Total Nitrogen / Total Phosphorous Water Pollution Sensor Priorities

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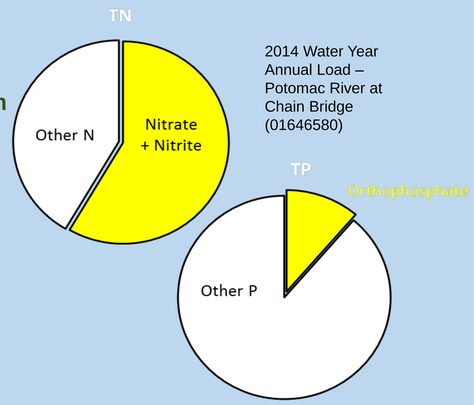
What are TN/TP?

- **Total Nitrogen (TN): sum of dissolved N (nitrate*, nitrite, ammonia/ammonium, and organic N) and particulate N**
- **Total Phosphorous (TP): sum of dissolved P (ortho-phosphate*, polyphosphate, organic phosphate) and particulate P**

Sensor available



2014 Water Year Annual Load – Potomac River at Chain Bridge (01646580)

http://cbrim.er.usgs.gov/index.html

Why does TN/TP matter?

- **National aquatic resource surveys consistently find TN and TP are widespread pollutants in lakes and rivers and streams**
- **More than 2 out of 5 river and stream miles are impacted by excess nutrients (EPA National Rivers and Streams Assessment)**

MERIS/ESA, processed by NOAA/NOS/NCCOS (Oct. 8, 2011)

- **Impacts to drinking water, eutrophication, and the development of harmful algal blooms**

Current Approach – TN/TP Monitoring

- **Laboratory Methods – Whole Water Samples**
  - Persulfate digestion for N and P (colorimetric) ✗
  - High-temperature catalytic oxidation for N (chemiluminescence) ✗
- **Laboratory Methods- Computation**
  - Total Kjeldahl digestion plus dissolved constituents not oxidized (e.g. TKN plus nitrate plus nitrite) ✗
  - Dissolved N plus particulate N measured by high temperature combustion oxidation ✗
- **Surrogate Modelling Techniques** ✗

✓ EPA-Approved
✗ Not EPA-Approved

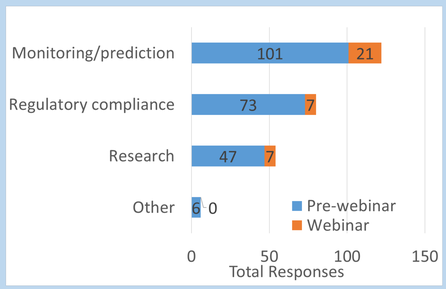
Drawbacks to Current Approaches

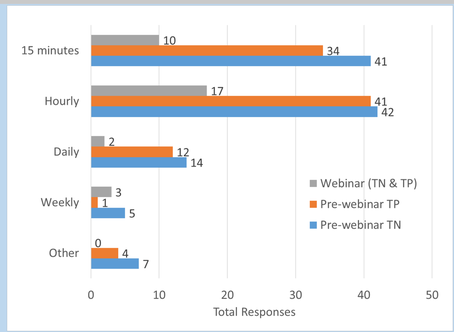
- **Lab-based methods:**
  - Time lag from sample collection to data
  - Difficult to make real-time decisions (e.g. process control)
- **High per-sample collection & analysis cost**
- **Limited data (due to cost)**
- **Lab instruments require trained analysts**
- **High uncertainty, site-specific (surrogates)**

Summary of TN/TP Feedback

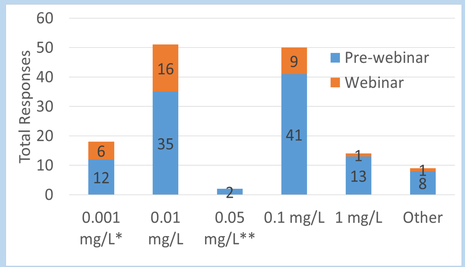
Characteristic	Need
Limit of Detection	Lower: <0.1 mg/L
Accuracy	5%
Sampling Frequency	15 min or 1 hour
Deployment Length	1 month
Data Logging	Integrates with existing data logger
Data Transmission	Cellular or Manual Download
Price	$1,000 - $3,000

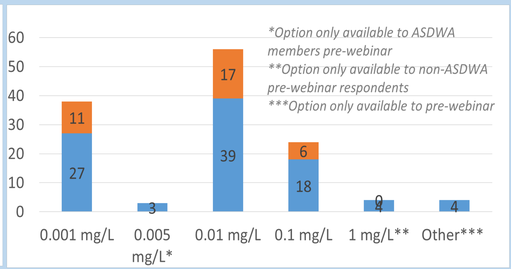
Reasons for Monitoring, Sample Frequency



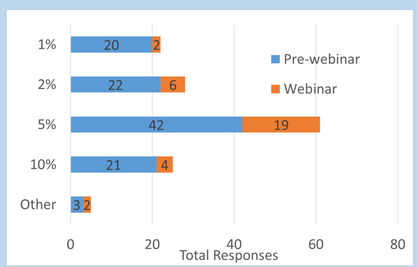


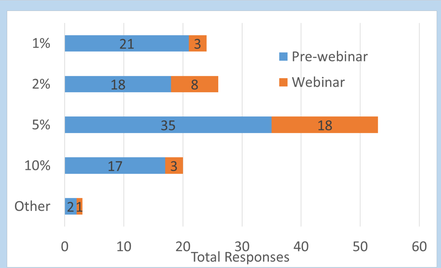
TN Limit of Detection, TP Limit of Detection



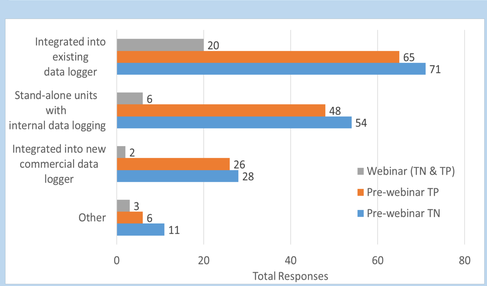


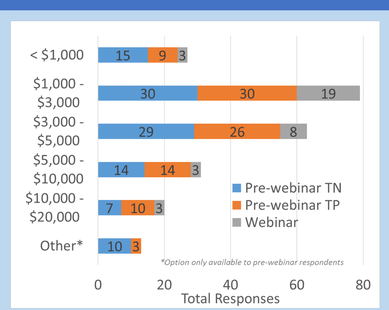
TN Accuracy, TP Accuracy



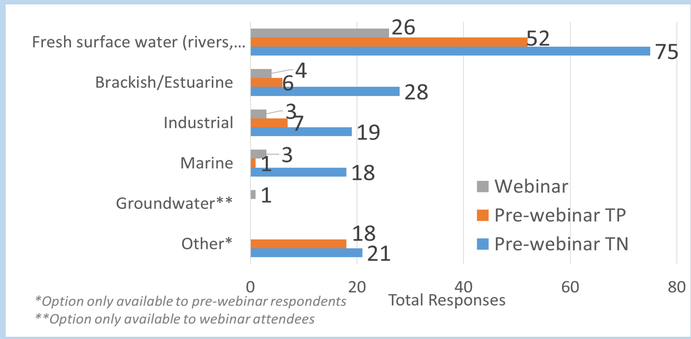


Data Integration, Desired Price

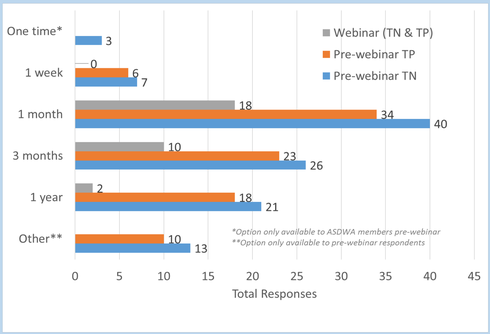




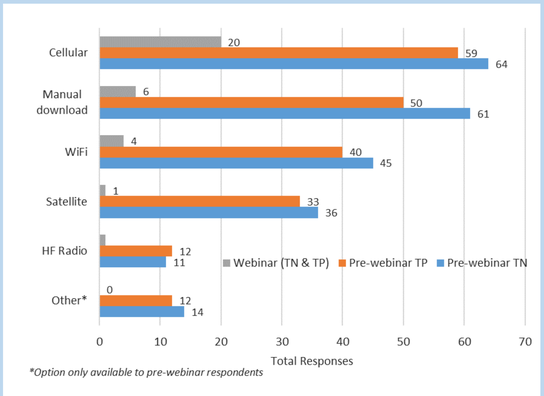
Sampling Environment



Deployment Length



Data Transmission



Potential Benefits of Advanced TN/TP Sensors

Benefits

- "Real-time" data
- Easy to operate
- Continuous monitoring
- Field-deployable
- Portable
- Affordable

Next Steps

Suggestions Welcome!

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U.S. Geological Survey
U.S. Park Service
Water Environment Federation