DEWOOS – A Concept That Should Be an Effective Program

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Contributors to DEWOOS Concept:

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DEWOOS – The Delaware Estuary Watershed to Ocean Observing System

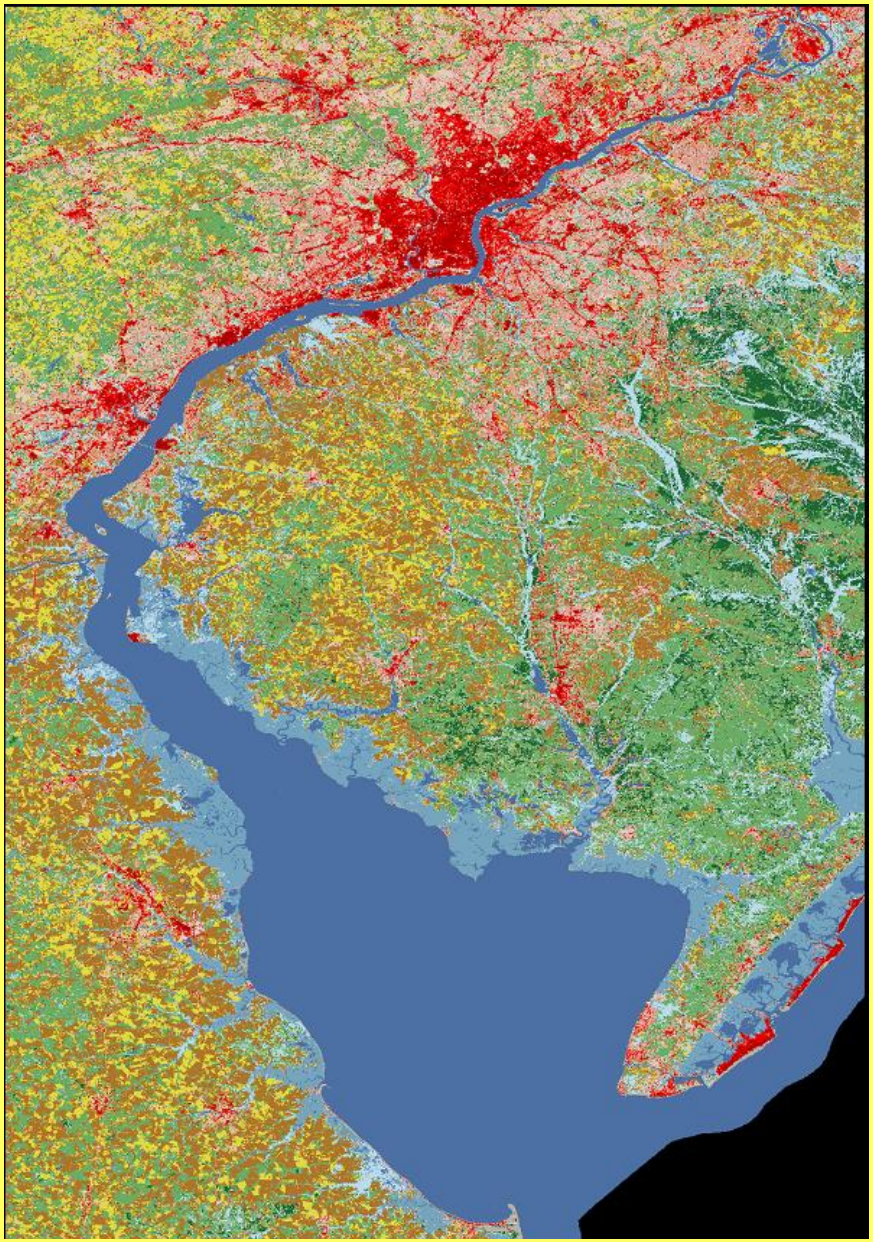
Purpose: To develop an effective observing program for the Estuary of the Delaware Watershed, River, and Bay that will advance the national and regional IOOS goals:

- Detecting and forecasting oceanic components of climate variability
- Facilitating safe and efficient marine operations
- Ensuring national security
- Managing resources for sustainable use
- Preserving and restoring healthy marine ecosystems
- Mitigating natural hazards
- Ensuring public health

Importance of Delaware Estuary

- Fourth largest urban region in US
- Drinking water supply to over 16 million people
- One of largest oil refinery and chemical industry centers of country
- Second largest petrochemical port in US
- Major electrical generation capacity including large nuclear plants
- Once major US center for sturgeon, shad
- Center for horseshoe crab population – associated migratory shorebirds

Urban region with over 5 million people



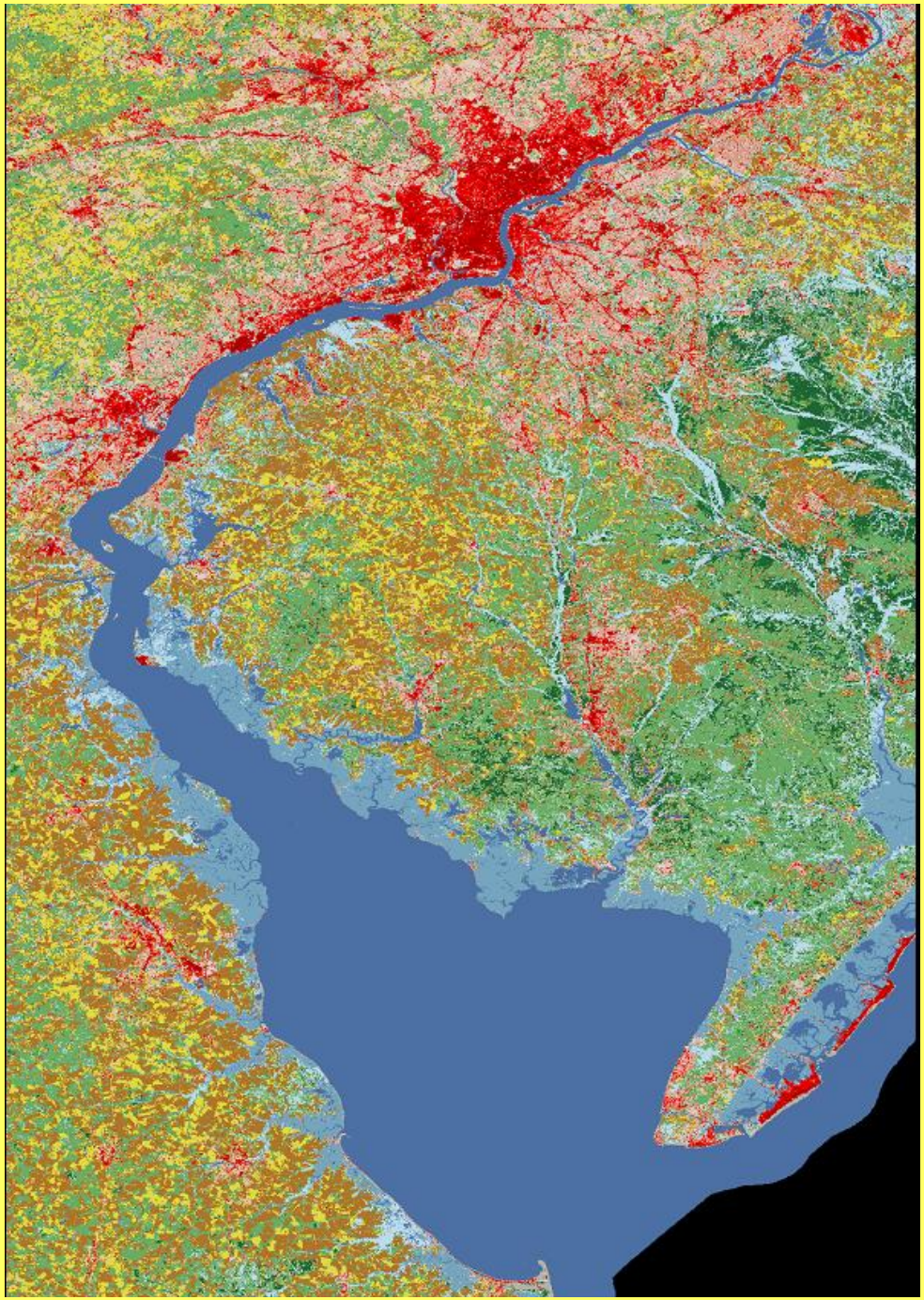
Head of tide at Trenton, NJ

100 km long tidal river – one of world's largest tidal freshwater estuaries

120 km long saline stretch into Delaware Bay

Delaware Bay with little water, terreginous, or anthropogenic inputs

GIS-based map by Yoana Voynova from USGS database

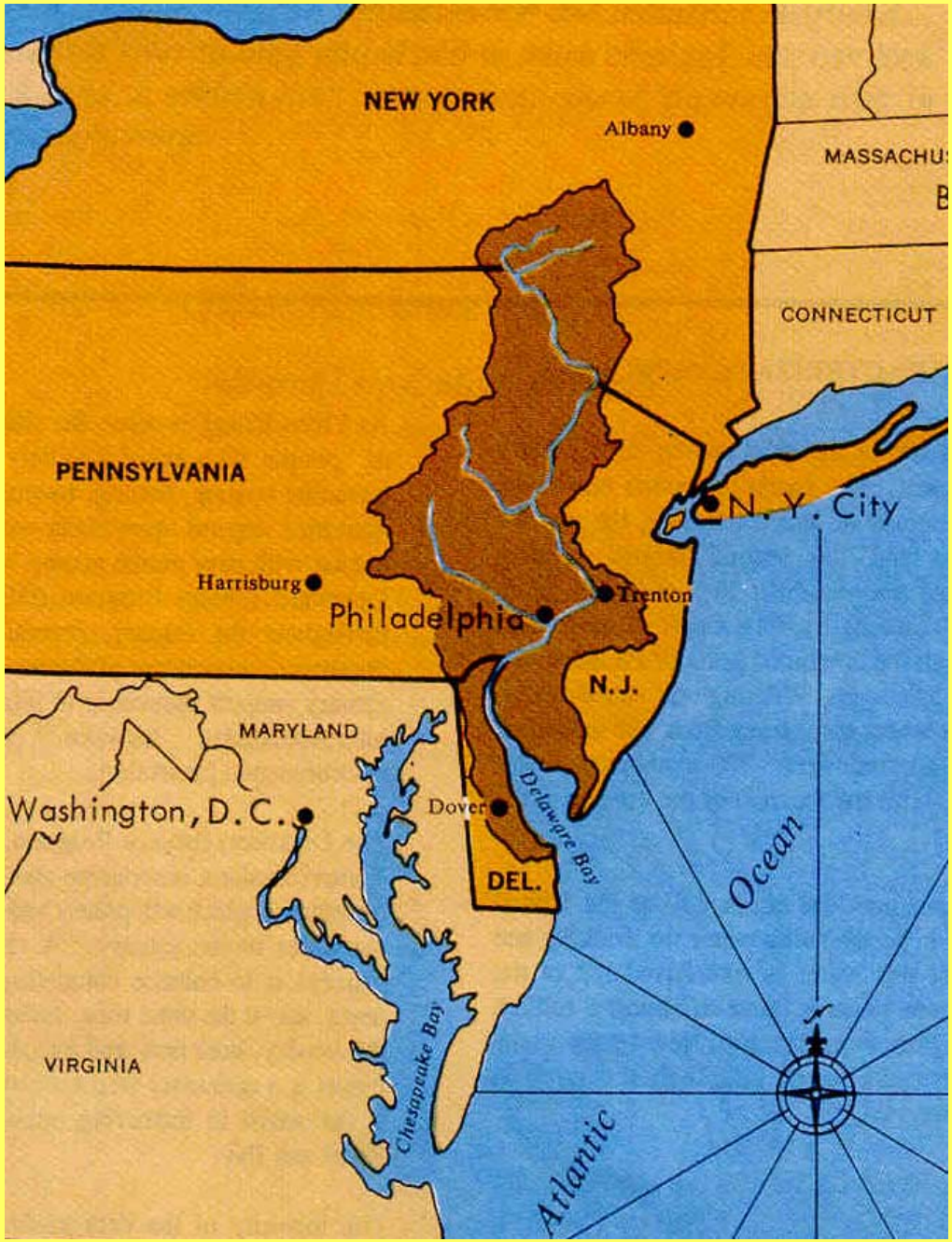


Delaware Estuary Land Cover

- Open Ocean
- Open Water
- Low Intensity Residential
- High Intensity Residential
- Urbanized
- Heavily Urbanized
- Bare Rock-Sand-Clay
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Pasture
- Row Crops
- Wetlands

Heavily urbanized tidal river

Marsh surrounded saline bay



Delaware Estuary Watershed

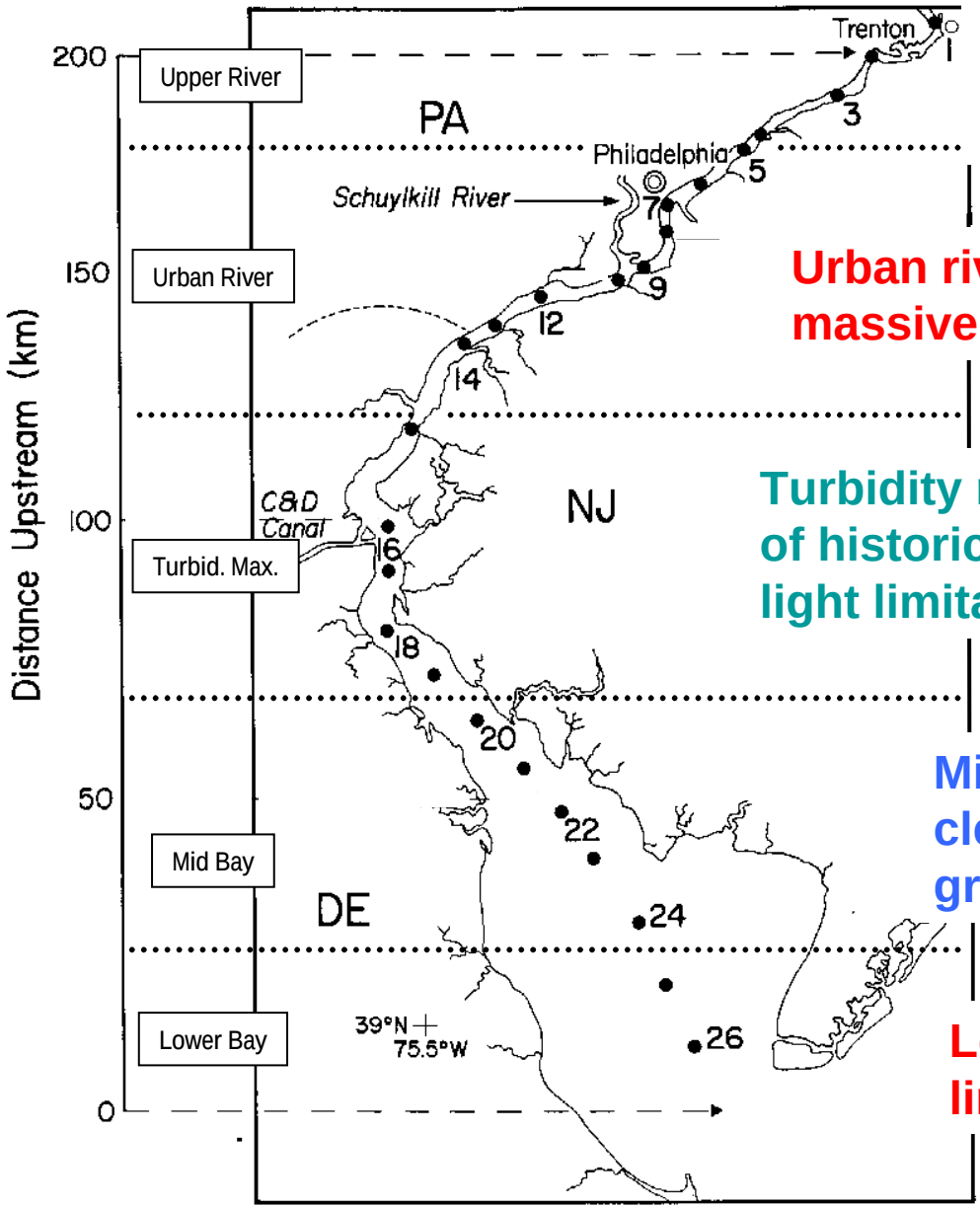
Watershed (33,254 km^2)

Water surface (2,070 km^2)

Tidal river (91 km^2)

Water inputs:
- **Delaware R – 58%**
- **Schuylkill R – 14%**
- **saline region – 11%**

NOAA NEEA areas
USGS flows



Upper tidal river – clear, composite agricultural and municipal inputs from fall line

Urban river – relatively clear, local massive municipal inputs

Turbidity maximum – resuspension of historical TSS inputs – strong light limitation

Mid-bay – grading from turbid to clear, relatively high nutrients grading to limitation

Lower bay – very clear, nutrient-limited

Advantages of Delaware Estuary

Over 80% of water inflow in freshwater river

Most anthropogenic inputs in urban river

Most terrigenous inputs at two gauging stations

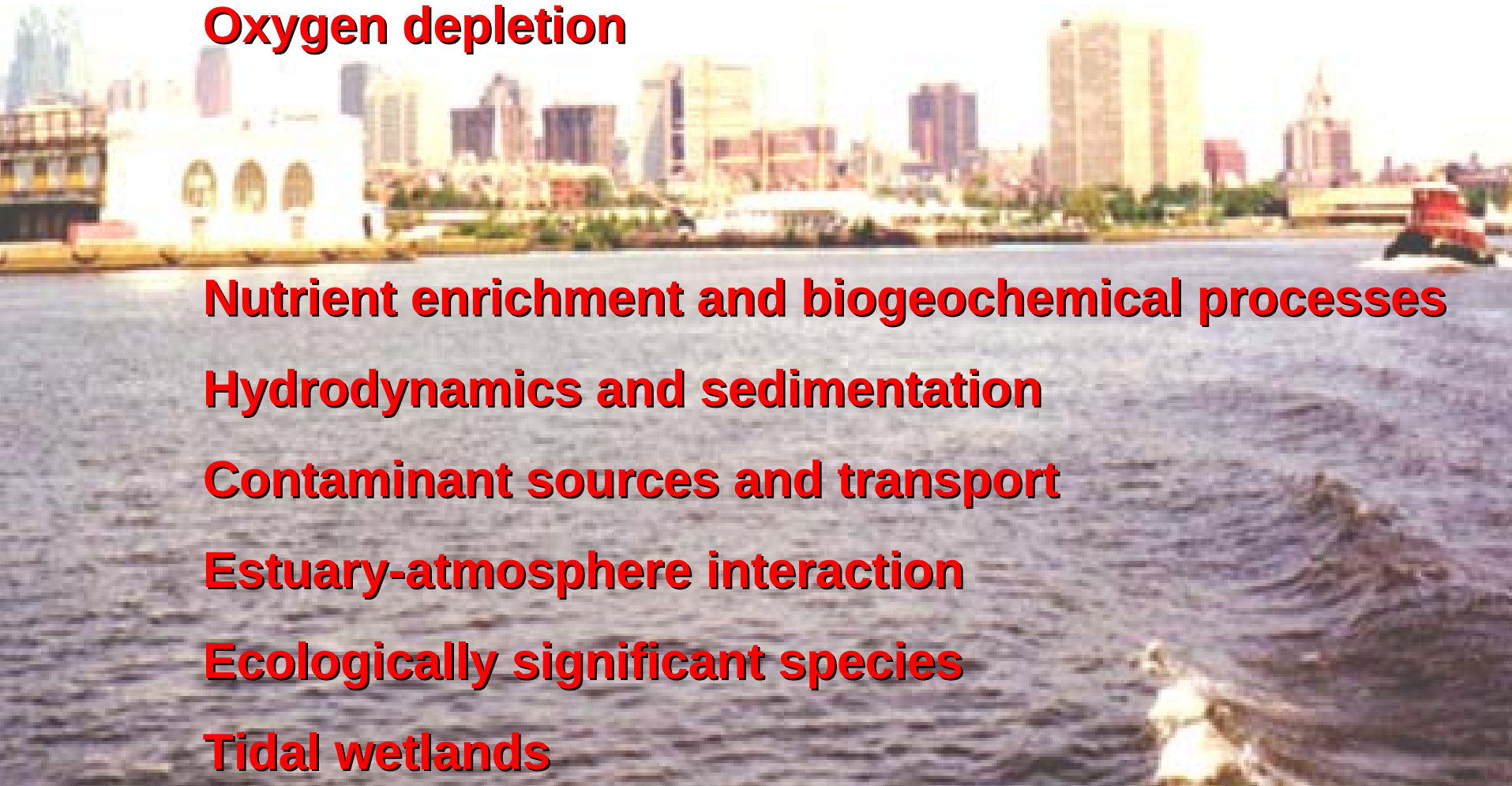
Marshes buffer lower estuary terriginous inputs

Delaware Bay simple geometrically

- Bay opens in regular funnel shape
- One tidal length long
- Dominant river channel focuses flow

Thus: Can characterize much with input gauging and center estuary transect monitoring

Environmental Quality and Ecosystem Health Issues



Freshwater inflow

Oxygen depletion

Nutrient enrichment and biogeochemical processes

Hydrodynamics and sedimentation

Contaminant sources and transport

Estuary-atmosphere interaction

Ecologically significant species

Tidal wetlands

What Measurement Capabilities Do We Have?

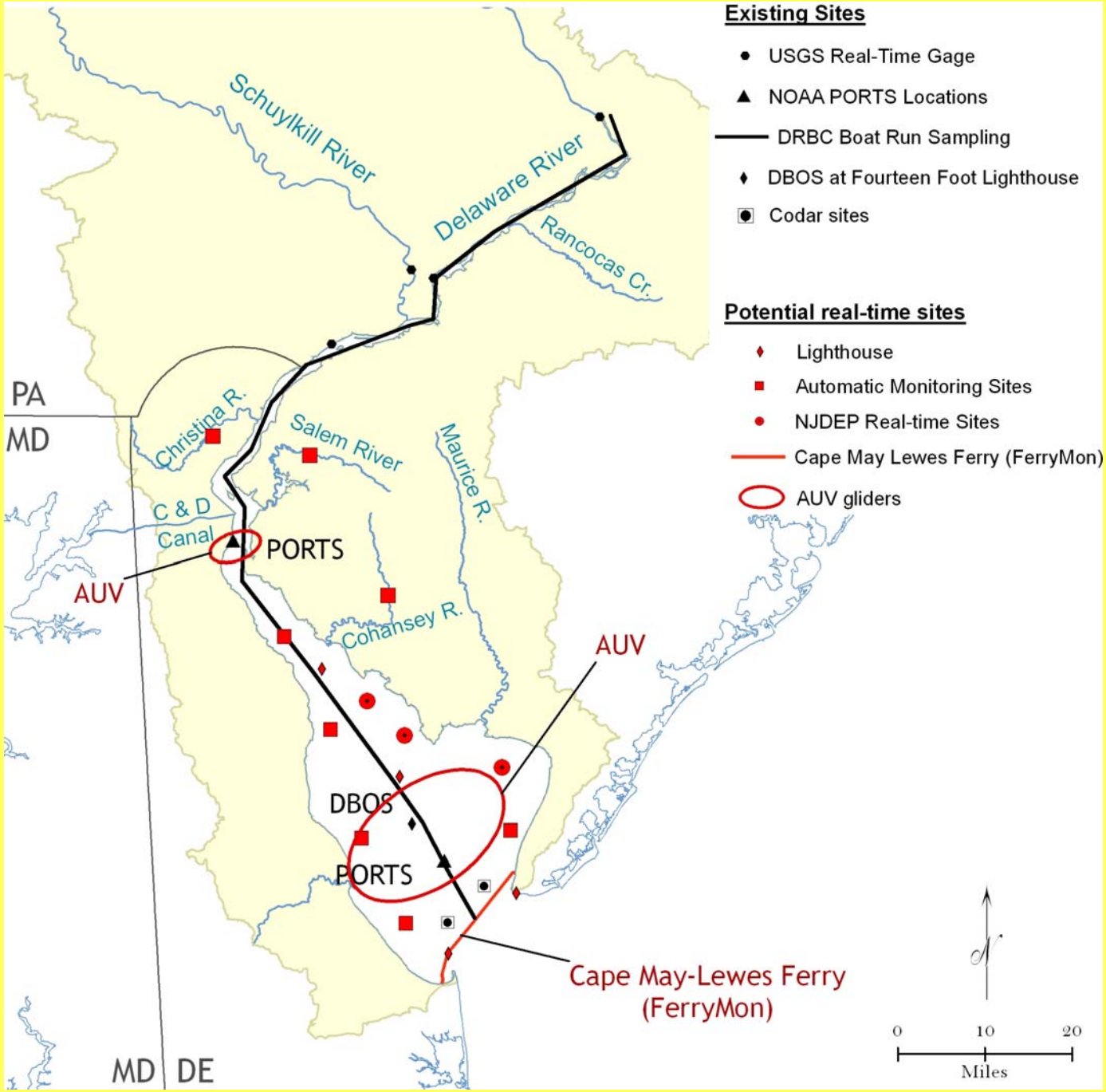
DRBC Boat Run Monitoring – Consistent discrete station sampling along axis of estuary since 1967 – water quality parameters

USGS gauging stations (Trenton, Philadelphia, and smaller) with daily water discharge plus some chemical and suspended sediment measurements

NOAA PORTS – several locations with continuous physical and meteorological parameters

DBOS – oceanographic and meteorological continuous measurements on Fourteen Foot Lighthouse (UD)

CODAR – two to three lower bay continuous current profiling stations



Map prepared and modified by Karen Reavy, DRBC

USGS

Water Resources | National Water Information System: Web Interface

Data Category: Real-time | Geographic Area: New Jersey | GO

USGS 01463500 DELAWARE RIVER AT TRENTON NJ

PROVISIONAL DATA SUBJECT TO REVISION

Available data for this site | Time-series: Real-time data | GO

National Weather Service flood stage for this gage is 20 feet.

This station managed by the West Trenton, NJ Water Science Center.

Available Parameters	Output format	Days
☐ All 8 Available Parameters for this site	◉ Graph	7 (1-31)
☑ 00060 Discharge	○ Graph w/ stats	GO
☑ 00010 Temperature, water (Pennsylvania side)	○ Graph w/o stats	
☑ 00065 Gage height	○ Table	
☑ 00400 pH (Pennsylvania side)	○ Tab-separated	
☑ 00095 Specific cond at 25C (Pennsylvania side)		
☑ 00301 Diss oxygen,%saturtn (Pennsylvania side)		
☑ 00300 Dissolved oxygen (Pennsylvania side)		
☑ 63680 Turbidity, Form Neph (Pennsylvania side)		

Summary of additional data for this site

http://waterdata.usgs.gov/nj/nwis/uv?01463500

Discharge, cubic feet per second

Most recent instantaneous value: 20,900 01-19-2007 13:15

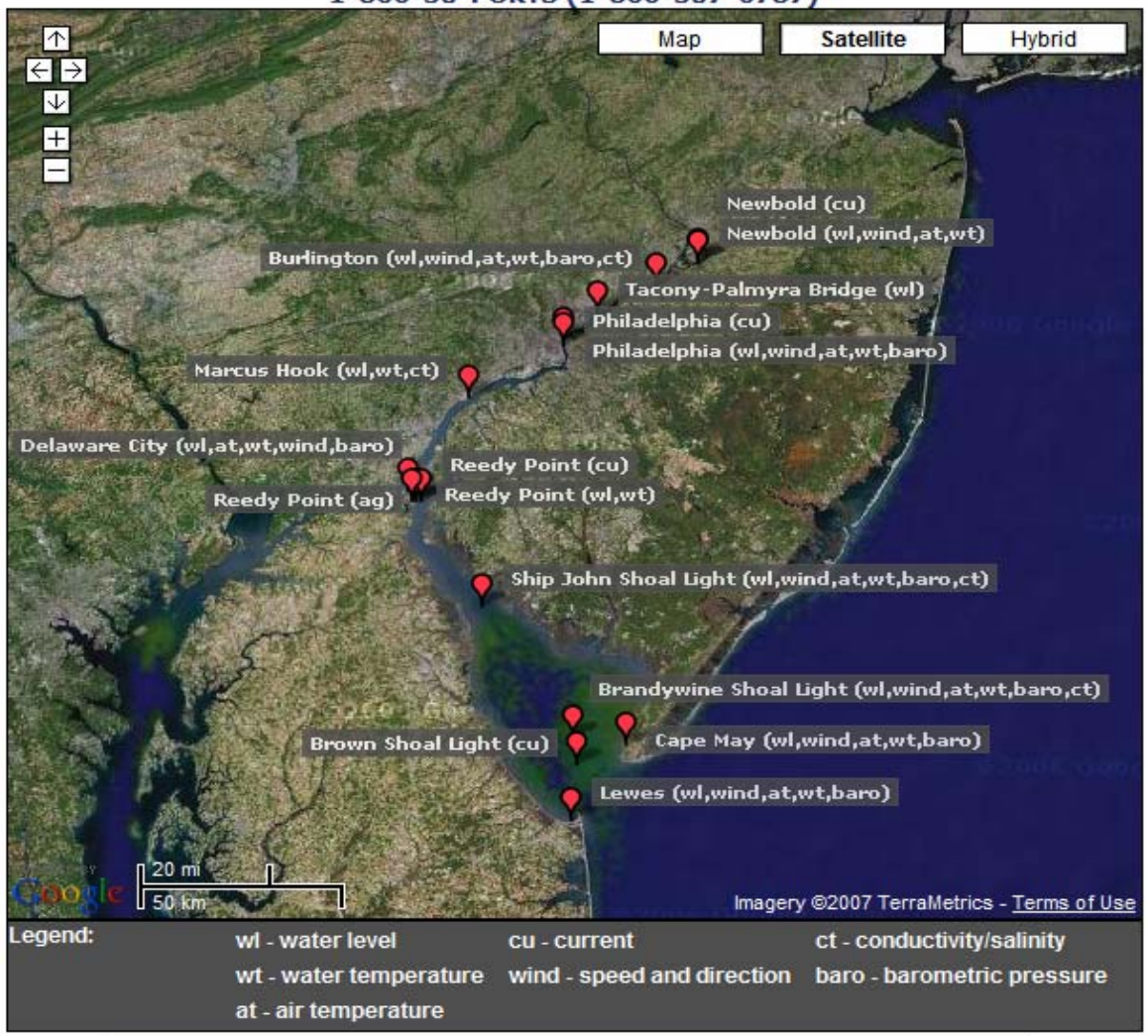
station selection

Brandywine Shoal Light
Brown Shoal
Burlington Highway Bridge
Cape May
Delaware City
Lewes
Marcus Hook
Newbold
Philadelphia
Reedy Point Air Gap
Reedy Point
Ship John Shoal Light
Tacony/Palmyra Bridge

Return to PORTS page

Delaware River and Bay PORTS®

Click HERE for text-based PORTS® Screen
Voice data response system:
1-866-30-PORTS (1-866-307-6787)



January 19, 2007

Delaware Bay Observing System
DBOS

UNIVERSITY OF DELAWARE

Fourteen Ft. Bank Lighthouse

- System
- Online Data
- Research
- News & Events
- Links

http://www.udel.edu/dbos/

Historical Information

Delaware Bay Observing System - College of Marine Studies - Newark & Lewes, DE - USA

Sea Grant | Graduate College of Marine Studies | University of Delaware

Other Existing Programs

USGS – other NWIS sites, Delaware River monitors

Additional DRBC sampling programs

NJ DEP Real time sites in Delaware Bay

DE DNREC Real time sites in Delaware Bay

My research sampling program (Sharp, UD)

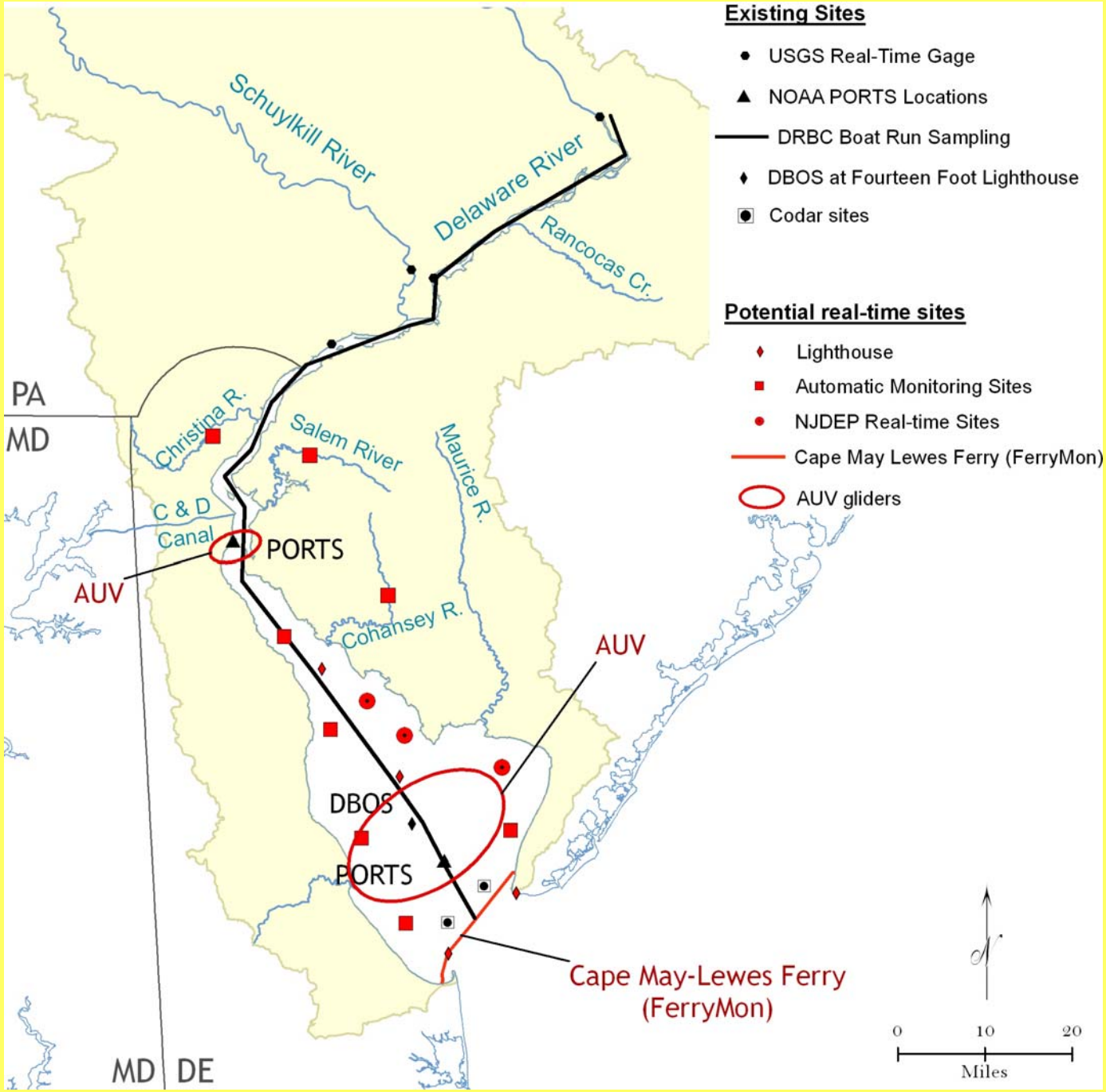
Delaware Environmental Observing System, DEOS (UD Department of Geography)

Kirchman Microbial Observatory, Luther test ORION observatory

Others?

Additional Programs to Add or Upgrade

- Improved river and bay real time monitoring – more sites, more sensors (add to USGS sites?)
- More light house telemetered sites
- Improved or added sites with depth profiling capability
- Ferry Monitoring
- AUVs – automated remotely directed “gliders”


Existing Sites
USGS Real-Time Gage
NOAA PORTS Locations
DRBC Boat Run Sampling
DBOS at Fourteen Foot Lighthouse
Codar sites
Potential real-time sites
Lighthouse
Automatic Monitoring Sites
NJDEP Real-time Sites
Cape May Lewes Ferry (FerryMon)
AUV gliders
Schuylkill River
Delaware River
Rancocas Cr.
PA
MD
Christina R.
Salem River
Maurice R.
C & D
Canal
PORTS
AUV
Cohansey R.
AUV
DBOS
PORTS
Cape May-Lewes Ferry
(FerryMon)
MD
DE
0
10
20
Miles

Example of DEWOOS Potential and Needs for Improvement in Future

Dissolved oxygen – important water quality – ecosystem parameter

Good example of use of extant programs:

- **DRBC boat run transects**
- **USGS gauging stations and other NWIS stations**
- **Research vessel surface mapping**

Example of need for better integration and access of data from various programs

Example of need for additional measurements

Delaware Estuary Oxygen Dynamics

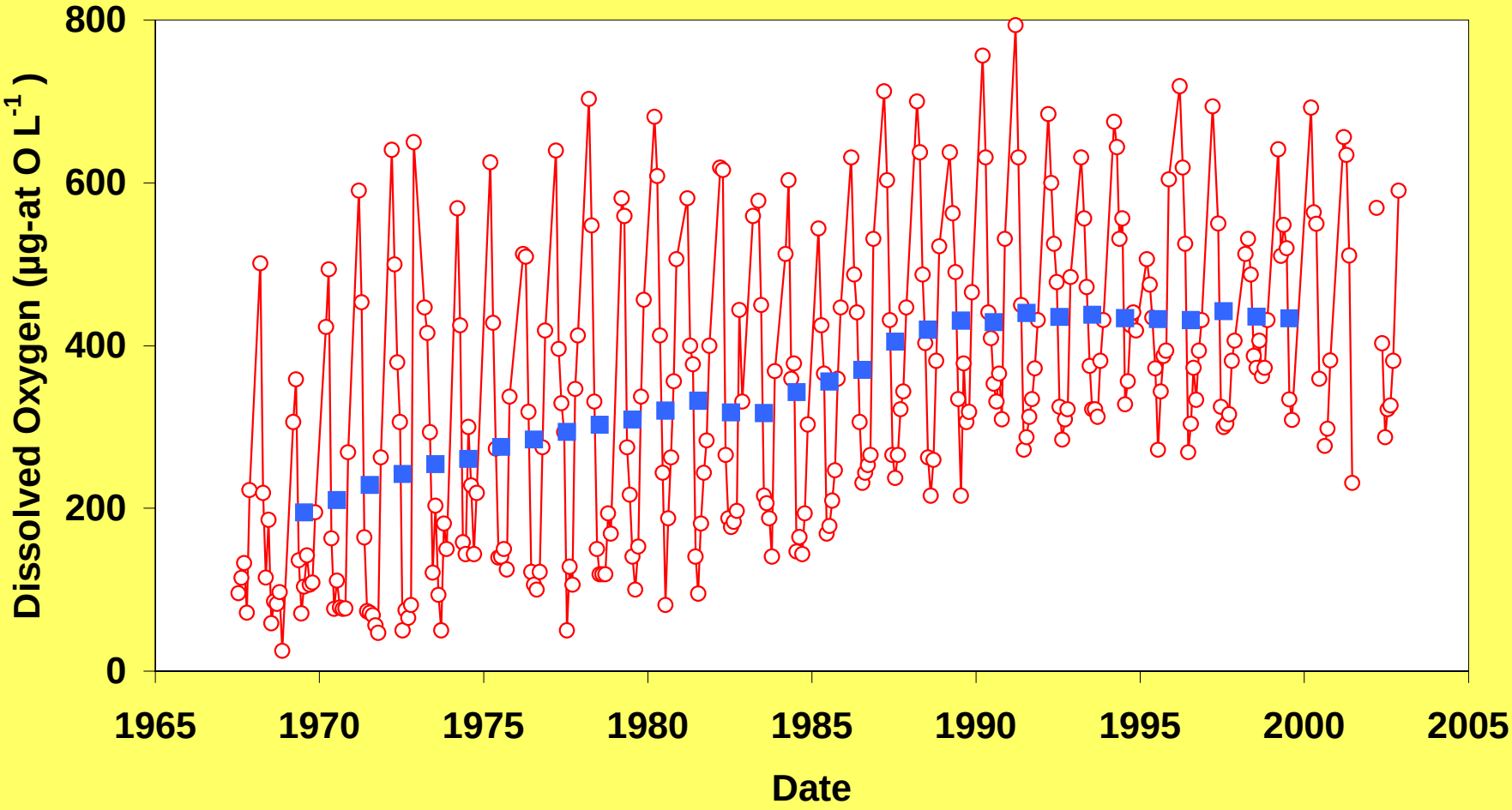
Formerly, urban Delaware River had extreme oxygen depletion in summer – eliminated with improved sewage treatment.

Presently, in spite of very high concentrations of nutrients, primary production is not elevated and there is no excess algal production.

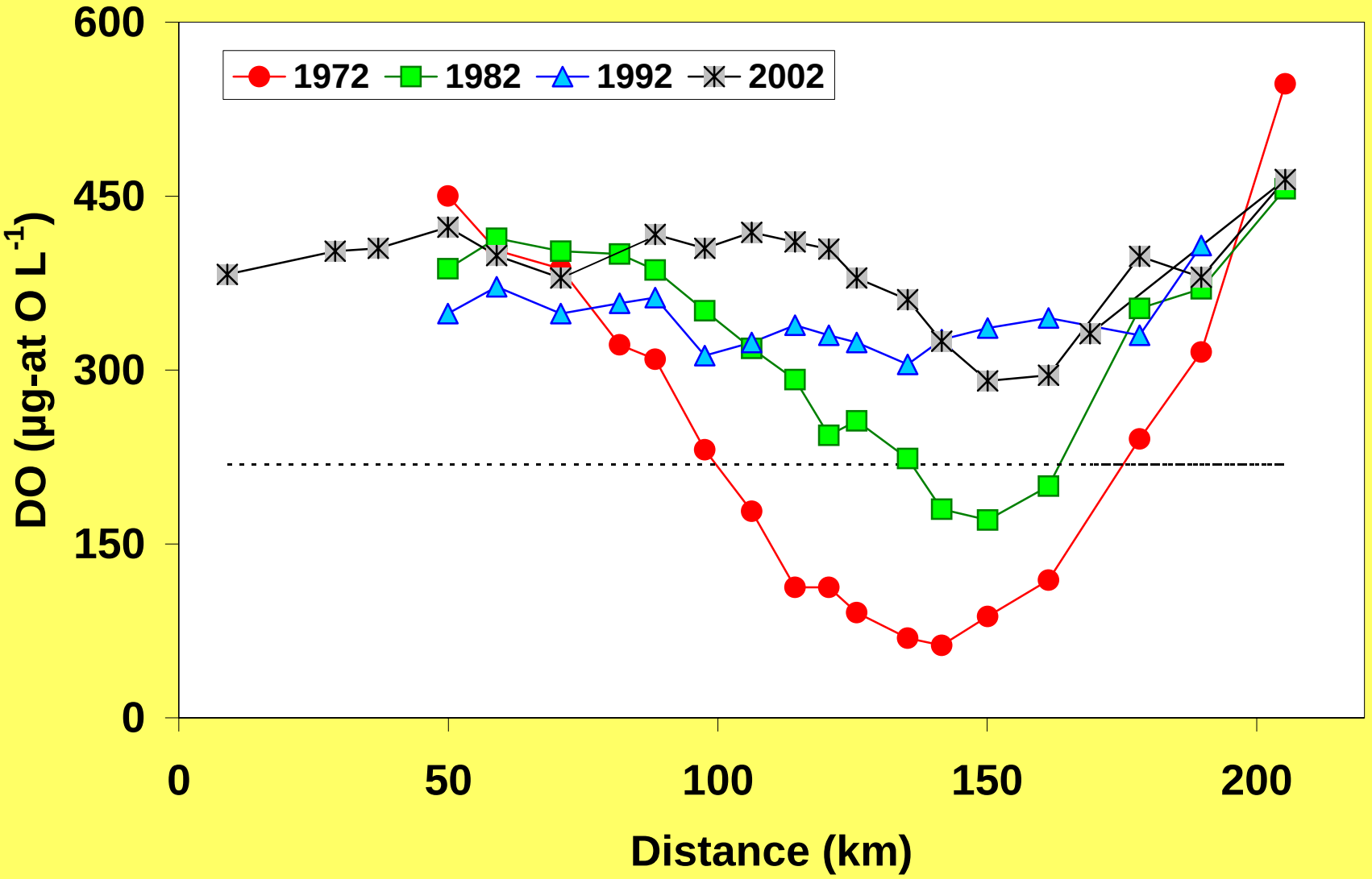
Could riverine oxygen demand increase?

Delaware Bay is well-mixed in summer with no bottom water isolation from stratification; bay is stratified for 2-8 weeks in spring (temperatures very cold, no oxygen depletion).

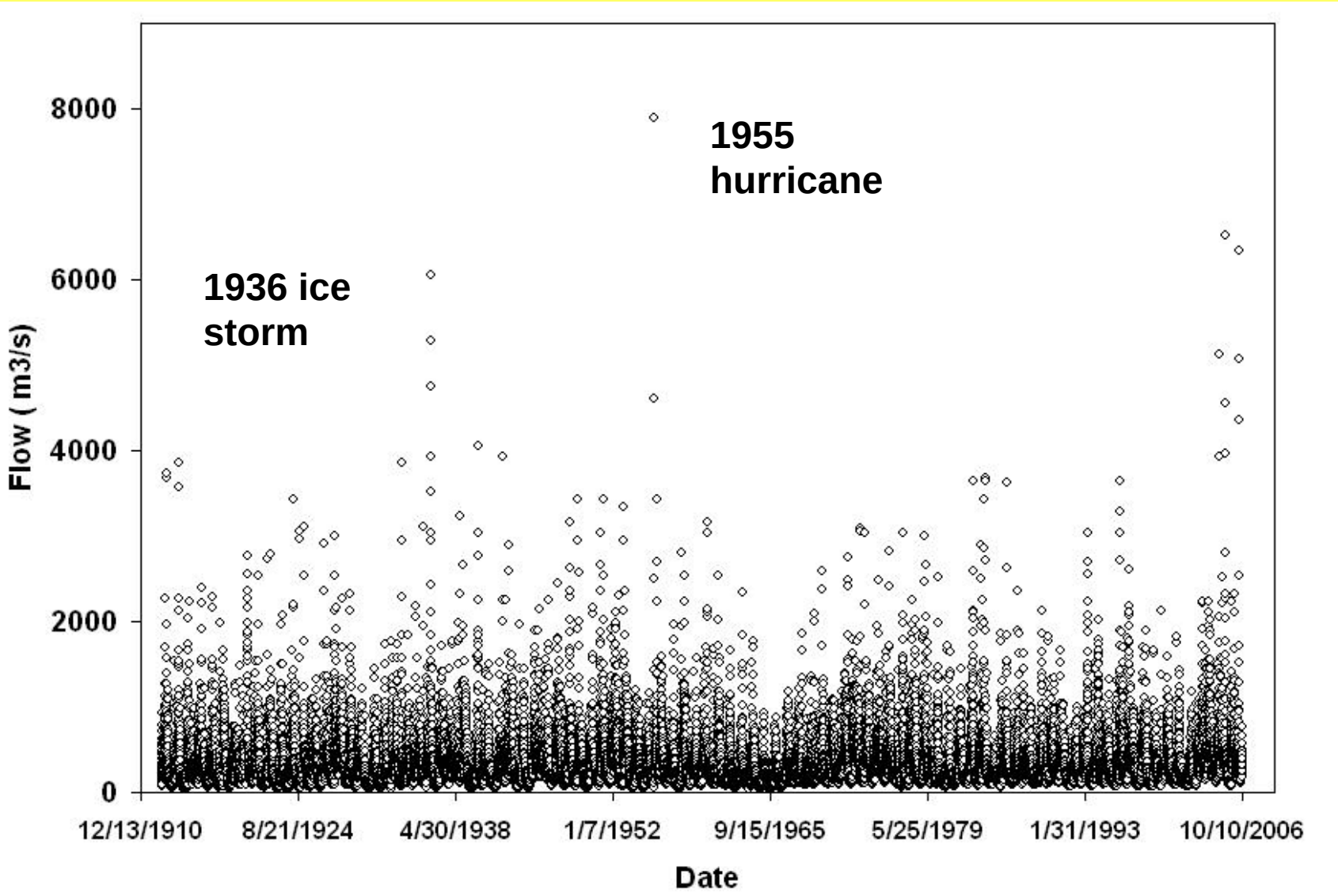
Could hydrological change cause summer stratification and lead to summer hypoxia?



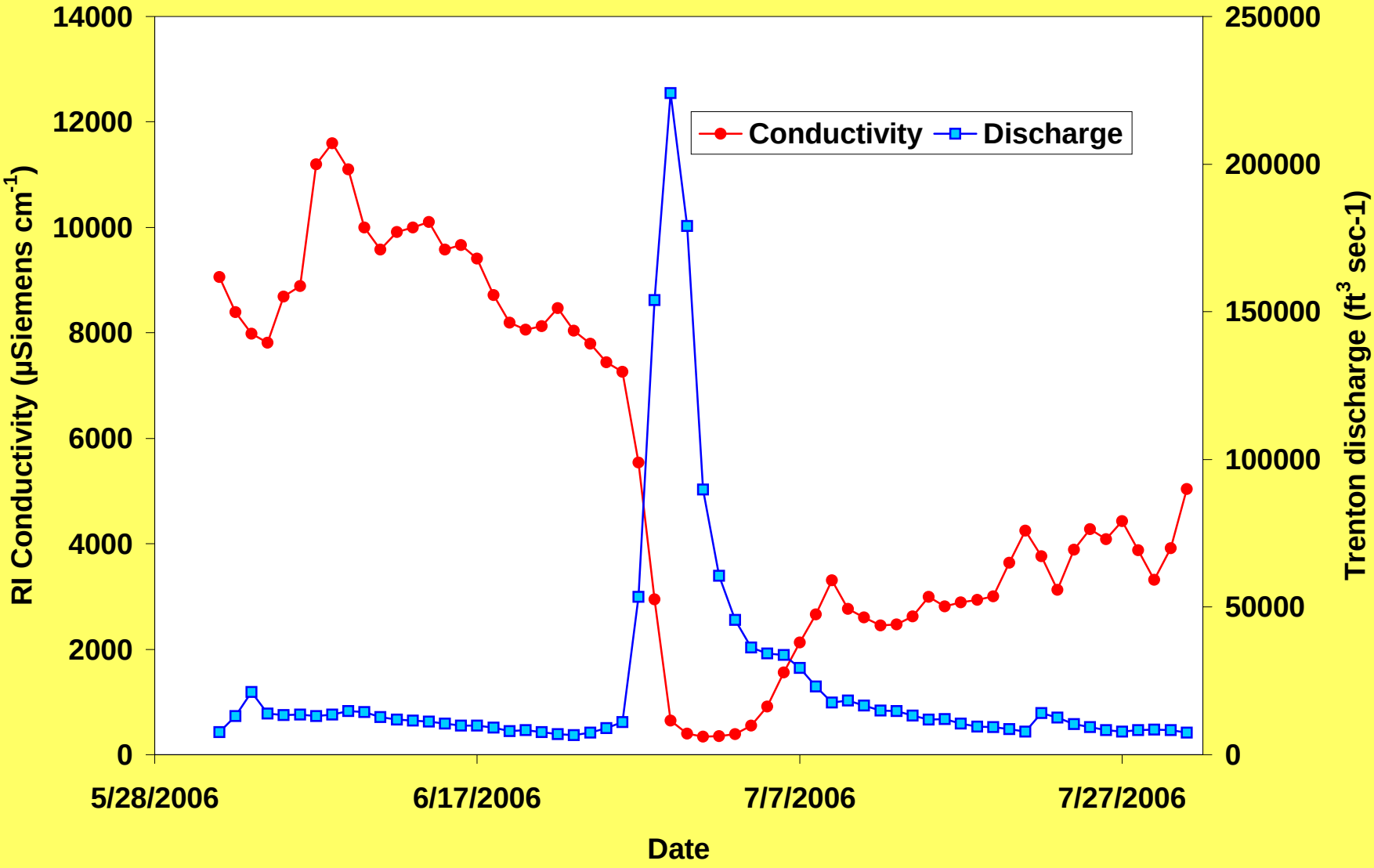
Urban river region had extreme oxygen depletion in summer in the past. DO concentration in river (near Philadelphia Airport) from DRBC Boat Run monitoring, 1967-2004.



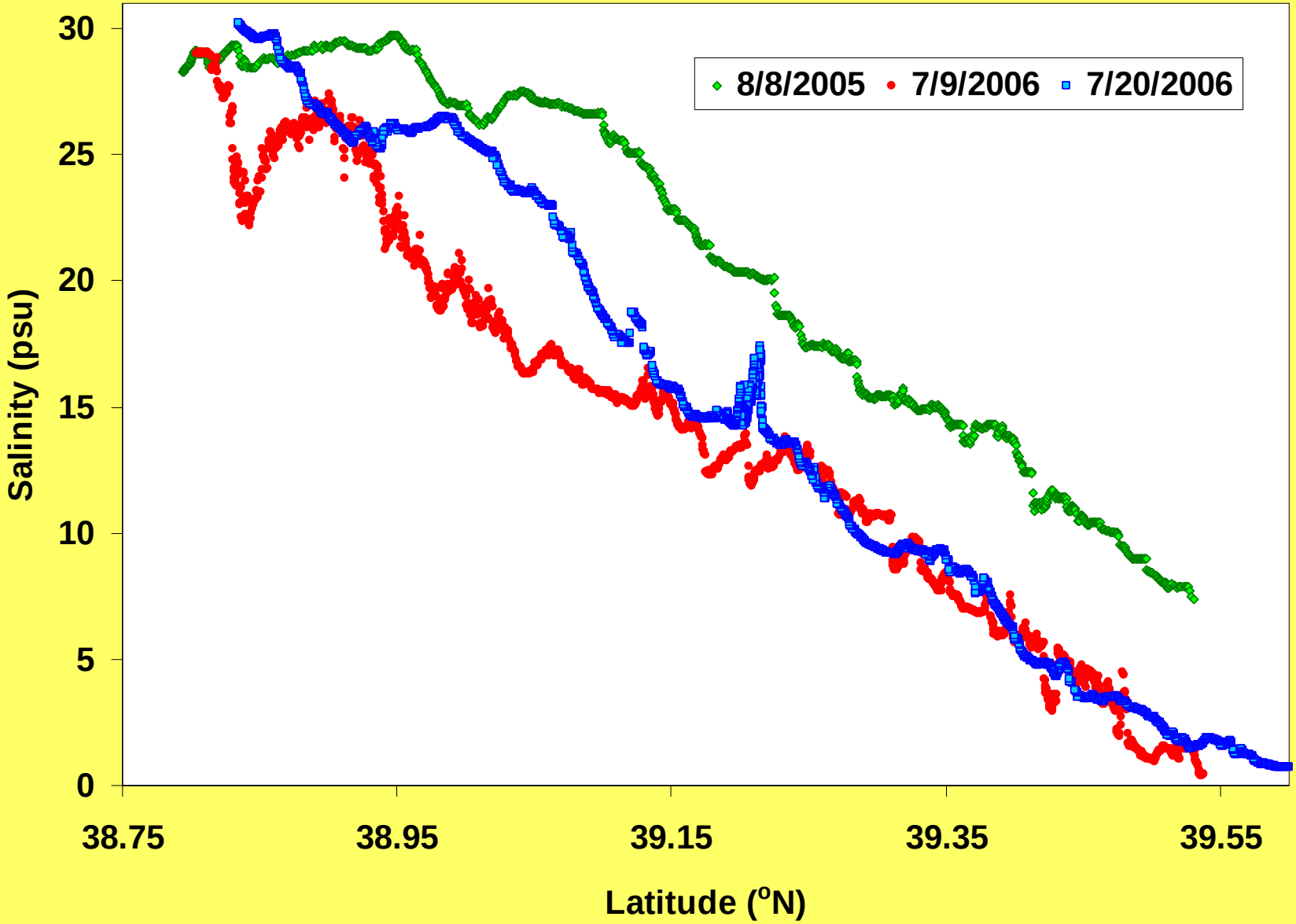
Oxygen sag in summer extended along much of urban river down into the upper part of Delaware Bay. Average July-August oxygen from DRBC Boat Run data over past 4 decades. Dashed line = 3.5 mg/L.



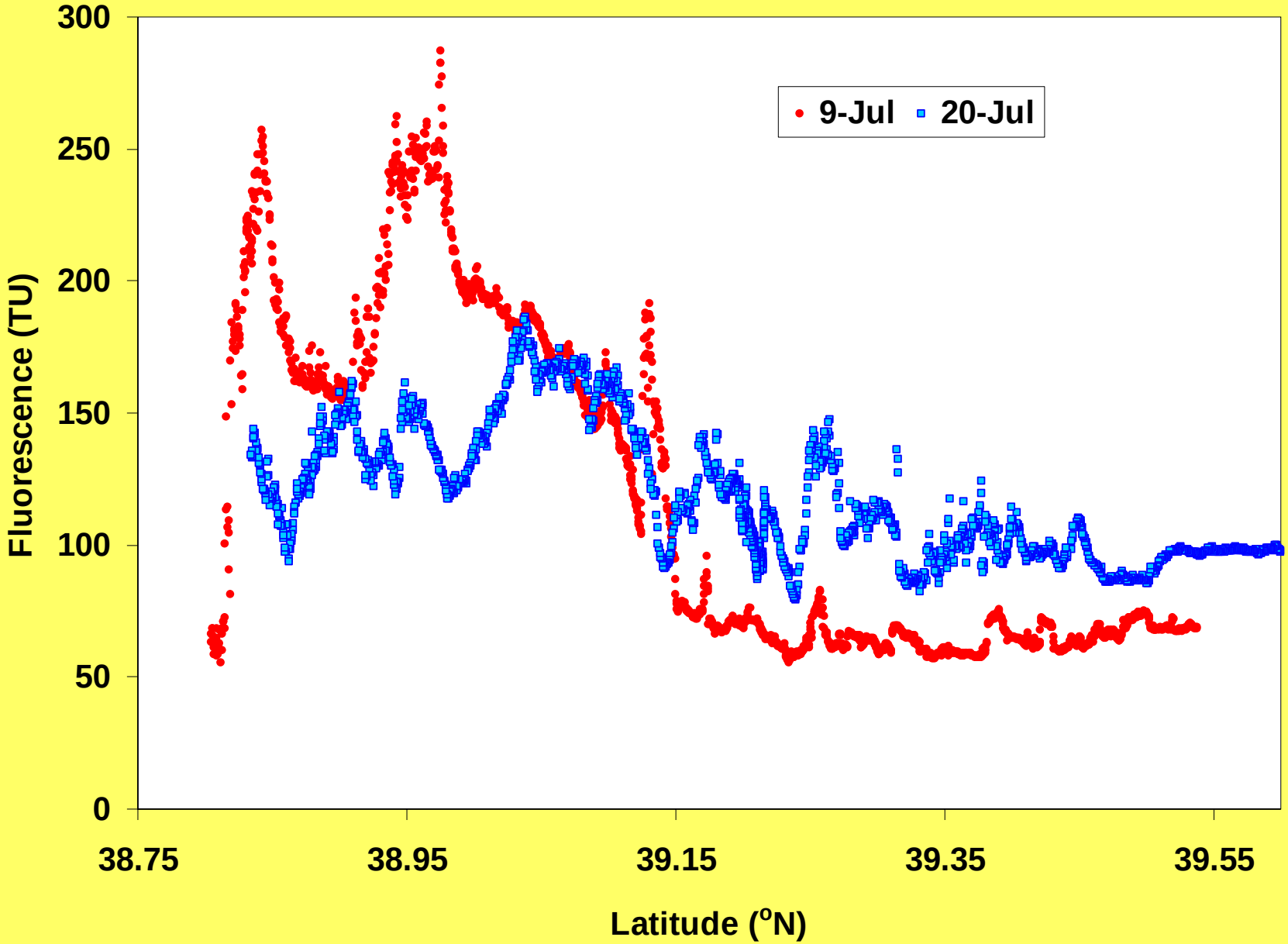
Delaware River discharge from 1912-2006 – 3 of 5 largest discharge events in Sept 2004, April 2005, June 2006. Could this cause warm weather stratification?



Discharge at Trenton and Conductivity at Reedy Island – summer 2006



Salinity transects at time of large discharge in 2006



Increased production from large discharge? Bottom water oxygen?

Next Steps for DEWOOS

Need to develop easy access web page:

- Capture and format data from existing programs
- Interpret data enough to be able to make illustrations
- Put data in GIS-based map format for access
- Develop links to existing web sites so future data will also be accessible

Add more Bay continuous stations, including depth