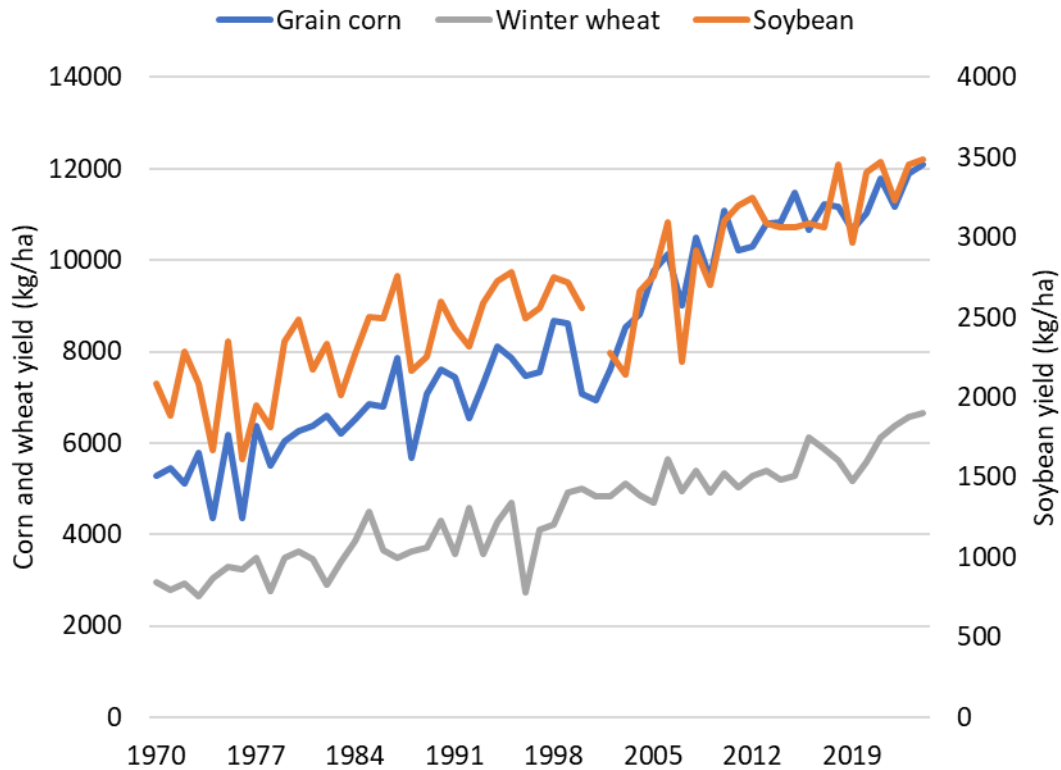


Agricultural Intensification and Dormant-Season Water Quality

Catherine Eimers
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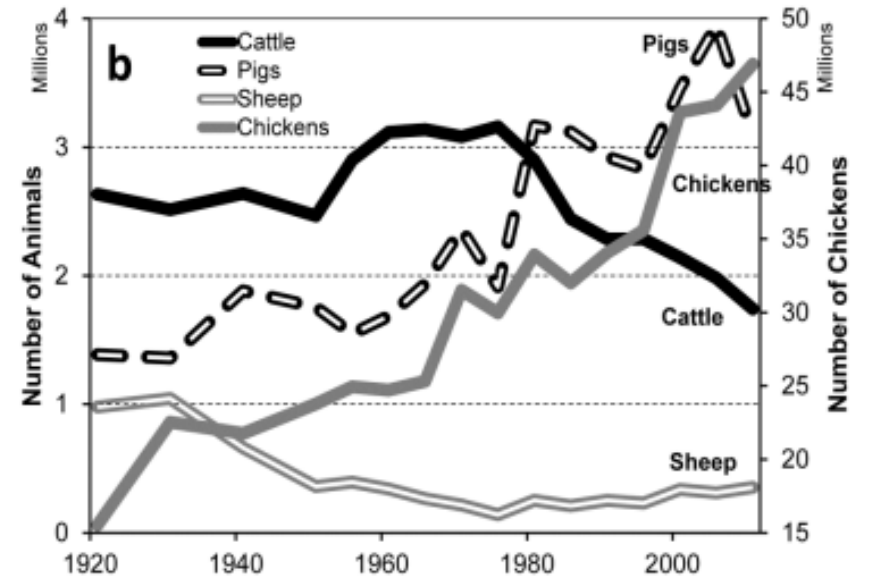
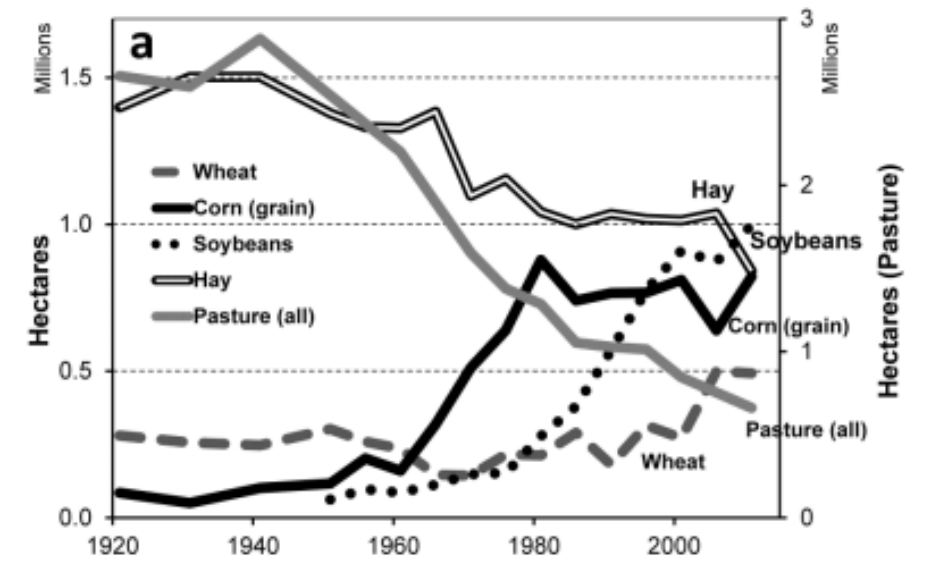


Agricultural 'intensification' trends in Ontario:



Changes in crop yield (kg/ha) in Ontario 1970 – 2024

From OMAFA Historical Grain Corn, Soybeans and Winter Wheat Yields



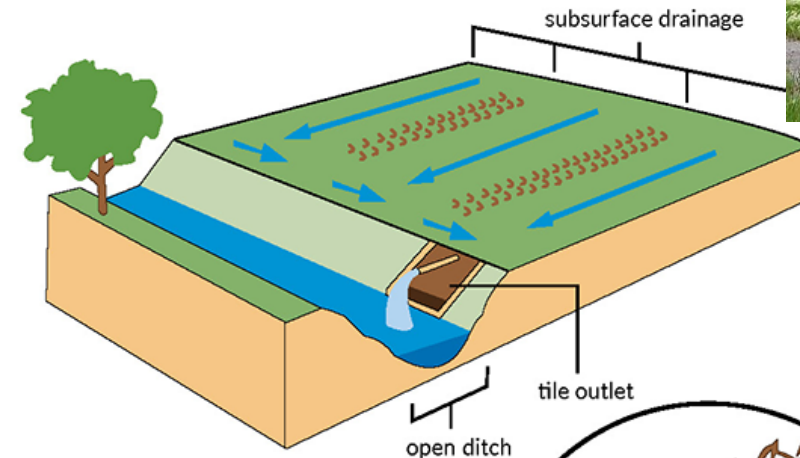
Changes in area planted to different crops (a) and livestock numbers (b) in Ontario 1921-2011.

From Smith (2015)

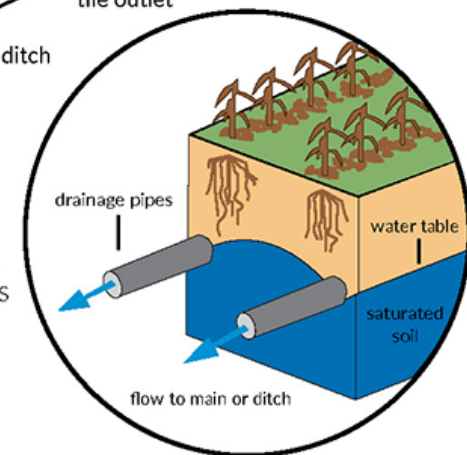
And expansions in tile drainage ...

- Drainage extends the growing season and improves crop yield
- Dual water quality impacts =>
 - Less (particulate) phosphorus via overland flow & erosion
 - More dissolved nutrient (like nitrate & dissolved P) delivery directly to streams & lakes

How drainage tile works

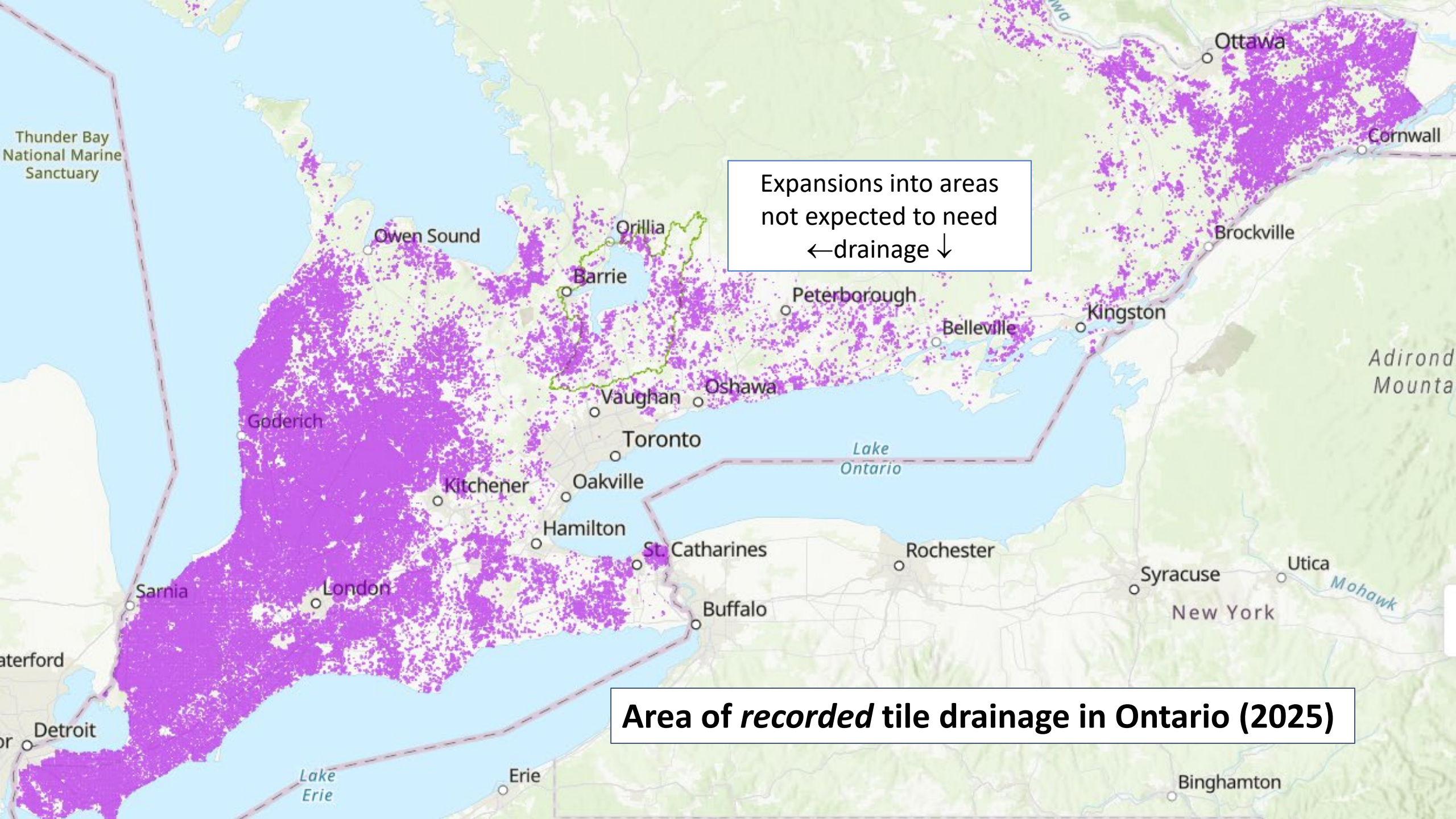


Farmers use subsurface drainage tile to drain excess water from croplands. This keeps crops from becoming waterlogged and increases crop yield. However, the tile can also send excess nutrients and other pollutants into waterways.



Source: Missourian reporting

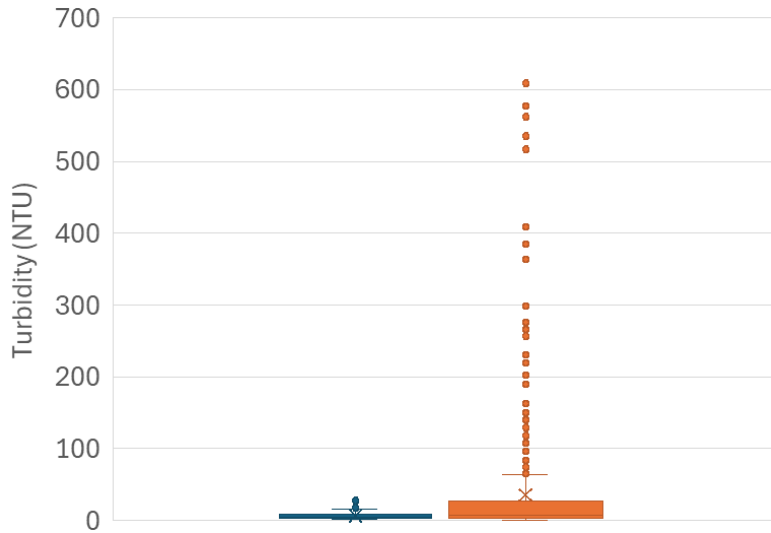
JOY MAZUR/Missourian



Different effects on N vs P and the *form* of P:

Turbidity in tiles vs. streams

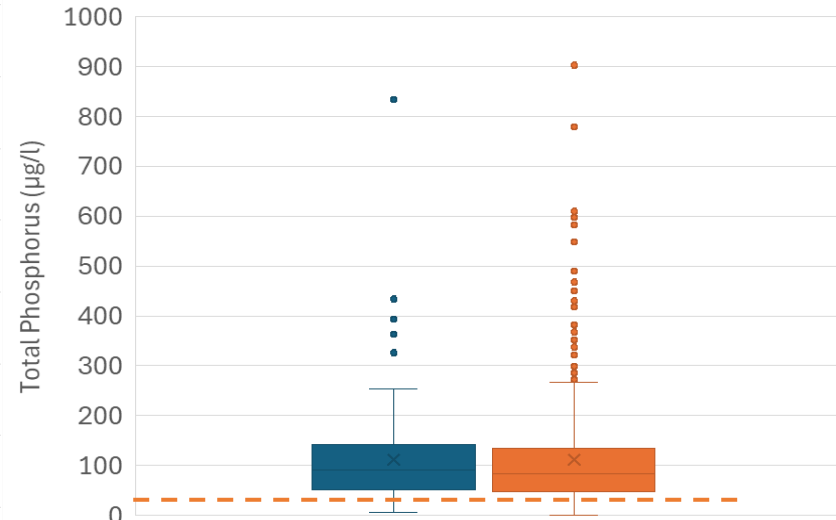
■ Tiles ■ Streams



These data suggest that the majority of TP in tile water is dissolved (bioavailable)

Total P in tiles vs. streams

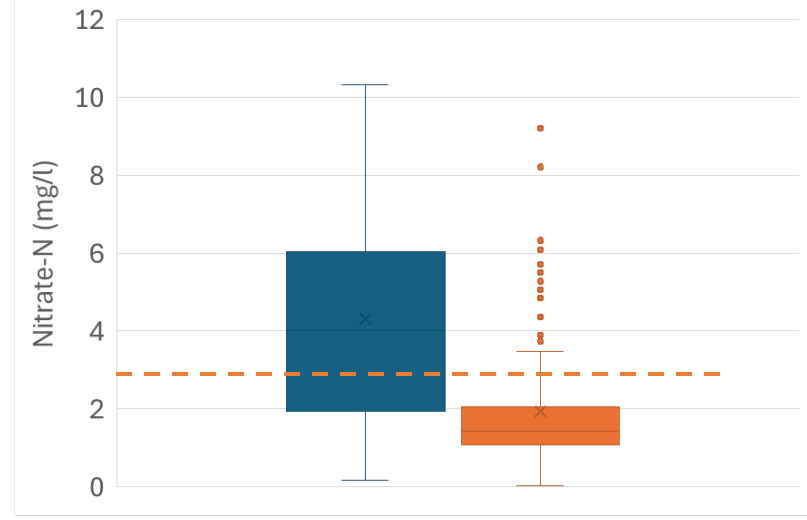
■ Tiles ■ Streams



TP concentrations are similar in rivers and tiles. And routinely exceed WQG (30 µg/l)

Nitrate-N in tiles vs. streams

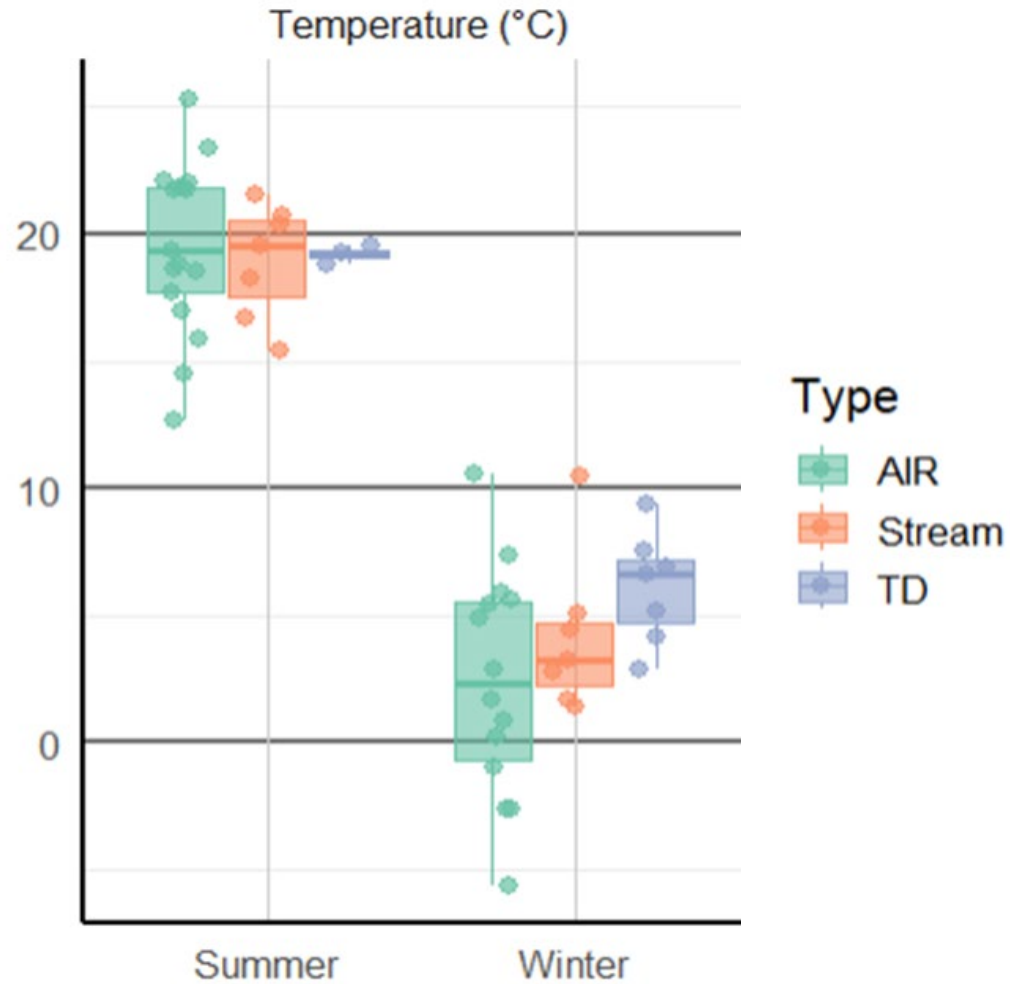
■ Tiles ■ Streams



Nitrate-N levels are always higher in tiles than in recipient water bodies. And exceed WQG (3 mg/l)

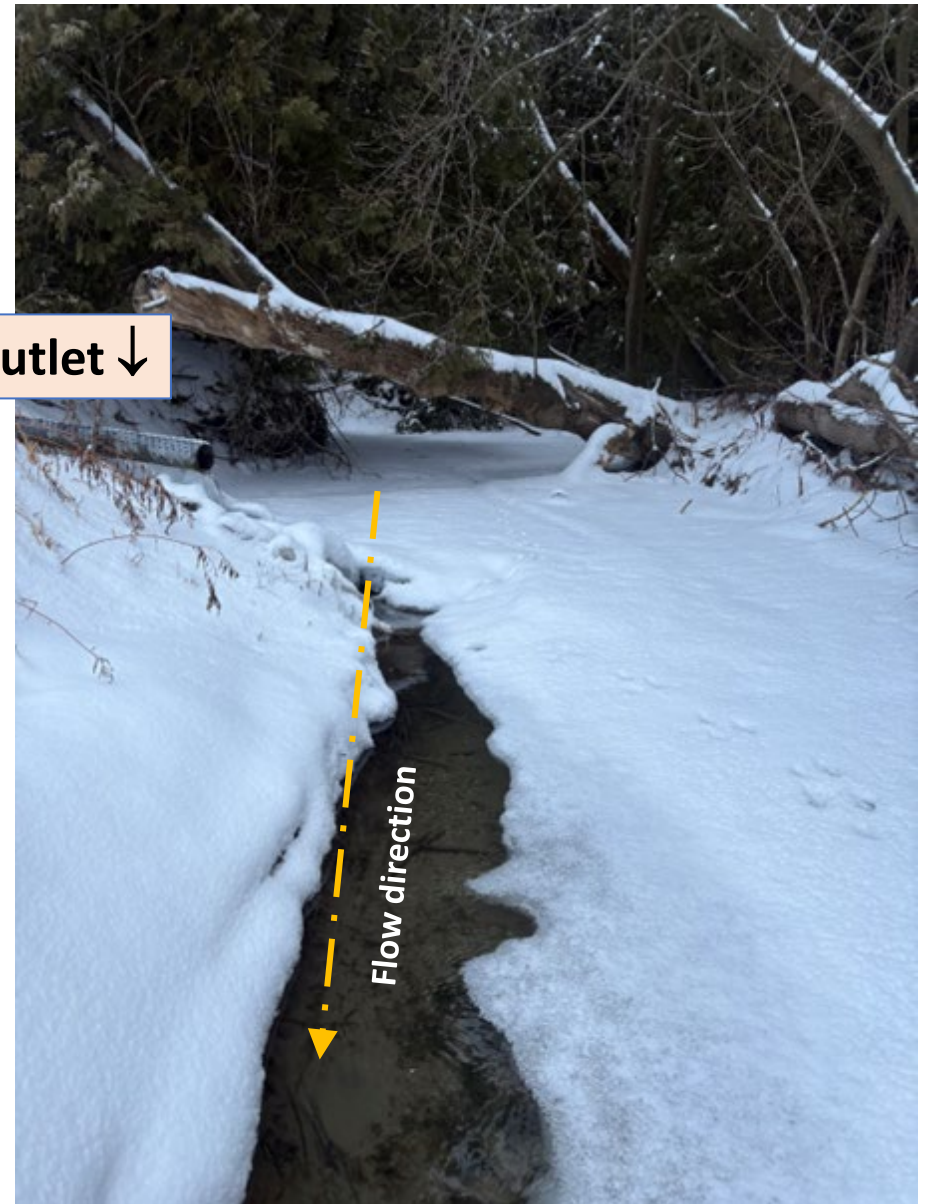
Monitoring data from the Kawartha Lakes (just east of L Simcoe!) and Ganaraska River watersheds

Tiles flow almost continuously through the winter:



Tile water is on average 4°C warmer than recipient stream water in winter

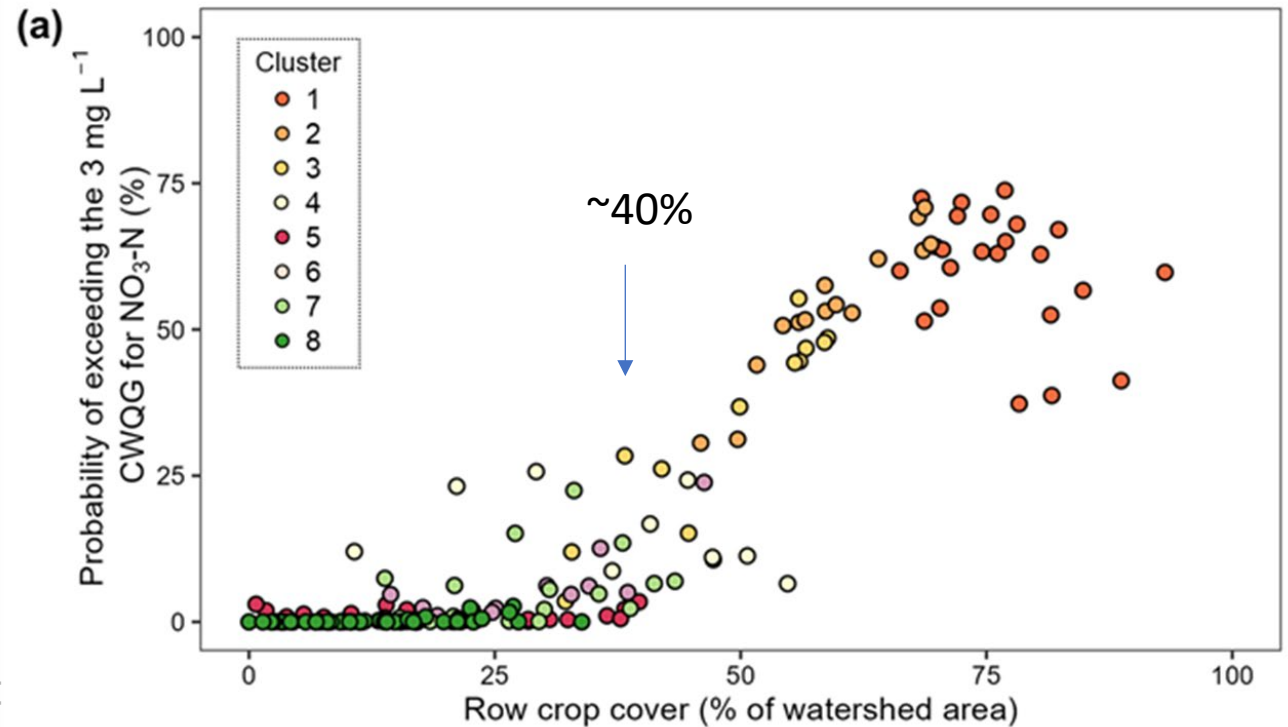
Tile outlet ↓



Branch of the Ganaraska River showing how warm tile flow maintains open water (photo from Jan 2026)

Lessons learned?

- Changes in nutrient stoichiometry should be expected
 - Multi-nutrient approach to management (P and N)
- Changes will be largest during the winter
 - **Monitor during 'dormant' season; and not just at the big tributaries**
- Tile flow affects more than just water quality...hydrology, thermal regime & ice dynamics



From Chan, R., Arhonditsis, G. B., Thompson, K. A., & Eimers, M. C. (2024). A regional examination of the footprint of agriculture and urban cover on stream water quality.