National Monitoring Network for Coastal Waters and Their Tributaries: the Delaware River Basin Demonstration Project

2009 Delaware Estuary Science and Environmental Summit
January 13, 2009

Eric Vowinkel
USGS New Jersey Water Science Center
USGS Co-Chair Methods and Data Comparability Board of the National Water Quality Monitoring Council
vowinkel@aol.com

Robert Tudor
Deputy Executive Director
Delaware River Basin Commission
robert.tudor@drbc.state.nj.us
Outline of Presentation

• Brief history of the “National Network”
• Pilot Inventory Phase of monitoring in basin
• Demonstration Phase in Delaware Basin
• Data Management (DEWOOS)
• Where are we going from here?
• Most of my current monitoring takes place **inside** the Delaware Basin.

• However, I live **outside** the Delaware River Basin.

• Better the Eagles than the Cowboys or Redskins!!!!

• Good luck this weekend!!!
Network Origins

- **U.S. Commission on Ocean Policy**
  - Chapter 15, Creating a National Monitoring Network

- **U.S. Ocean Action Plan**
  - Advancing our Understanding of the Oceans, Coasts, and Great Lakes
  - Create a National Water Quality Monitoring Network

- **Other links**
  - [http://ocean.ceq.gov/](http://ocean.ceq.gov/)
Purpose: Provide a national forum for coordination of consistent and scientifically defensible methods and strategies to improve water quality monitoring, assessment and reporting. Promote partnerships to foster collaboration, advance the science, and improve management within all elements of the water quality monitoring community.

HOW THE COUNCIL WORKS
- Advisory Committee on Water Information
- Work Groups
- Organization Chart
- Terms of Reference
- History
- Meeting Minutes

PRODUCTS OF THE COUNCIL
- Council Brochure
- Activities and Products (July 2007)
- Meeting Presentations
- Publications
- The Framework for Monitoring

NATIONAL MONITORING NETWORK
- About the Network
- Network Report
- Network Pilot Studies

Pilot Study Reports now available!
The pilot phase of the National Water Quality Monitoring Network (Network) for U.S. Coastal Waters and their Tributaries is complete for three geographic areas: Delaware Bay, Lake Michigan, and San Francisco Bay. The pilot phase of the Network examines current monitoring and gaps in relation to the proposed Network design. Learn more about the pilots...

NATIONAL MONITORING CONFERENCES
- National Conference Information and Results:
  - 2006 Conference Results
  - Conference Results (1996-2004)

WHO'S WHO ON THE COUNCIL
- Membership List
- Member Agencies
- State and Regional Councils
- Contacts
- Contact the Council

IN THE NEWS...
- What's New?
- Scheduled Council Meetings
- Other Meetings of Interest
- Success Stories
National Water Quality Network

- Phase I - Network Design (FY 05 & 06)
- Phase II - Pilot Inventory: 3 basins (FY07)
- Phase III - Demonstration Projects (FY08-10?)
- Phase IV – Implementation: fill gaps and provide necessary enhancements to existing monitoring programs (FY 11 and beyond)
Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA)

http://www.macoora.org/

- Integrated Ocean Observing Systems (IOOS) formed
- MACOORA formed to integrate observations from Cape Hatteras to Cape Cod
- Held a water-quality workshop in Philadelphia in 2008
“National Network”

• **Network of Networks:** use existing Federal/State/local networks
• **Link watersheds, estuaries, near coastal, and ocean observations**
• **Integration of monitoring strategies:** discrete, continuous, probabilistic, and satellite
• **Physical, chemical, and biological observations**
• **Data comparability** issues addressed
• **Data management and access:** sharing data
• **3 Pilot and Demonstration study areas**
  – Delaware River Basin
  – Lake Michigan
  – San Francisco Bay
Link monitoring in watersheds
to estuaries
to near coastal and oceans using comparable data
Resource Compartments

- Estuaries
- Near-shore waters
- Off-shore waters
- Great Lakes
- Coastal beaches
- Wetlands
- Flow and flux from
  - Rivers and streams
  - Ground water
  - Atmospheric deposition
Network will Address Management Questions

- **Status**: What is the condition of the Nation’s waters?
- **Trends**: Where, how, and why are water quality conditions changing over time?
- Are water quality goals and standards being met?
- Are strategies to protect water quality working?
Constituent Categories

1. **Physical**: Flow magnitude and direction, physical habitat, sediments, water-quality characteristics (T, pH, SC, DO, turbidity)

2. **Chemical**: 
   - **Inorganic**: major ions, nutrients, metals and metalloids
   - **Organic**: Bulk organics, volatile organic compounds, pesticides, halogenated hydrocarbons, polycyclic aromatic hydrocarbons, contaminants of emerging concern

3. **Biological**: Diversity, toxicity, algae, macro-invertebrates, fish
National Work Groups

- Steering
- Nutrients
- Contaminants
- Biology
- Rivers
- Wetlands
- Ground Water
- Atmosphere
- Estuary
- Near shore
- Ocean

Nutrient Requirements for the National Water Quality Monitoring Network for U.S. Coastal Waters and their Tributaries

Nutrients Workgroup

Members

Jane Caffrey, co-Chair
Center for Environmental Diagnostics and Bioremediation
University of West Florida
Pensacola, FL 32514

Tamim Younos, co-Chair
Virginia Water Resources Research Center
Virginia Tech
Blacksburg, VA 24061

Michael Connor
San Francisco Estuary Institute
Oakland, CA 94621
<table>
<thead>
<tr>
<th>Analyte</th>
<th>Range</th>
<th>Detection limit</th>
</tr>
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<tbody>
<tr>
<td>Dissolved ammonium</td>
<td>0.007–0.50 mg N L⁻¹</td>
<td>0.007 mg N L⁻¹</td>
</tr>
<tr>
<td>Dissolved nitrate plus nitrite</td>
<td>0.007–10.0 mg N L⁻¹</td>
<td>0.007 mg N L⁻¹</td>
</tr>
<tr>
<td>Dissolved ortho phosphate</td>
<td>0.001–5.0 mg P L⁻¹</td>
<td>0.001 mg P L⁻¹</td>
</tr>
<tr>
<td>Dissolved silica</td>
<td>0.003–4.0 mg Si L⁻¹</td>
<td>0.003 mg Si L⁻¹</td>
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<tr>
<td>Particulate nitrogen</td>
<td>0.01–100 %</td>
<td>0.01%</td>
</tr>
<tr>
<td>Particulate phosphorus</td>
<td>0.005–5.0 mg P L⁻¹</td>
<td>0.005 mg P L⁻¹</td>
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<tr>
<td>Total dissolved nitrogen</td>
<td>0.001–10.0 mg N L⁻¹</td>
<td>0.001 mg N L⁻¹</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>0.03–15.0 mg N L⁻¹</td>
<td>0.03 mg N L⁻¹</td>
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<tr>
<td>Total dissolved phosphorus</td>
<td>0.01–5.0 mg P L⁻¹</td>
<td>0.01 mg P L⁻¹</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>0.01–10.0 mg P L⁻¹</td>
<td>0.01 mg P L⁻¹</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>0.01–150 µg L⁻¹</td>
<td>0.01 µg L⁻¹</td>
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<tr>
<td>Dissolved oxygen</td>
<td>0–15 mg L⁻¹</td>
<td>0.1 mg L⁻¹</td>
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<tr>
<td>Total suspended sediments</td>
<td>1–20,000 mg L⁻¹</td>
<td>10 mg L⁻¹</td>
</tr>
<tr>
<td>Conductivity/salinity</td>
<td>0–1,000 mS cm⁻¹</td>
<td>1–100 µS cm⁻¹</td>
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<tr>
<td>Dissolved organic carbon</td>
<td>0.22–50 mg C L⁻¹</td>
<td>0.22 mg C L⁻¹</td>
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<tr>
<td>Dissolved inorganic carbon</td>
<td>3–24 mg C L⁻¹</td>
<td>3 mg C L⁻¹</td>
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<tr>
<td>pH</td>
<td>1–12 pH</td>
<td>0.01 pH</td>
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<tr>
<td>Particulate carbon</td>
<td>0.01–100 %</td>
<td>0.01%</td>
</tr>
<tr>
<td>Photosynthetically active radiation</td>
<td>0.01–10,000 µmol m⁻² s⁻¹</td>
<td>0.01 µmol m⁻² s⁻¹</td>
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**Tier 1—required**

- Dissolved inorganic nitrogen (DIN)
- Dissolved organic nitrogen (DON)
- Total nitrogen (TN)
- Total dissolved nitrogen (TDN)
- Particulate nitrogen (PN)
- DIN = NO₃NO₂ + NH₄
- TDN = DIN + DON
- TN = TDN + PN
- DON = TDN - DIN

**Tier 2—recommended**

- Total Phosphorus (TP)
- Dissolved inorganic phosphate (DIP)
- Ortho phosphate (oPO₄)
- Particulate phosphate (PP)
- Total dissolved phosphorus (TDP)
- DIP = oPO₄
- TP = TDP + PP
- TDP = DOP + oPO₄
- TP = oPO₄ + DOP + PP
National Network riverine head of tide and upstream sites at HUC 6 level

http://acwi.gov/monitoring/network/design/Entire_Report_v18_060506.doc

• Only Delaware River at Trenton met criteria of HUC6 pore point in the original design in the Delaware River Basin

• Pilot study determined that more river sites were needed
Probabilistic Estuarine Monitoring in the Mid-Atlantic IOOS Region from Network

http://acwi.gov/monitoring/network/design/Entire_Report_v18_060506.doc

- Designed by USEPA ORD
- Need to coordinate with EPA probabilistic estuary monitoring in 2010
National Monitoring Network Pilot Studies

**Of Current Interest...**

*Pilot Study Reports now available!* The pilot phase of the National Water Quality Monitoring Network (Network) for U.S. Coastal Waters and their Tributaries is complete for three geographic areas: Delaware Bay, Lake Michigan, and San Francisco Bay. The pilot phase of the Network examines current monitoring and gaps in relation to the proposed Network design. The new pilot reports are linked below.

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**Draft Pilot Study Summary Report**

Summary report tables (Draft)

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**Delaware Bay**

The Delaware River Basin encompasses 13,539 square miles (mi²) and contains one of the longest un-dammed rivers in the United States, extending 330 miles from the confluence of its East and West branches at Hancock, N.Y. to the mouth of Delaware Bay. Significant amounts of historical and current water-quality monitoring (physical, chemical, and biological) has been conducted in the watersheds, estuaries, near-shore, and off-shore parts of the basin by Federal, State, local, private, and academic entities. It is the intent of this effort to inventory, compare methods, and enhance data exchange in support of the National Monitoring Network. The watershed is home to more than 200 fish species, and provides habitat for federally protected endangered species such as dwarf wedgemussels, short-nose sturgeon, bald eagles, and bog turtles. Nearly 15 million people (about 5% of the nation’s population) rely on the waters of the Basin for drinking water which includes about 7 million people in New York City and northern New Jersey who live outside the Basin.

- [Pilot Study Report](#)
- [Key Partners](#)
- [Proposal](#)
DELAWARE RIVER BASIN
NATIONAL WATER QUALITY MONITORING NETWORK
PILOT STUDY
FINAL REPORT

REPORT COORDINATORS:
Mr. Robert Tudor (Delaware River Basin Commission)
Dr. Eric F. Vowinkel (USGS, NJ Water Science Center)

RESOURCE COMPARTMENT WORKGROUP CHAIRS:
Estuaries Workgroup Chair:
Dr. Jonathan H. Sharp (College of Marine and Earth Studies, University of Delaware)
Near-shore Workgroup Chair:
Mr. Robert Connell (NJ Dept. of Environmental Protection)
Off-shore Workgroup Chair:
Dr. Scott Glenn, (Institute of Marine and Coastal Sciences, Rutgers Univ.)
Rivers Workgroup Chair:
Dr. Josh Kohut (Institute of Marine and Coastal Sciences, Rutgers Univ.)
Groundwater Workgroup Chair:
Dr. Eric F. Vowinkel
Wetlands Workgroup Chair:
Dr. Eric F. Vowinkel
Atmospheric Deposition Workgroup Chair:
Dr. Danielle Kreeger (Partnership for the Delaware Estuary)
Data Management Workgroup Chair:
Dr. Lisa A. Rodenburgh (Dept. of Environmental Sciences, Rutgers Univ.)
Dr. David R. Legates (Dept. of Geography, University of Delaware)

February 7, 2008
## Table 1. Steering Committee Members, Affiliations, and Commitment.

<table>
<thead>
<tr>
<th>Member</th>
<th>Affiliation</th>
<th>Commitment</th>
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<tbody>
<tr>
<td>Robert Tudor</td>
<td>Delaware River Basin Commission (DRBC)</td>
<td>Chair</td>
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<tr>
<td>Rick Kropp</td>
<td>U.S. Geological Survey NJ Water Science Center (USGS)</td>
<td>USGS Liaison</td>
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<tr>
<td>Jeff Fischer</td>
<td>U.S. Geological Survey NAWQA (USGS)</td>
<td>NAWQA Liaison</td>
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<tr>
<td>Jon Kushwara</td>
<td>U.S. Environmental Protection Agency (USEPA)</td>
<td>USEPA Liaison</td>
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<tr>
<td>R. Scarborough</td>
<td>National Oceanographic and Atmospheric Association (NOAA) DE Dept. of Natural Resources and Env. Control (DNREC)</td>
<td>NERRS and DNREC Liaison</td>
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<tr>
<td>Ed Santoro</td>
<td>Delaware River Basin Commission (DRBC)</td>
<td>Inventory</td>
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<tr>
<td>Eric Vowinkel</td>
<td>NWQMC Methods and Data Comparability (MDCB)</td>
<td>Methods</td>
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<tr>
<td>Paul Morton</td>
<td>NJ Water Monitoring Coordination Council (NJWMCC)</td>
<td>Data Exchange</td>
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<tr>
<td>Danielle Kreeger</td>
<td>Partnership for the Delaware Estuary</td>
<td>Wetlands</td>
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<tr>
<td>Leslie McGeorge</td>
<td>NJ Depart. of Environmental Protection (NJDEP):</td>
<td>NJWMCC</td>
</tr>
<tr>
<td>Jonathan Sharp</td>
<td>U. Delaware (UDEL) College of Marine and Earth Studies</td>
<td>Estuaries, Acad.</td>
</tr>
<tr>
<td>Scott Glenn</td>
<td>Rutgers Univ. Institute of Marine &amp; Coastal Sciences (IMCS)</td>
<td>Coastal, Academia</td>
</tr>
<tr>
<td>Lisa Totten</td>
<td>Rutgers University Cook College</td>
<td>Atmos., Academia</td>
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</table>
DRB Pilot and Demonstration study area

- Entire Delaware Basin
- 4 states—NY, PA, NJ, DE
- Several Physiographic Provinces and Ecohabitats
- In late 2007 the Pilot Work Group submitted a competitive grant proposal to the NOAA IOOS for improved spatial monitoring in the DRB using discrete, continuous, and other monitoring platforms in the rivers, estuary, near shore
Network Demonstration Phase

- USGS obtained $1 million in new program funds for Network in both FY08 and FY09
  - $300K for Demonstration Areas each getting $100K per year to enhance monitoring
  - $400K per year for 5 USGS Stations to become NASQAN sites—Delaware River at Trenton @ $75K/yr
  - $300K per year for USGS NWIS and USEPA STORET Water Quality Data Exchange (WQX) and database management activities
USGS Improvements to Monitoring in the Delaware River Basin to Meet the Needs of the National Monitoring Network for U.S. Coastal Waters and Their Tributaries

Objectives FY08-09

• Improve nutrient and carbon analyses as per Nutrient Work Group recommendations
  – Major head of tide stations in the basin
  – Estuary Boat Run sites
• Improve real-time monitoring along river and estuary
  – New site at Delran T, SC, pH, DO and turbidity
  – upgrade other stations to include turbidity
• Delaware River at Trenton upgraded to a USGS NASQAN site. This supplements existing NAWQA site and DRBC, NJDEP, and PADEP monitoring.
Delaware Estuary Boat Run Sites

- Data collected since early 1970’s
- 22 sites along estuary spine sampled 16 times per year on same day
- Nutrients
- Carbon
- Bacteria
- VOCs
- Other
- Upgrading nutrient and carbon analyses to meet Network needs
NWQMN Delaware River Basin Demonstration Area
Sensor and Discrete Monitoring Network

- Existing 5 parameter real-time sensors
- New 5 parameter real-time sensor
- Upgraded to 5-parameter real-time sensor with turbidity
- Possible real-time sensors
- DEL-NMN discrete monitoring sites for nutrients and carbon
USGS Delaware Basin Network Monitoring Sites

- Nutrient and carbon sites
  - Delaware River at Trenton (16 times in FY08 for NAWQA/NASQAN)
  - Schuylkill River
  - Christina River
  - Maurice River
- Real-time sites on mainstem of Delaware River
  - Trenton
  - Delran (new)
  - Ben Franklin Bridge
  - Chester, PA
  - Reedy Island
DELAWARE RIVER AT TRENTON--LOADS
FILTERED NITRATE PLUS NITRITE AND TOTAL NITROGEN

Unpublished data subject to revision
Delaware River at Trenton
Continuous temperature and dissolved oxygen

Unpublished data subject to revision
Unpublished data subject to revision
DELAWARE RIVER AT TRENTON--NITRATE PLUS NITRATE USING CONTINUOUS vs. DISCRETE EWI SAMPLES

Unpublished data subject to revision: (Source: Bonnie Gray and Jack Gibs USGS NJWSC)
Results of continuous real-time monitoring on
the dissolved oxygen at 4 sites on Delaware River and estuary

Dissolved oxygen

Conductance

Unpublished data subject to revision
DEWOOS
Delaware Estuary-to-Watershed-to-Ocean Observing System
DEWOOS

- Proposed **integrated watershed and coastal environmental data-management system** that can be applied to a variety of watersheds across the nation—"use the data we already have".
- Initially based on DEOS concept
- MACOORA provided seed money to start project to David Legates at UDEL
- Demonstrate how a cooperative regional monitoring system can be linked to and enhance the National Water Quality Monitoring Network
- One-stop shopping web site for data in the DRB
Users of Water Data

- Water quality managers
- Water supply managers
- Water security managers
- Public health officials
- Regulatory agencies
- Maritime traffic—PORTS
- Search and rescue operations
- Boaters--marina and yacht clubs
- Fishermen
- Academic
Data Sources to DEWOOS

Figure 5. Relation of DEWOOS to other Federal, State, and local data management systems.
DEWOOS Data Type Platforms

- **Standard ‘station-based’** data where an observing platform remains in a fixed position and records data on a regular basis.
- **Research-specific measurements** taken for a short time period.
- **Lagrangian observations** from observing platforms that move.
- **Gridded data** acquired by remote sensing technology and spatial interpolation methodologies.
Historical Boat Run Data

- WQ data back to the early 1970’s
- DO sag below Philadelphia decreasing as wastewater treatment plant improvements
- Need to improve data storage and retrieval
- Need to integrate with real-time data
USGS/EPA Data Exchange

USGS: Jon Scott, Nate Booth, Dorrie Gellenbeck, I-Lin Kuo
USEPA: Dwane Young

Example: Water-quality sites with nitrate data in the Delaware River Basin (HUC0204) from NWIS & STORET
More Precise Assessment of Benthic Conditions in Delaware Bay
Where do we go from here?

- **Communicate, cooperate, collaborate** (find funding for continued development of DEWOOS)
- **Develop methods to integrate**
  - analysis of discrete point, continuous, probabilistic, satellite, water-quality data
  - atmospheric, river, ground water, wetlands, estuary, near coastal, and ocean observations to tell the story of water quality in the Delaware River Basin
- **Implementation phase???
- **Water-quality website on MACOORA homepage**