<u>What's In Your Watershed?</u> Salt and Water Quality in the Southern Cayuga Lake Watershed

Tompkins County Cooperative Extension, Ithaca, NY December 7, 2016 Community Science Institute and Cayuga Lake Watershed Network



## Volunteer Stream Monitoring Reveals Rising Salt Levels in Ground Water

Stephen Penningroth, Executive Director Community Science institute



## **Community Science Institute**



Nonprofit 501(c)3 tax-exempt environmental organization founded in 2000

<u>Mission:</u> Partner with community-based volunteer groups to better understand and protect local streams and lakes by collecting and disseminating scientifically credible, regulatory-quality data that inform long-term, sustainable management strategies

Staff: Four (4) full-time, five (5) part-time

Budget: \$226,000 in 2015

<u>Partnerships between volunteer groups and certified environmental testing lab</u>: Our lab has been certified by NY State and EPA since 2003 for chemistry and microbiology, including phosphorus and nitrogen nutrients, E. coli, sediment, chloride and several other indicators; also certified for drinking water

<u>Stream biomonitoring partnerships with volunteer groups</u>: Two (2) staff are certified BMI taxonomists who support volunteers' collection and analysis of BMI organisms as indicators of general ecosystem health

<u>Public online data archive at database@communityscience.org</u>: Public can view maps and graphs, search over 90,000 results and download search results free of charge

Volunteer-CSI monitoring partnerships investigate salt (NaCl) at over 100 stream locations in the Cayuga Lake watershed using chloride (Cl) as a marker







### How to tell if a chemical in a stream comes from groundwater

- In the global hydrologic cycle, water in the atmosphere falls to the ground, recharging groundwater supplies
- Flowing downgradient due to gravity, groundwater enters surface water bodies such as streams and lakes
- At base flow, most of the water in streams comes from groundwater; the chemical composition is the result of, a) Interactions between groundwater and the minerals in its path, and b) Chemicals entering from the surface
- Following a heavy rain or snow melt, the concentrations of groundwater constituents in streams decrease due to dilution by the relatively pure rain water or snow melt running off the surface, i.e., by stormwater runoff

### Long-term data sets indicate:

Salt enters streams through groundwater, and
In most streams, salt increases from headwaters to mouth



### Salt in Streams Comes From Groundwater

■ Baseflow ■ Storm Water



### Long-term data sets indicate:

Salt enters streams through groundwater, and
In most streams, salt increases from headwaters to mouth



# Salt Concentrations Increase from the Headwaters to the Mouths of Streams

Headwaters Mouth

60



Are Salt Concentrations Increasing in Cayuga Lake Tributary Streams?

Long-term monitoring results show that Cayuga Lake tributary streams:

- A) Get their salt from groundwater
- B) Have substantially higher salt concentrations downstream compared to upstream

But -- are salt concentrations (as indicated by chloride) increasing, decreasing or staying the same over the years?

The answer appears to be that in many streams, salt concentrations are increasing.



Visual inspection of chloride concentrations at stream mouths over a period of years, as displayed in CSI's public online database, provides a point of departure for analysis of rising salt levels in streams and, by direct inference, in groundwater.





# Upward Trend of Base Flow Chloride Concentrations at the Mouth of the Cayuga Inlet, 2011-2016, is 3.7 mg/L/year



Upward Trend of Base Flow Chloride Concentrations at the Mouth of Fall Creek, 2002-2016, is 1.5 mg/L/year



Upward Trend of Base Flow Chloride Concentrations at the Mouth of Taughannock Creek, 2006-2016, is 1.5 mg/L/year



## Chance Observations of Elevated Chloride (Salt) on East Hill



Chance **Observations** of Elevated Chloride (Salt) on South Hill

Surfacewater Features Streams Canals Pipelines Waterbodies Coastlines Catchments Hydrologic Units

1995

1

![](_page_16_Figure_2.jpeg)

## Conclusions

- 1. Salt is rising in groundwater throughout the southern Cayuga Lake watershed.
- 2. Salt concentrations in groundwater are rising at annual rates of about 1.5 to 3.7 mg/L/year.
- 3. Salt concentrations are 2x 4x higher near the mouths of streams than near their headwaters, indicating that the rise in groundwater salt correlates with road density increases and land use changes from rural to urban/commercial.
- 4. The surface waters around Ithaca are littered with surprising pockets of high salt concentrations; high salt on South Hill might contribute to the faster rise and higher levels of salt in the Cayuga Inlet compared to other streams.
- 5. Possible sources contributing to rising salt levels include road salt, water softeners and geology.

![](_page_17_Picture_6.jpeg)

![](_page_18_Picture_0.jpeg)

## Acknowledgements

<u>CSI's volunteer monitoring partner groups</u> – These data would not exist without them

Lab Analyses Michi Schulenberg Laura Dwyer Diana Beckenhaupt BMI Analyses Adrianna Hirtler Slides, statistical analyses, publicity, refreshments Claire Weston

Abner Figueroa