Brook Trout in the Toronto Region: Boyce's and Centerville Creek Case Study

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TORONTO & REGION
REMEDIAL ACTION PLAN

Region of Peel
Working for you

The Living City Foundation

Toronto and Region Conservation
for The Living City

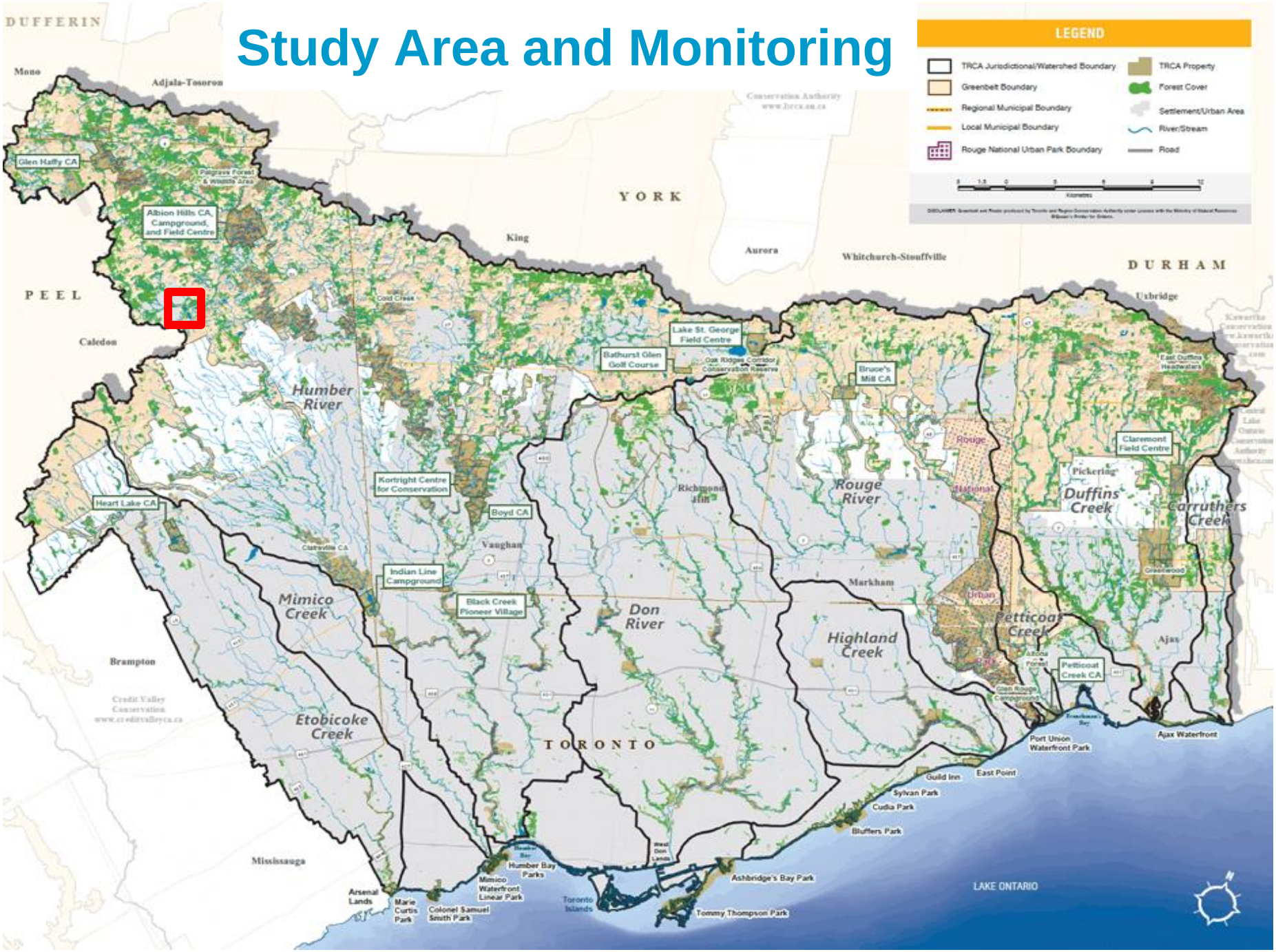
Monitoring Background

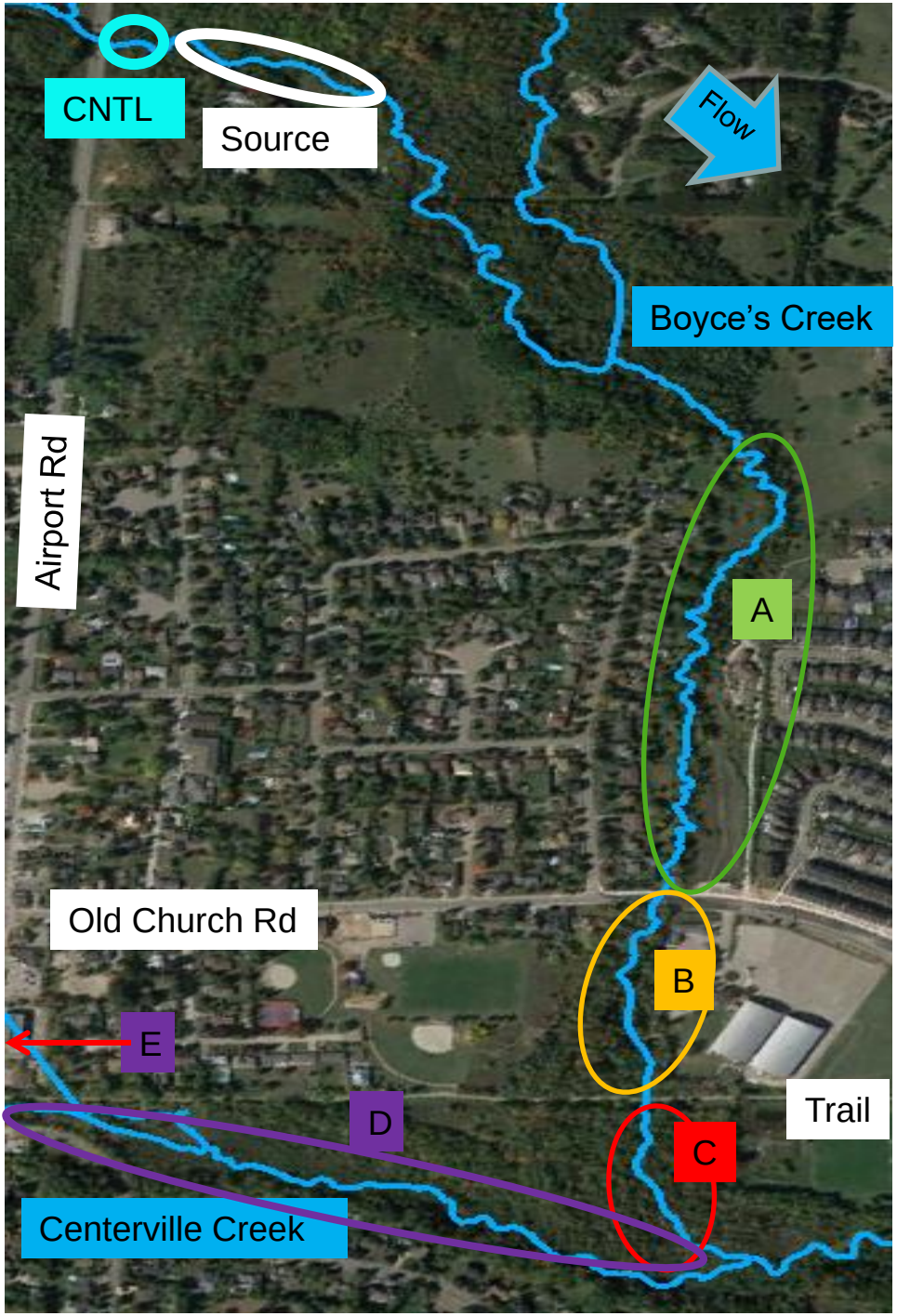
Purpose:

1) To identify potential impacts from municipal groundwater taking on local stream ecosystem.
2) Assist the Region of Peel with on-going and longer term decision making regarding water-taking and supply needs

Brook Trout used as an indicator species due to dependence on groundwater for spawning nests (redds)

Study Area and Monitoring





Monitoring (2004-2012)

- Temperature
- Groundwater Pumping Rates
- Brook Trout abundance and size
- Spawning activity (# Redds)
- Comparing pre-pumping years (2004-2006) to post **pumping years (2007-2016)**

- 2011 Sediment Loading Events reported

Monitoring (2012-2016)

- Turbidity
- Particle Sediment size


CNTL
Source
Boyce's Creek
Airport Rd
A
Old Church Rd
B
Trail
D
C
Centerville Creek

Questions

1. Temporal trends in Brook Trout:
    A) Spawning Activity (# Redds)
    B) CPUE

2. Water temperature, ground pumping rates, and sediment loading events

- Temperature positive relationship with Groundwater Pumping

*- Comparing pre-pumping (2004 - 2006) to **post pumping** (2007-2016)*

- Sediment events reported in 2011 and continue to 2016

Temporal trend in Spawning

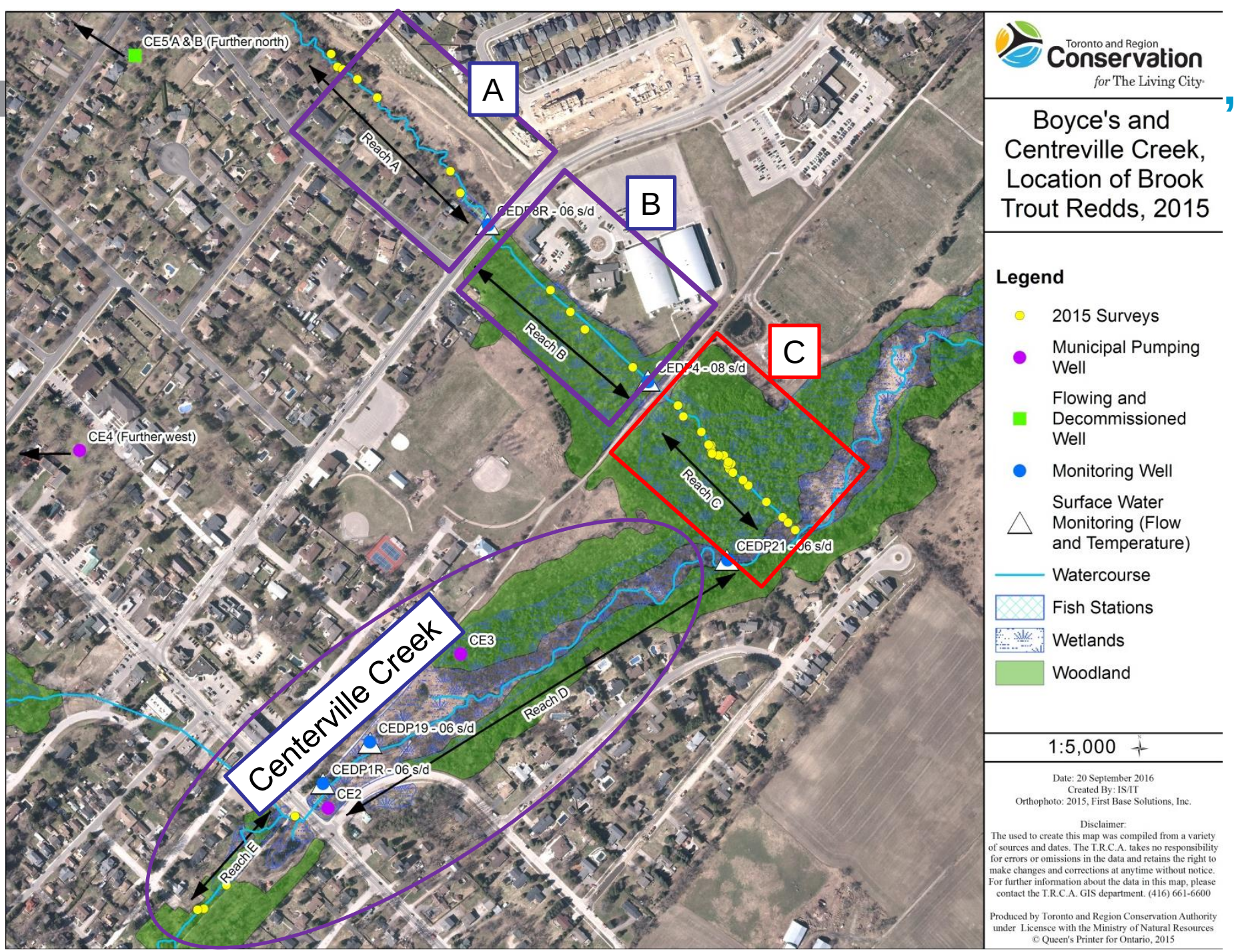
Continue (less frequency and magnitude)

Pumping increases

Pre-Pumping Baseline

Year

Pumping rate decreased significantly



Toronto and Region Conservation for The Living City

Boyce's and Centreville Creek, Location of Brook Trout Redds, 2015

Legend

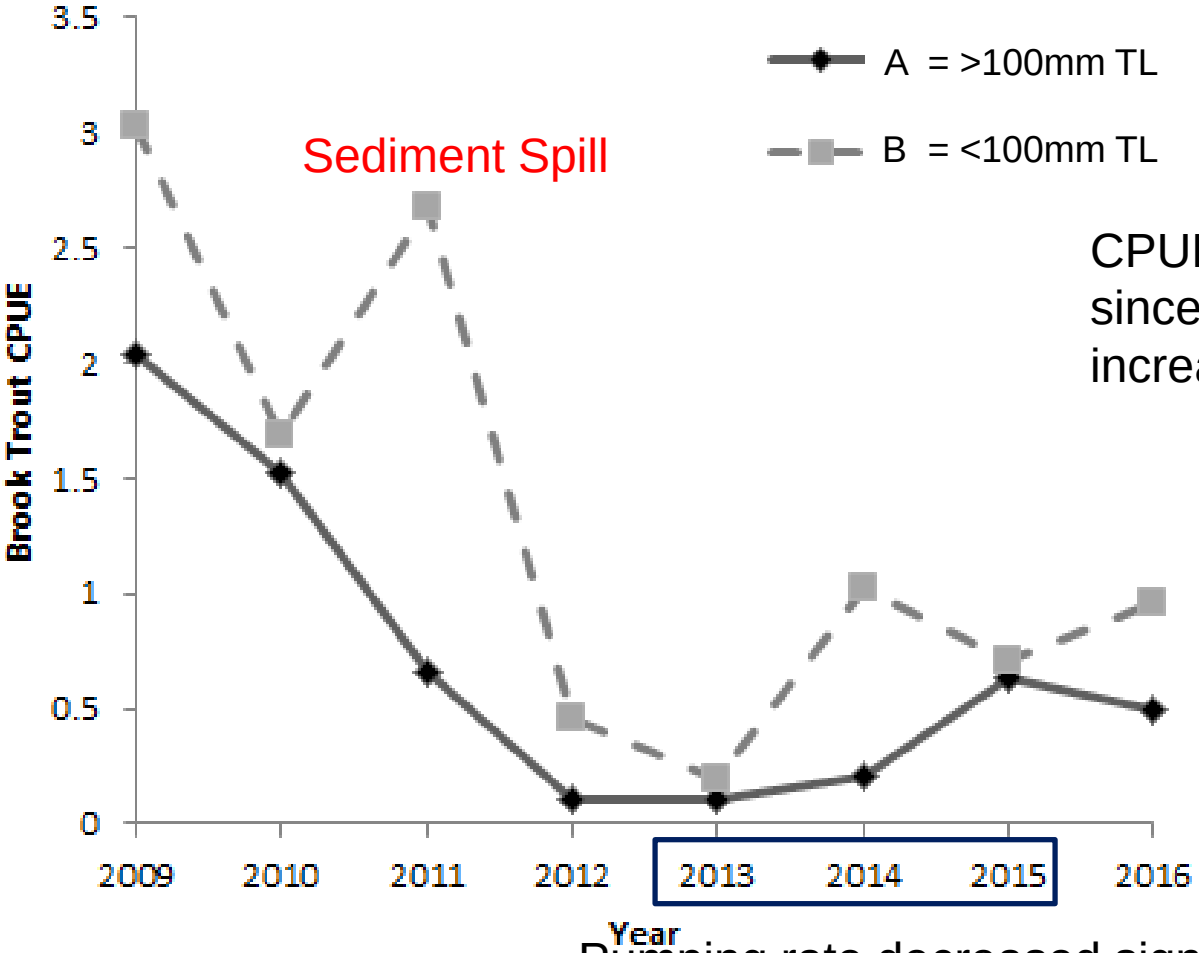
- 2015 Surveys
- Municipal Pumping Well
- Flowing and Decommissioned Well
- Monitoring Well
- Surface Water Monitoring (Flow and Temperature)
- Watercourse
- Fish Stations
- Wetlands
- Woodland

1:5,000

Date: 20 September 2016
Created By: IS/IT
Orthophoto: 2015, First Base Solutions, Inc.

Disclaimer:
The used to create this map was compiled from a variety of sources and dates. The T.R.C.A. takes no responsibility for errors or omissions in the data and retains the right to make changes and corrections at anytime without notice. For further information about the data in this map, please contact the T.R.C.A. GIS department. (416) 661-6600

Temporal trend in CPUE
Boyce's Creek

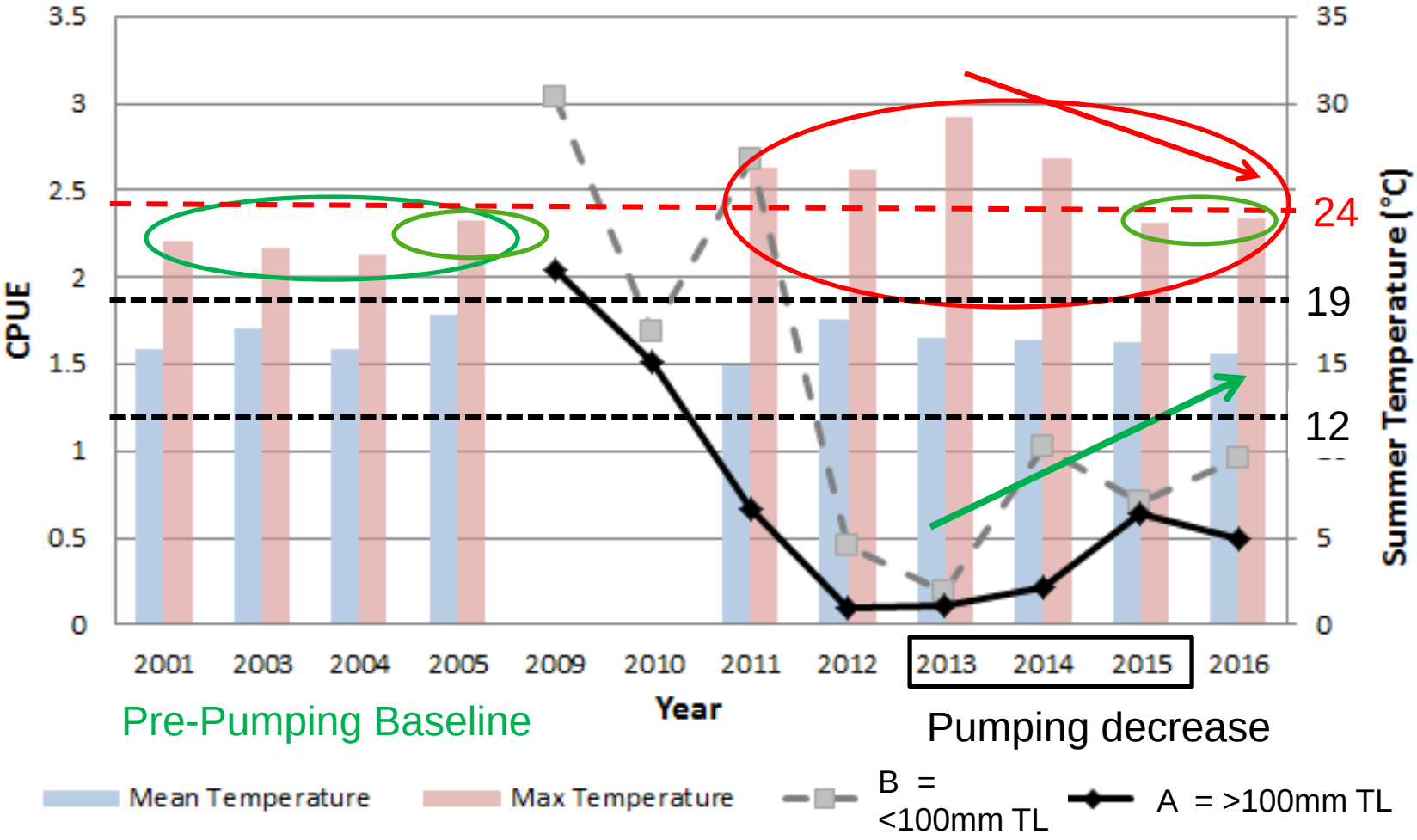


CPUE has decreased over time since pumping began with slight increase from 2013-2016

Pumping rate decreased significantly

Water Temperature and CPUE

Boyce's Creek



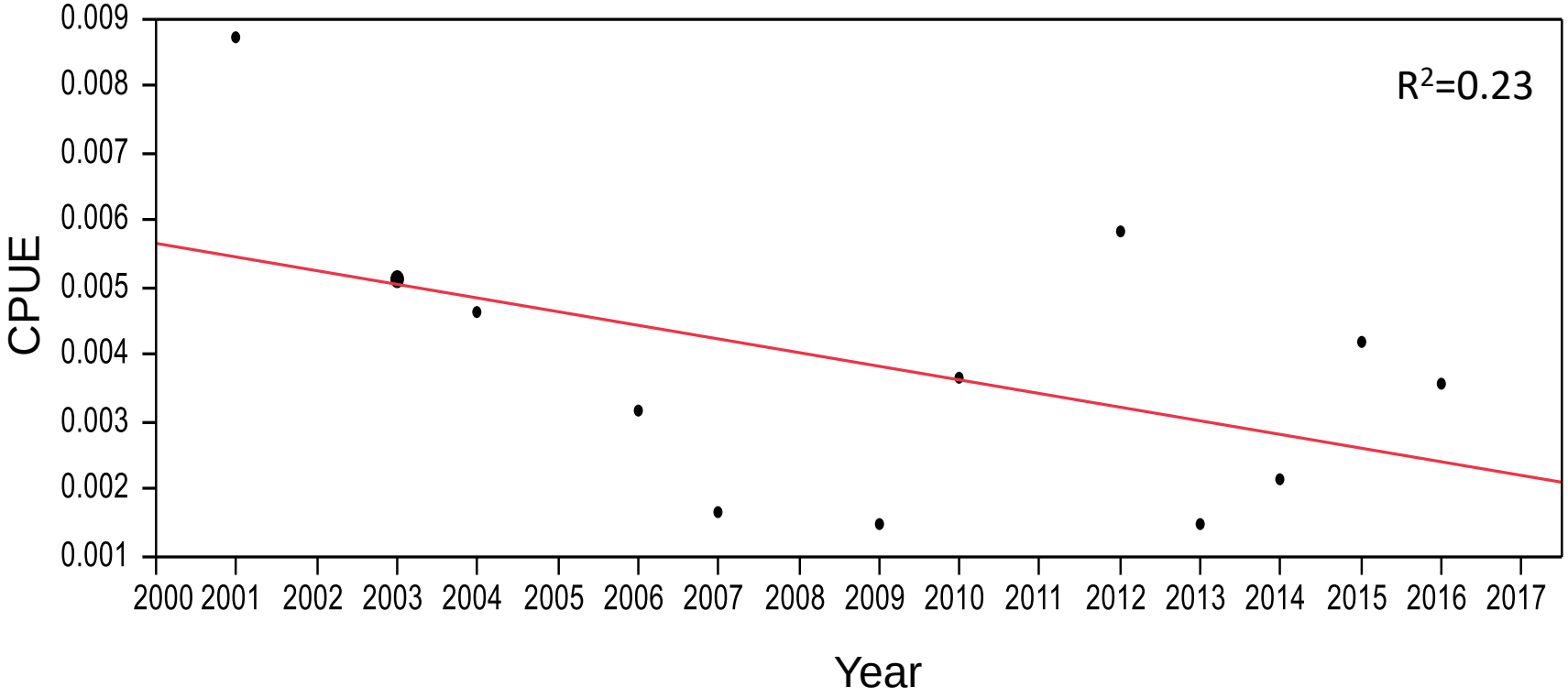
Optimal Temperature Range (Waco and Taylor, 2010, Wehrly *et al*., 2003)

Conclusion and Extrapolation

- CPUE decreased with significant differences between pre and post ground water pumping years.
- Spawning decreased with increased ground water pumping rates but also due to sediment loading events.
- Water temperature has an inverse relationship with Groundwater pumping rates.

- Do we see similar trends in Brook Trout across the Toronto Region?

Trend in TRCA Brook Trout Occurrence:

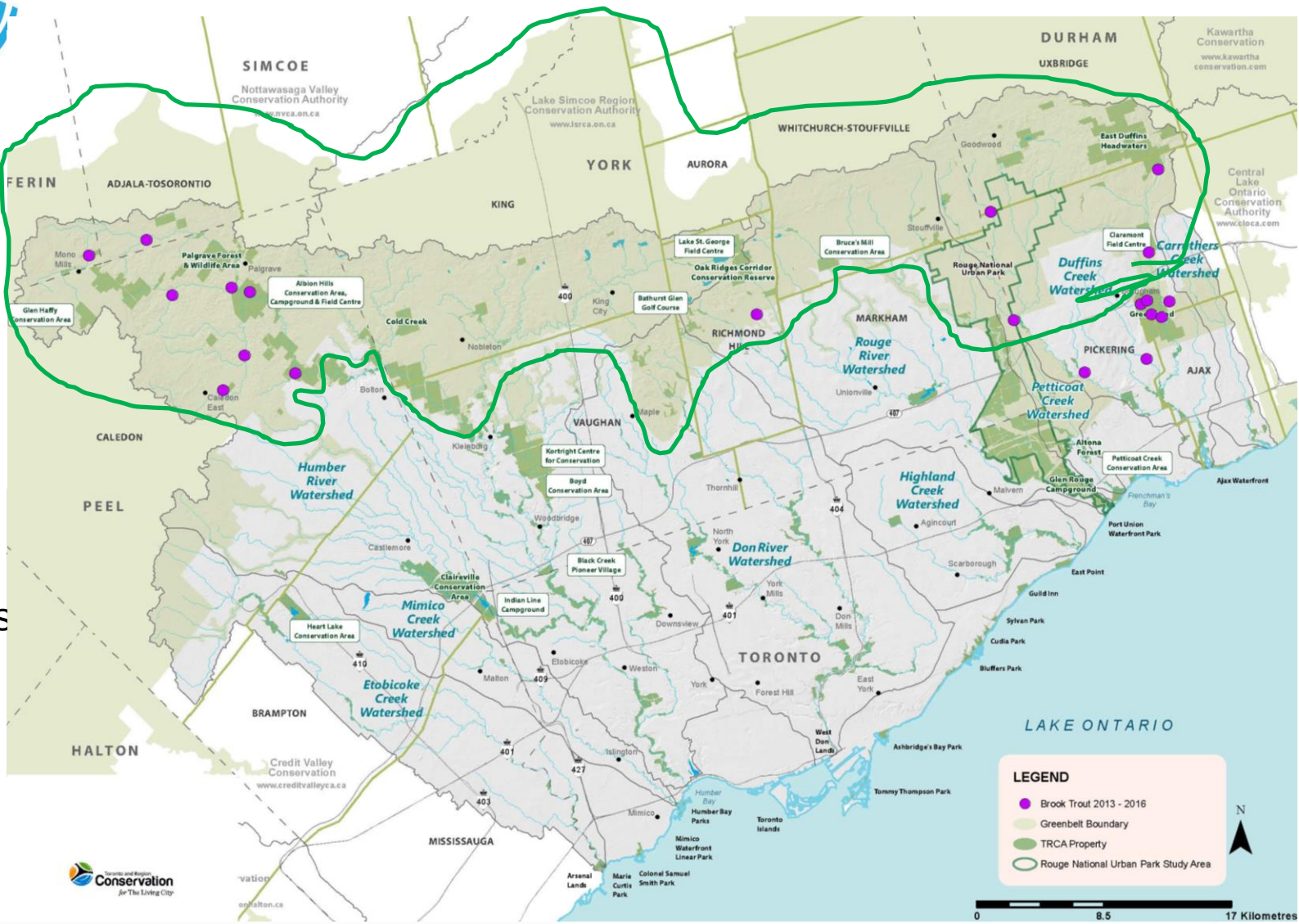


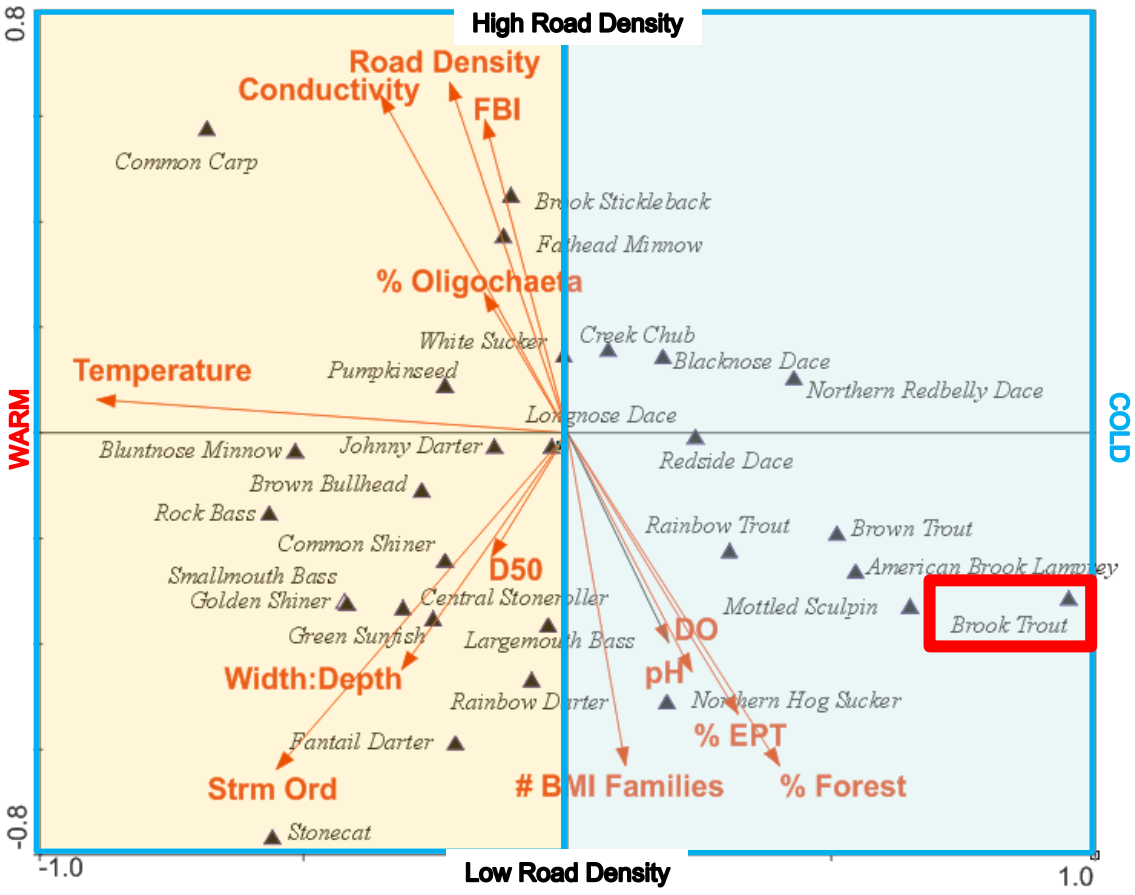
CPUE = 0.4143185 - 0.0002043*Year

Where do we find Brook Trout in TRCA Jurisdiction?

2001 - 2012
- 38 sites
- 3 watersheds (Humber, Rouge, Duffin's)
- Green Belt, ORM lands

2013 - 2016
- 19 sites
- 3 watersheds (Humber, Rouge, Duffin's)
- Green Belt, ORM lands





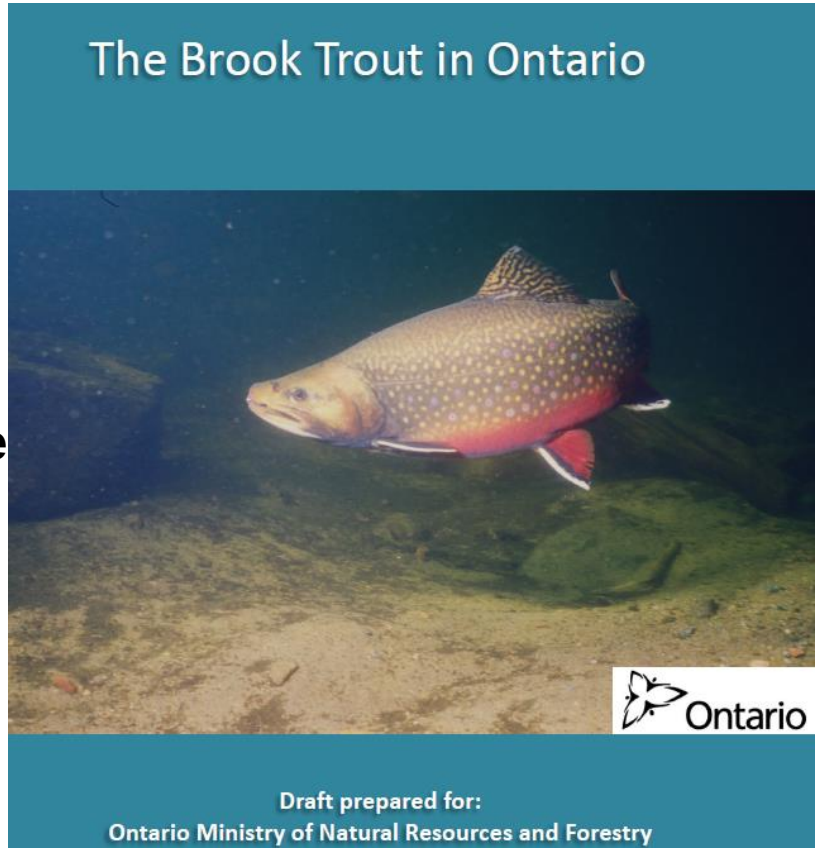
Axis	% Total Variance	Cumulative %	Driver 1	Driver 2
1	27.7	27.7	Temperature	Stream Order
2	25.1	52.8	Road Density	Specific Conductivity
3	19.4	72.2	DO	Road Density

What do these sites have in common?

- High DO
- pH range from ≈ 6.5 – 8
- Water temperatures < 24°C, > rarely spikes
- Surrounding area has low to little land use change (% Forest)
- Stream sediment mainly gravel with lots of interstitial spaces (%EPT)
- Lower levels of urbanization (Road Density)
- Low levels of conductivity, less influence of NaCl.
- FBI is low hence influence of P and N is lower

Threats to Brook Trout:

1) Climate Change
2) Stocking and Invasive Species
3) Habitat Fragmentation
4) Land Use change (Urbanization, Agriculture Forestry, Mining, damming)
5) Exploitation
6) Water Taking (Groundwater)
7) Cumulative Effects



Conclusion and Knowledge Gaps

- Trends in the TRCA jurisdiction mimic those documented in Southern and Northern Ontario
- Threats are similar if not identical to the threats affecting Redside Dace
- Trends in Redside Dace and Brook Trout populations are very similar
- CA roles (regulatory, guidance, restoration/habitat creation) mainly influences land use change and habitat fragmentation
- Both species have very low tolerance to urbanization and aquatic habitat disturbance or change

- How much habitat is enough habitat to support or prevent the decline of Redside Dace and Brook Trout in urban areas? CA monitoring activities are essential for this!
- What does a healthy population look like (10 fish per km^2 or 100 per km^2) and what is realistic in urban areas? OR have we already passed a threshold of no return?
- Where are our restoration priorities? Should we rather focus our effort on prevention vs. habitat restoration (cost-benefit analysis)?

Acknowledgments

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