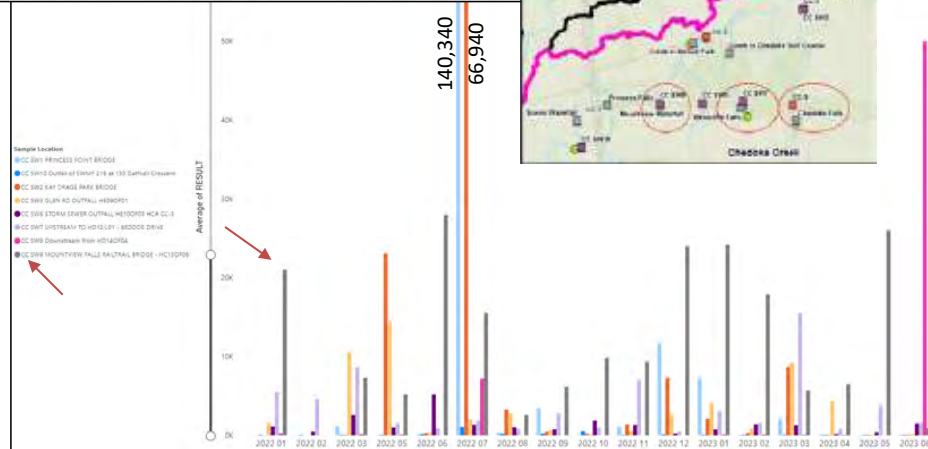


Chedoke
Creek

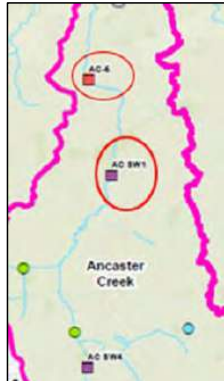


What do these graphs tell us?

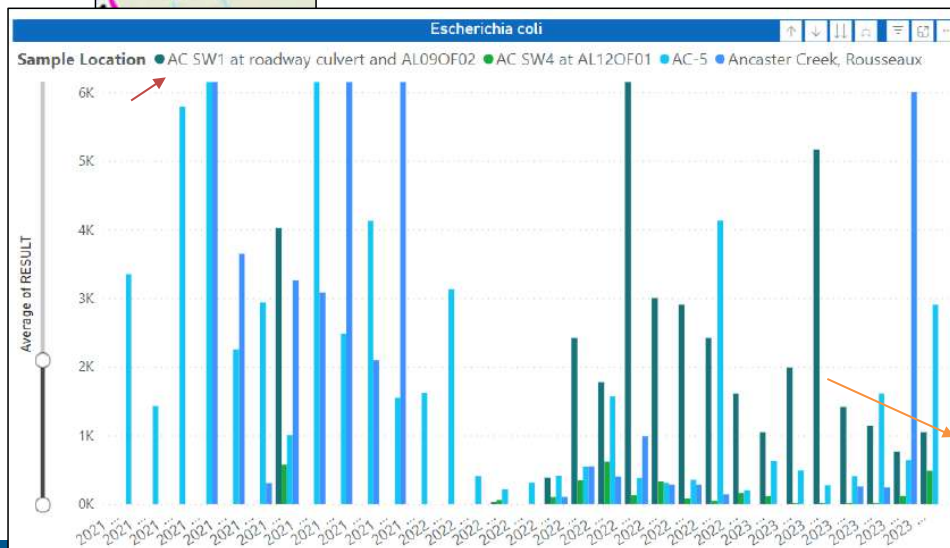
- Upper Brow results VS. Lower Chedoke
 - CC SW9 consistently higher concentrations



Ancaster Creek – Areas of Interest

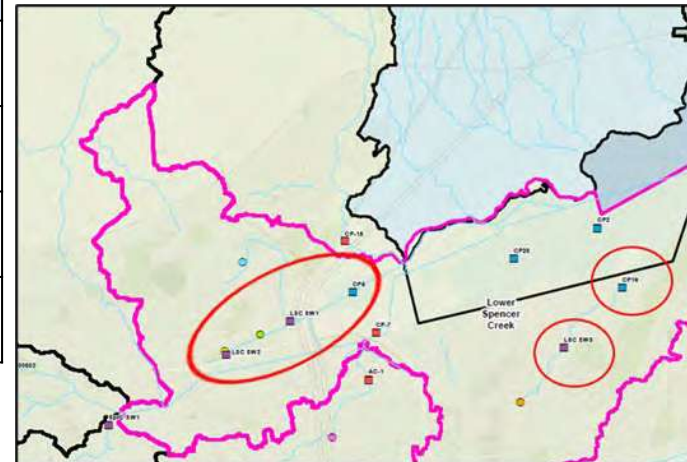


LOCATION	PARAMETER OF CONCERN	OTHER INFORMATION
HCA's AC-5 (Wilson at Rousseaux)	E. coli, Nitrate	
SWQP AC SW1 (north side - Golf Links Rd)	E. coli, Nitrate	Evidence of another possible cross-connection at sample location – open communication with WDWWC team. In February 2022, SLXC team has corrected 2 upstream.

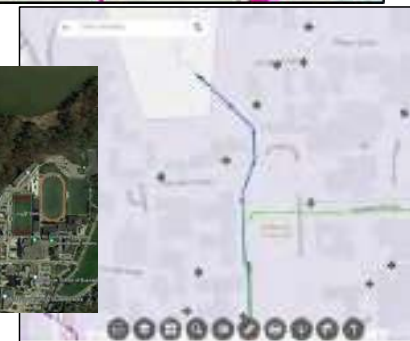


Spencer Creek (Spring Creek & Lower Spencer Creek) & Cootes Paradise – Areas of Interest

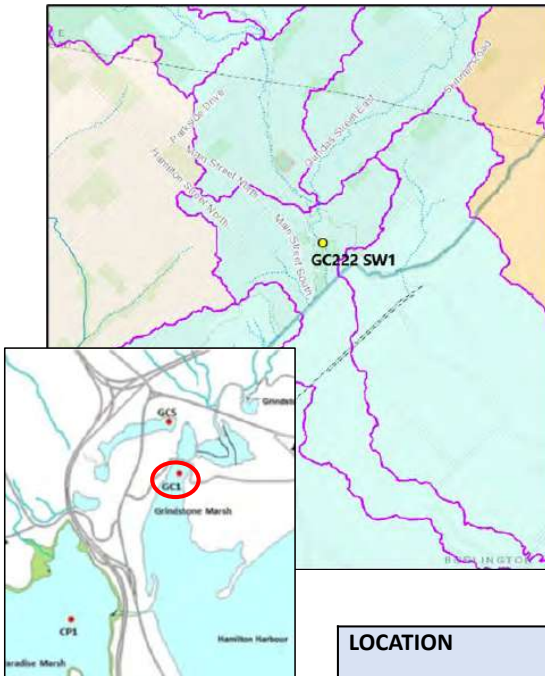
LOCATION	PARAMETER OF CONCERN
SWQP LSC SW1 & SWQP LSC SW2 (Desjardin Canal)	Ammonia, E. coli, Nutrients, TKN, Phosphate (including Ortho), Copper, Zinc
SWQP LSC SW3 (downstream to Sterling CSO – Hamilton Aviary)	Chloride
RBG's CP-5 (West Pond) Downstream to the Dundas WWTP	DO – extreme lows & highs, Phosphorus, Nutrient, Algae blooms
RBGs CP-16 (Westdale Inlet) downstream to Sterling CSO & City's LSC SW3	Phosphorus, TSS



City working with RBG and McMaster to determine drainage agreements and water Quality to Cootes, at CP10.1.

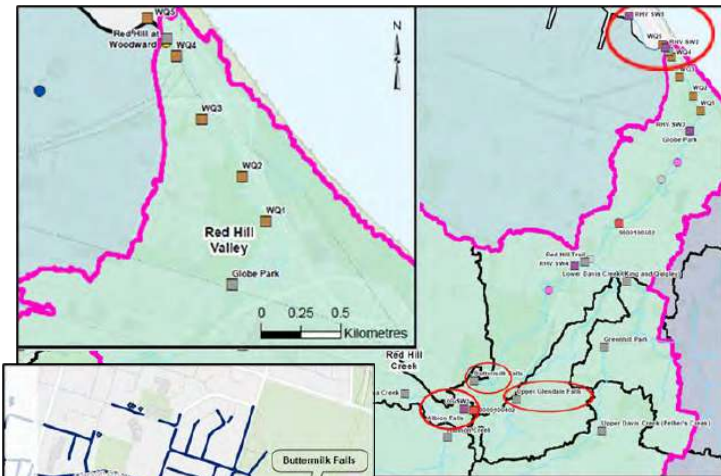


Grindstone Creek & Marsh – Areas of Interest



LOCATION	PARAMETER OF CONCERN	OTHER INFORMATION
RBG's GC1 (lower Grindstone)	TP, TSS	
Conservation Halton – multiple locations	TP, TSS (wet events) & Nitrates on 6 th Concession Tributary	2014 vs. 2021 WQ Study

Red Hill Valley – Areas of Interest



Upper RHV

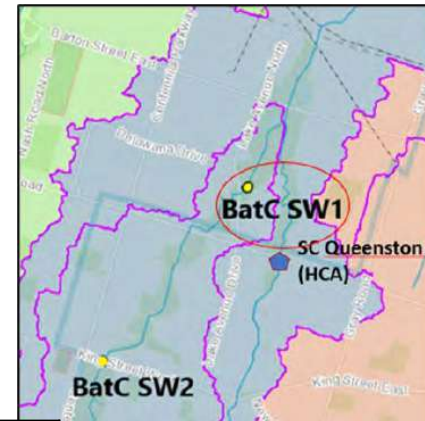
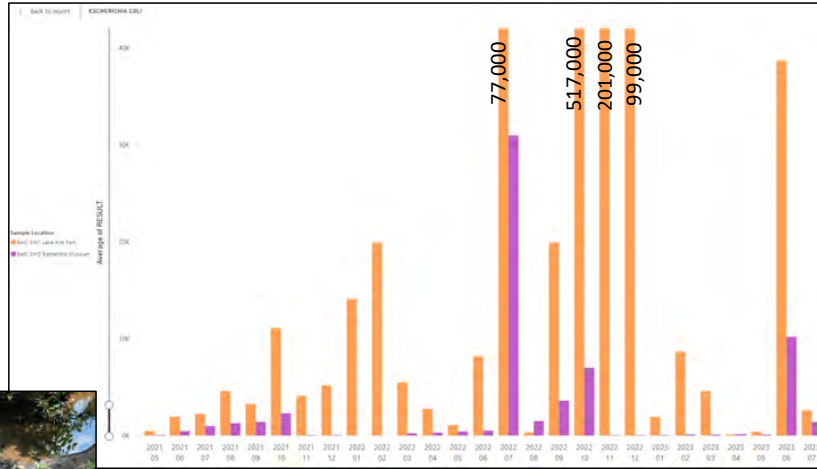
LOCATION	PARAMETER OF CONCERN
City's UO SW1 (HCA's Albion Falls)	E. coli, Zinc
Redeemer's Buttermilk Falls, including City Storm Outfall	E. Coli, Nitrate, total phosphorus, and Chloride

Lower RHV

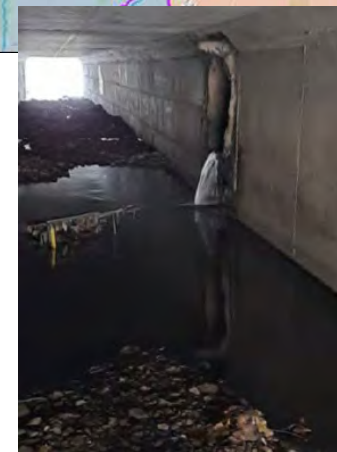
LOCATION	PARAMETER OF CONCERN	OTHER INFORMATION
City's RHV SW1 & SW2 (downstream to WWTP)	Lower DO & higher temperatures, Phosphorus (including Ortho), Ammonia (including Unionized), Nutrients	Additional time and samples needed to determine how new outfall location and effluent is influencing WQ in lower RHC.
WUP Locations – long term WWTP outfall study	NA	WQT reviewed WUP's 2022 Report. No updates to provide – similar trends noted from previous years.
DFO's DOT Program	DO & Temperature	As water flows downstream from Upper Red Hill Creek (City's SWQP RVH SW3 – Rennie Brampton), you can see that the natural cycle of dissolved oxygen disappears downstream of the HWWTP.

Redeemer taking WQ samples again this summer. No updates to provide on 2023 WQ results.

Battlefield Creek



BatC SW1 (Lake Ave. Park)

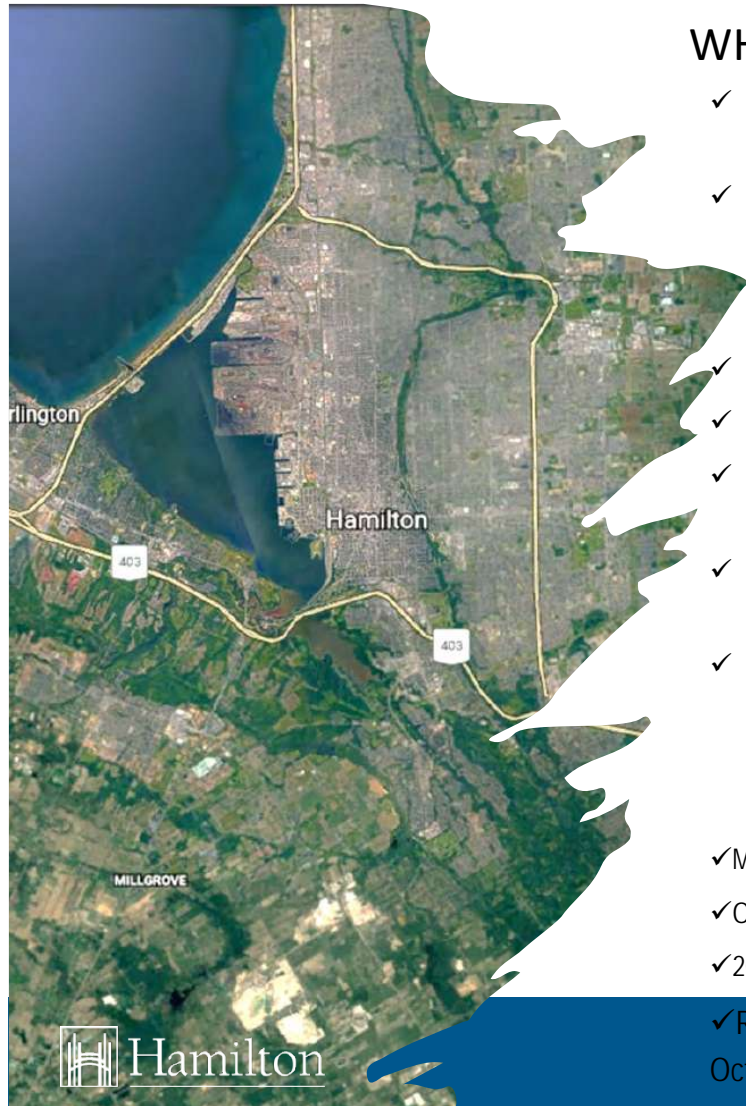


PARAMETER OF CONCERN	OTHER INFORMATION
Ammonia (including unionized), cBOD, E.coli, Phosphorus (including Ortho), Nitrate/Nitrites, TNK, Zinc.	<p>There appears to be an observed trend of WQ degradation and/or changes in WQ Chemistry between the up- (BatC SW2) and down- (BatC SW1) stream location – both visual and chemical.</p> <p>Possible Cross Connection upstream to BatC SW1 at SD070F01. Observed a plunge pool with a steady flow of water, SAN debris comprised of broken-down tissue, and heavy film on water just downstream. Algae/high nutrient evidence on the stream sediment. Notified WDWWC of the location.</p> <p>As of July 25, 2023, Pipetek has completed 1.4km of CCTV investigation – no findings. They still have another 1.1km to complete.</p>

Urban Core (Hamilton Harbour) – Areas of Interest



LOCATION	PARAMETER OF CONCERN	OTHER INFORMATION
City's SWQP UC SW8 (Ottawa St N)	Ammonia including unionized, E. coli, Nitrate/Nitrites, Phosphorus, Temperature (consistent ~5-10 degrees warmer), Total Metals (Al, Cu, Pb, Zn)	Warm water discharge upstream to sample location.
City's SWQP UC SW9 (Kenilworth Ave N)	Ammonia including unionized, Phosphorus, Total Metals (Al, Cu, Pb, Zn)	
City's SWQP UC SW10 (Strathearne Ave)	Ammonia including unionized, Chloride, E. coli, Nitrate/Nitrites, Phosphorus (including Ortho), Total Metals (Al, Cu, Pb, Zn)	
DFO/MECP/ECCC:	DO, Temp., Nutrients	Hamilton Harbour face significant periods of hypoxia, and even anoxia. DFO's work indicates these periods are increasing during the summer. DO concentrations are becoming much more variable during the winter, and hypoxia is occurring earlier in the summer.



WHAT WE DID: 2022 & Q1-Q2 2023

- ✓ 1st & 2nd Science Days HHRAP Presentation – February 2022/23
- ✓ Monthly sampling ALL 33 locations that were proposed in the Phase 1 of the SWQP
 - ✓ Due to Park Boat H&S SOP hold-up, no monthly Ham Harbour locations have been sampled in 2023 (other than January 2023).
- ✓ Annual Report to Council – July 2022 / June 2023
- ✓ WQT Attended the Latornell CA Symposium – October 2022
- ✓ WQT attended a BARC meeting – Presented the bones of the SWQP – November 2022
- ✓ 1st Semi-Annual Review of SW Data, including Partner Data - September 2022 & January 2023
- ✓ 2023 Q1 Framework Review
 - ✓ Suggestions submitted for 2023 but due unknown circumstances (MECP Orders), modifications/changes to SWQP on hold until 2024.

CONTINUING IN 2023

- ✓ Monthly Grab Sampling
- ✓ On-going Monthly WQ Results Review & Semi-Annual Trending
- ✓ 2023 Q4 Internal & External Data Sharing MOU Review
- ✓ Requested to attend the Latornell CA Symposium again – October 2023



THANK YOU!

CITY'S 24-HR SPILLS REPORTING LINE:

905-540-5188