McMaster GWFO Update

New (proposed) GWFO Site - West Campus WELL Network

Sensors Logging every 10 Minutes

Weather Station (WS)
- Air temperature and humidity
- Rain gauge
- Wind speed and direction
- Solar radiation
- Soil temperature and moisture

Water Level Loggers (WL)

Water Quality Sensor (WQ)
- Water temperature
- DO
- Conductivity/Salinity
- Turbidity
- TDS
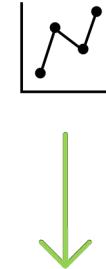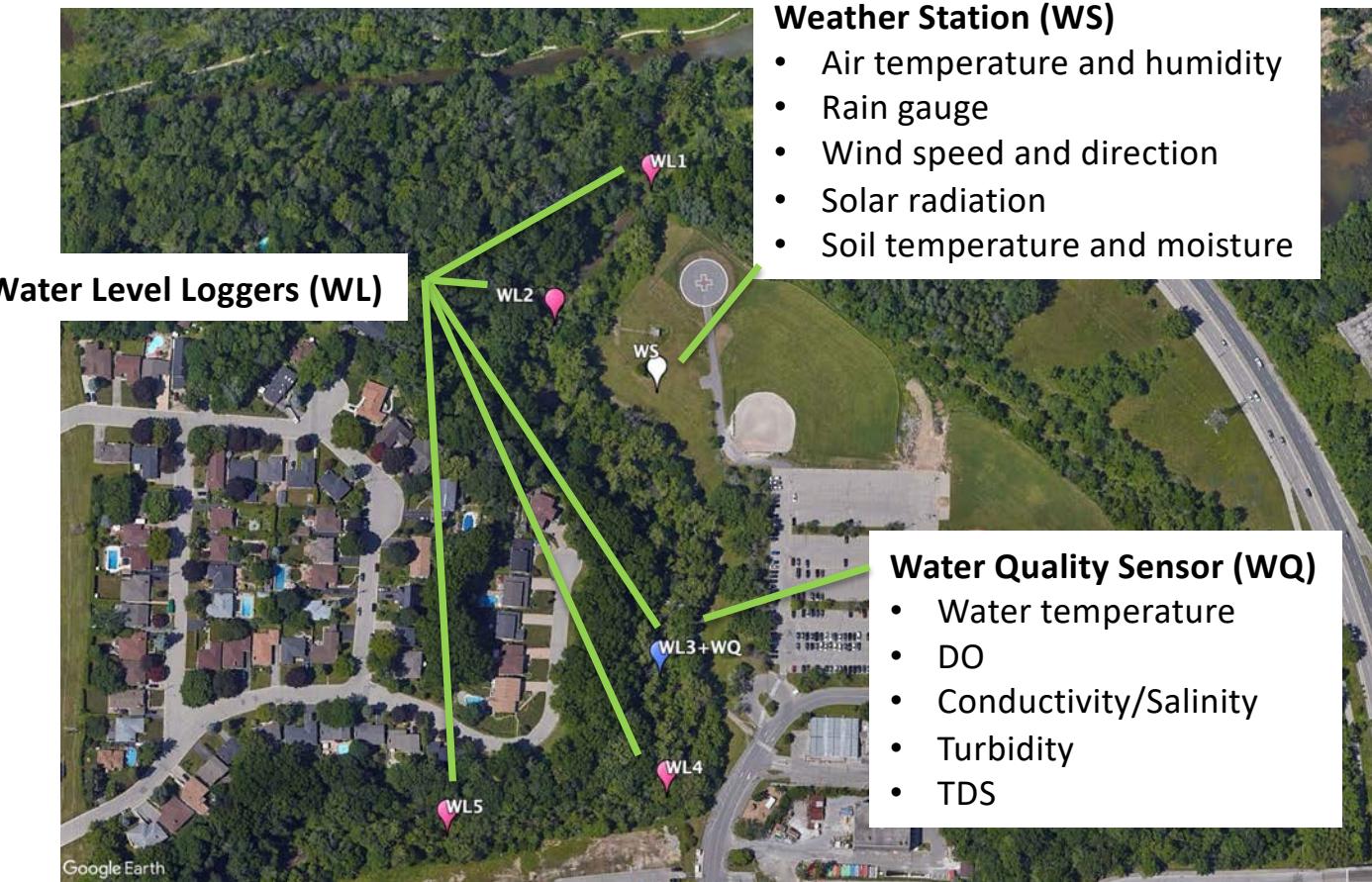
Data remotely sent to online database
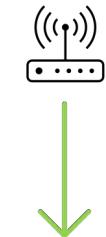
Online dashboard updated in real-time

Ancaster Watershed Monitoring Sites
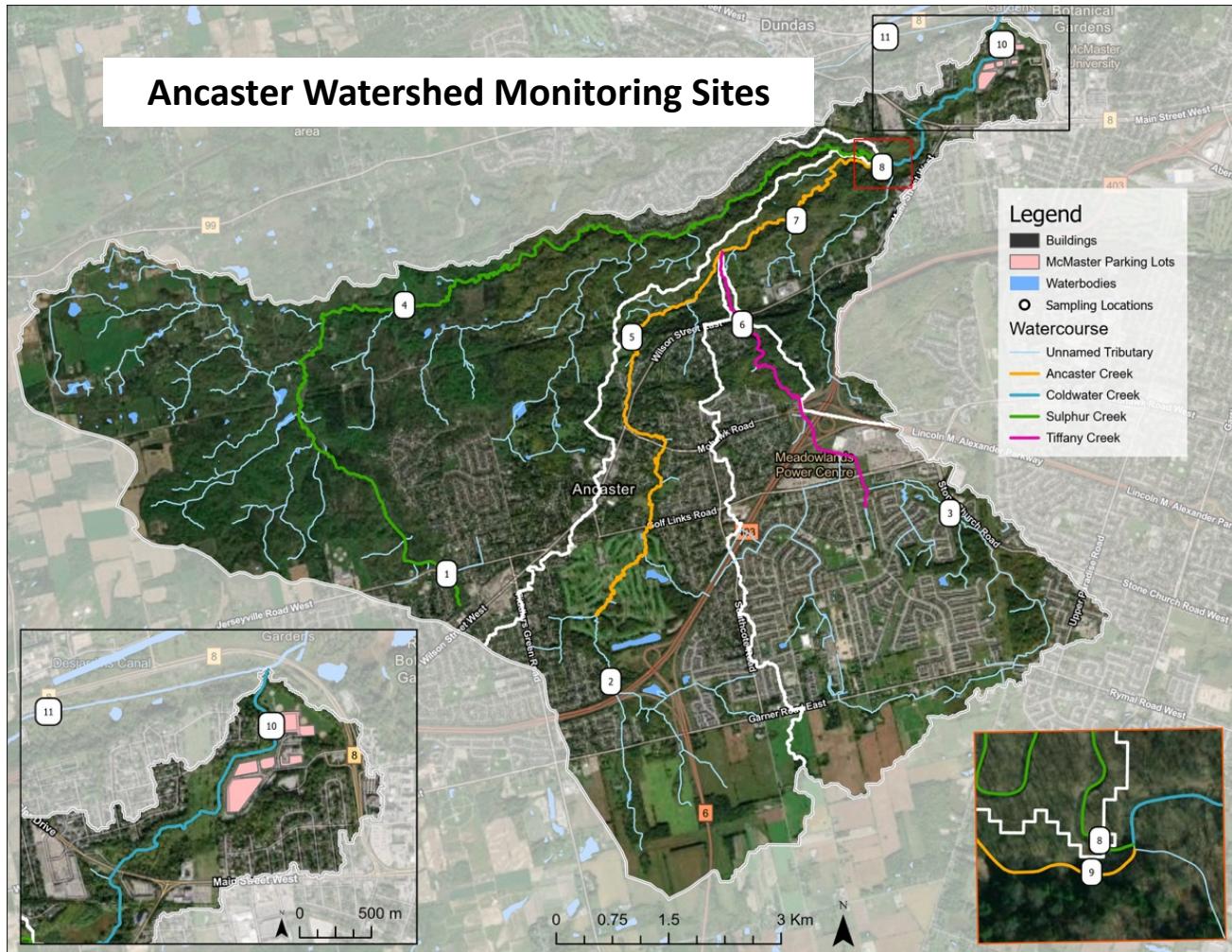
Water Quality (bi-weekly)
- Water chemistry
- Nutrients
- E. coli

Ecology (seasonally)
- Fish
- Benthic invertebrates

Geomorphology (yearly)
- Channel dimensions
- Channel slope
- Substrate

West Campus WELL Network

Nibi (Water) Observatory for Boreal Ecohydrological Landscapes

An Ecohydrological Observatory for Watersheds and Wetlands in the Georgian Bay Biosphere Mnidoo Gamii

GEORGIAN BAY BIOSPHERE
MNIDOO GAMII

Nibi is Anishinaabemowin for Water and NOBEL is located on traditional Anishinabek territory

Photo: Joseph Hartmann

NOBEL

# Nibi (Water) Observatory for Boreal Ecohydrological Landscapes

Data collected

- Reference EC station 2015–present
- Post-fire EC tower 2019–present
- Water level (logging) at 64 sites
  - 36 sites deployed prior to 2021
- Discharge at 16 sites (burned and unburned)
- Time-lapse photography
  - Vegetation phenology
  - Snow depth
- Soil moisture and temperature
- Micrometeorological
  - T/RH; solar radiation; wind speed; rainfall; atmospheric pressure

NOBEL

Soil Burn Severity

Hydrological Implications of Impact of Organic Soil Combustion?

RdNBR
High: 1500
Low: -500

N

0 1 2 3 4 5 Kilometers
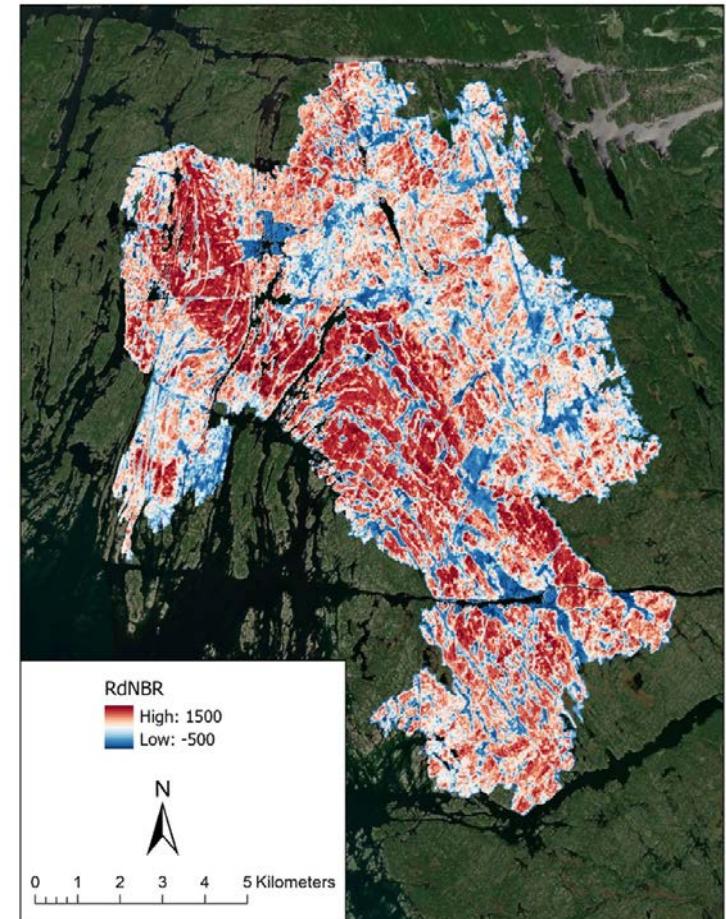
McMaster Ecohydrology Lab
Lab publication: Tekatch et al., 2025 (Ecohydrology)

Soil Burn Severity

Combustion of organic soil

# Re-PEAT: Post-fire soil development

Re-PEAT: Post-fire soil development

McMaster Ecohydrology Lab

GWFO - Turkey Point Observatory
CA-TP1, CA-TP3, CA-TP4, CA-TPD, CA-TPA, Flux Sites

-Turkey Point Flux Station
  (42° 42' 55'' N, 80° 22' 20'' W)
  about 20 km southwest of Port Dover,
  near Lake Erie in Southern Ontario.

- Conifer White Pine Age-sequence forests (2002
- Deciduous Carolinian forest (2012)
- Agricultural site (2020)
-All five sites within 20 km radius

- Mean annual temperature: 8.0 °C
- Mean annual precipitation: 1036 mm

83-yr Pine site tower

'20-year-old' - TP02
Base diameter: 11.6 cm
Height: 5.8 m,
~ 1567 trees/ha
CA-TP1
2004 photo

'48-year-old' – TP74
DBH: 17.9 cm
Height: 16.2 m
~ 1600 trees/ha
CA-TP3

'83-year-old' – TP39
DBH: 37.2 cm
Height: 22.9 m
~ 413/321trees/ha
CA-TP4

'90+-year-old' – TPD
DBH: 23.1 cm
Height: 25.7 m
~504 trees/ha
CA-TPD
Deciduous Forest

Agricultural Site – TPAg
Land area 36 ha
CA-TPA

Turkey Point Observatory - 2026 Updates

- CA-TP1 site (2002 pine plantation site) terminated in December 2025 after 24 years of operation. Trees grew taller than flux tower (limited fetch).

- **A new site called CA-TPU (TP urban) established and fully operation as of January 2026, located new McMaster Campus on a newly planted forest in a suburban area. Tower is 10m tall. Site has solar & AC power.**

- All five TPO site have been upgraded with SmartFlux system.

- Four sites upgraded with Li-7200 IRGAs, while TPU site uses new Li-7500 IRGA.

- TPO is now representative of all major biomes and land cover types in the Great Lakes region.

CA-TPU (urban site) - Ancaster

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(LiDAR, Alex Peace)
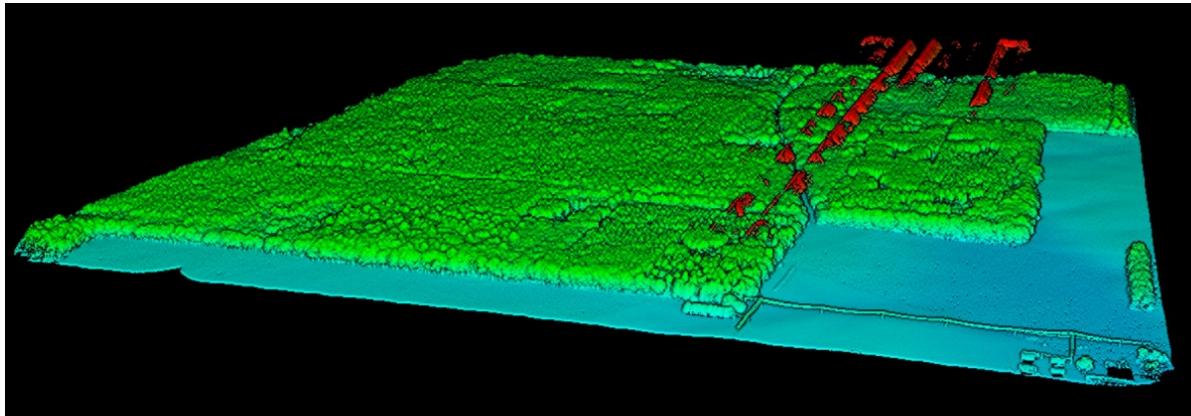
Turkey Point Observatory –2025 Publications

- Arango Ruda, E., & Arain, M. A. (2025a). Impacts of drought on water fluxes and water-use efficiency in an age-Sequence of temperate conifer forests. *Hydrological Processes,* 39: e70134. https://doi.org/10.1002/hyp.70134

- Arango Ruda, E., & Arain, M. A. (2025b). Evaluating hysteresis patterns in sap flow of a red pine forest subjected to different variable retention harvesting treatments. *Journal of Geophysical Research: Biogeosciences,* 130, e2024JG008363. https://doi.org/10.1029/2024JG008363

- Steinschneider, S., Arain, M.A., Coulibaly, P., Gronewold, A., Gail K., (2025). Climate and hydrologic change across the Great Lakes region in North America and other transboundary waters. *Open Access Government.* openaccessgovernment.org/article/climate-and-hydrologic-change-across-the-great-lakes-region-and-other-transboundary-waters/194486.

- Reed, D., Chu, H., Peter, B., Chen, J., Abraha, M., Amiro, B., Anderson, R.G., Arain, M., et al., 2025. Network of networks: Time-series clustering of Ameriflux sites. *Agricultural and Forest Meteorology.* 372 (2025) 110686. https://doi.org/10.1016/j.agrformet.2025.110686.

- De, R., Bao, S., Koirala, S., Brenning, A., Reichstein, M., Tagesson, T., Liddell, M., Ibrom, A., Wolf, S., Šigut, L., Hörtnagl, L., Woodgate, W., Korkiakoski, M., Merbold, L., Black, T.A., Roland, M., Klosterhalfen, A., Blanken, P.D., Knox, S., Sabbatini, S., Gielen, B., Montagnani, L., Fensholt, R., Wohlfahrt, G., Desai, A.R., Paul-Limoges, E., Galvagno, M., Hammerle, A., Jocher, G., Reverter, B.R., Holl, D., Chen, J., Vitale, L., Arain, M.A., Carvalhais, N., (2025). Addressing Challenges in Simulating Inter–Annual Variability of Gross Primary Production. *Journal of Advances in Modeling Earth Systems*, 17(5) e2024MS004697. https://doi.org/10.1029/2024MS004697

- Deen T.A., Arain M.A., Champagne O., Chow-Fraser P., Nagabhatla N., Martin-Hill D. (2025). Blue and Green Water Scarcity in the McKenzie Creek Watershed of the Great Lakes Basin. *Hydrological Processes.* 39:e70038. https://doi.org/10.1002/hyp.70038.

- Arain, M.A., (2025e). Assessing the impacts of climate stressors, natural disturbances and management activities on forest ecosystems in the Great Lakes region. The Professional Forester by Ontario Professional Foresters Association (OPFA). 258: 25-30.

Turkey Point Observatory – Data Publications

- M. Altaf Arain (2025a), AmeriFlux FLUXNET-1F CA-TP1 Ontario - Turkey Point 2002 Plantation White Pine, Ver. 5-7, AmeriFlux AMP, (Dataset). https://doi.org/10.17190/AMF/2006962

- M. Altaf Arain (2025b), AmeriFlux BASE CA-TP4 Ontario - Turkey Point 1939 Plantation White Pine, Ver. 5-5, AmeriFlux AMP, (Dataset). https://doi.org/10.17190/AMF/1246012

- M. Altaf Arain (2025c), AmeriFlux BASE CA-TPA Ontario Turkey Point Observatory Agricultural Site, Ver. 1-5, AmeriFlux AMP, (Dataset). https://doi.org/10.17190/AMF/2563529

- M. Altaf Arain (2025d), AmeriFlux FLUXNET-1F CA-TPD Ontario - Turkey Point Mature Deciduous, Ver. 5-7, AmeriFlux AMP, (Dataset). https://doi.org/10.17190/AMF/1881567

GWFO Yukon Sites

- Wolf Creek Research Basin
- Tombstone Waters Observatory
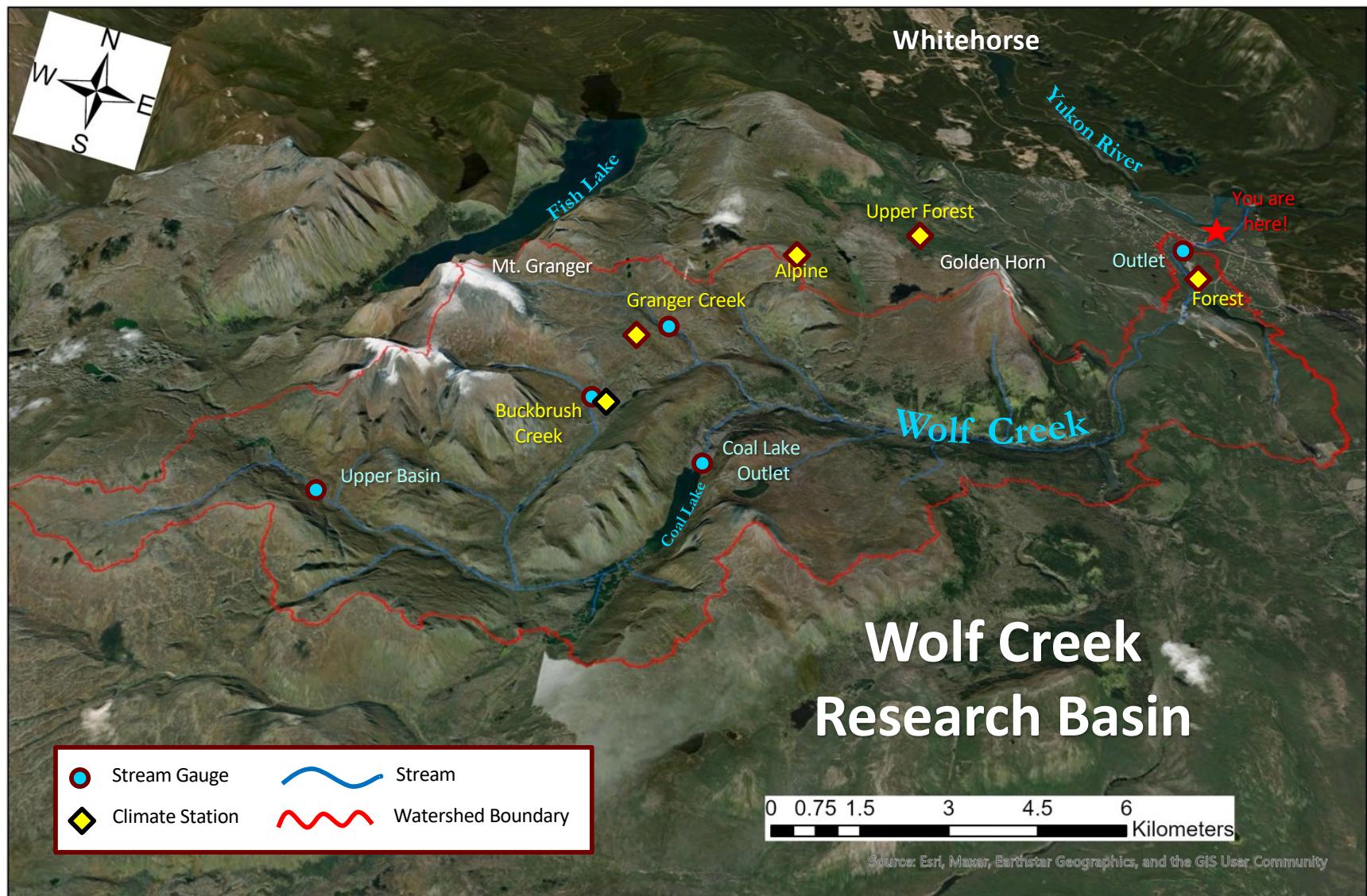
Traditional territories of the Kwanlin Dün, Ta'an Kwäch'än Council and Carcross/Tagish First Nations

Long-term climate and water measurements

Forest   Upper Forest   Buckbrush   Plateau   Alpine
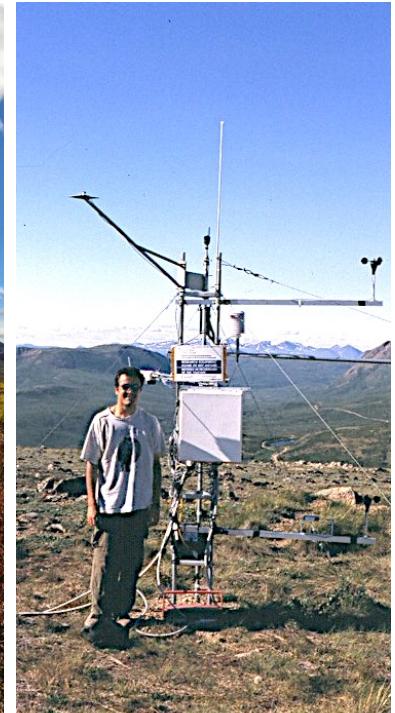
Measurements in Wolf Creek began in 1993, and is the second oldest northern hydrological observatory

Tombstone Waters Observatory

Watershed Hydrology Group
McMaster University

GWFO GLOBAL WATER FUTURES OBSERVATORIES

Objectives

Understand the vulnerability of water resources and their response to climate change along the Dempster Highway.

- Streamflow and Flooding
- Water Quality
- Permafrost Thaw
- Climate Change

About Us

Scientists and Students from McMaster University, Carleton University, University of Calgary and Yukon University

Our Goal

Establish streams and rivers along the Dempster Highway as long term observatories of environmental change working with the Tr'ondëk Hwëch'in Hän Nation and other stakeholders

Km185
Km175
Km104
Km99
Km71
Km44

Land Cover
- Forest
- Shrub
- Grasses/Mosses/Lichens
- Bare
- Water
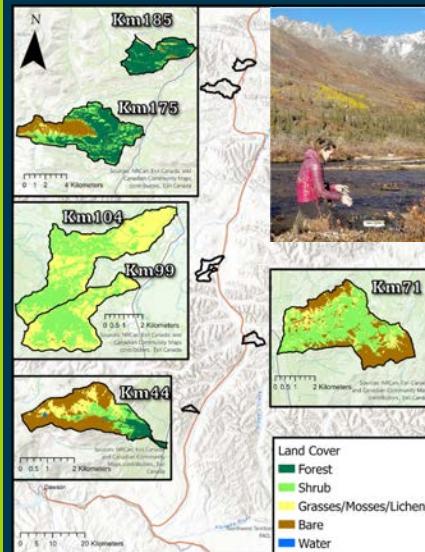
Watersheds of Interest

— PLEASE GET IN TOUCH —
Sean Carey - McMaster University
✉ careysk@mcmaster.ca

Km 185
Km 180
Km 175

Km 104
Km 99
Km 71
Km 44
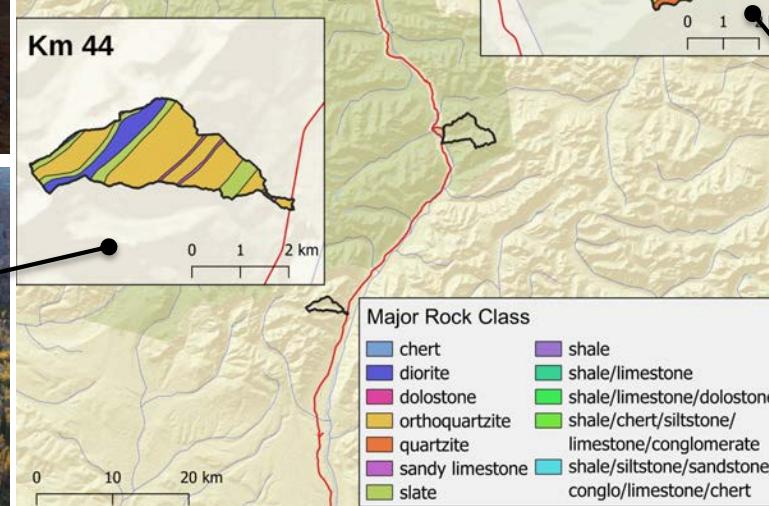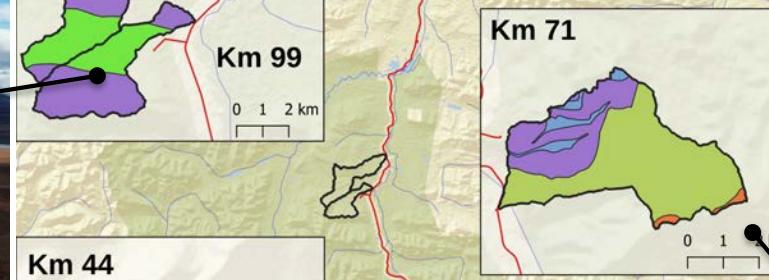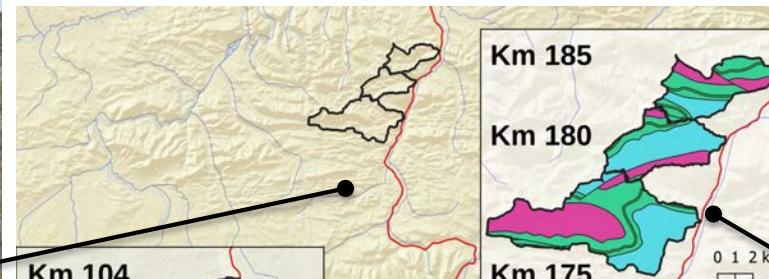
Major Rock Class

chert	shale
diorite	shale/limestone
dolostone	shale/limestone/dolostone
orthoquartzite	shale/chert/siltstone/
quartzite	limestone/conglomerate
sandy limestone	shale/siltstone/sandstone/
slate	conglo/limestone/chert

We are seeing changes now wherever we look - 2025