Cayuga Lake Modeling Project: Lake and Tributary Monitoring

2013Progress to Date

Cayuga Lake Study

- targeting phosphorus and related features of water quality
- composed of 5 technical elements
  1. tributary monitoring – to support specification of material loading rates (pounds per day)
  2. lake monitoring for water quality measures and biological communities

  underway in 2013
  3. a two-dimensional transport model for the lake
  4. watershed/land use modeling – establishing dependence of tributary loads on land use
  5. a phosphorus/eutrophication model for the lake – quantifies dependence of lake quality on tributary and point source inputs
- a phased (multi-year) study
- guided by a Quality Assurance Project Plan (QAPP)
  - 491 pages, elements 1-4

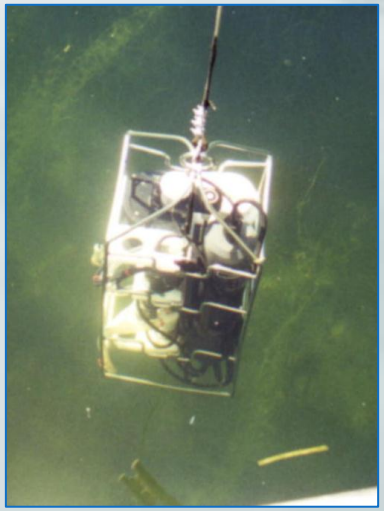
2013 Program Summary: Lake

- Lake-Wide Program
  - Collect detailed water chemistry profiles, biological communities data, and *in-situ* measurements from 10 locations (entire axis of lake), from near surface to near bottom
  - Biweekly, April through October – Goal: 15 surveys
- Frequent-South Program
  - Collect detailed water chemistry profiles from 4 locations (southern shelf region), from near surface to near bottom
  - 2 times per week, June through September – Goal: 25 surveys

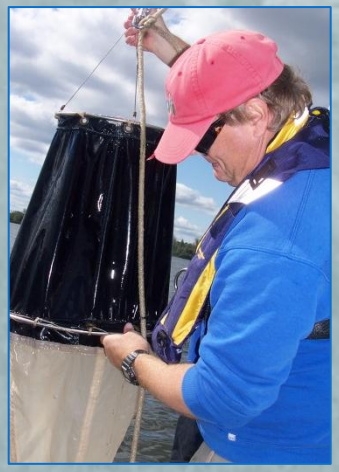
Lake Monitoring

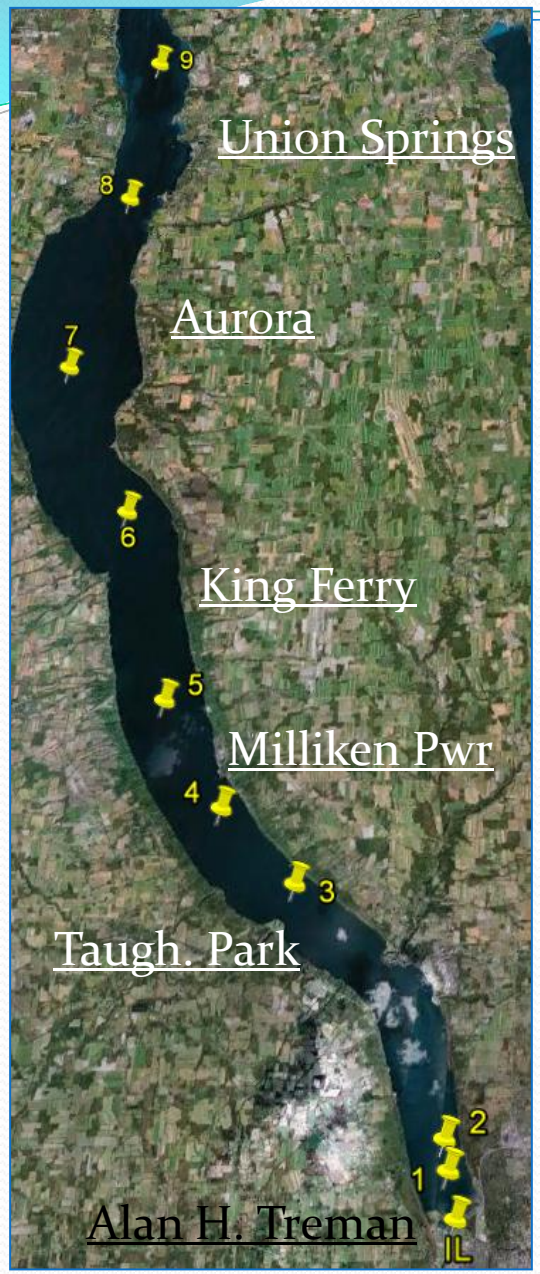
Water Collection

Physical Measurements



Biology Sampling



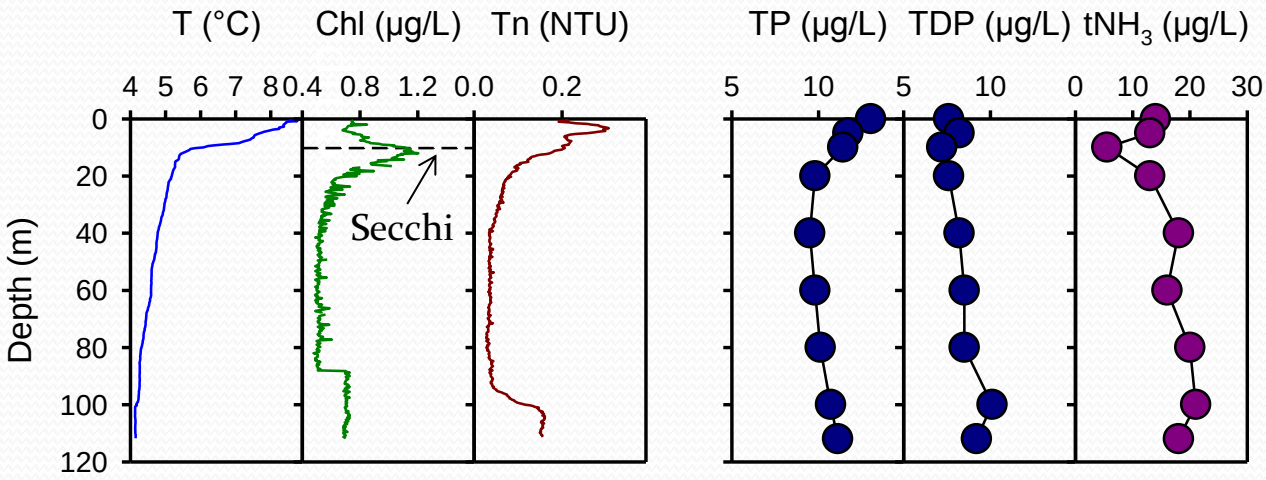


Lake-Wide Monitoring

comprehensive whole lake surveys

- began Apr. 8
- 5 successful surveys (5 attempts)
- 5 of 15 surveys complete
- on schedule for completion

example data from Site 5 on May 7



Frequent-South Monitoring

- limited to southern region
- began June 2013
- 2 successful trips on 6/7 and 6/11
- on schedule for completion

2013 Program Summary: Tributaries

- Routine Program
  - Collect water chemistry samples and *in-situ* measurements to support material loading (kg/d) estimates at 5 tributaries (Fall, Salmon, Inlet, Six Mile, and Taughannock)
  - Biweekly, April through October – Goal: 15 samples (per tributary)
- Event Monitoring Program
  - Collect water chemistry samples during wet weather with auto-samplers at: Fall Cr., Salmon Cr., Cayuga Inlet, and Six Mile Cr.
  - Goal: 4 events (per tributary)
- Synoptic Event Monitoring Program
  - Collect water chemistry samples during wet weather at 5 locations along Fall Cr. and 5 locations along Salmon Cr. from mouth and upstream locations
  - Goal: 2 synoptic events (per tributary)
- Bioavailable Phosphorus Assessment
  - Collect and filter samples from 4 tributaries (Fall Cr., Salmon Cr., Cayuga Inlet, and Six Mile Cr.) and point sources to assess proportion of phosphorus available to grow algae in Cayuga L.
  - Goal: 3 sampling events

Automated Water Quality Platform

- Site 2
  - measuring temperature, specific conductance, and turbidity at 15 min intervals

- in collaboration with T. Cowen (Cornell Univ.)

Automated Water Quality Platform

- Inlet
  - measuring temperature, specific conductance, and turbidity at 15 min intervals
  - paired with Cornell's flow meter will assess turbidity loads to the lake

Tributary Monitoring

Water Collection

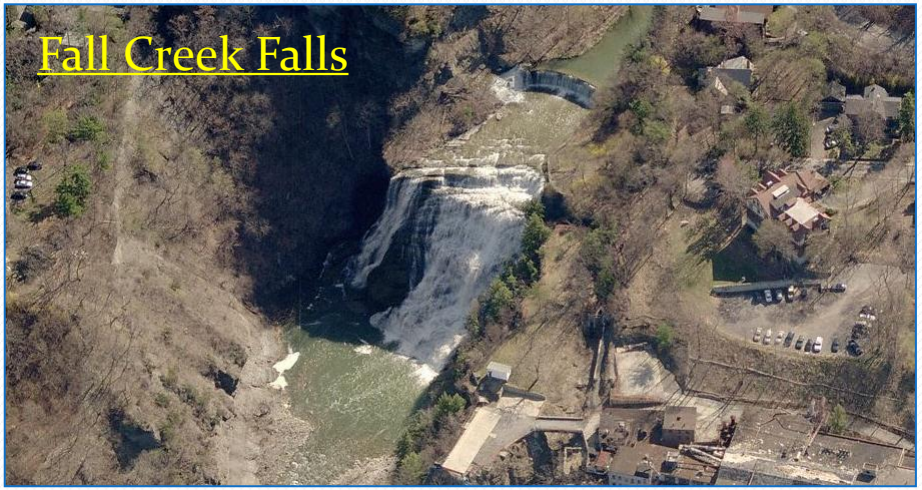
In-situ Measurements

Event Monitoring

Routine Tributary Monitoring

sampling near trib. mouths

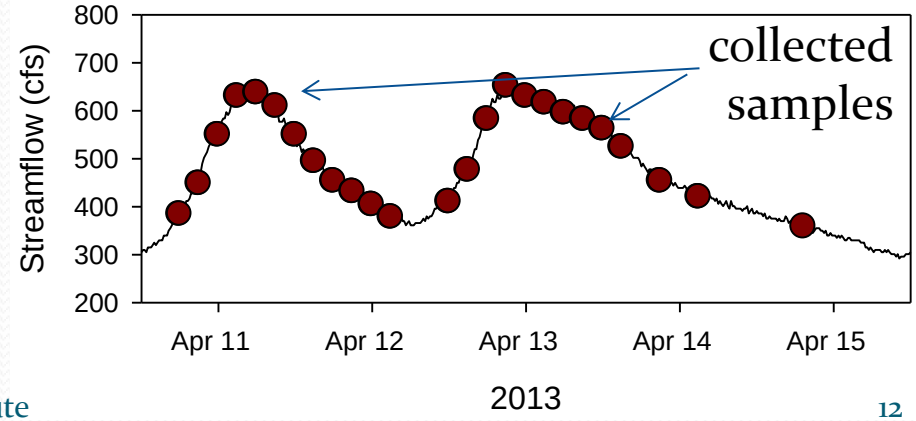
- began Apr. 22
- 5 successful surveys (5 attempts)
- 5 of 15 surveys complete
- on schedule for completion



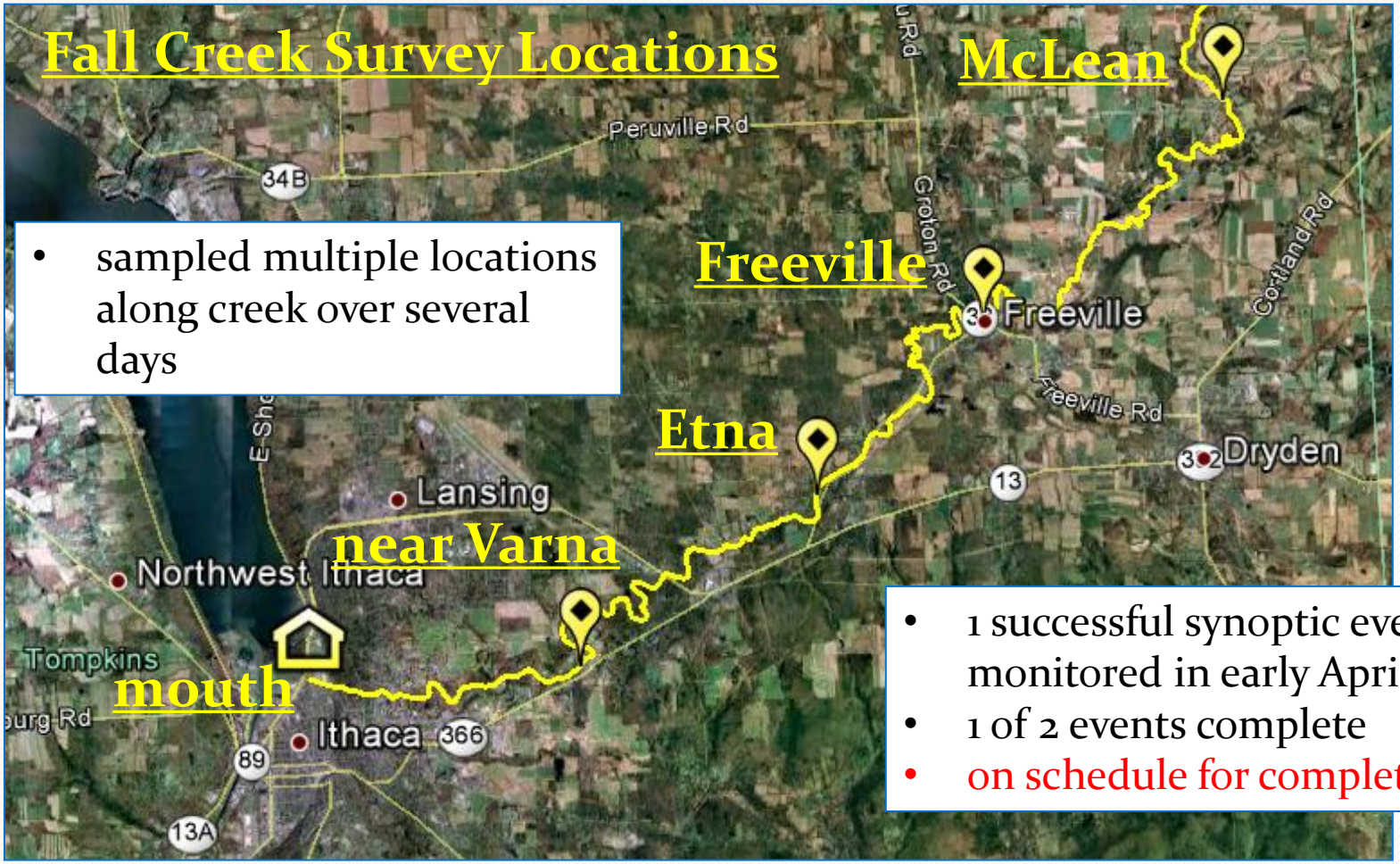
Event Monitoring

- all auto-samplers installed in late March
- 2 wet weather events monitored successfully in early April
- all 4 tributaries
- 2 of 4 events complete
- on schedule for completion

streamflow from Fall Cr. Apr. 11 runoff event

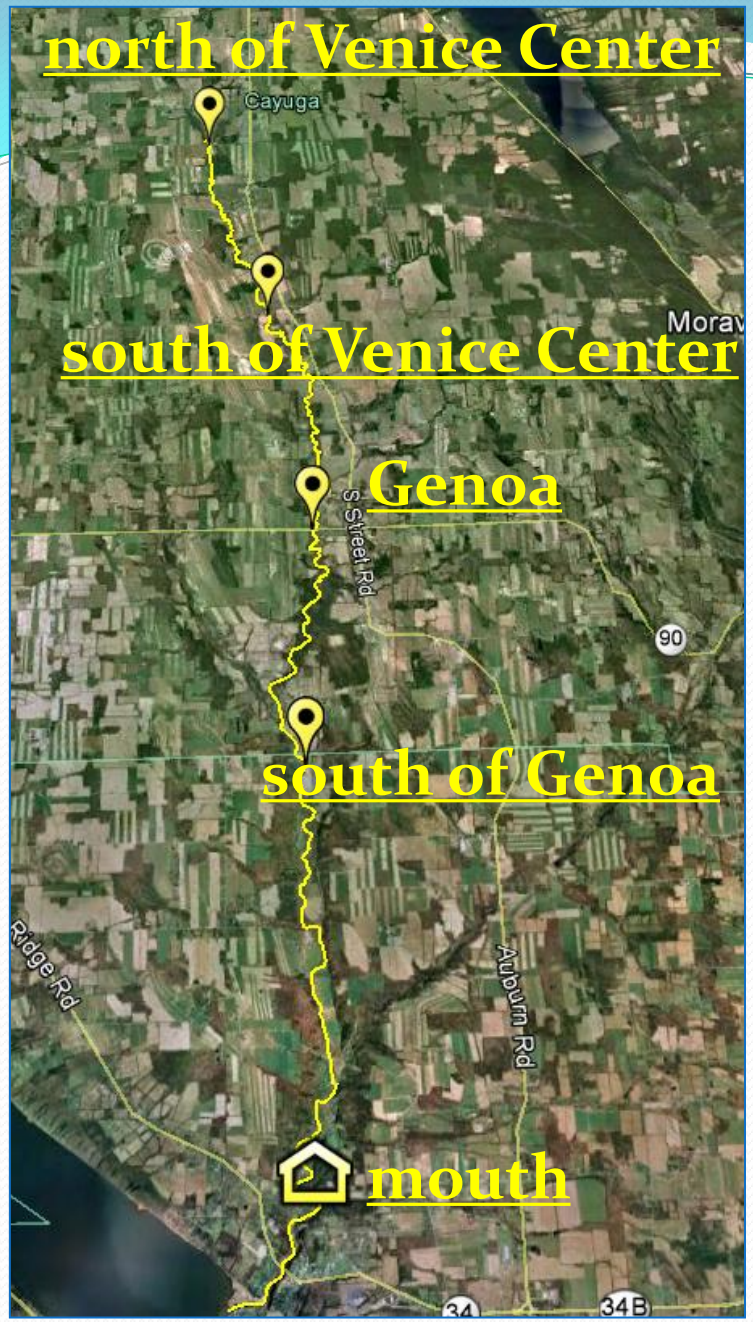


Synoptic Survey Monitoring



- sampled multiple locations along creek over several days

- 1 successful synoptic event monitored in early April
- 1 of 2 events complete
- on schedule for completion

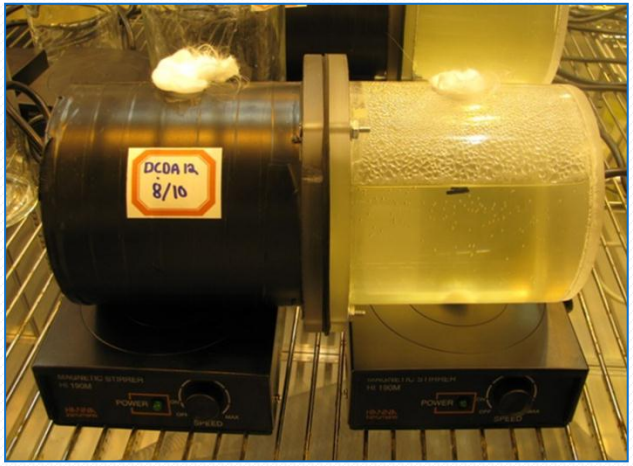


Synoptic Survey Monitoring

Salmon Creek Survey Locations

- sampled multiple locations along creek over several days
- 1 successful synoptic event monitored in early April
- 1 of 2 events complete
- on schedule for completion

Tributary and Wastewater Treatment Plant Bioavailability Assessment



- 2 of 3 samples from IAWWTP collected
- 1 of 3 samples from tributaries collected
- on schedule for completion

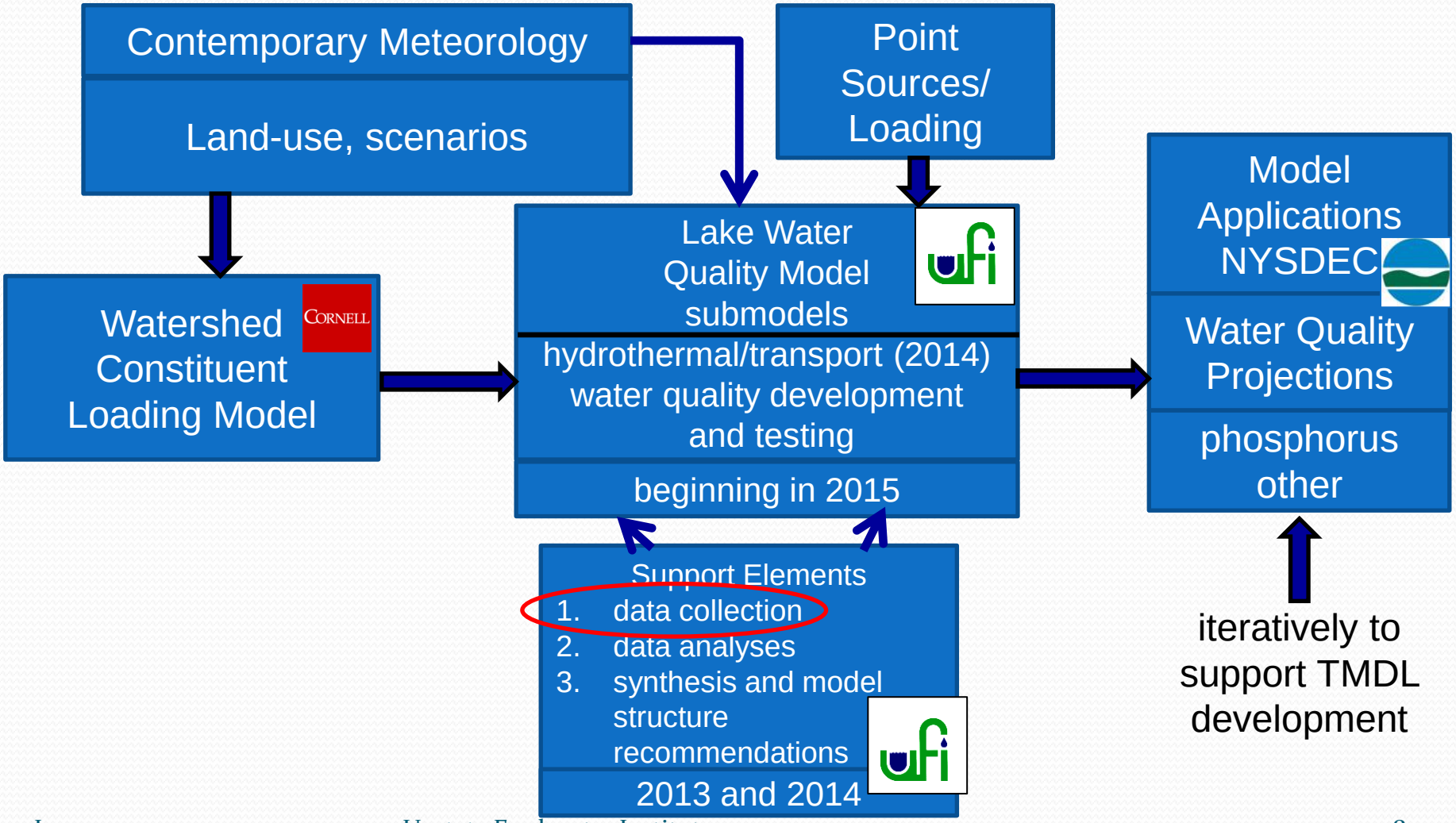
2013 Program Summary: Acquisition of Other Data Sets

- Data Sources and Ongoing Analysis
  - LSC Monitoring
  - Dr. David Bouldin
  - CSLAP
  - Seneca County (Dr. J. Makarewicz) – lake, North
  - CSI
  - IAWWTP – effluent, tribs, lake
  - CHWWTP – effluent
  - NYS DEC

Summary

- Monitoring began April 1, 2013
- Tributary auto-sampling equipment was installed in late March
- All scheduled tasks in April and May on the lake have been completed
- Early June lake monitoring has progressed according to the sampling plan
- All routine tributary tasks have been completed
- Half of the required tributary runoff events and synoptic events have been successfully monitored
- Bioavailability studies have begun and UFI is ready to collect more samples when opportunities (runoff events) present themselves
- UFI and Cornell have collaboratively installed and maintain additional automated monitoring equipment in the lake and inlet to support project goals

Components of a Water Quality Model for Cayuga Lake and Interplay of Elements



Accessing Data Reports Online

- Draft data reports of Lake-Wide surveys are available online
  - *In-situ* water quality profiles from 10 sites along entire lake
- Usually available 1-2 days after survey completion

http://energyandsustainability.fs.cornell.edu/util/clmp/lakemonitoring.cfm

2013 Cayuga Lake

Lake-Wide Seabird Profiles

June 6, 2013 Provisional Data Summary

Submitted: for review; for discussion purposes only

Anthony R. Prestigiacomo
Research Scientist

2013 Cayuga Lake Map

Site Numbers and Description

Site 9: 2.3 mi N of Frontenac Island

Site 8: 2.5 mi S of Union Springs

Site 7: 2.1 mi W Aurora

Site 6: 1.1 mi N of Sheldrake Pt.

Site 5: 1.8 mi N of Milliken Power Plant

Site 4: 1.6 mi S of Milliken Power Plant

Site 3: ~ 0.5 mi NE of Taughannock Park Marina

Site 2: 0.9 mi NW of Cornell Sailing Club

Site 1: 0.6 mi N of Allan H. Treman Marina

Site IL: ~ across from Allan H. Treman Launch Area

Guide to Abbreviations and Units

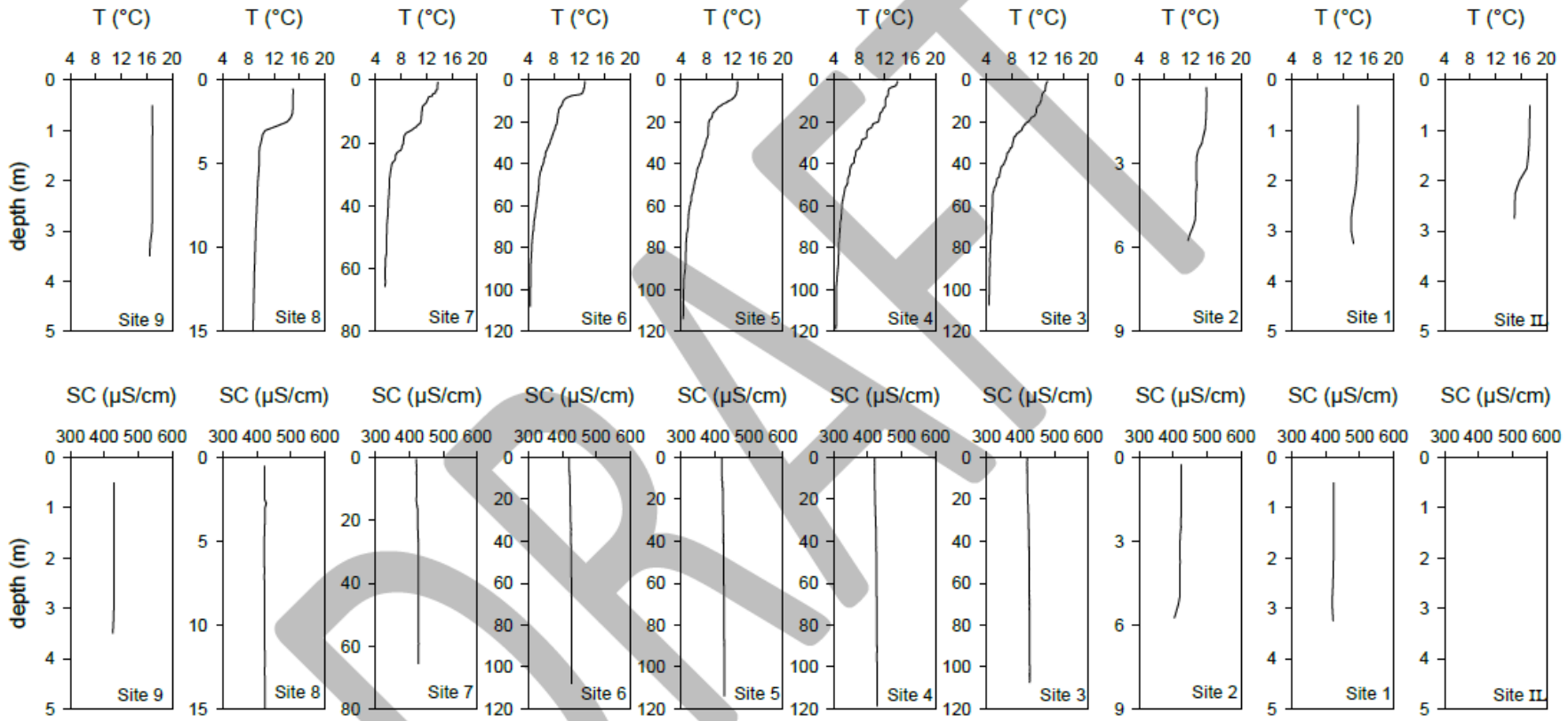
Sea Bird Profiles of Cayuga Lake collected by Upstate Freshwater Institute

Profiles display variability of the measured parameter with depth (in meters, notice the significant change in scale) and at the sampling locations along Cayuga Lake.

- **Temperature** (units are degrees C)
- **Specific Conductance (SC)** indicates the ability of water to convey an electrical current, which is a measure of the lake water's ionic content and activity (normalized to a temperature of 25°C). Units of specific conductance are micro Siemens per centimeter (µS/cm)
- **Turbidity (Tn)** is a measure of water clarity (the extent to which particles suspended in the water scatter light). Lower turbidity waters appear clear, while higher turbidity waters appear cloudy. Turbidity is reported in units of NTU, which stands for Nephelometric Turbidity Units.
- **Beam Attenuation Coefficient (BAC)** is another measure of water clarity. The unit of measure is per meter (m^{-1}), signifying the extent to which light is absorbed or scattered per meter of water depth. Like turbidity, low values signify more transparency and higher values more opacity.
- **Chlorophyll (Chl)** is a measure of the photosynthetic pigment present in the water column, and indicates the abundance of phytoplankton (algae) suspended in the water. Units are µg/l, which is equivalent to parts per billion.
- **Photosynthetically Active Radiation (PAR)** designates the amount of solar radiation within the spectral band that plants and algae can use in the process of photosynthesis. PAR declines with depth in the water column, as light is scattered and absorbed. The depth of penetration of PAR defined the "photic zone", where light is present to support photosynthesis. The units of PAR are micro Einsteins per square meter per second ($\mu Em^{-2}s^{-1}$).
- **Secchi Disk Transparency (SD)** is another measure of water clarity, and one that is standard for lake monitoring programs. The Secchi disk is a 20 cm diameter plastic disk with alternating quadrants of black and white, on a calibrated line. The monitoring team lowers the Secchi disk through the water column and records the depth at which it is no longer visible to the observers on the boat. Secchi disk is reported in meters. Higher Secchi disk readings signify clearer water.

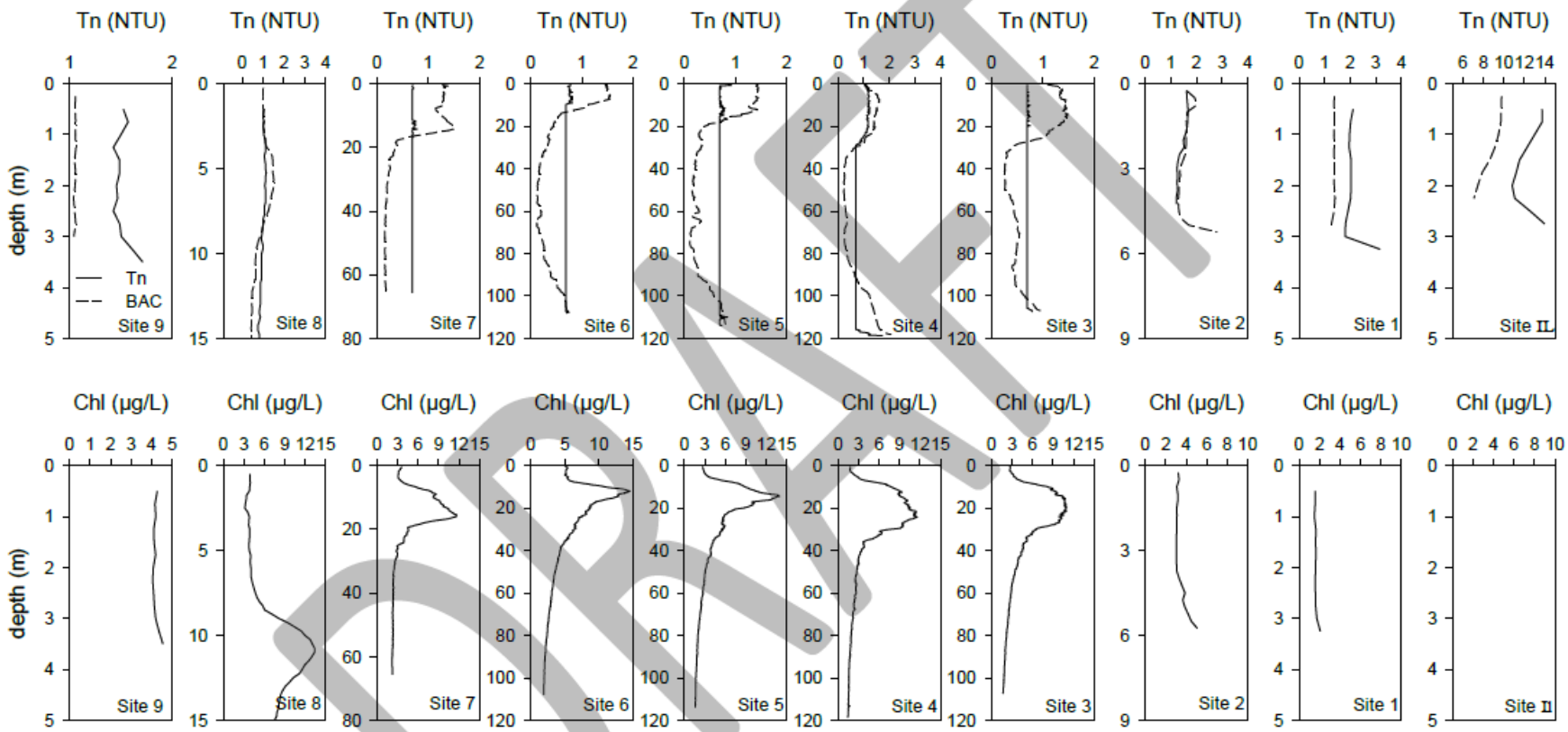
Temperature and Specific Conductance Profiles

North to South →



Turbidity, Beam Attenuation, and Chlorophyll Profiles

North to South →



PAR with Secchi Disc Profiles

North to South →