



# The Kent County Land Ocean Biogeochemical Observatory: Real-time Hourly Determination of Water Quality in the Delaware Bay Ecosystem.

William J. Ullman<sup>a</sup>, William Gagne-Maynard<sup>b,a</sup>, Sarah J. Fischer<sup>a</sup>, Yoana G. Voynova<sup>a</sup>

<sup>a</sup> School of Marine Science and Policy, University of Delaware, Lewes DE 19958

<sup>b</sup> Carleton College, Northfield, MN 55057



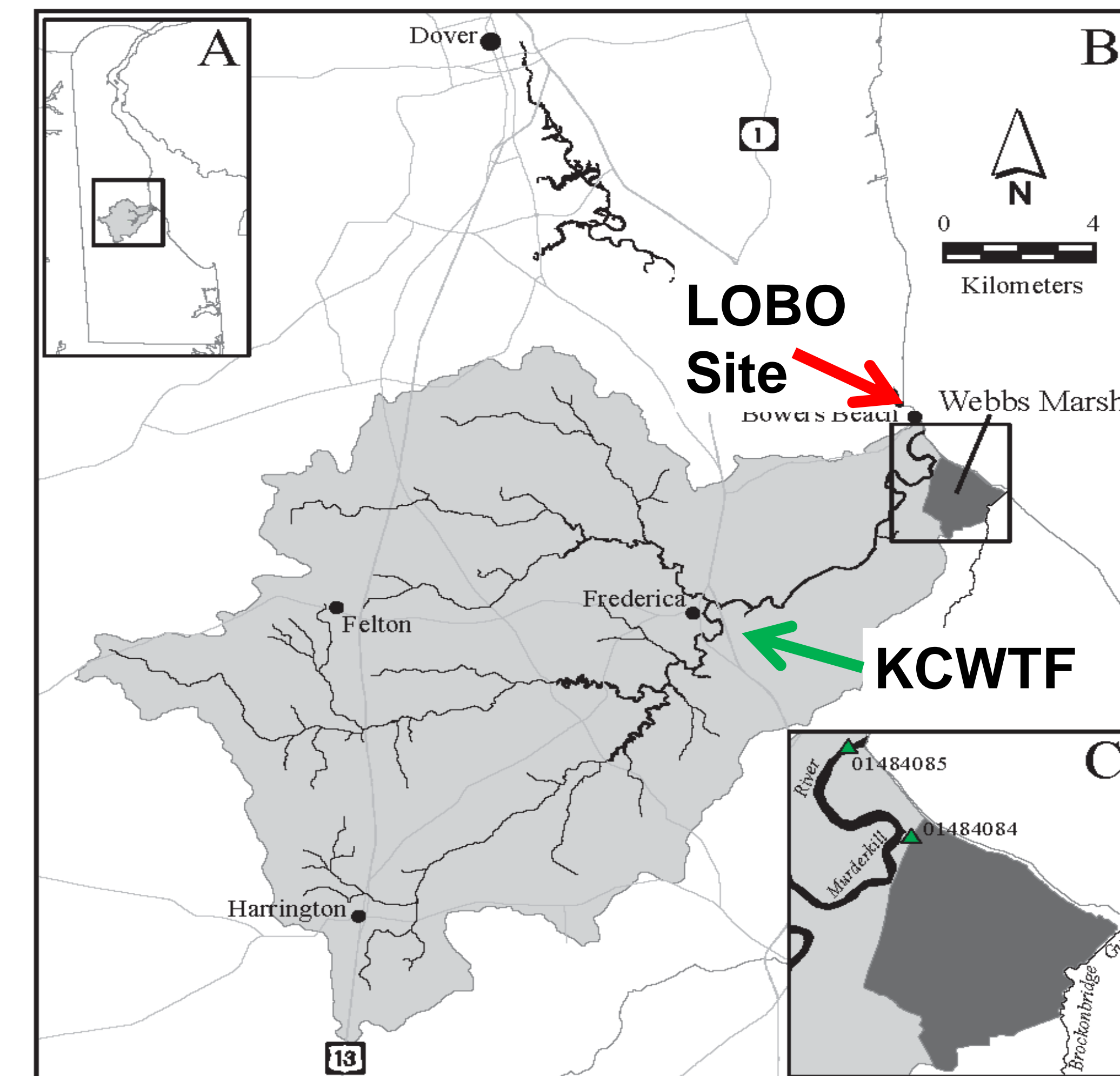
## Project Summary:

In collaboration with the Kent County Board of Public Works, Delaware's Department of Natural Resources and Environmental Control, and the U.S. Geological Survey (USGS), the University of Delaware is now operating a real-time water quality monitoring station at Bowers, Delaware, at the intersection of the Murderkill Estuary and Delaware Bay. The Land Ocean Biogeochemical Observatory (LOBO) instrument was designed by Seabird Scientific, Satlantic, and WETLabs, all now represented by Hach-Hydromet. The following parameters are measured on an hourly basis: conductivity, temperature, pressure, dissolved oxygen, turbidity, chlorophyll, CDOM (colored dissolved organic matter), nitrate ( $\text{NO}_3^-$ ) and orthophosphate ( $\text{PO}_4^{3-}$ ). The LOBO is deployed under a public dock adjacent to a USGS gauging station (01484085; Murderkill River at Bowers, DE). Preliminary LOBO results are available on the web at [kentcounty.loboviz.com](http://kentcounty.loboviz.com) within minutes of the completion of the analyses. The web interface allows the public to view and graph the preliminary data. Quality assured data is also available from the principal investigator on a monthly basis. USGS determinations of discharge allow for hourly and longer term determinations of material exchange rates of particles,  $\text{NO}_3^-$ , and  $\text{PO}_4^{3-}$  between the Murderkill Estuary and Delaware Bay. The LOBO data are being used: (1) to better understand how these loads affect other biogeochemical parameters within the Murderkill Estuary; (2) to determine how storms affect nutrient loads; and (3) to assess the success of the implementation of pollution control strategies in the watershed and estuary. At the Bowers site, many of the dissolved parameters appear to be conservative due to high rates of mixing between Murderkill Estuary and Delaware Bay waters. However, as inferred by property-salinity plots, there are variations in the mixing end-members due to biogeochemical processes in the watershed and in the Delaware Bay, and to discharge to the estuary from the Kent County Wastewater Treatment Facility.

Manufacturer	Instrument	Parameters
Satlantic	LOBO: STOR-X Computer/Data Logger	Power, Sensor, and Data Management
Satlantic	SUNA Nitrate Reagent-Free UV Sensor:	Nitrate ( $\text{NO}_3^-$ )
WET Labs	ECO-CDS Sensor: Scattering and Fluorescence	Colored Dissolved Organic Matter (CDOM)
WET Labs	Cycle- $\text{PO}_4$ sensor: Single Channel Analyzer	Phosphate ( $\text{PO}_4^{3-}$ )
WET Labs/Seabird	WQM - Water Quality Monitor: Multiple Parameter Sensor with Anti-Fouling	Salinity, Temperature, Dissolved Oxygen, Conductivity, Turbidity, Depth, Chlorophyll



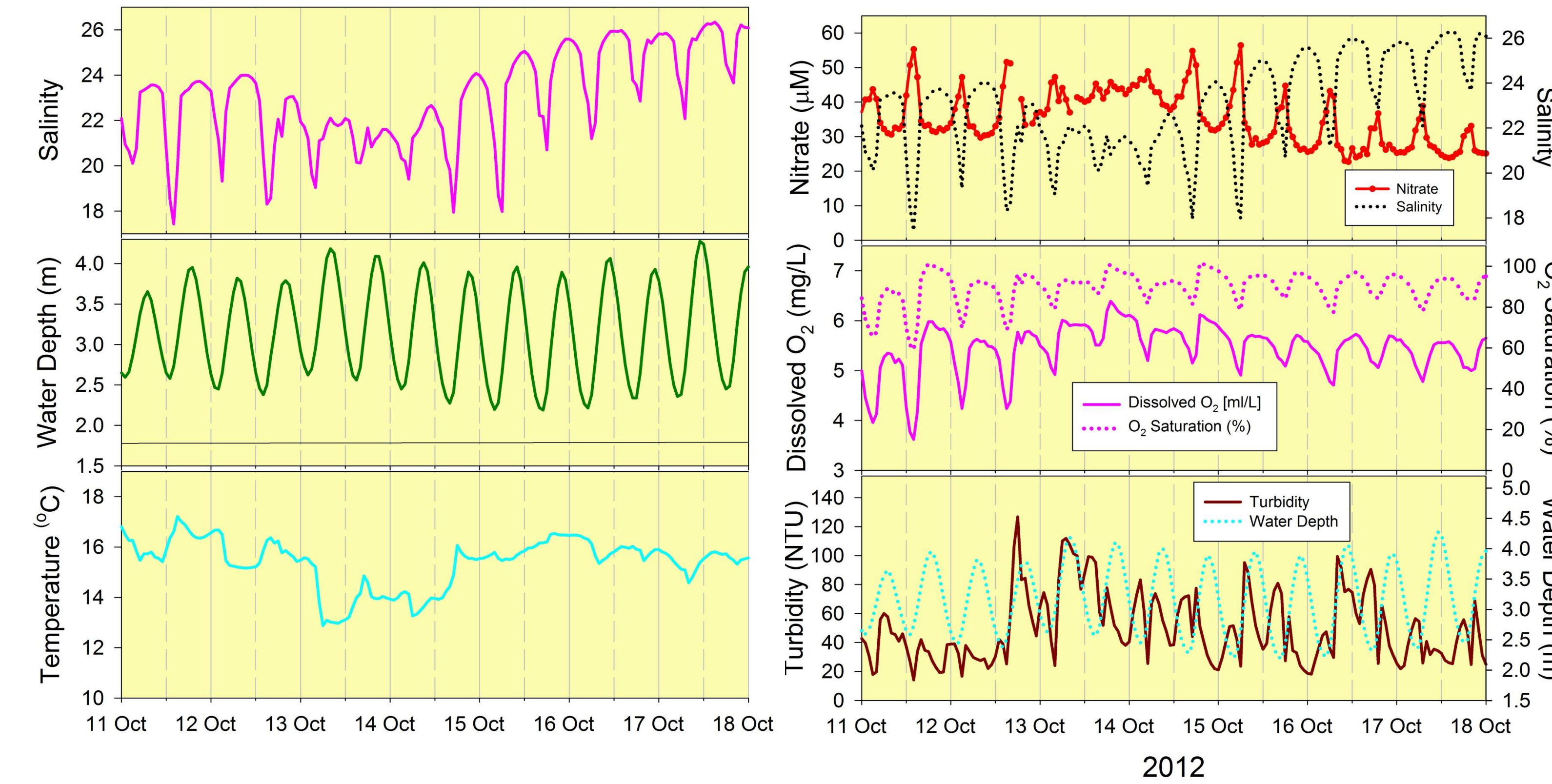
LOBO & USGS Site Bowers, Delaware, Looking East to Delaware Bay.



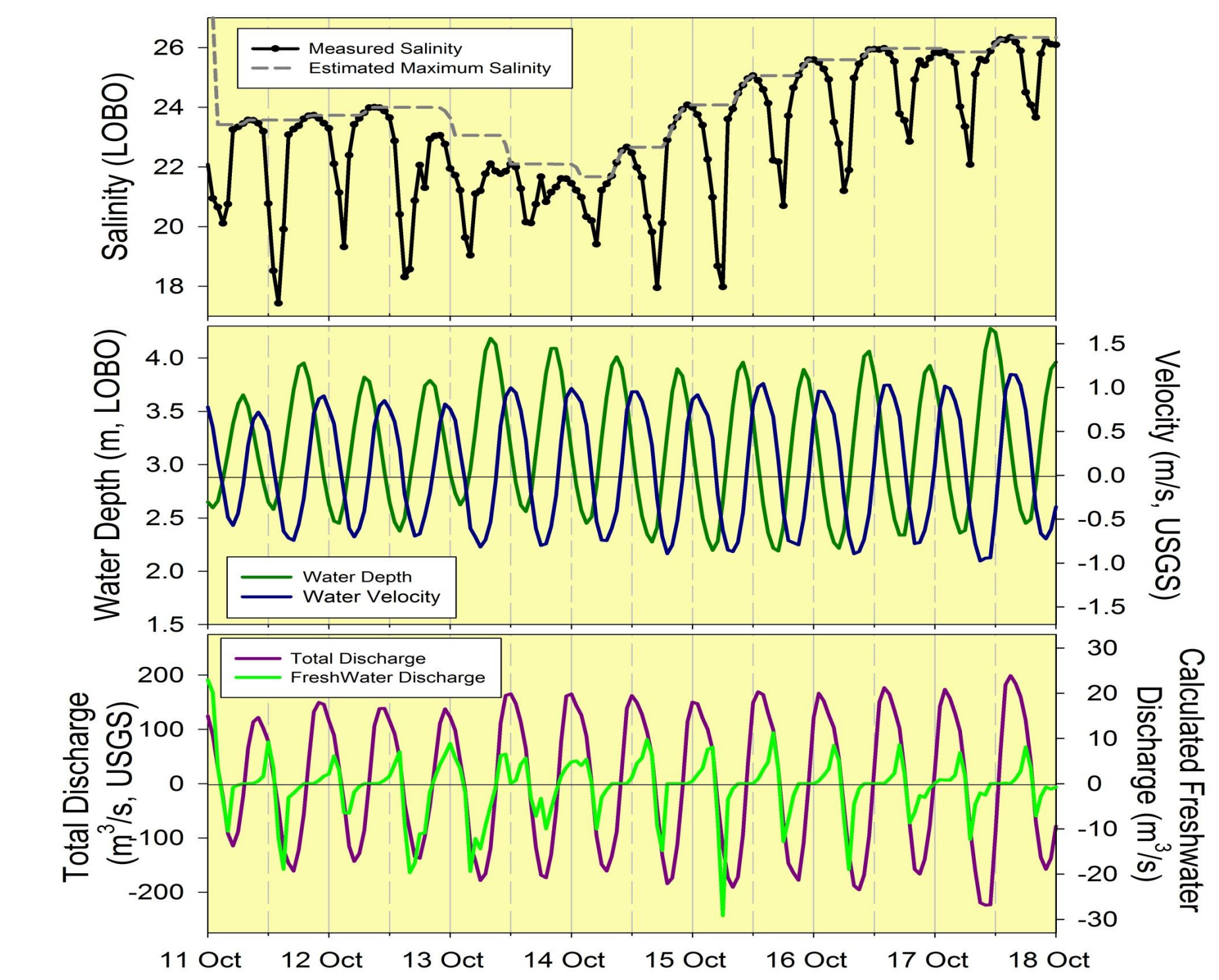
Murderkill Watershed and Estuary, showing Location of LOBO/USGS Monitoring Station at Bowers Beach and the Location of the Kent County Wastewater Treatment Facility

## Applications

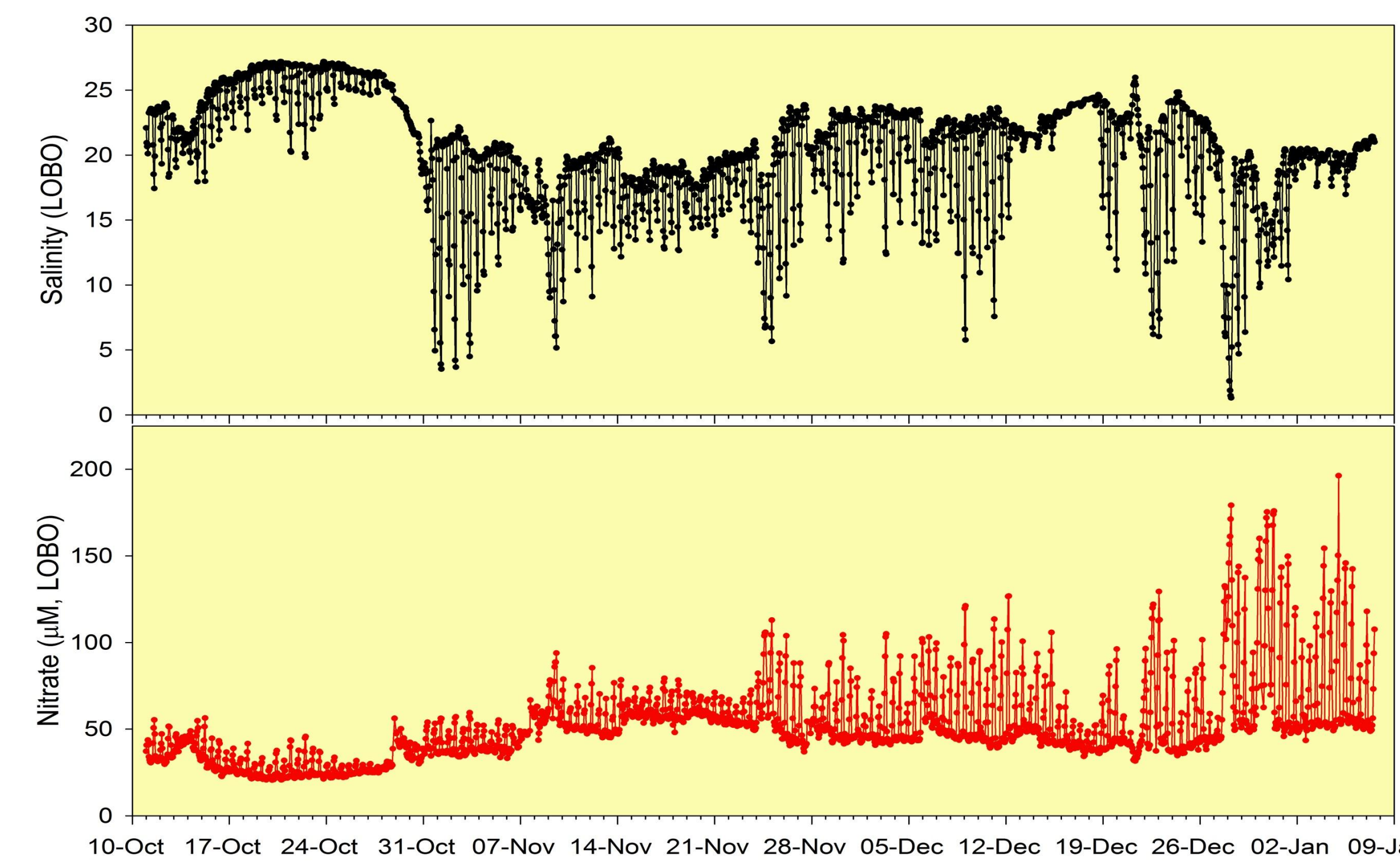
### Short Time Series



### Freshwater Balance



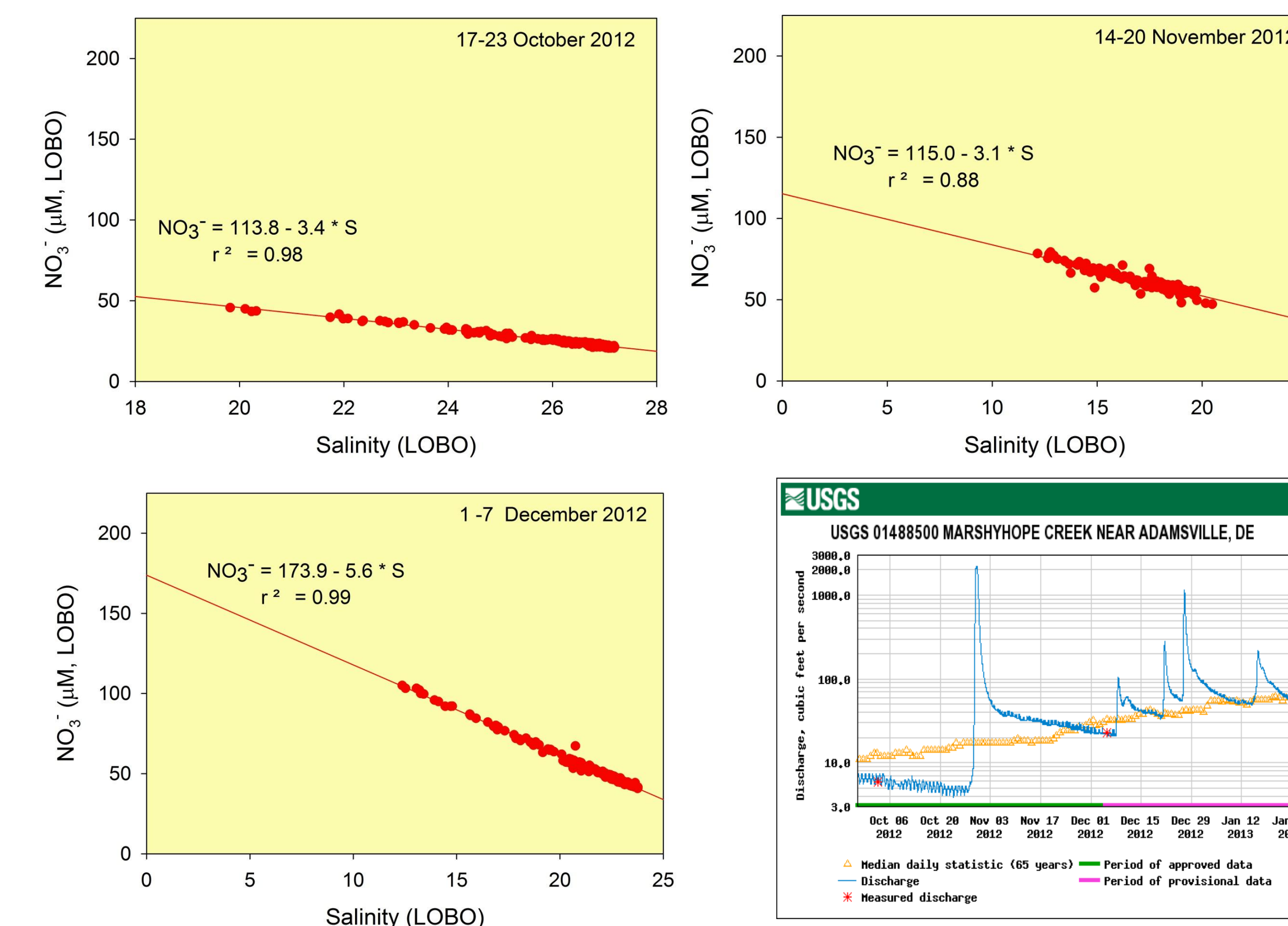
### Long Time Series



### Preliminary Observations

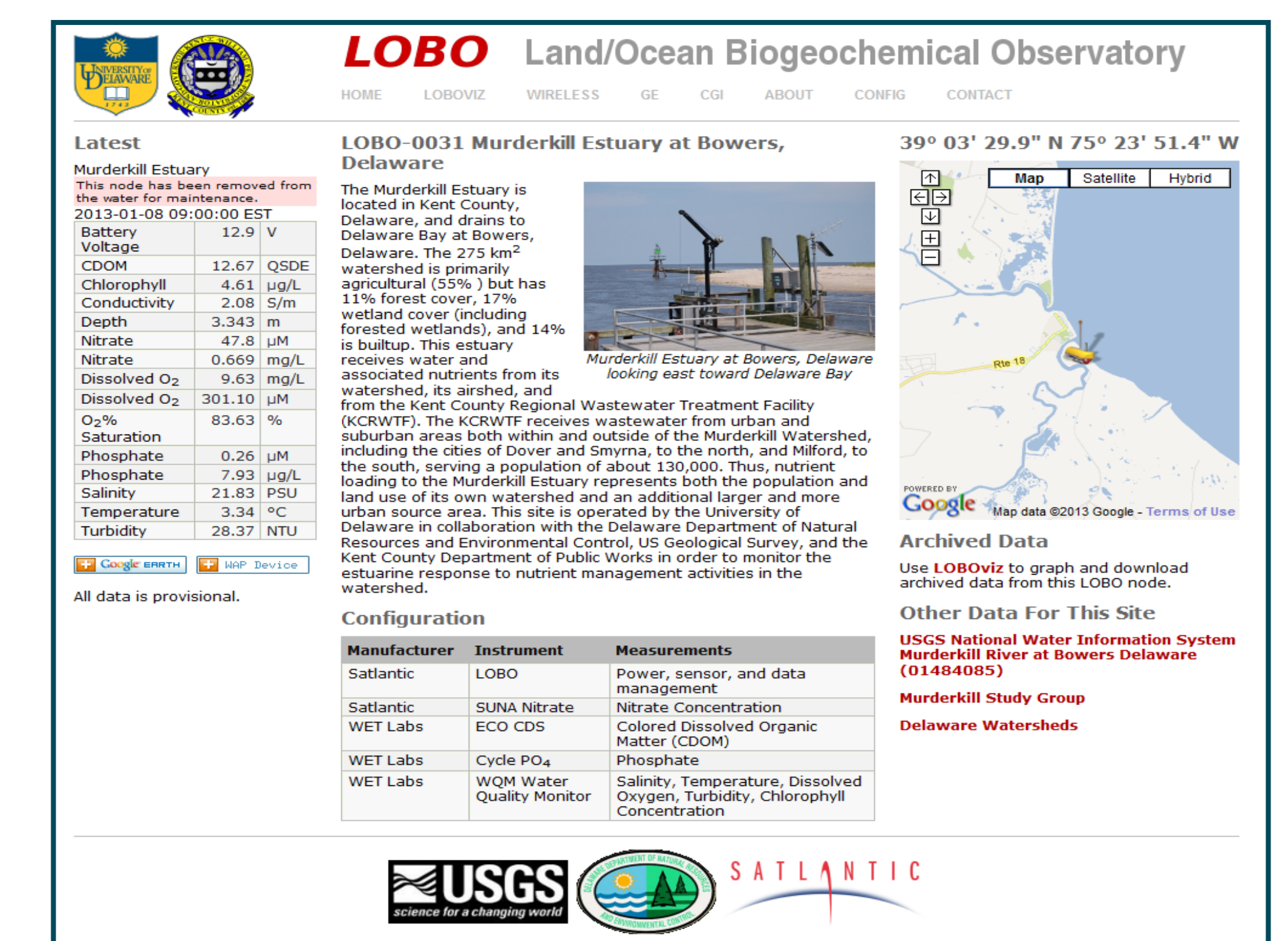
- Salinity at the Bowers site is controlled by a balance between local rainfall and runoff, Delaware Estuary rainfall and runoff, and offshore winds.
- From Bowers data, it is possible to monitor changes in  $\text{NO}_3^-$  loads associated with upland, estuarine, and wastewater contributions.
- Storm events, particularly those associated with offshore downwelling-favorable winds, lead initially to increases in salinity and decreases in watershed associated  $\text{NO}_3^-$  loads. Immediately following these events, however, are periods with lower salinity and higher contributions of  $\text{NO}_3^-$  from the local watershed.

### Mixing Curves

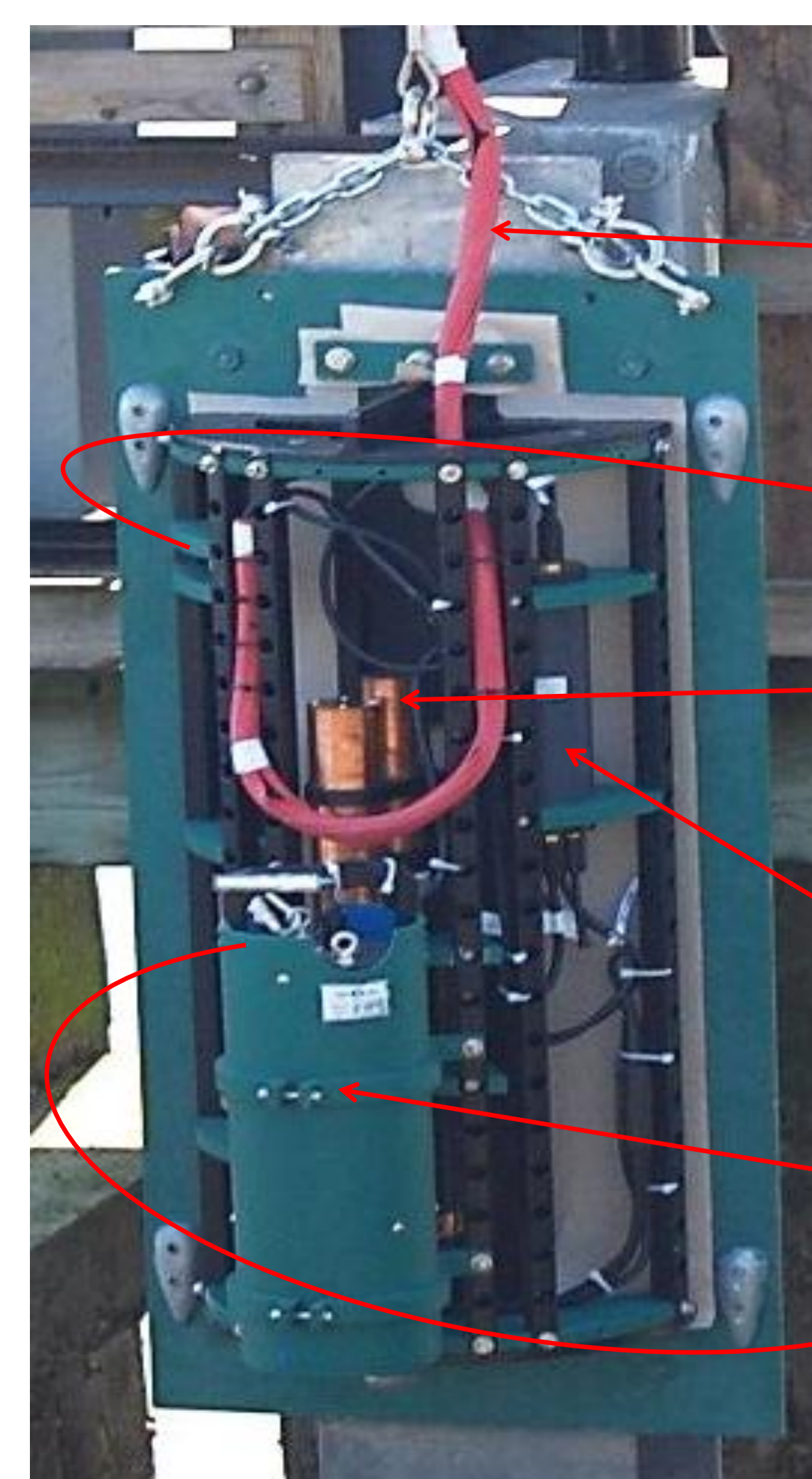


Mixing curves for a soluble substance determined by the LOBO at Bowers site can be used, together with freshwater discharge (Data from the nearby USGS gauging station at Marshyhope Creek, shown above) to estimate the total loads of that substance from all sources in the Murderkill Watershed to Delaware Bay. The above mixing curves show the seasonal trends in these  $\text{NO}_3^-$  concentrations.

Online Data With Plotting Capability at [kentcounty.loboviz.com](http://kentcounty.loboviz.com) (plotting link at lower right)



For more information, contact William Ullman ([ullman@udel.edu](mailto:ullman@udel.edu)) or Yoana Voynova ([yvoynova@udel.edu](mailto:yvoynova@udel.edu)). Funding for this project is provided by the Kent County Levy Court and Department of Public Works (Hans Medlarz, Director) with additional assistance from the Delaware Department of Natural Resources and Environmental Control and the US Geological Survey.



Power and Data Cable

ECO-CDS (CDOM)

WQM

STOR-X Data Logger

Cycle- $\text{PO}_4$

SUNA ( $\text{NO}_3^-$ )

### Data Intercomparison

