Toronto and Region Conservation Authority Hydrology and Water Resources Programs and Special Projects

Guest Lecture
GEOG 4400: Physical Hydrology and Water Resources
York University

Presented by: Lyndsay Cartwright, Data Analyst

March 12, 2019

Toronto and Region Conservation Authority

Outline

- About conservation authorities and the TRCA
- TRCA programs (related)
  - Flood protection and erosion control
  - Water quality monitoring
- Special projects
  - Wetland water balance
  - Wet weather flow
  - Climate change vulnerability assessment
  - Watershed planning
- In-class exercise
- Questions/comments/discussion

About Conservation Authorities

- Concerns about the unhealthy state of the land and water during the 1930s and 1940s
- Impacts of drought and deforestation led to soil loss and flooding
- Conservation Authorities Act (1946)
- Province + municipalities = conservation authority
- Local
- Watershed boundaries for natural resource management

Conservation ONTARIO
Natural Champions

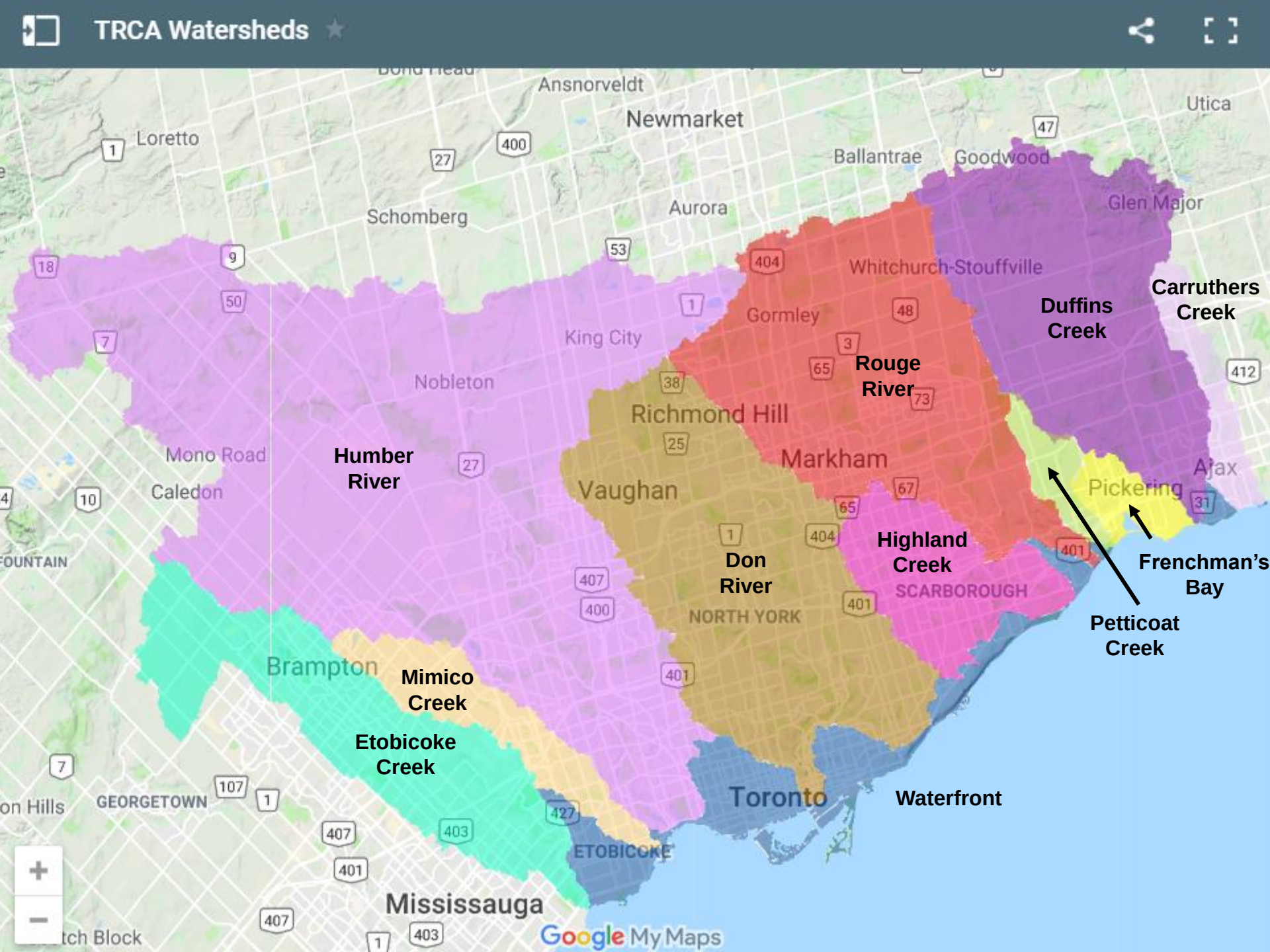
Jobs!

About Conservation Authorities

- Hurricane Hazel…
- Conservation Authorities Act amended
  - Acquire lands for recreation and conservation purposes
  - Regulate that land for the safety of the community
- Now involved in a wide range of activities
  - Education/outreach, monitoring, science

About the TRCA

- Year in review 2018 (youtube)
- Water risk management
- Planning and development review
- Watershed studies and strategies
- Regional biodiversity
- Greenspace securement and management
- Tourism and recreation
- Education and outreach
- Sustainable communities


TRCA Watersheds
Ansnorveldt
Newmarket
Utica
Loretto
Ballantrae
Goodwood
Glen Major
Schomberg
Aurora
Whitchurch-Stouffville
Carruthers Creek
Duffins Creek
Gormley
King City
Rouge River
Nobleton
Richmond Hill
Humber River
Mono Road
Caledon
Markham
Vaughan
Ajax
Pickering
Highland Creek
Don River
SCARBOROUGH
NORTH YORK
Frenchman's Bay
Petticoat Creek
Brampton
Mimico Creek
Etobicoke Creek
Toronto
Waterfront
GEORGETOWN
ETOBICOKE
Mississauga
Google My Maps

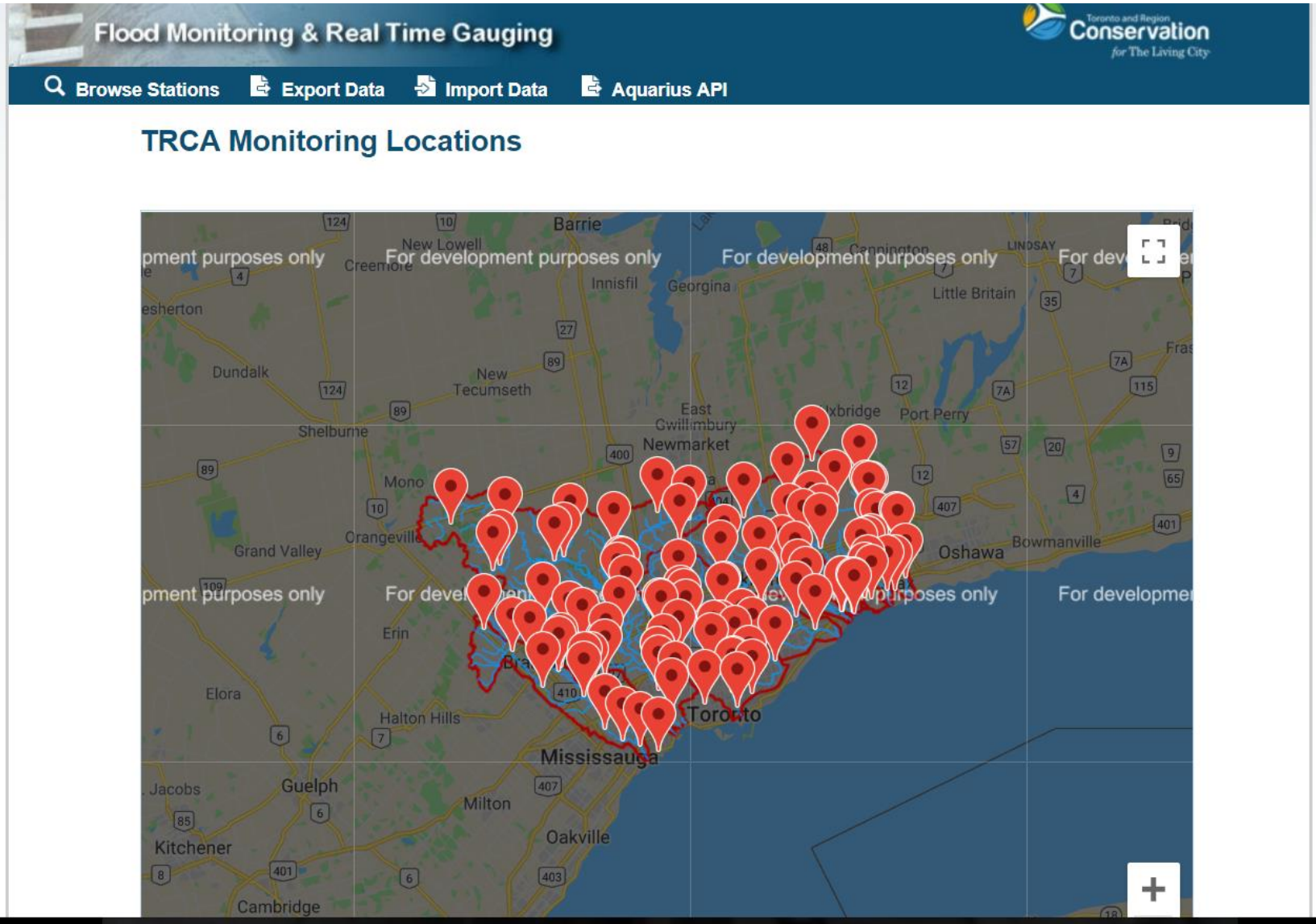
Water and Erosion Risk Management

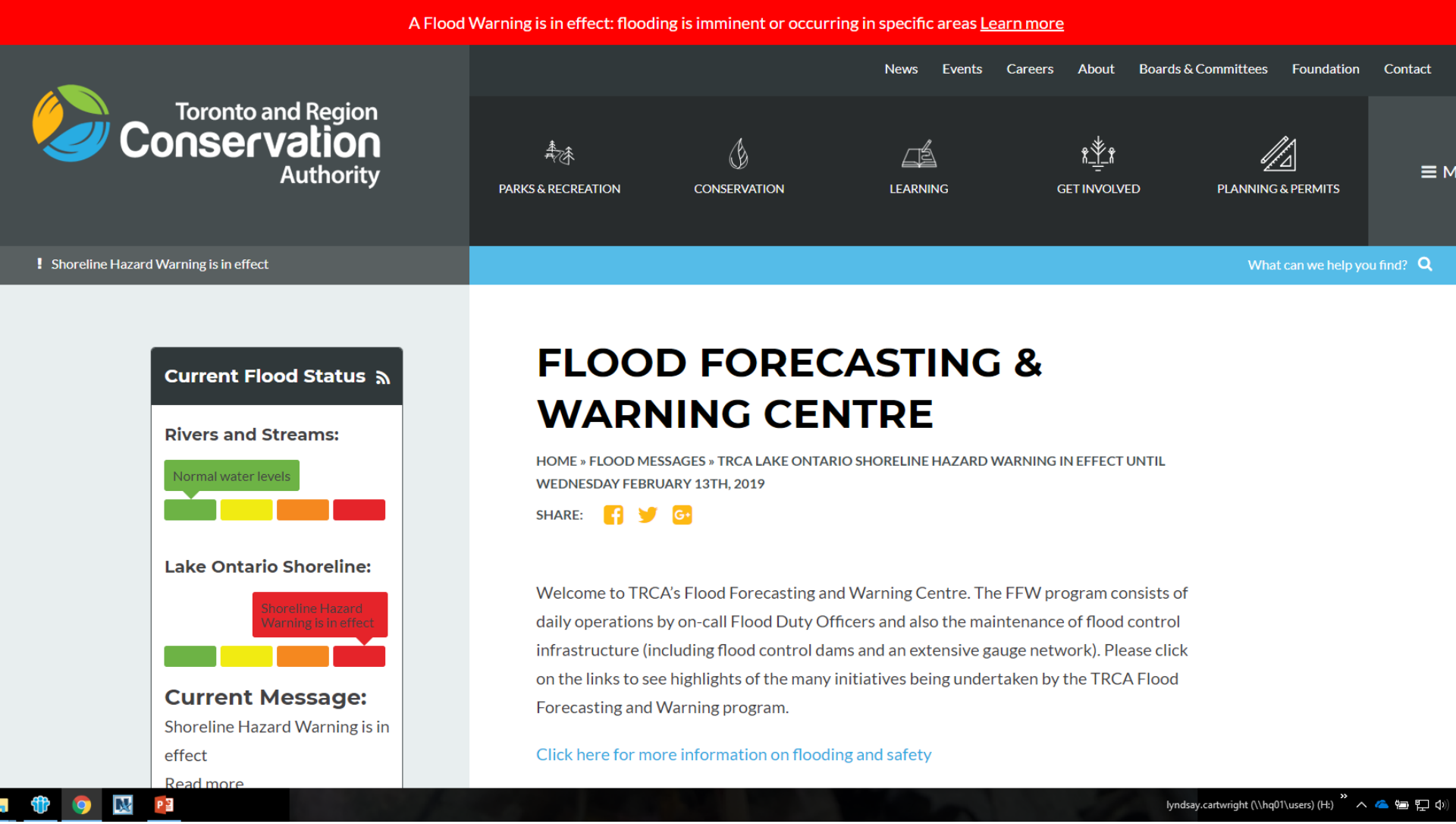
Toronto and Region Conservation Authority

Flood Forecasting & Warning

- A principal mandate of the TRCA is to reduce the risk to life and damage to property caused by flooding.
- We do this by providing local agencies and the public with notice, information and advice so that they can respond during severe rainfall events with the potential for flooding, and during flood related emergencies.
- TRCA Flood Risk Management works to prepare and respond to our changing environment, the increasing needs of our municipal partners and the health and well being of our living city.

Real-time gauging





- Feb 12, 2019: winter storm, wave heights of >2m

Erosion Risk Management Program

- Under the Conservation Authorities Act, TRCA has the power both on public and private lands to:
  - Identify and monitor areas affected by flooding, erosion and slope instability
  - Remediate erosion/slope stability hazards
- Encourage proactive prevention, protection, and management of erosion issues on private and public property
  - Divert stormwater run off
    - LIDs
    - Rain barrels
    - Green roofs
    - Permeable pavements

Sustainable Technologies Evaluation Program (STEP)

Sustainable Technologies
EVALUATION PROGRAM

Fostering Sustainability
Through Innovation

Toronto and Region
Conservation
Authority

About STEP

- A conservation authority-led initiative that fosters broader implementation of technologies that protect water resources and reduce our carbon footprint
- Strong science and monitoring component
- Guidelines for best practices (municipalities, developers)

OUR PROJECTS

Urban Runoff & Green Infrastructure

Erosion & Sediment Control

Natural Features & Systems

Salt Management

Renewable Energy

Heating & Cooling

Energy Conservation

Smart Grid

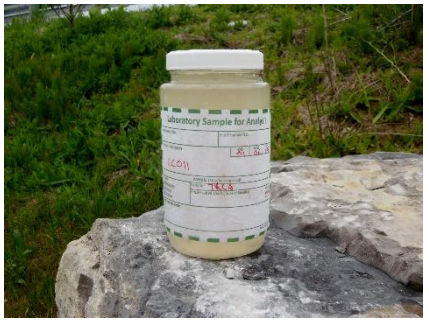
Kortright/Archetype sustainable house

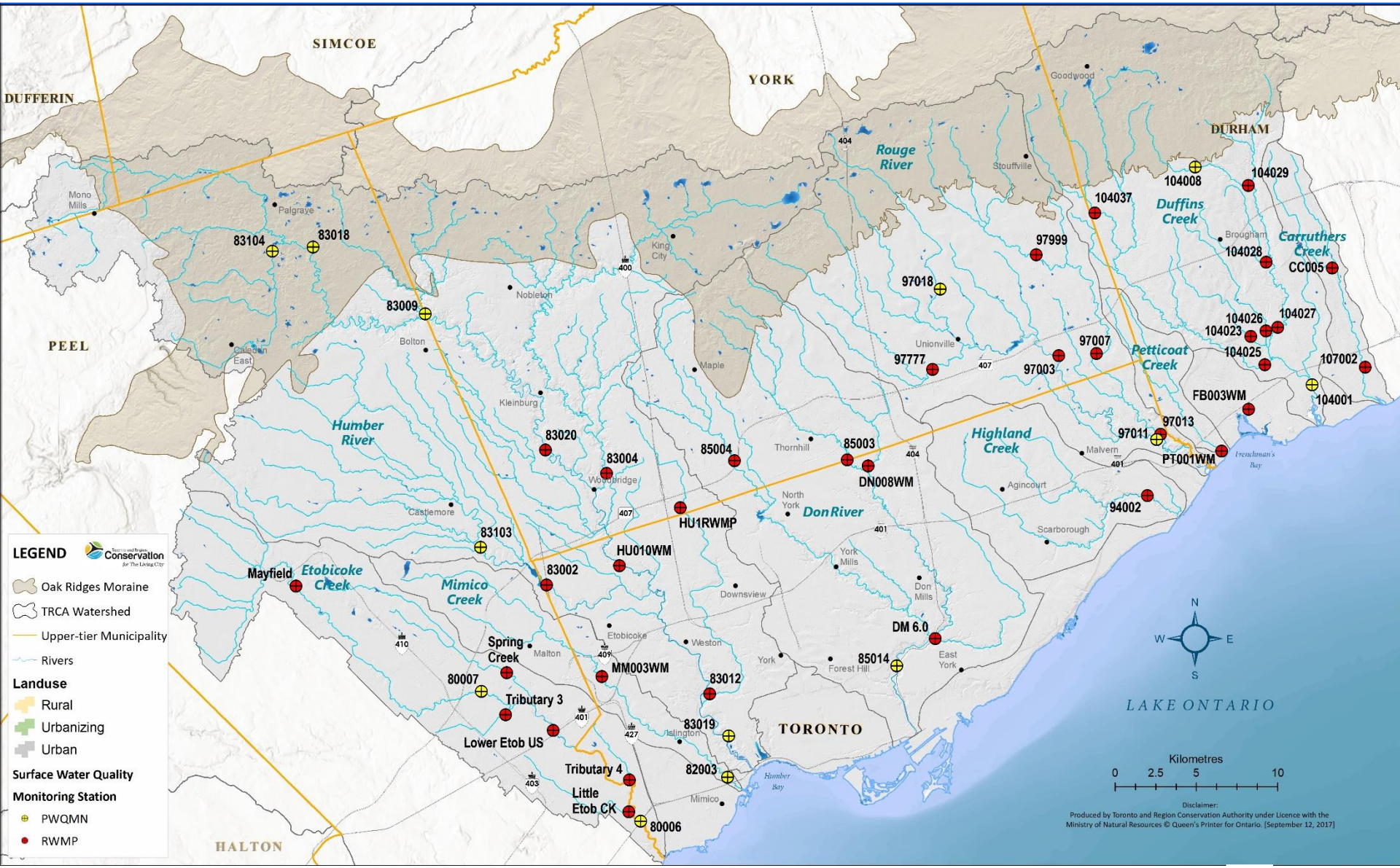
Regional Watershed Monitoring Program (RWMP)

Toronto and Region Conservation Authority

Regional Watershed Monitoring Program

- Aquatic habitat and species (WNV)
- Terrestrial habitat and species
- Surface water quality
- Groundwater
- Technical training
- *Also waterfront monitoring





Provincial Water Quality Monitoring Network Partnership

Applications

- Temporal trends and spatial patterns
  - 5 year report, annual report
- Watershed planning
- Watershed reporting
- Special projects
- Provincial database

Canadian Environmental Sustainability Indicators

Water quality in Canadian rivers

ECCC (2019)

Long-term decline in stream total phosphorus concentrations: A pervasive pattern in all watershed types in Ontario

Katie L. Stammler [a,*], William D. Taylor [a], Mohamed N. Mohamed [b]

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[b] Ontario Ministry of the Environment and Climate Change, 125 Resources Rd., Etobicoke, ON, CAN, M9P 3V6, Canada

Using chloride as an indicator of urbanization to detect changes in the benthic invertebrate community over a 10-year period in Toronto, Canada

Project Example 1 – Wetland Water Balance

Toronto and Region Conservation Authority

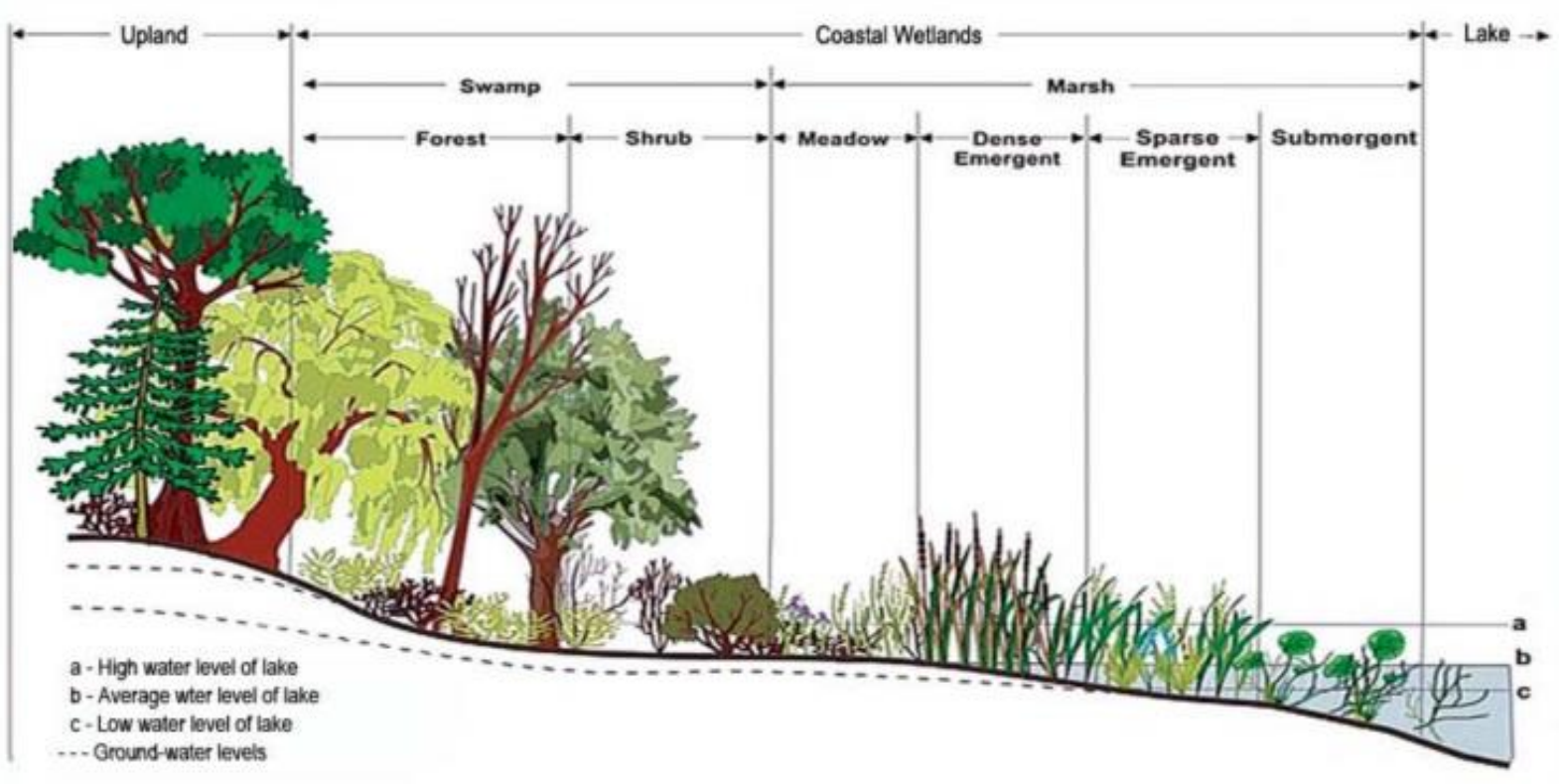
Enhancing wetland protection by defining eco-hydrological thresholds of disturbance

Neil Taylor
Research Analyst

Laura DelGiudice
Senior Manager

Toronto and Region Conservation Authority

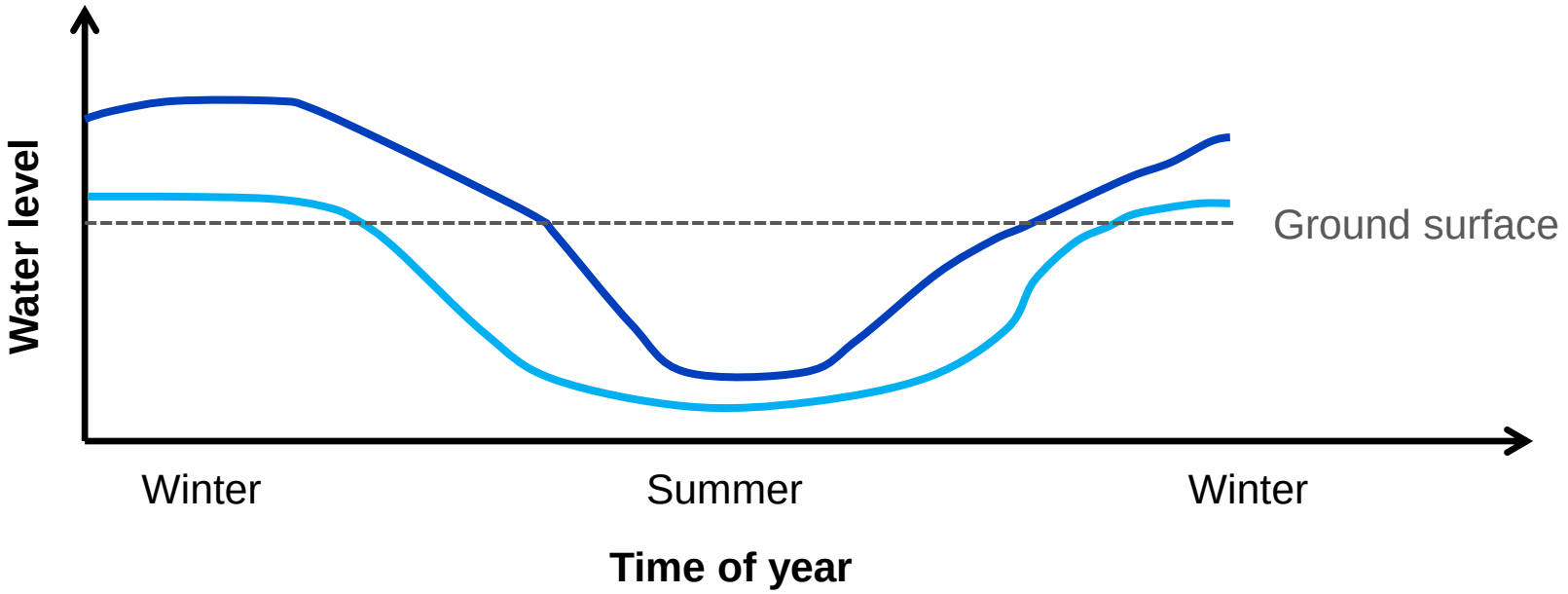
Wetland ecohydrological gradients



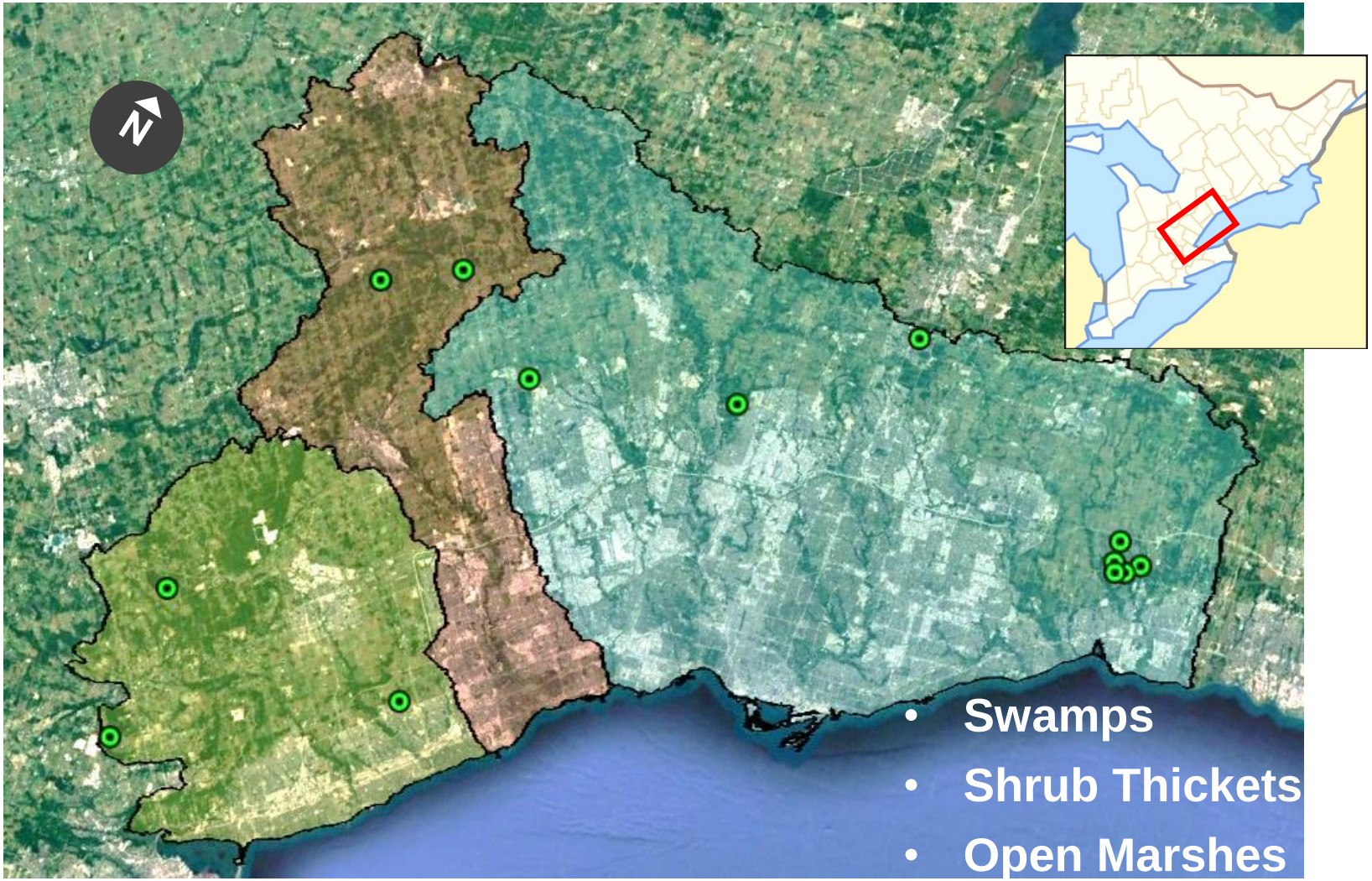
SEASONALLY WET ⟷ YEAR-ROUND OPEN WATER

The problem

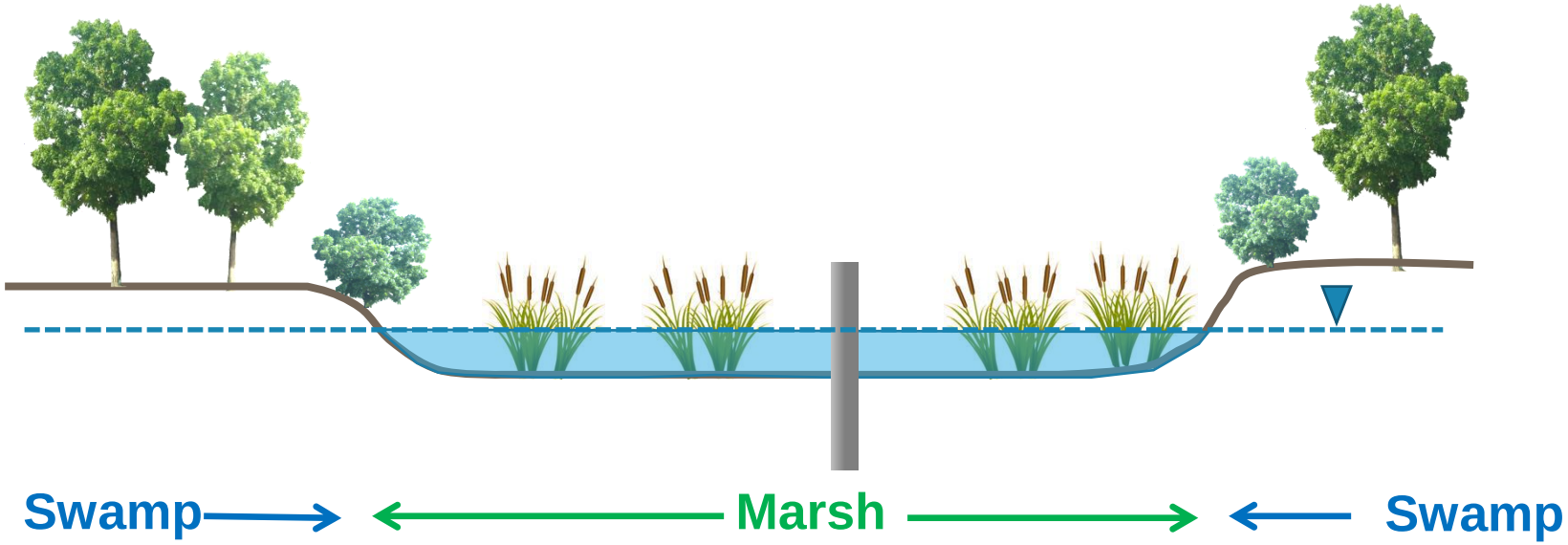
When will we see loss of / change in community / ecological functions?



Monitoring sites



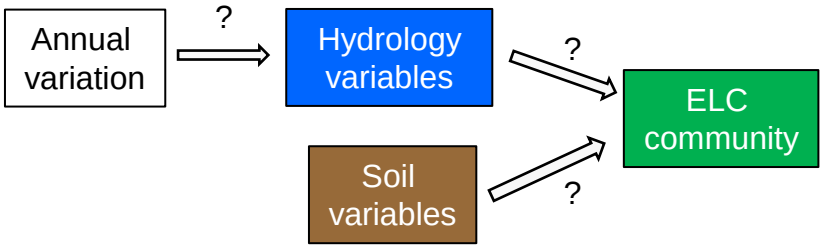
Data collection and assumptions



- 1D hydroperiod, homogenous ecological + topographical unit
- Analysis limited to growing season (Apr 10–Nov 16 = 220 days)
- Palustrine or isolated headwater systems (<~50 ha)
- Also soil chemistry (pH, OM%, P, K, Ca, Mg, CEC)

Objectives and Methods

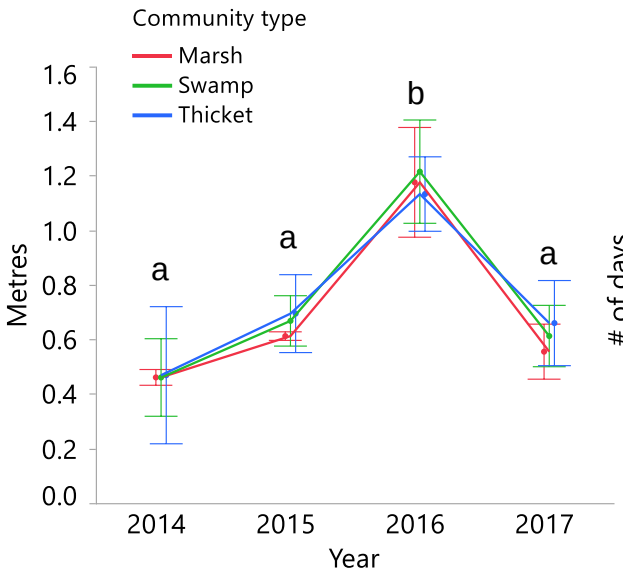
- Explore variability in hydrology and soil variables among community types and among years (2014-2017)
  - Indicators of hydrologic alteration



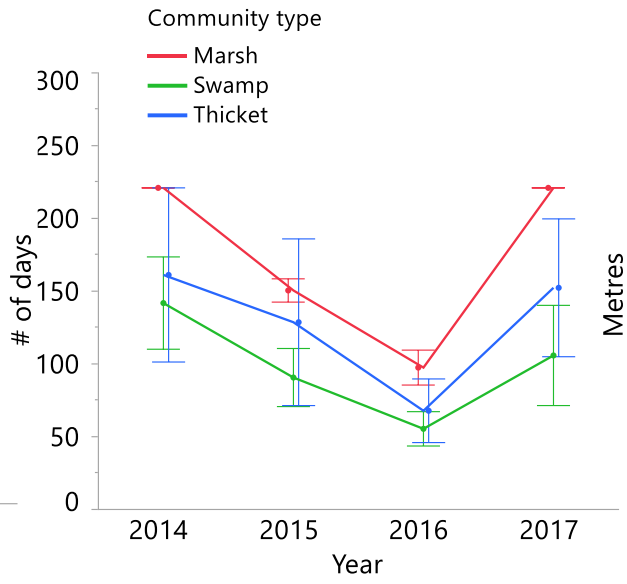
- Determine the relative influence of hydrology and soil variables in predicting community type

Results

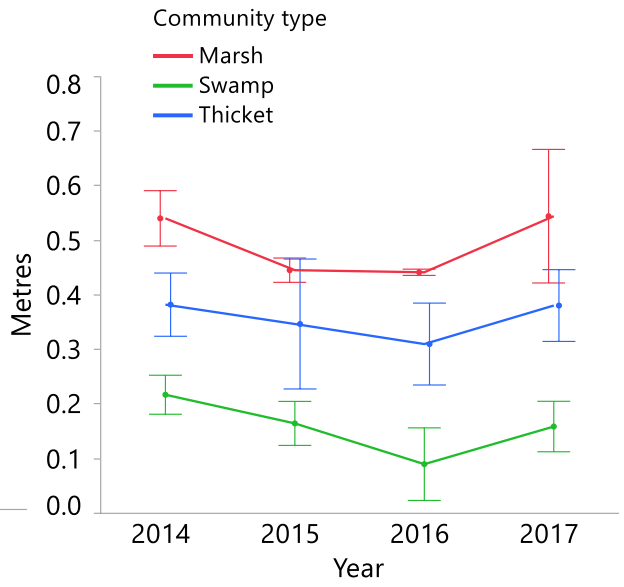
Annual range
(max-min difference, metres)



Total duration of inundation
(# of days)



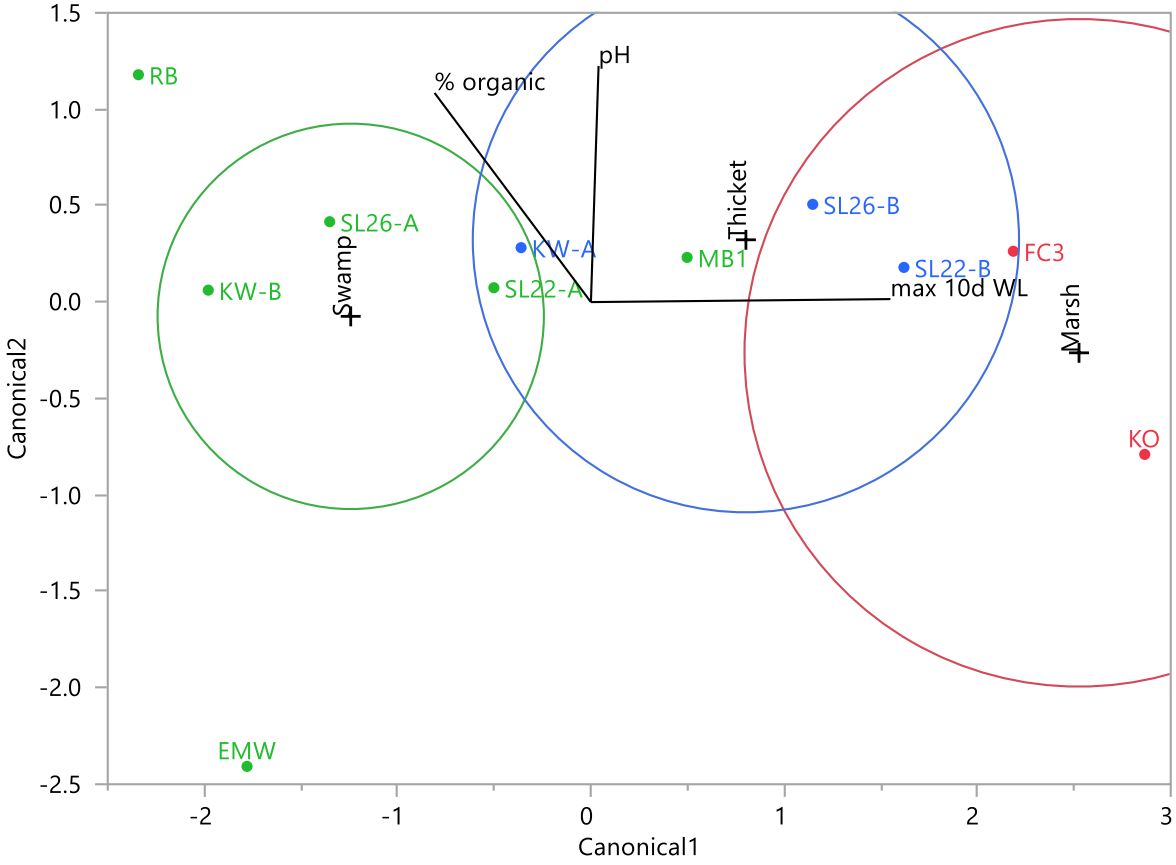
Maximum 10-day average water level
(metres, relative to surface)



Soils

- % organic matter and [Mg] significantly lower in marshes compared to both swamps and thickets

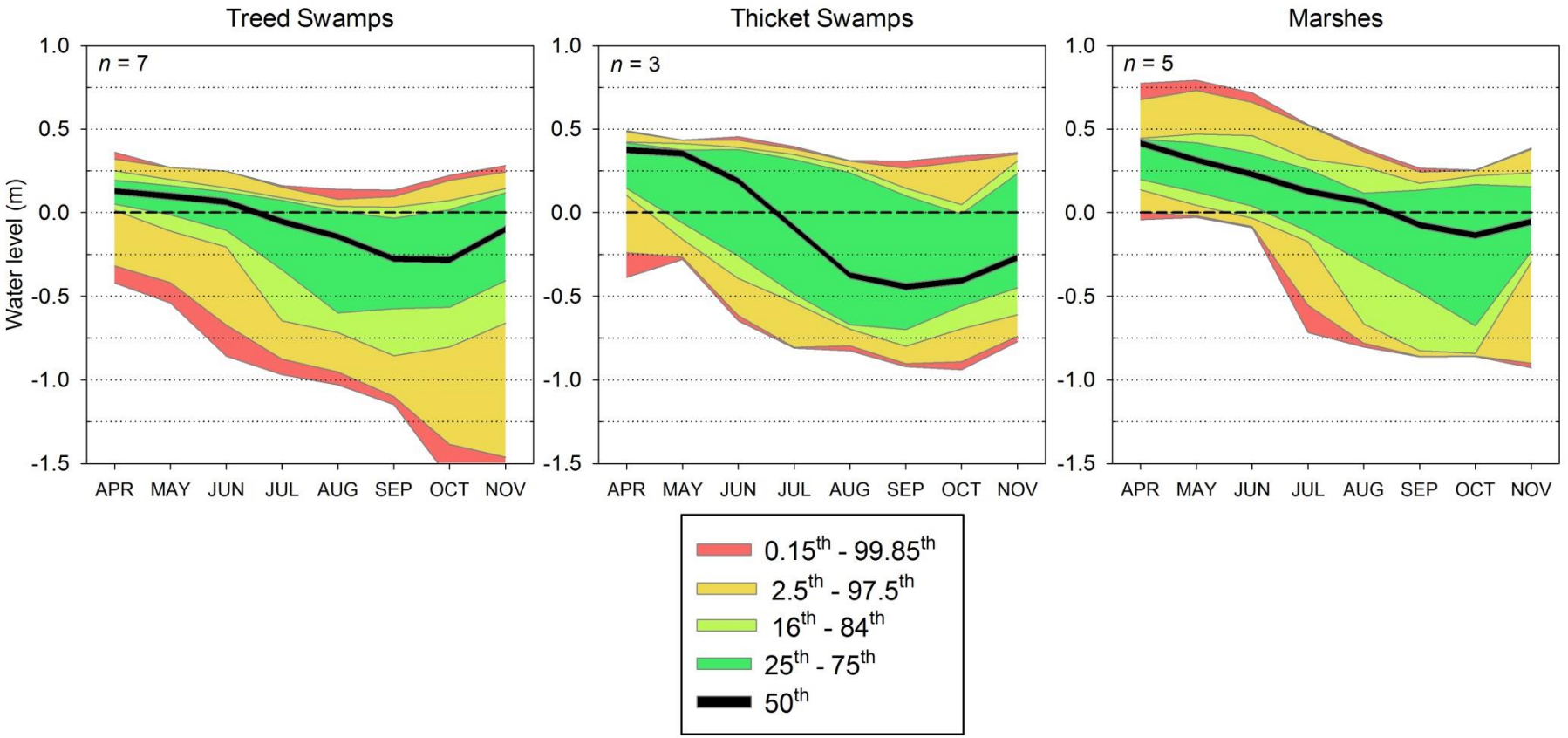
Results



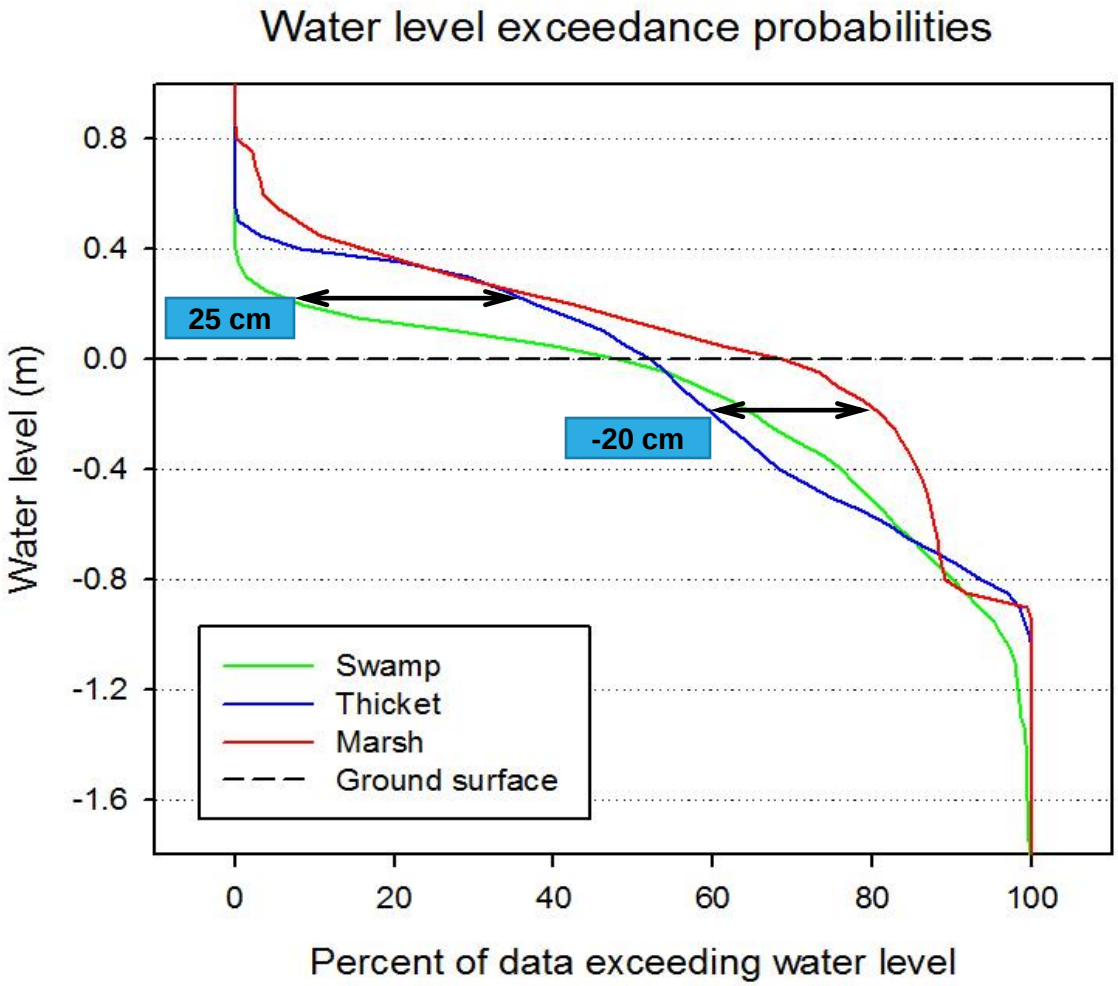
Groupings more related to maximum 10-day water level

Three groups occupy different regions of the ordination space

Hydroperiod: visual comparison



Hydroperiod: percent data greater than Y-axis depth



Conclusions

- Clear statistical differences in hydroperiod between Marsh & Swamp communities; Thickets harder to distinguish
- High inter-annual variability and multiple correlations among metrics (e.g. flood duration and flood depth)
- Possible upper threshold for Swamps at ~25 cm flood depth
- 97% of data for all communities within range +0.5 to -1.0 m → small differences (±20–30 cm) in water level may be enough to drive differences

Project Example 2 – Toronto Wet Weather Flow (actually Toronto Water)

Background

- 1987, IJC Toronto and Region identified as an AOC
- BUI – degraded water quality
- Stormwater runoff and CSOs, heavy rains and snow melts
- 2003 – Wet Weather Flow Master Plan
  - Long-term (25 years, $1 billion) goal of eliminating adverse effects of wet weather flows on the environment
  - 13 objectives (WQ&Q, natural areas/wildlife, sewer infrastructure)


EverStart
MARINE/RV
27DC-850N
6712
ISCO

Project Example 3 – Climate Change Vulnerability Assessment

Toronto and Region Conservation Authority

TRCA Terrestrial Ecosystem Climate Change Vulnerability Assessment

Neil Taylor, Research Analyst

Namrata Shrestha, Senior Research Scientist

December 17, 2018

Toronto and Region Conservation Authority

Purpose and Scope

- Determine and map relative degree of terrestrial ecosystem vulnerability to climate change stressors
- Incorporate climate change considerations into Natural Heritage System planning and management
- Evaluating intrinsic vulnerability of existing terrestrial natural system to types of climate stressors expected to become more frequent / extreme in future
  - RCP 8.5, 2050s
- Builds on Peel Region Climate Change Vulnerability Assessment

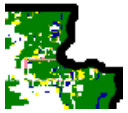
Methodology

0 = low vulnerability
1 = med vulnerability
2 = high vulnerability

Vulnerability Indicators:

A. Summer ground surface temperature 

B. Climate sensitivity of native vegetation 

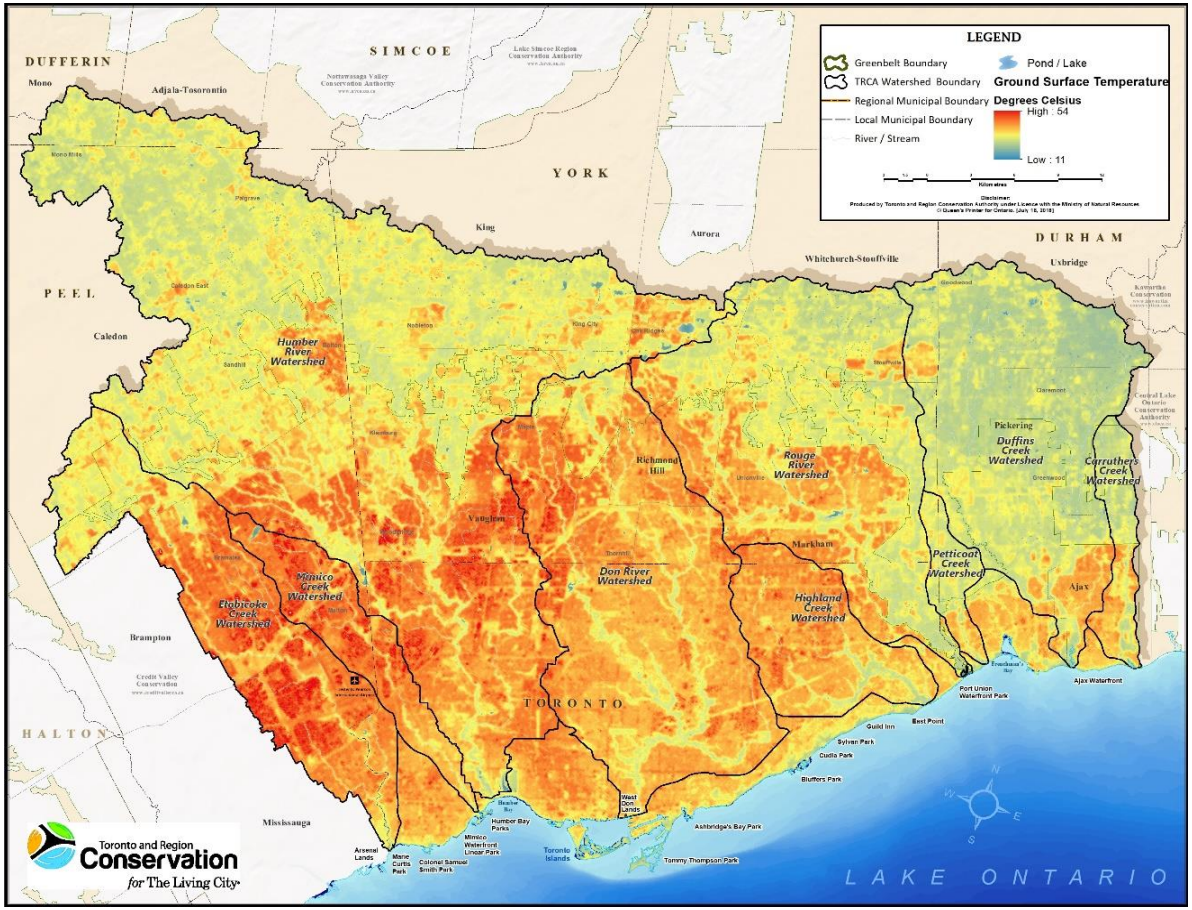
C. Habitat patch score (shape, edge, connectivity) 

D. Soil drainage rating (texture + slope) 

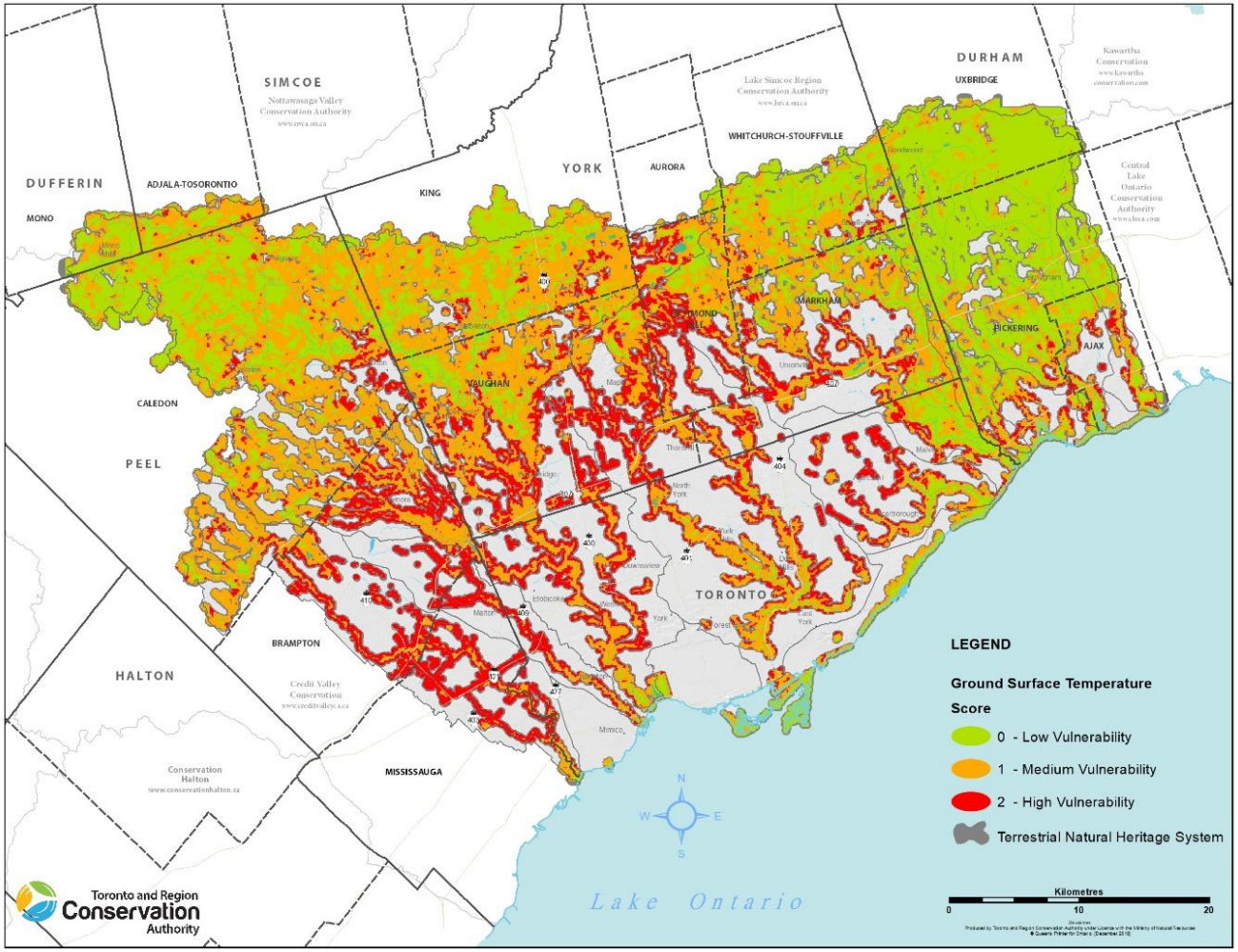
E. Wetland vulnerability (stability of hydrological regime) 

→ Additive score = sum of equally weighted individual vulnerability scores

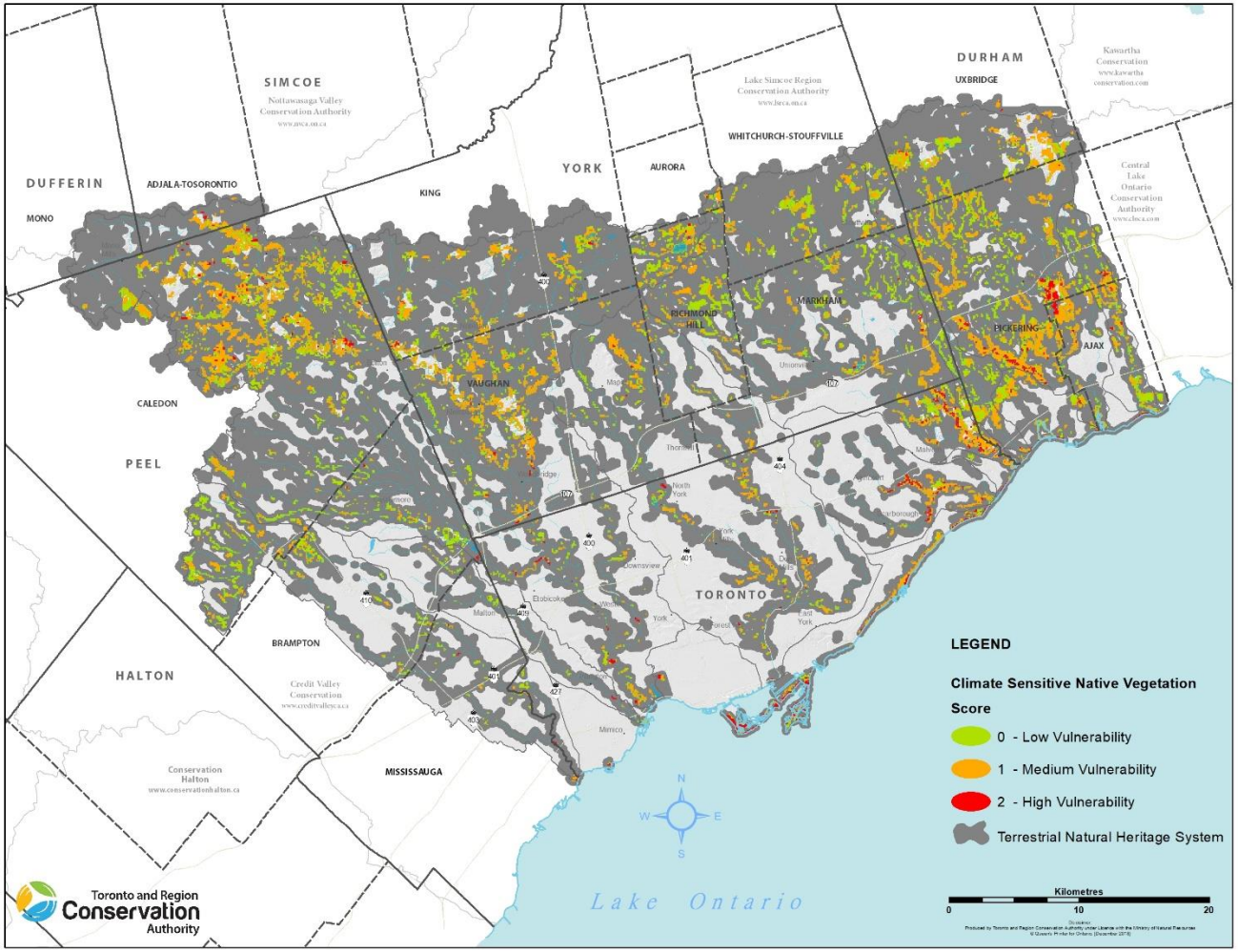
A. Ground surface temperature



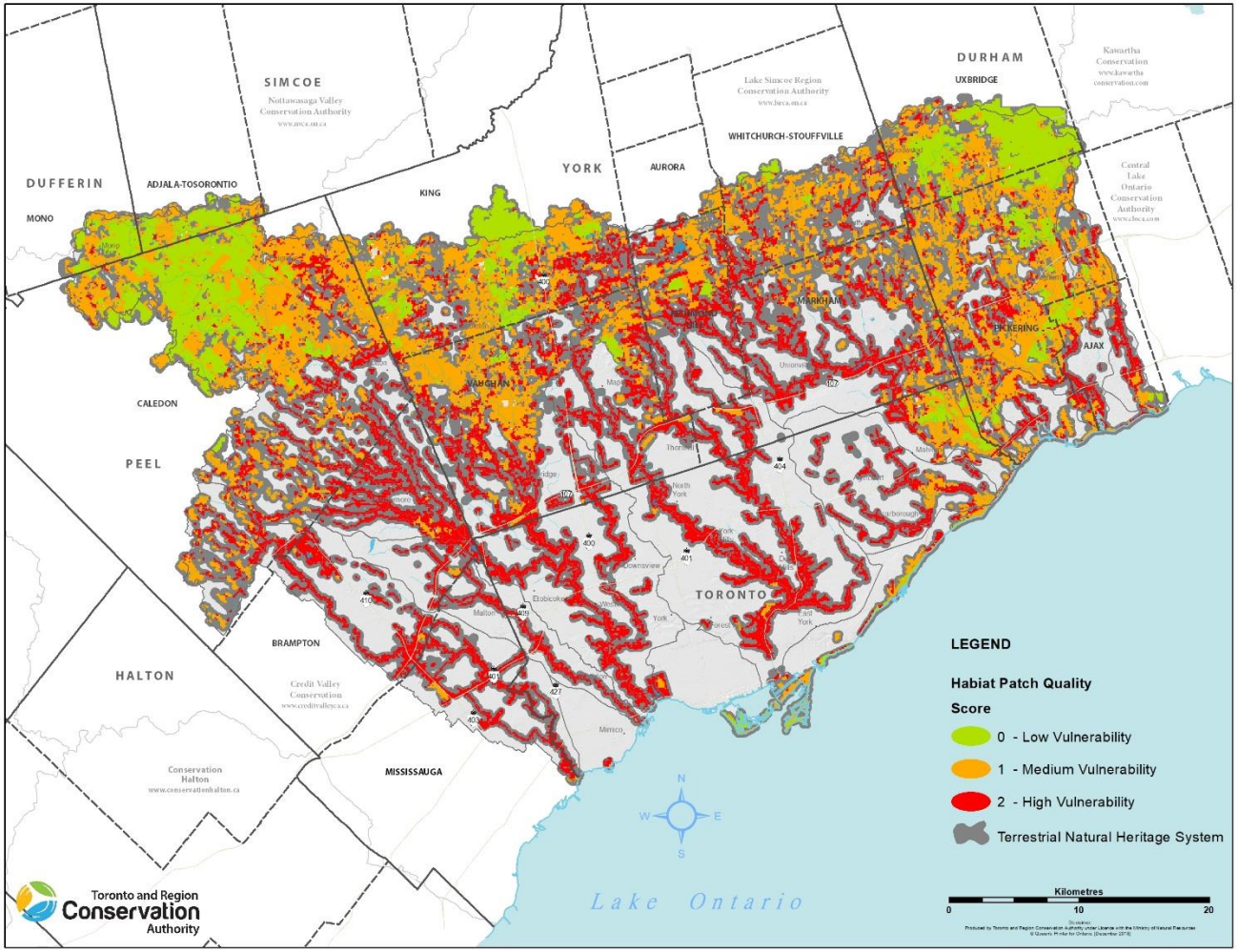
A. Ground surface temperature



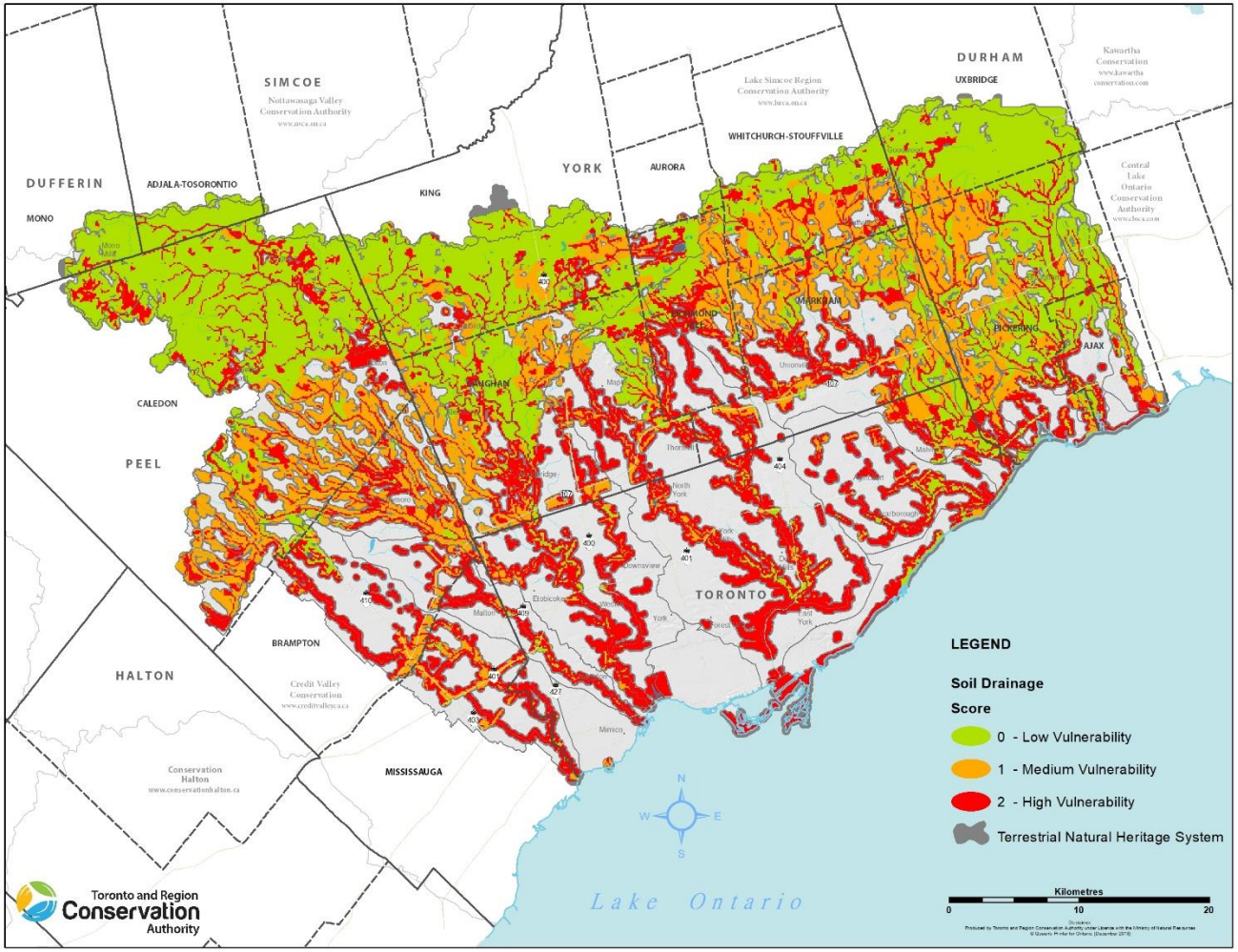
B. Climate sensitive native vegetation



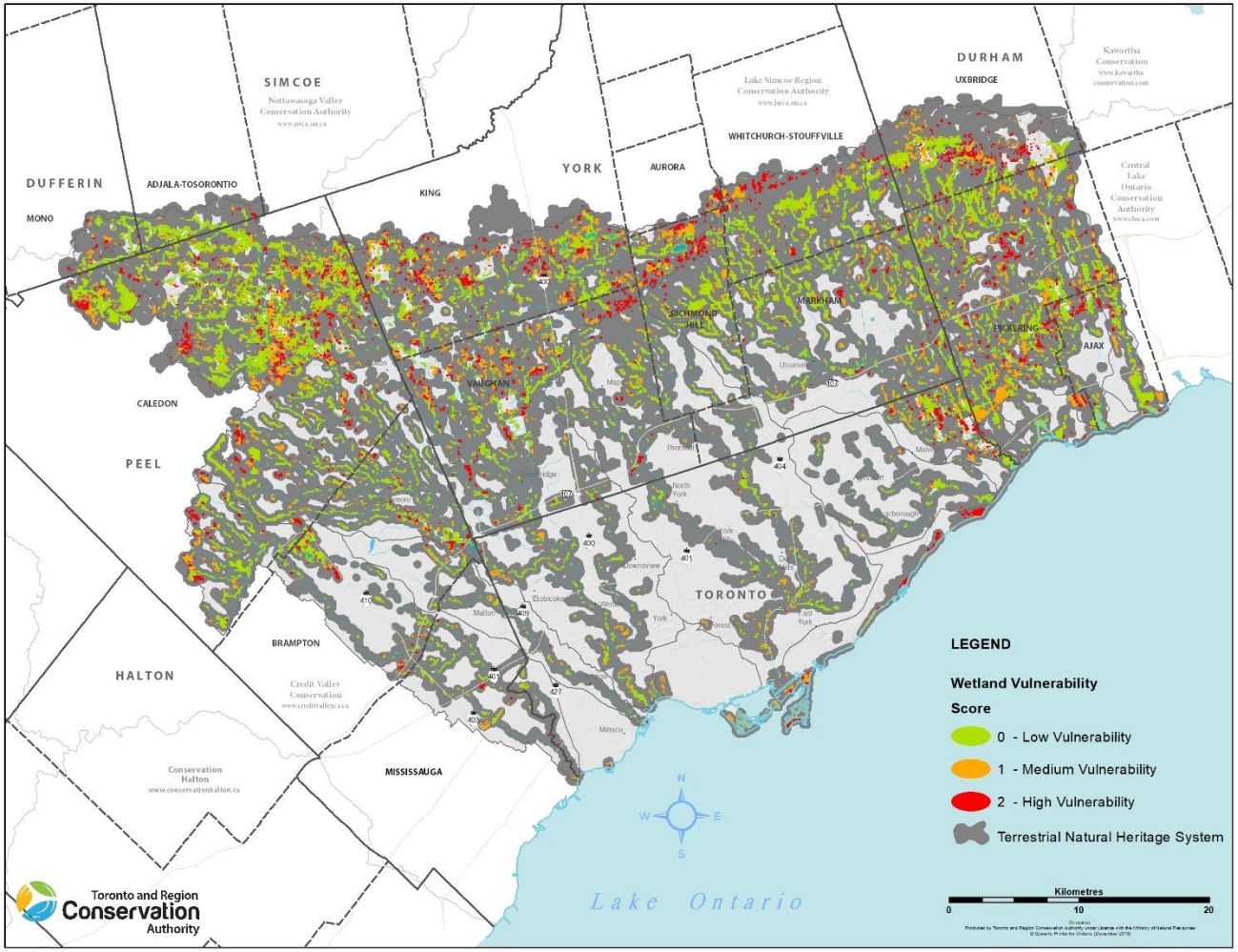
C. Habitat patch quality



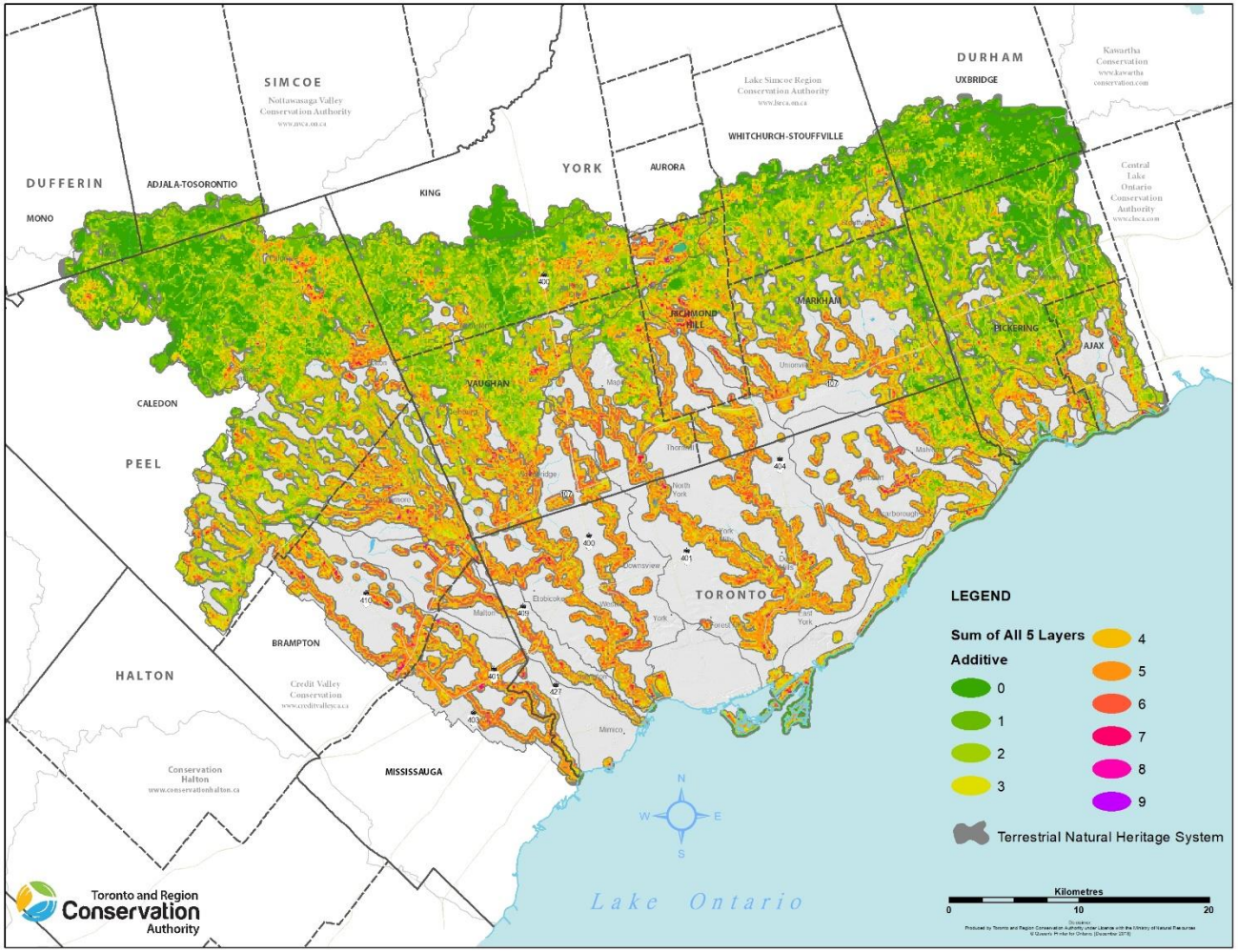
D. Soil drainage rating



E. Wetland hydrological stability



Final additive vulnerability score (1-10)



Application to ecosystem management

- Restoration planting programs
  - Community types to plant (more resilient species/communities)
  - Where to target planting/restoration (IRP; high vulnerability areas)
  - Compensation
- Species migration/connectivity
- Watershed planning

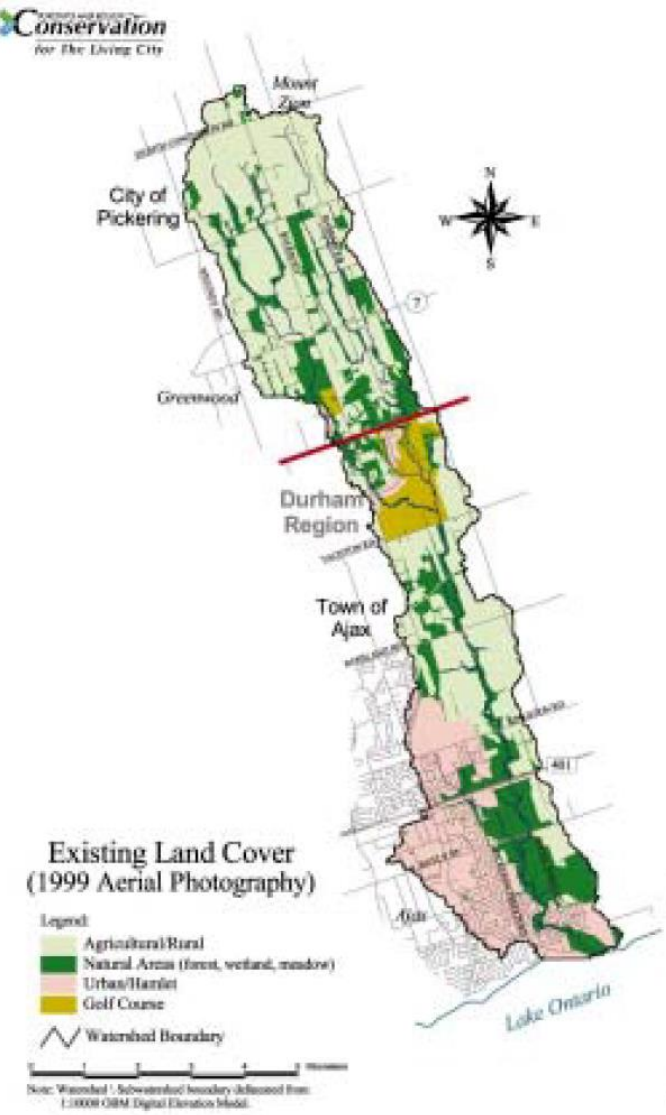
Project Example 4 – Watershed Planning

Toronto and Region Conservation Authority

Watershed planning

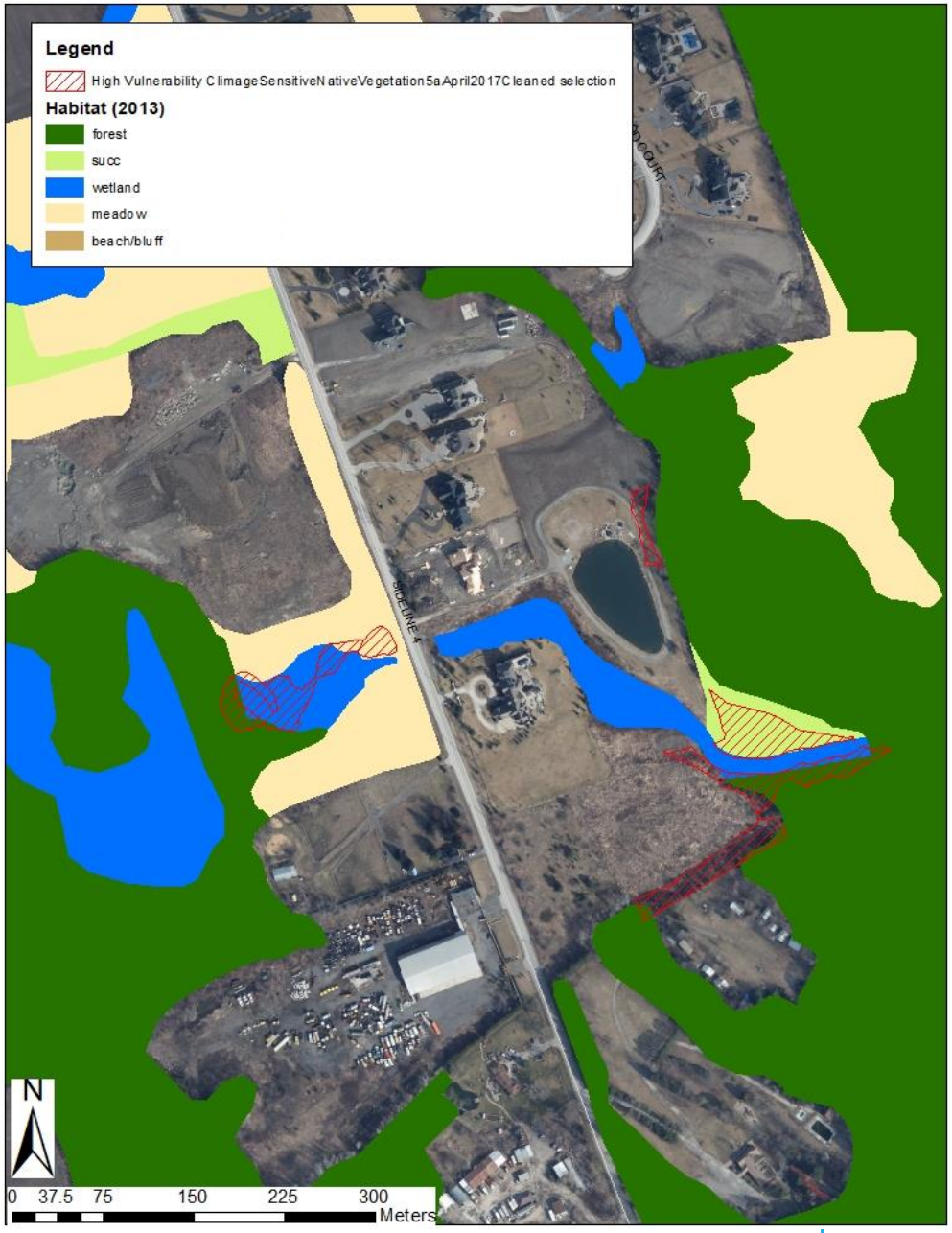
- Formally introduced in 1946 through the Conservation Authorities Act
- Tool for identifying natural systems for protection, providing water management recommendations and the overall protection of ecosystem function at an ecologically relevant scale
- Updating watershed plans now
- Scenario analysis
  - Current
  - + Official plan
  - + Enhanced Natural Heritage system
  - + Development

2003 Carruthers Creek Watershed Plan



Tools for watershed planning

- Climate change vulnerability assessment layer
  - Include high vulnerability vegetation communities in the natural heritage system
  - Target high vulnerability urban areas for mitigation



Tools for watershed planning

- Water quality and quantity modelling
  - Soil and water assessment tool (SWAT)
- Groundwater quality and quantity modelling
  - Discharge
  - Ecologically significant groundwater recharge areas (ESGRAs)
- Need to look across watershed boundaries too (ESGRAs, habitat connectivity)

In-class exercise

- You work for the TRCA and you have been asked by “Region X” to determine if several stormwater management ponds (SWMPs) are affecting the temperature of stream X
- This reach of stream X is occupied by Redside Dace (*Clinostomus elongatus*)
- You have a group of field staff at your disposal along with
  - Temperature loggers
  - Flow gauges (for discharge)

Exercise

- Each group does a bit of research on one aspect (~15 min)
  - SWMPs (benefits, issues, mitigation)
  - Redside Dace (thermal and other habitat needs)
  - Temperature loggers and flow gauges (what they are and what they can do)
- Present information (<5 min/group = 15 min)
- Each group uses combined knowledge to think of a monitoring plan and analysis (15 min)
- Each group presents plan/analysis (5 min each = 15 min)

For more about TRCA's programs:

https://trca.ca/conservation/flood-risk-management/
https://trca.ca/conservation/erosion-risk-management/
https://trca.ca/conservation/environmental-monitoring/
https://trca.ca/conservation/sustainable-neighbourhoods/
https://sustainabletechnologies.ca/
https://ctcswp.ca/
@TRCA_HQ

Questions/comments/discussion

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