WHAT'S IN YOUR WATERSHED – KEUKA OUTLET AND OTHER TRIBUTARIES

Stephen Penningroth, Ph.D.

Executive Director, Community Science Institute, Ithaca, NY

Dresden Hotel, Dresden, New York

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Sponsored by the Seneca Lake Pure Waters Association

Community Science Institute

Nonprofit tax-exempt environmental organization founded in 2000

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

Budget: $226,000 in 2015

Environmental Testing Lab: NY State and EPA certified since 2003 for chemistry and microbiology, including phosphorus and nitrogen nutrients, E. coli, sediment and a dozen other indicators; also certified for drinking water

Biological stream monitoring: Two (2) staff are certified BMI taxonomists

Online database: Public can view, search and download data free of charge at database.communityscience.org

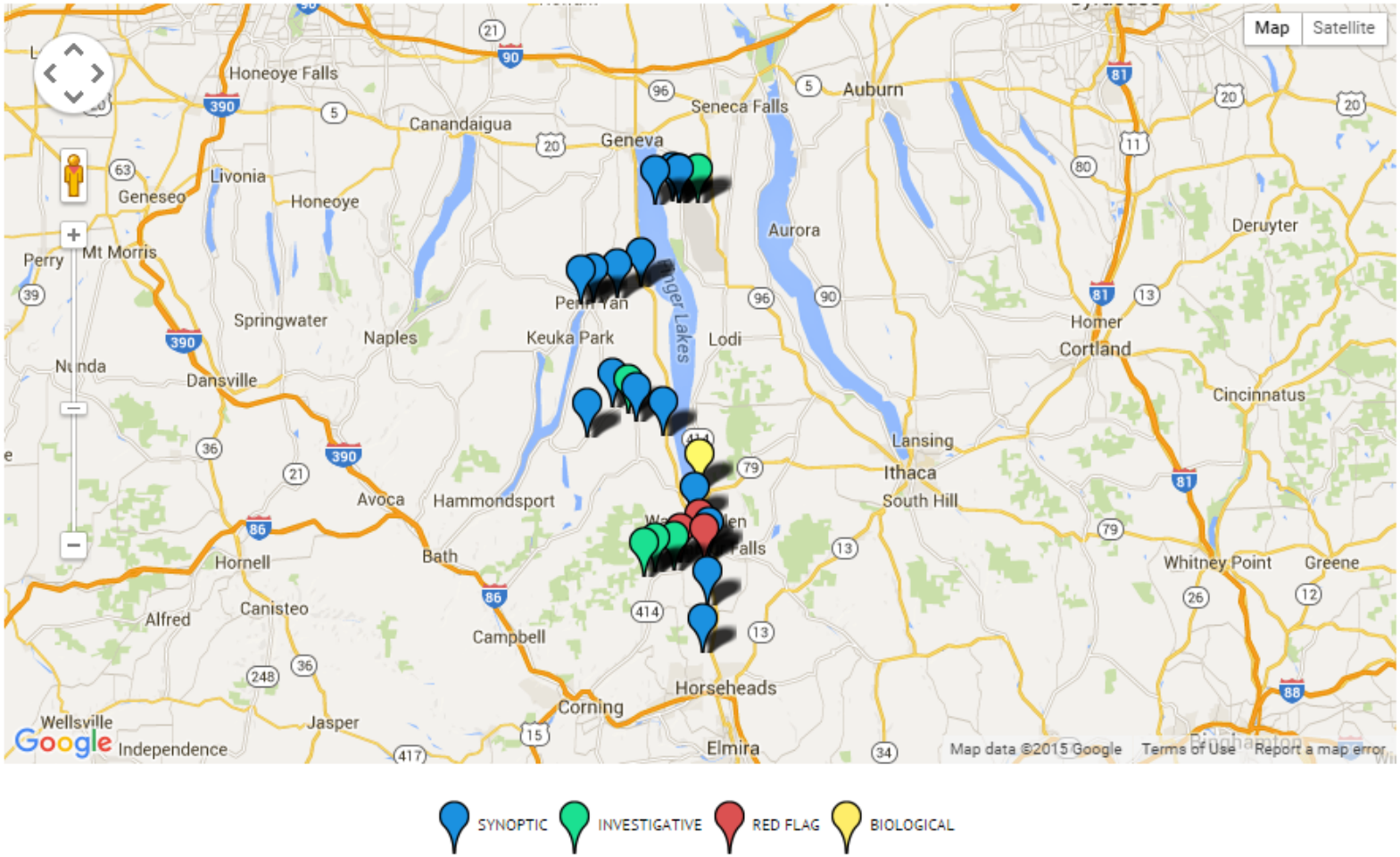
Mission: Partner with community-based volunteer groups to better understand and protect local water resources by collecting and disseminating scientifically credible water quality data that inform long-term, sustainable management strategies

"Lean, mean data-generating machine for local communities and their streams!"

Seneca Lake Tributary Stream Monitoring Program

- Water quality in Seneca Lake depends on water quality in tributary streams
- Some potential sources of impacts on streams: Waste water treatment plants, agriculture, industrial facilities, military installations
- SLPWA volunteers collect samples at fixed stream locations several times a year and transport them to CSI lab in Ithaca for certified analysis
- Chemical indicators are chosen to reveal the nature, magnitude and possible source(s) of impact(s)

Seneca Lake Watershed Monitoring Region - Volunteer Monitoring Locations



SYNOPTIC INVESTIGATIVE RED FLAG BIOLOGICAL

Summary of 2014-2016 Monitoring Results for Seneca Lake Tributary Streams

Catharine Creek:

Base flow: E. coli, total phosphorus, and organic nitrogen/ammonia are significantly elevated downstream of WWTP in Montour Falls; slightly elevated near mouth at Seneca Lake.

Stormwater: Impacts are increased below WWTP and at Seneca Lake; phosphorus and nitrogen impacts appear at Havanna Glen mouth location

Pathogenic bacteria and nutrients suggest impacts from WWTP effluent and agriculture; also slight impacts from marina and/or urban Watkins Glen

Summary of 2014-2016 Monitoring Results for Seneca Lake Tributary Streams (cont'd)

Big Stream:

Base flow: E. coli elevated at most locations; phosphorus elevated downstream of WWTP in Dundee

Stormwater: Very large increases in E. coli at all locations; significant increases in phosphorus at most locations; moderate increases in organic nitrogen/ ammonia at all locations

Pathogenic bacteria and nutrients suggest impacts primarily from agriculture; possible impact from WWTP phosphorus at base flow

Summary of 2014-2016 Monitoring Results for Seneca Lake Tributary Streams (cont'd)

Reeder Creek:

- **Base flow**: E. coli elevated at all locations; phosphorus extremely high, ~ 1,000 ug/L upstream, but decreases downstream
- **Stormwater**: Very large increases in E. coli, decreasing downstream; significant decreases in phosphorus at all locations

Results suggest: a) Phosphorus contamination of groundwater at Seneca Army Depot, and b) Impact from Five Points waste water treatment facility

No evidence of metals, radioactivity or VOCs

Summary of 2014-2016 Monitoring Results for Seneca Lake Tributary Streams (cont'd)

Keuka Outlet:

Base flow: E. coli, phosphorus and organic nitrogen/ammonia are elevated in Jacob's Brook tributary, also downstream from Penn Yan WWTP but to lesser degree

Stormwater: Exceptionally large increases in E. coli and phosphorus downstream from Jacob's Brook tributary and Penn Yan WWTP, lesser increases in nitrate-nitrogen. Note: No stormwater data for Jacob's Brook

Pathogenic bacteria and nutrients suggest mainly impacts from agriculture, lesser impacts from WWTP

What is E. Coli?

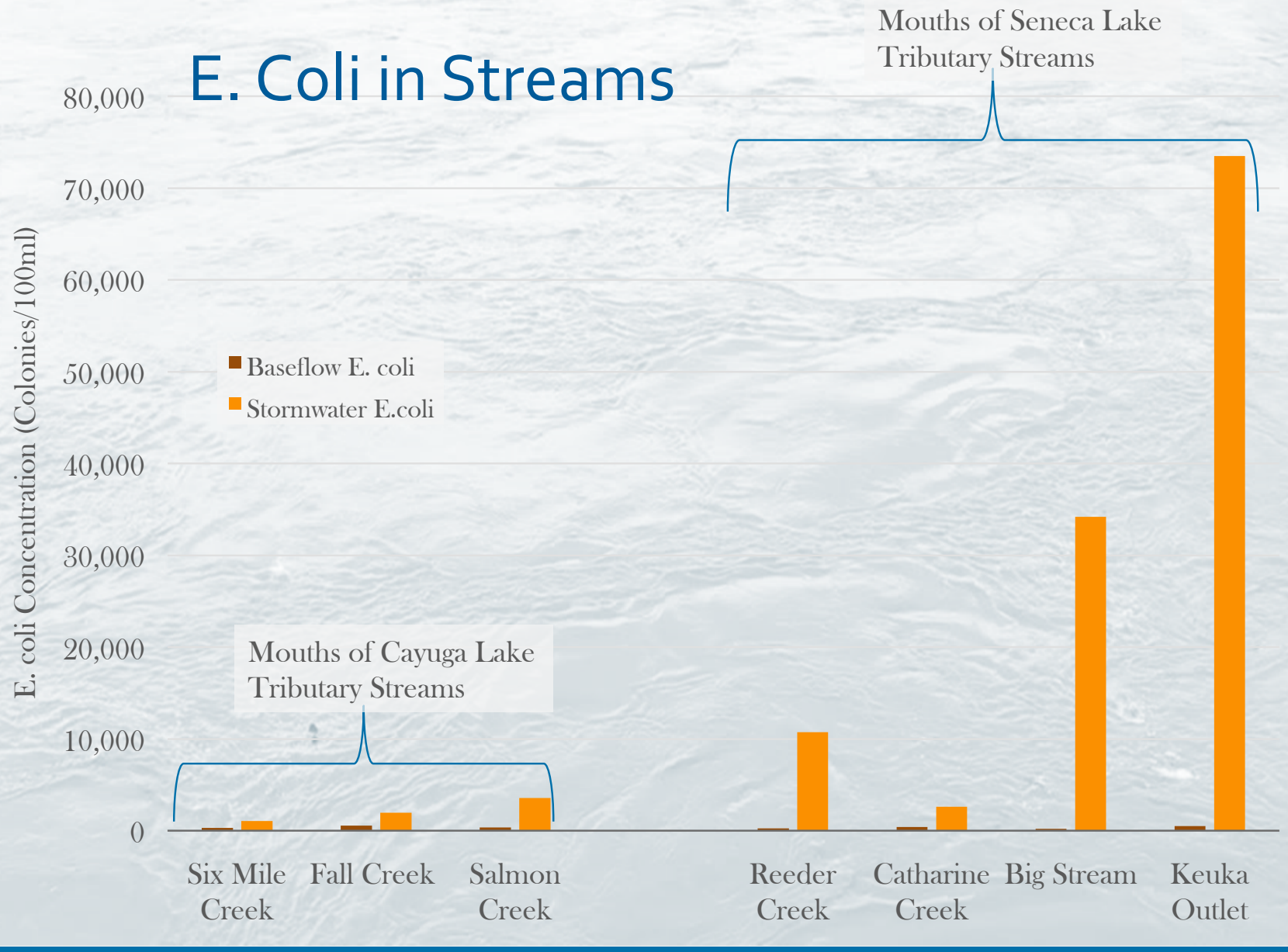
- Family of bacteria found in intestines of warm-blooded animals including birds
- Serves as a marker for risk of illness due to pathogenic bacteria
- Upper limit for contact recreation is 235 colonies/100 ml

High E. Coli Levels in Seneca Lake Streams

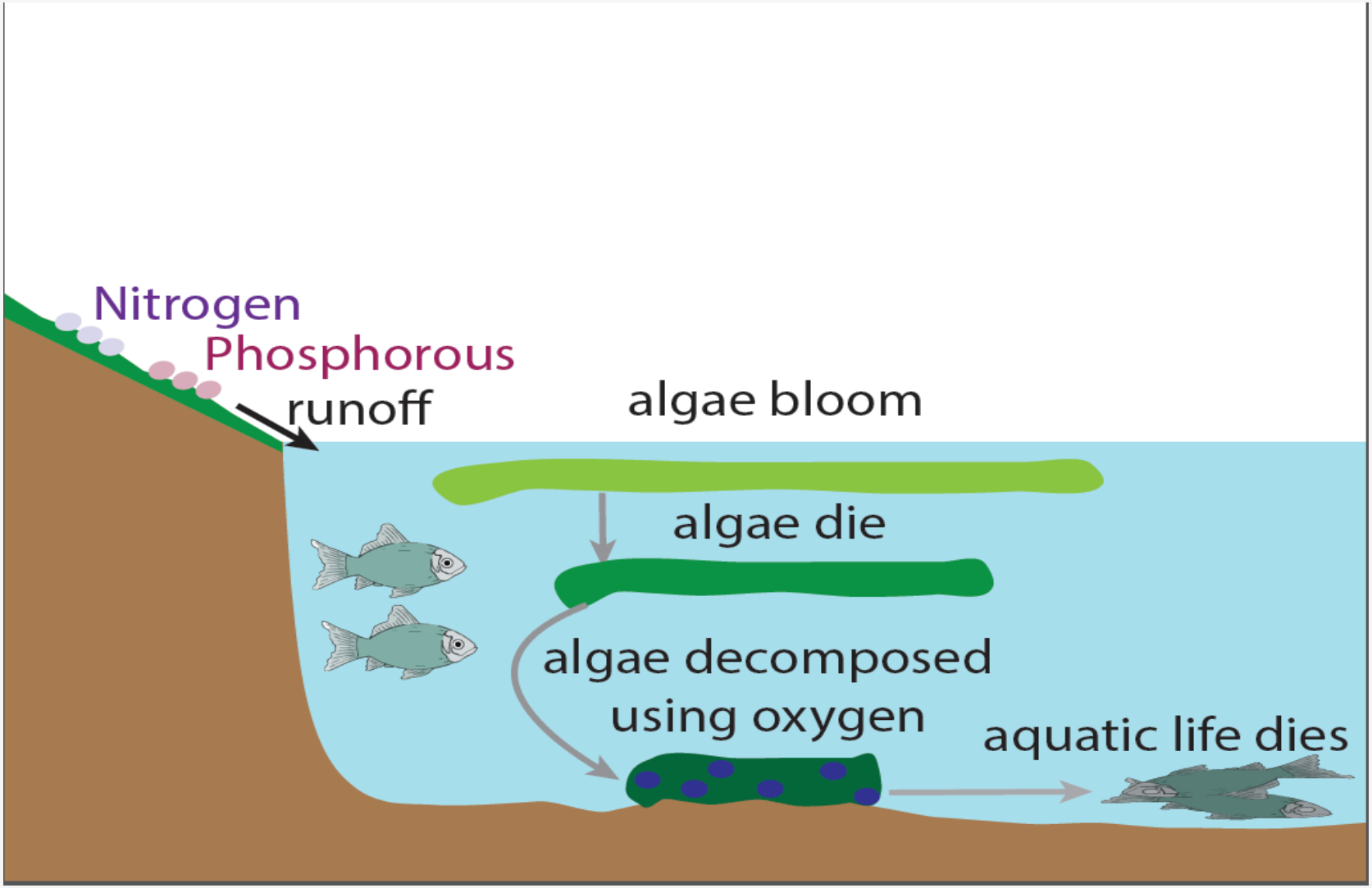
Base flow: Results to date indicate concentrations of E. coli tend to be elevated in Seneca Lake streams, exceeding 235 colonies/100 ml at most locations

Stormwater: Concentrations of E. coli increase greatly following rainfall, more than observed in southern Cayuga Lake tributary streams

E. Coli in Streams



Growth-Promoting Nutrients Are a Problem



A Brief Tour of Phosphorus Pollutants

Two general forms of phosphorus pollution are measured by lab:

1. **Dissolved phosphorus**

   Direct nutrient for algae, stimulates growth

2. **Particulate phosphorus**

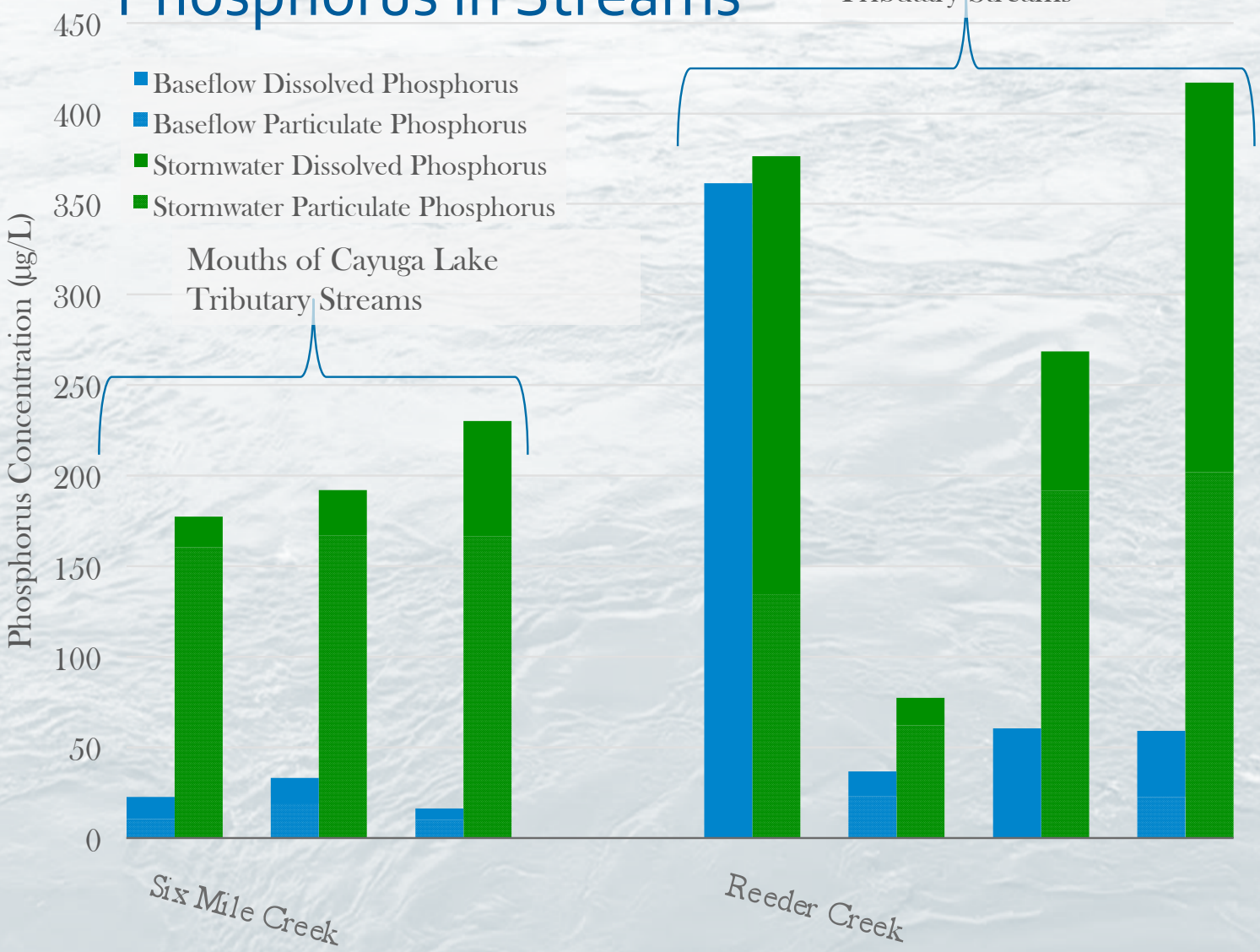
   a) Human and animal waste. Eventually dissolves and serves as nutrient to stimulate algal growth

   b) Soil particles. For the most part, phosphorus stays attached, does not dissolve and does not stimulate algal growth

Dissolved phosphorus is referred to as **"bioavailable,"** meaning it can act as a nutrient to stimulate growth.

Soil-bound phosphorus has limited bioavailability and therefore does not, as a rule, stimulate growth

Phosphorus in Streams



A Brief Tour of Nitrogen Pollutants

Two types of nitrogen measurement in SLPWA monitoring program:

1. **Nitrate- + Nitrite-nitrogen (NOx)**: These are two forms of inorganic nitrogen. Nitrate is a major component of fertilizer.

2. **Total Kjeldahl nitrogen**: Sum of organic nitrogen and ammonia; associated with animal and human waste

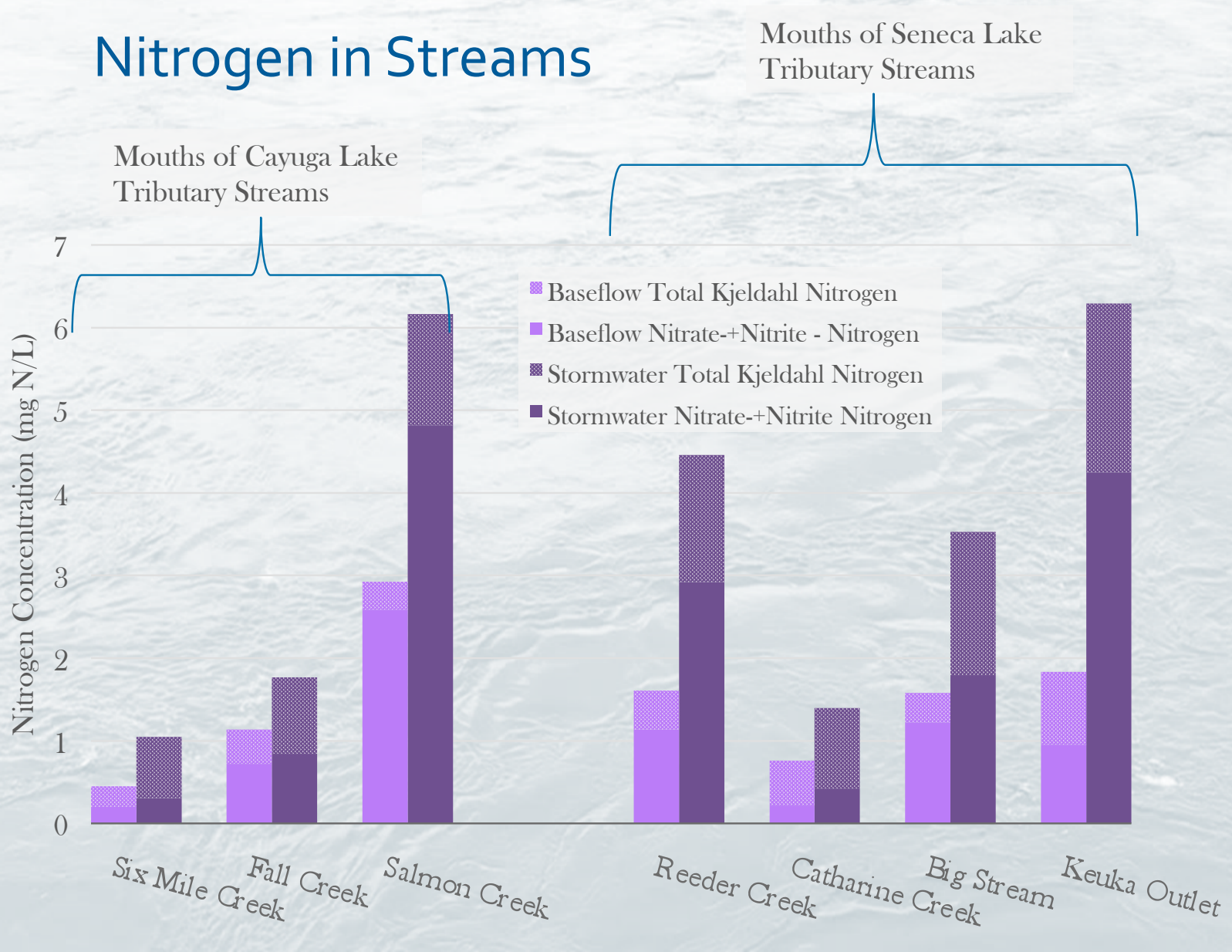
The **sum** of these two measurements is equal to **total nitrogen**.

These **two measurements** can be used to **distinguish** between nitrogen originating from **fertilizer** and nitrogen originating from **waste**.

Substantial **stormwater increases in** both types of **nitrogen** are observed in the **Keuka Outlet, Big Stream and Reeder Creek**.

Increases corroborate impacts due to **agriculture** and possibly also **waste water treatment plants**

Nitrogen in Streams



Focus on Keuka Outlet

Keuka Outlet appears to transport more phosphorus, nitrogen and E. coli to Seneca Lake than the other three streams monitored by SLPWA

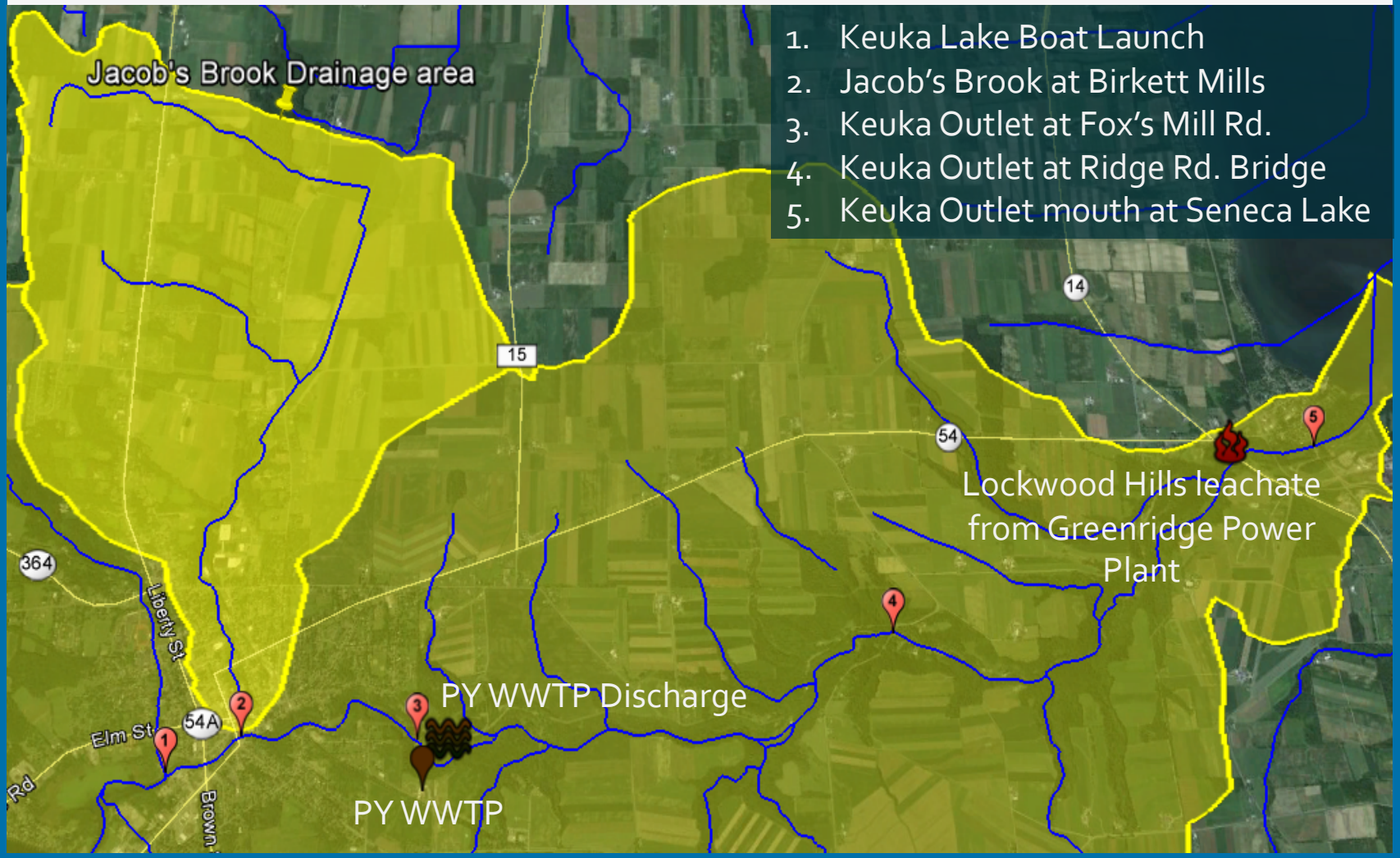
Samples from four locations along Keuka Outlet and one on the Jacob's Brook tributary suggest that most of the pollutants come from Jacob's Brook.

The Penn Yan waste water treatment plant and/or other small Outlet tributaries also contribute pollutants.

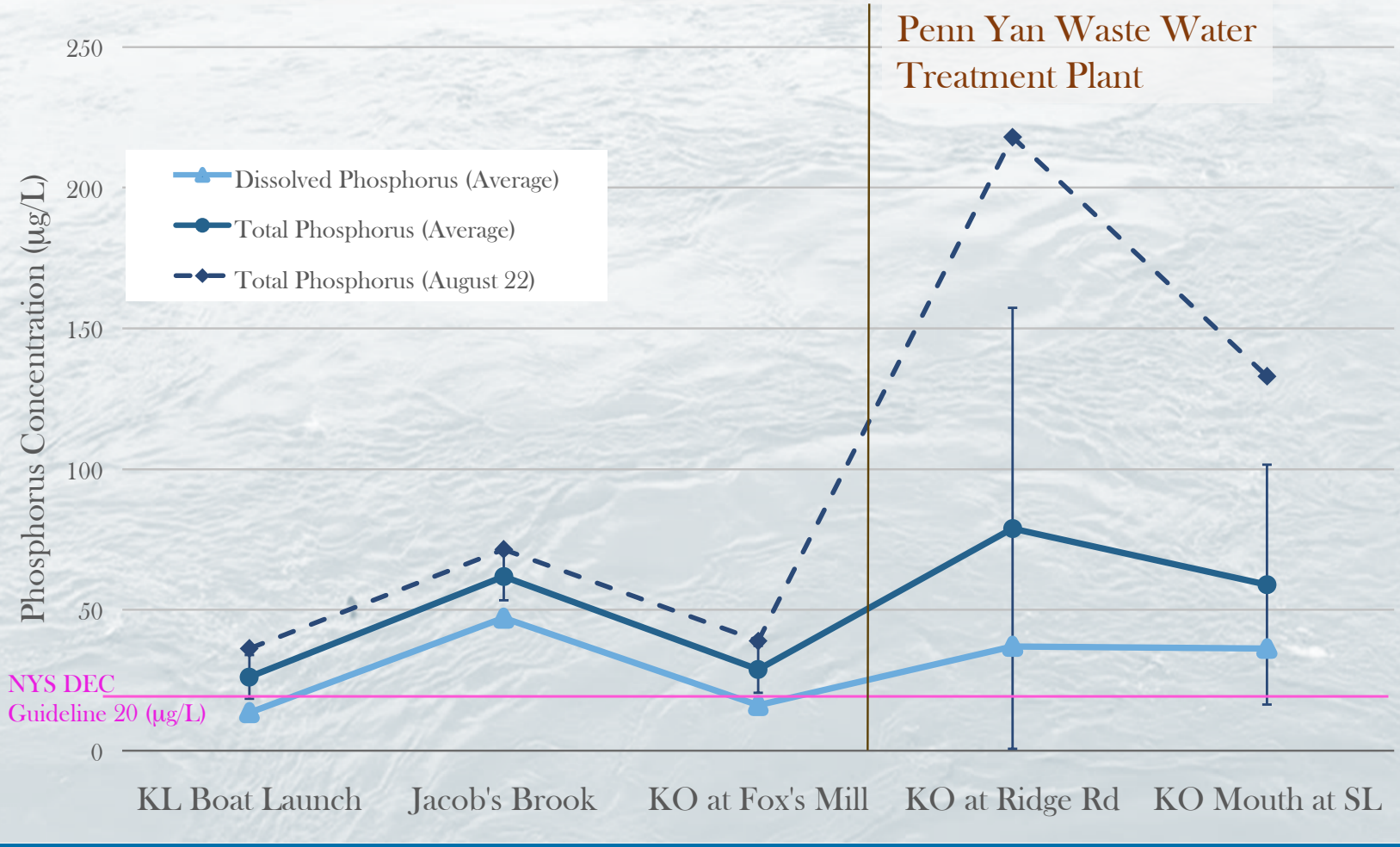
Keuka Outlet Monitoring Set Map

SYNOPTIC INVESTIGATIVE RED FLAG BIOLOGICAL

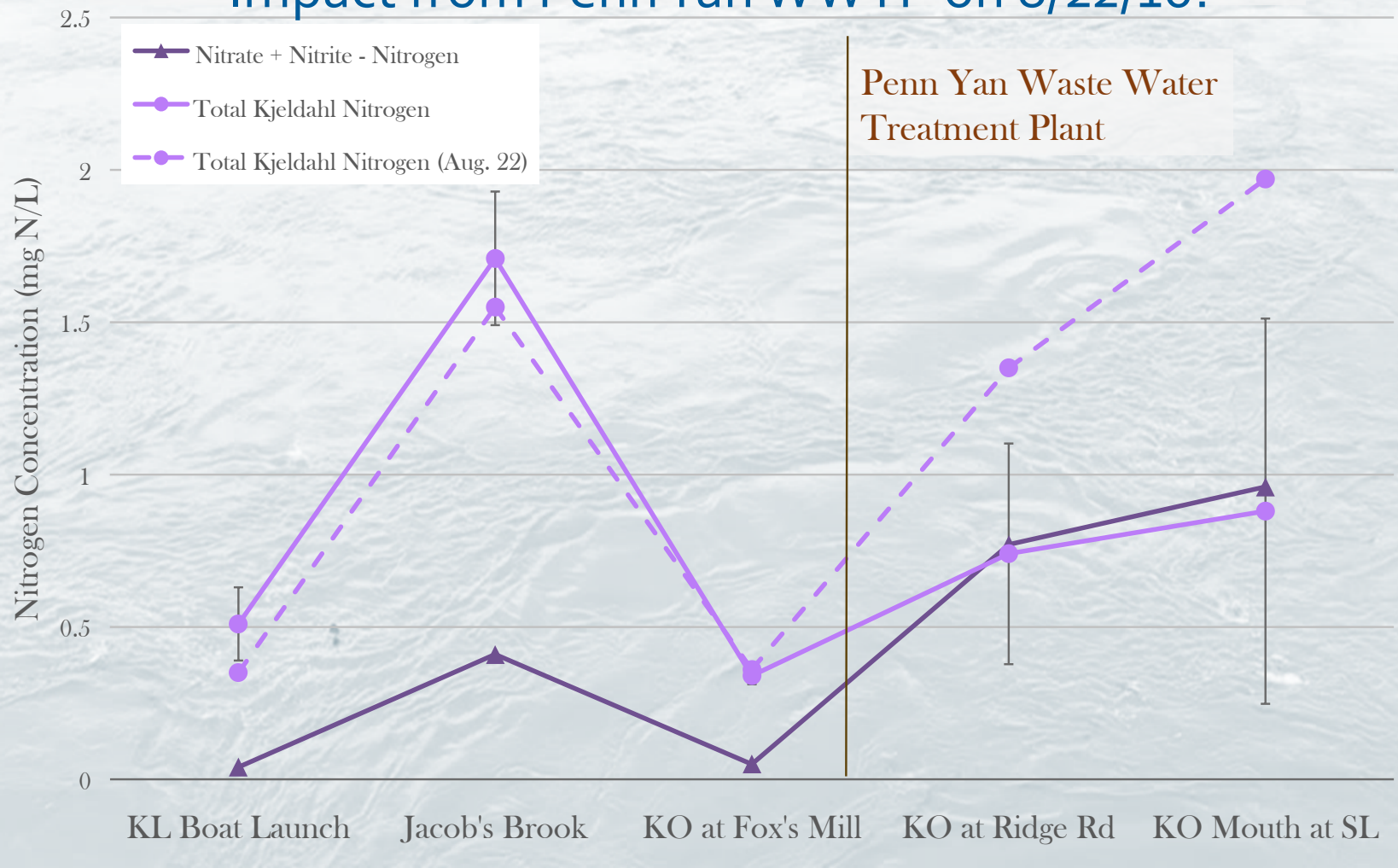
Keuka Outlet and Jacob's Brook Drainage Areas



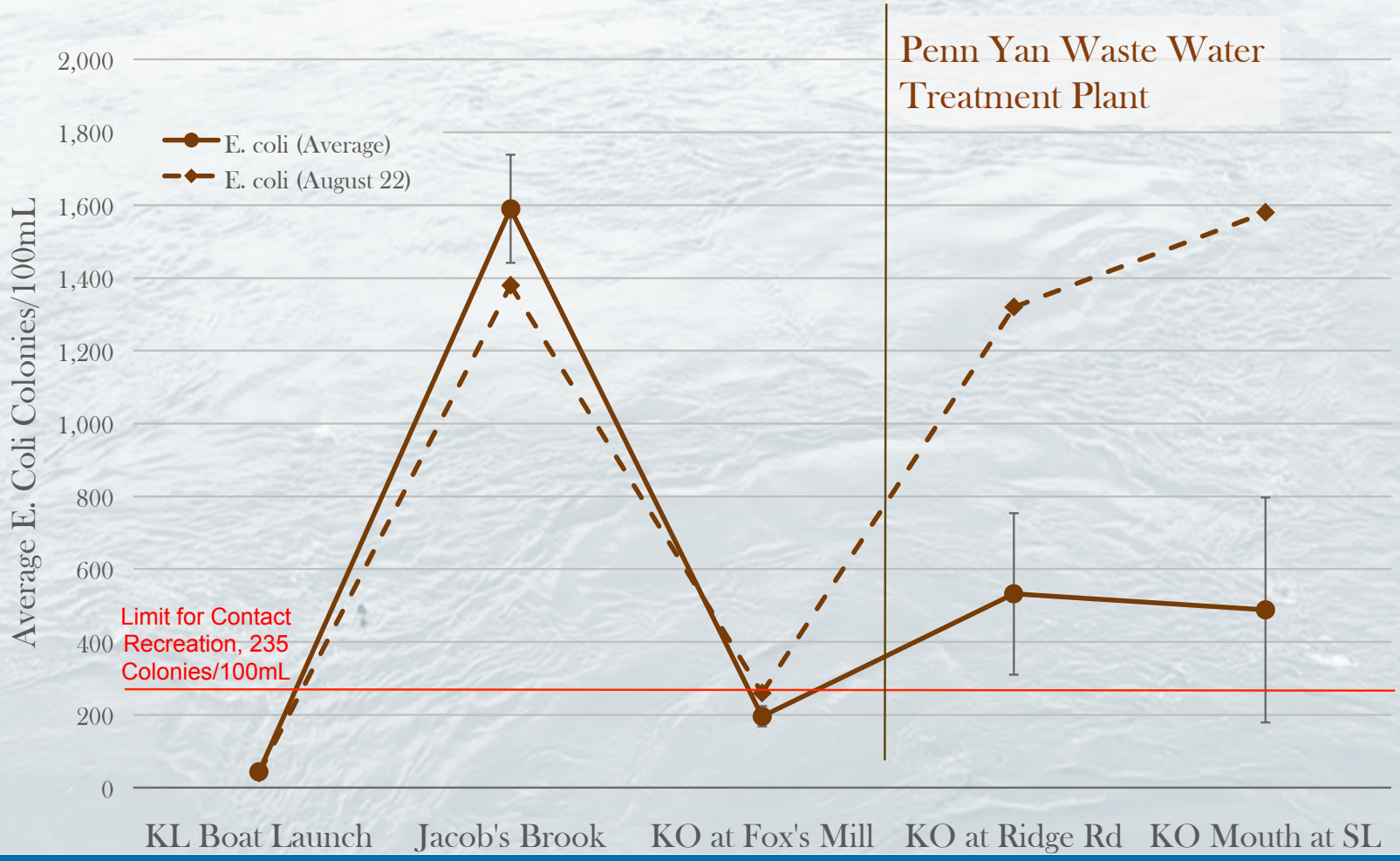
More **Phosphorus** in Jacob's Creek than in Keuka Outlet at **Base Flow**.
-- Impact from Penn Yan WWTP on 8/22/16?



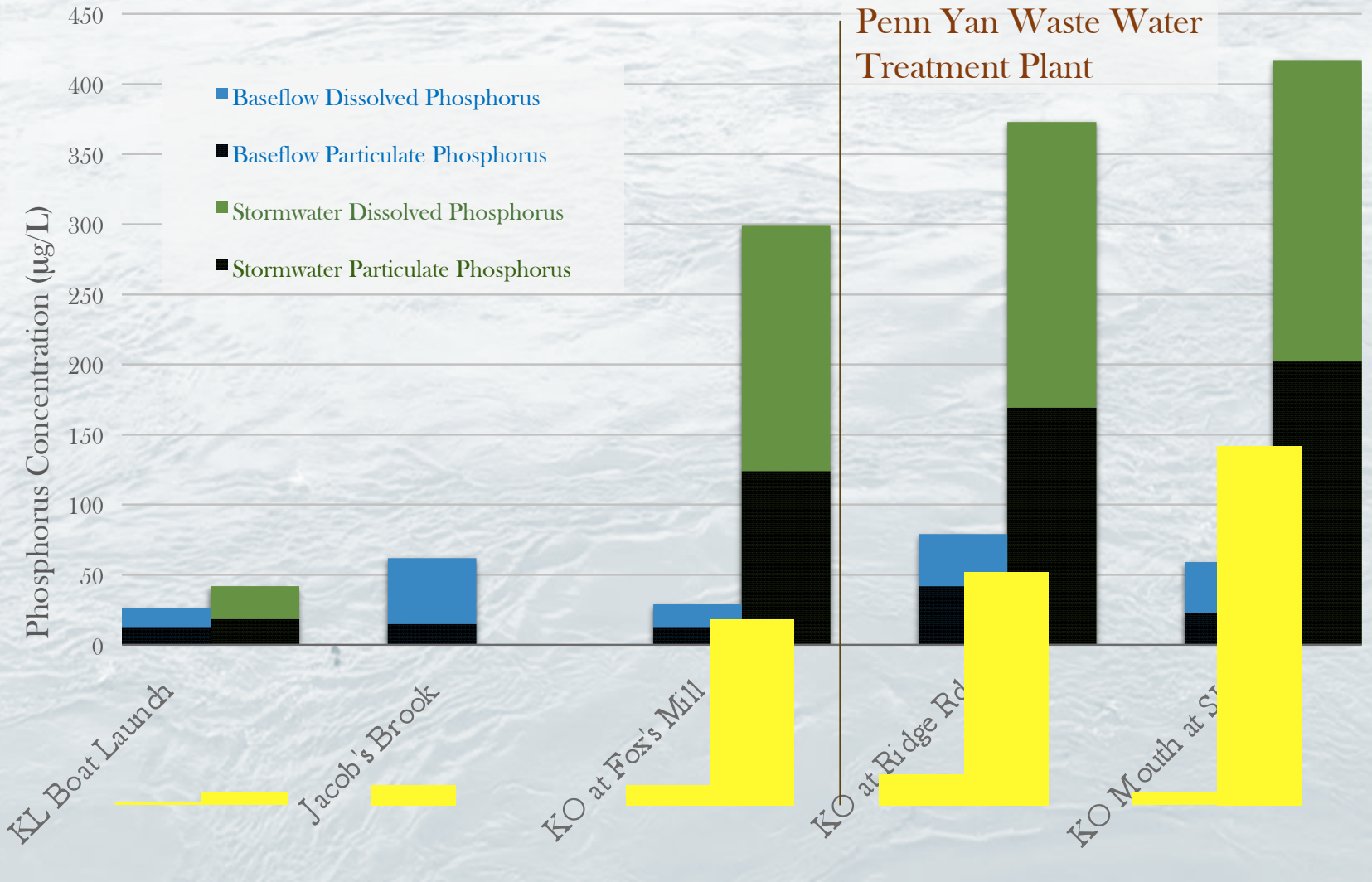
More **Nitrogen** from Waste in Jacob's Brook than in Keuka Outlet at **Base Flow**. -- Impact from Penn Yan WWTP on 8/22/16?



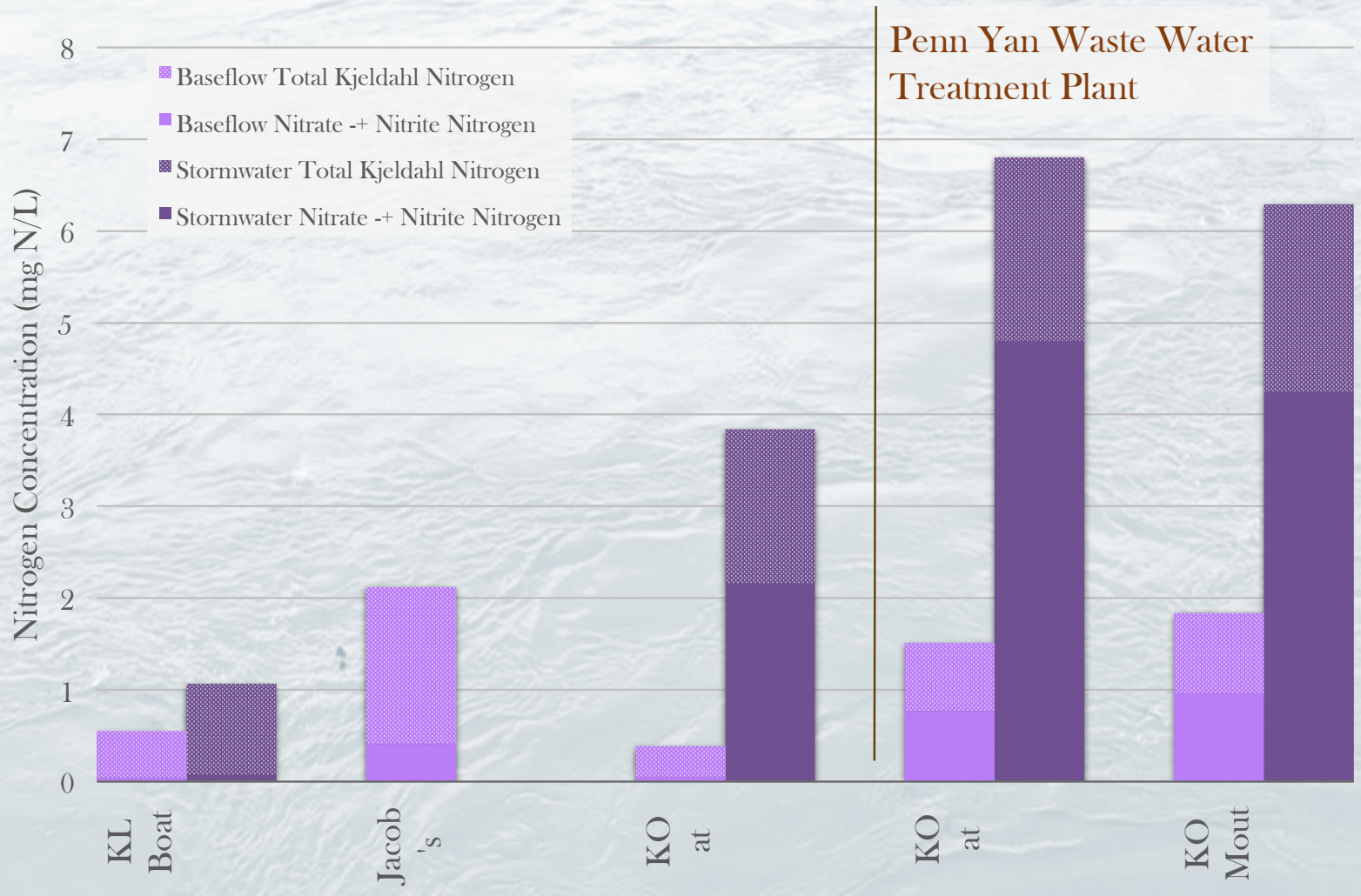
More **E. Coli** in Jacob's Brook than in Keuka Outlet at **Base Flow**. -- Impact from Penn Yan WWTP on 8/22/16?



Stormwater Runoff Produces Similar Increases in Dissolved Phosphorus and Particulate Phosphorus

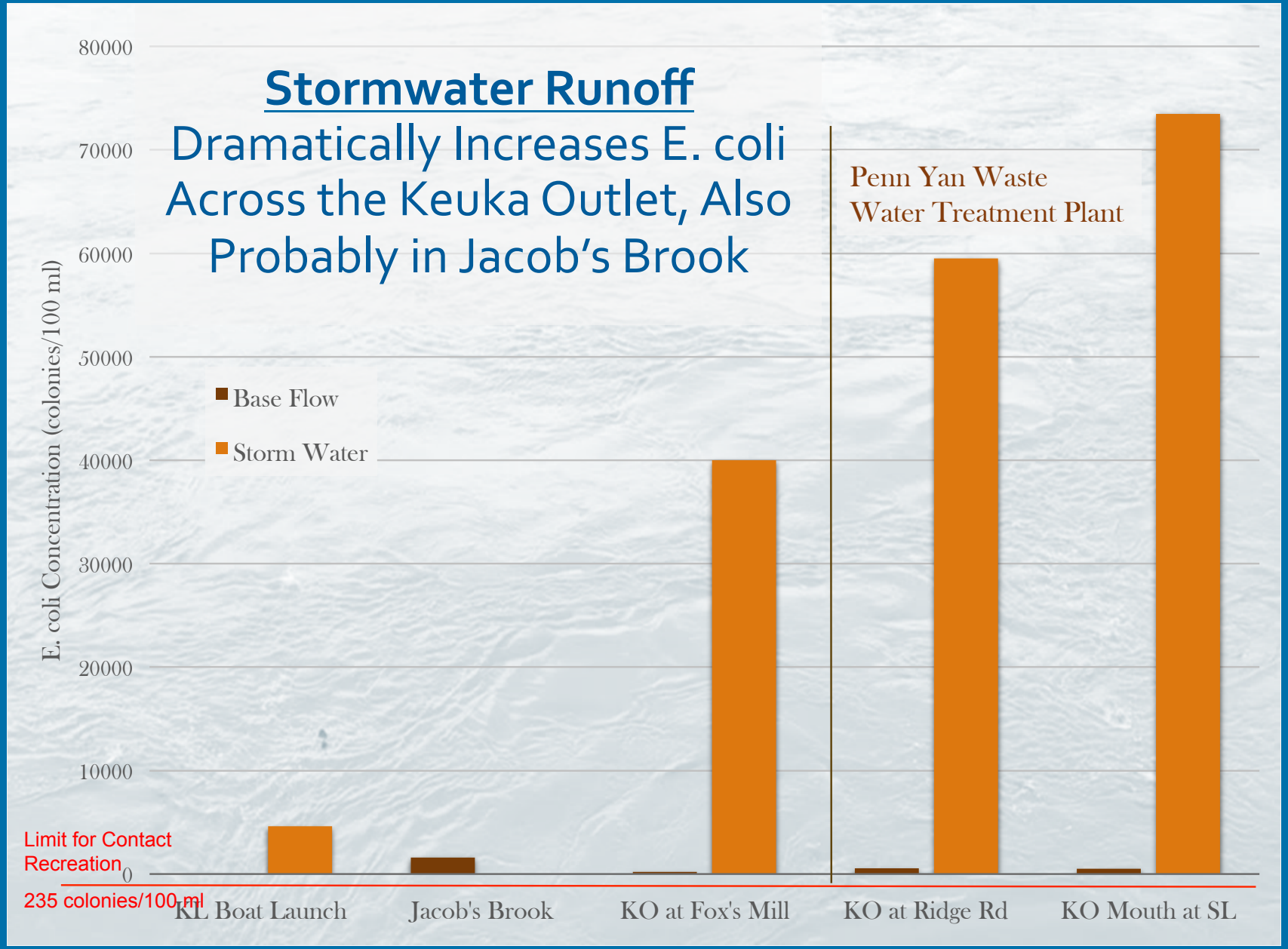


Stormwater Runoff Increases Nitrate-Nitrogen From Fertilizer More Than Kjeldahl-Nitrogen from Waste

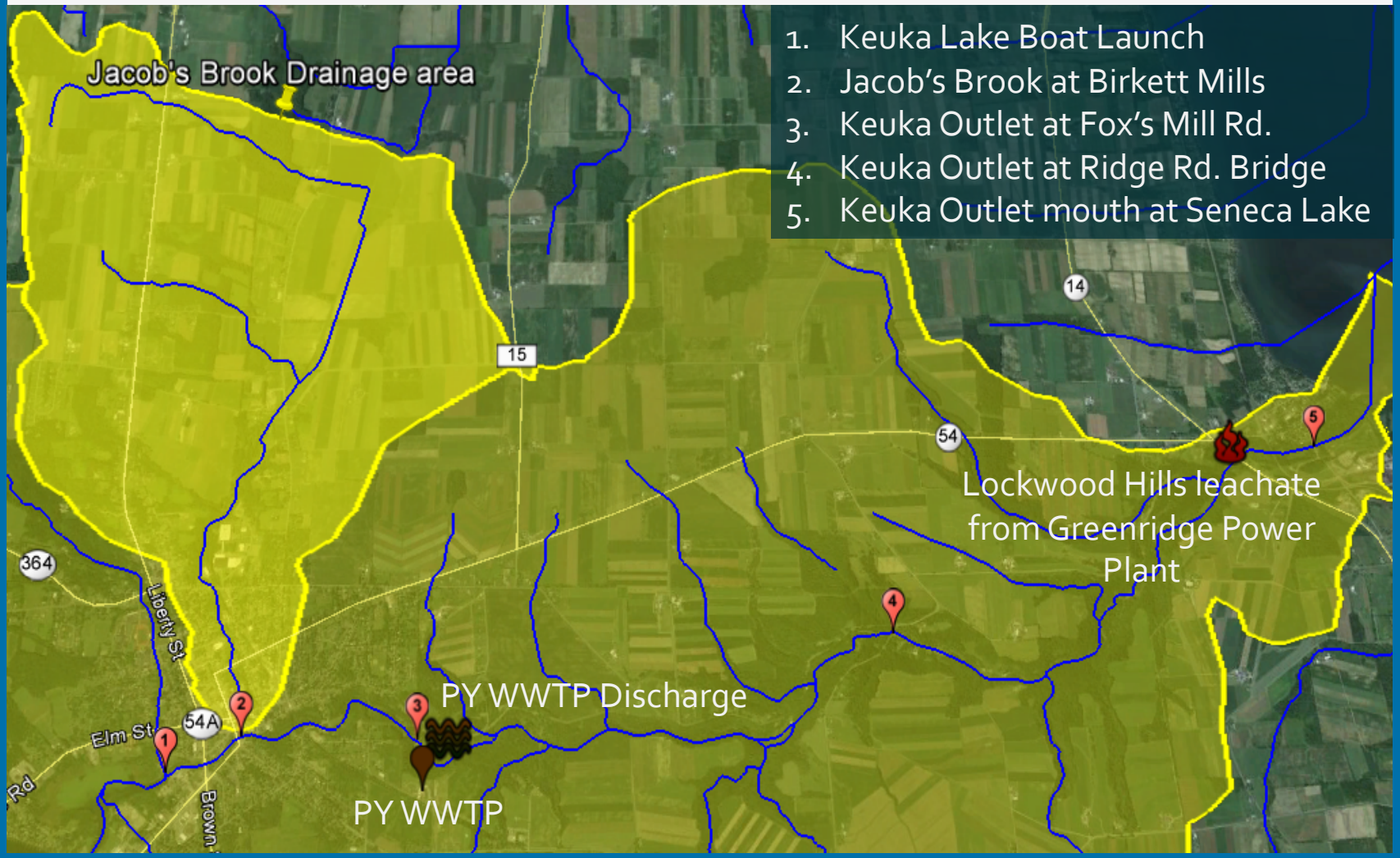


Stormwater Runoff

Dramatically Increases E. coli Across the Keuka Outlet, Also Probably in Jacob's Brook



Keuka Outlet and Jacob's Brook Drainage Areas



Benthic Macroinvertebrates (BMI)

- BMI are monitored by NYSDSEC as an important indicator of stream health
- CSI volunteers follow modified Hudson Basin River Watch protocols for BMI monitoring in streams yielding overall results for water quality rating similar to NYSDEC results
- BMI samples for Keuka Outlet were collected on 9/26/16 by seven SLPWA and Penn Yan area volunteers and picked/analyzed by Carol Hardy from SLPWA and other volunteers at Penn Yan Academy and the CSI BMI lab with support from CSI staff

	Total Family Richness	EPT Richness	Family Biotic Index	Percent Model Affinity	Organism Density/ Sample	BAP Value Biological Assessment Profile
Keuka Outlet - Upstream 9/26/16 42.657781, -77.035167 Upstrm of Penn Yan Wstwtr Trtmt	**12.0** slightly impacted	**6** slightly impacted	**4.01** non-impacted	**65%** non-impacted	4364	**7.1** slightly impacted
Keuka Outlet - Downstream 9/26/16 42.658278, -77.034332 Dwnstrm of Penn Yan Wstwtr Trtmt	**17.0** non-impacted	**6** slightly impacted	**4.95** slightly impacted	**50%** slightly impacted	2826	**7.3** slightly impacted

Results based on identification of 1562 individual organisms

Overall Water Quality Rating Based on BMI Biomonitoring: Slight Impact (both sites)

High density of organisms may be linked to high phosphorus levels

Conclusions Based on Preliminary Data

1. Seneca Lake tributary streams exhibit significant water quality impacts associated with agriculture and, to a lesser extent, with waste water treatment plants.

   In addition, Reeder Creek is impacted by groundwater phosphorus contamination associated with the Seneca Army

2. Preliminary results suggest that the Keuka Outlet exports more phosphorus, nitrogen and E. coli to Seneca Lake than other monitored tributaries during stormwater events.

3. Within the Keuka Outlet watershed, the greatest source of nutrients and E. coli appears to be the Jacob's Brook sub-watershed.

4. Preliminary results suggest that the Penn Yan waste water treatment plant, small tributaries, or both may also contribute pollutants to the Keuka Outlet, but to a lesser extent than Jacob's Brook.

Acknowledgements

- **Seneca Lake Pure Waters Association (SLPWA)**
  - Stream Team
  - Volunteer Sample Collectors
  - BMI Volunteers
  - Ed Przybylowicz – Google Earth map of Outlet drainage
- **Community Science Institute**
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  - Claire Weston – Graph and map slides
  - Adrianna Hirtler – BMI slide, support for BMI volunteers