Water Quality Management Programs

Namsoo Suk, Ph.D.
Director, Science and Water Quality Management

March 27, 2019
- Water Quality Standards

- Monitoring Programs
  - Special Protection Waters Monitoring Program
  - Boat Run Program
  - PCB TMDLs Monitoring Program
  - Special Monitoring Program
  - USGS Gages supported by DRBC
Water Quality Standards
What does the Compact cover?

- Article 4 – Water Supply
- **Article 5 – Pollution Control**
- Article 6 – Flood Protection
- Article 7 – Watershed Management
- Article 8 – Recreation
- Article 9 – Hydroelectric Power
- Article 10 – Regulation of Withdrawals & Diversions
- Article 11 – Intergovernmental Relations
- Article 12 – Capital Financing
Water Quality Standards

- **Designated Uses**: e.g., water supply, protection and propagation of aquatic life, recreation in and on the water.

- **Criteria**: numeric and/or narrative parameters to protect the designated uses.

- **Antidegradation Policy And Procedures**: to maintain and protect existing water quality.
From 1962, the Commission adopted Water Quality Regulations pursuant to Article 5 of the Compact; to protect aquatic life and human health for both carcinogenic and non-carcinogenic effects. Updated and revised periodically to the present; includes standards for mainstem Water Quality Management Zones, interstate tributaries, and some basin wide standards.
Monitoring Program

Delaware River Basin Commission
DELaware • New Jersey
Pennsylvania • New York
United States of America
Why do we monitor?

- To assess compliance with DRBC surface Water Quality Standards (Integrated Assessment)
- To define Existing Water Quality (EWQ) at boundary and interstate control points under the Commission’s Special Protection Waters (SPW) Regulations;
- To support model development; Model is used as a tool to determine
  - the total allowable loadings and to allocate allowable loadings to each source while maintaining water quality criteria [Total Maximum Daily Loads (TMDLs)]
  - No Measurable Change Evaluations
- To track the progress of WQ management programs (TMDLs, SPW)
- To track the salt front for reservoir operations;
- To identify new and emerging threats to water quality.
1. Special Protection Waters Monitoring Program
   - Upper and Middle Delaware Scenic Rivers Monitoring Program
   - Lower Delaware SPW Monitoring
2. Boat Run Program
3. PCB TMDLs Monitoring Program
4. Special Monitoring Program
5. USGS Gages supported by DRBC
Special Protection Waters (SPW)

- Exceptional water quality
- High ecological diversity
- ~75% of the non-tidal river is part of the National Wild and Scenic Rivers System
- Upper and Middle non-tidal Delaware River designated SPW in 1992 (point discharges)
- Non-point source requirements adopted in 1994
- Lower Delaware permanently designated July 2008
Lower Delaware (LDEL) Sites

Designated as Significant Resource Waters in 2008

EWQ established for BCPs and ICPs based on data 2000-2004 (n=40-50)

Assessment 1: 2009-2011 (n=15-30)
No Measurable Change Evaluation for Docket holders

Water Quality Model (QUAL2K)

- New Docket or Renewal
- Substantial Alterations or Additions
- Non-point source load
- Point source load
- Ambient WQ
- Model Calibration Validation
- NMC Evaluation
- Cumulative Impact Assessment
- Effluent Limitation
Summary Matrix of Measurable Changes: LDELS

440 Within-Site Comparisons at a Glance

Mostly Good News:
88% of water quality tests showed no degradation
Boat Run Monitoring Program

Where:
- Delaware Estuary (mainstem);

Parameter Groups:
- Nutrients, DO and other conventionals, solids, VOCs, bacteria, heavy metals and chlorophyll a

How Often:
- 22 sites, 8 times per year, ongoing

Purpose:
- Integrated Assessment
- Special studies for toxics, ambient toxicity, emerging contaminants

Shinyapps
PCB Monitoring Program

Where:
- Tidal and non-tidal Delaware River (mainstem)
- Water, sediment, fish and air

Parameter Groups:
- PCBs for all 209 congeners
- Dioxin Furans, OC pesticides

How Often:
- Every 3~5 years, ongoing

Purpose:
- Integrated Assessment
- Special studies for tracking PCB TMDLs
- Supporting states fish consumption advisories
Why PCB TMDLs needed for the Delaware Estuary?

- Production of PCBs banned in 1970s but
  - Active sources – aging transformers, electrical equipment, hydraulic equipment, paint, caulk
  - Inadvertent production of PCBs

- Fish consumption advisories for the entire Estuary and Bay issued by all three states.

- Listed as “impaired” by all three states in 1990s.

- PCB levels in ambient water are 100s to 1000s times greater than the WQ criterion.
Use of Monitoring Data in the Delaware Estuary

1) Fish Tissue
2) Ambient Water
3) Sediment
4) Atmosphere
5) Point Sources
Sediment Sampling
Total PCB Concentration (pg/g)

Collected 2016
- Less than 10,000
- 10,001 - 100,000
- 100,001 - 500,000
- 500,000 or Greater

Total PCBs Concentrations in Surficial Sediment in Delaware Estuary

Sediment Surveys 2000 and 2016
PCB Loadings Top Ten Point Source Dischargers (mg/day)

- 5,000
- 10,000
- 15,000
- 20,000
- 25,000
- 30,000
- 35,000

- 2005
- 2011
- 2013
- 2016

62% reduction
71% reduction
76% reduction
tPCB Concentrations 2004-2015

10^{-6} Cancer screening level = 1,500 pg/g

2015 data

River Mile & Species

Tidal

Non-Tidal
PCB loadings into the Delaware River Estuary have been identified and reduced since the Stage 1 PCB TMDLs
Lesser levels of fish consumption advisories
Still, long ways to go.
**Special Monitoring Program**

**Where:**
- Tidal and non-tidal Delaware River (mainstem)

**Parameter Groups:**
- Aquatic life designated use (eutrophication model)
- Ambient toxicity
- Emerging contaminants (PFAS)
- Bio-monitoring

**How Often:**
- Infrequent, ongoing

**Purpose:**
- Integrated Assessment
- Special studies for toxics, ambient toxicity, emerging contaminants
What’s Next?

What should be the next generation dissolved oxygen water quality criteria for the urban portions of the Delaware River Estuary to properly protect aquatic life use?
DRBC issued CBOD wasteload allocations (WLAs) for Zones 2 – 5 in 1968

- Implementation of CBOD WLAs
  - Via DRBC’s dockets (equivalent to NPDES permit)
  - Over 70 point source dischargers get CBOD effluent load limits
  - Minimum required CBOD percent reduction
  - Secondary treatment added at wastewater treatment plants 70’s & 80’s – funding CWA

- By 2000’s D.O criteria is nearly always met
Monitoring in Support of Eutrophication Model Development

Delaware at Trenton & Schuylkill at Philadelphia
- Twice per month

Tributary Monitoring
- 25 tributaries
- Once per month

Point Discharge Monitoring
- Res. for minutes, Sept. 2017
- Tier 1 (12 facilities) weekly
- Tier 2 (19 facilities) monthly

Primary Productivity in Upper Estuary
- 2 sampling events in 2018 (completed)
- 2 anticipated for 2019

Light Extinction Studies
- 3 events in 2018 (60 each) & 3 in 2019
- TSS, chl-a, turbidity, CDOM, secchi depth

Phytoplankton ID and enumeration
- Anticipated 2019
Next Steps: Linked EFDC – WASP8 Model

- Refine grid resolution
  - Better delineation of navigation channel
  - 8~10 vertical layers
  - Increase computational time step ~20 seconds
- Implementation of GVC hybrid grid
- Link 3-D fine grid EFDC and WASP8
- Initiate model calibration using 2017 – 2018 data sets

Fine-grid
2721 cells
Average: 770x1100 m
Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) Toxicity

EPA HA PFOS & PFOA 70 ng/L, NJDEP MCL PFNA 13 ng/L

- Scientific understanding is evolving

**Human Health Effects**
- Detected in blood serum (bind to protein)
- Association with liver damage, increased cholesterol, thyroid disease, decreased response to vaccines, asthma, decreased fertility and birth weight, pregnancy-induced hypertension/pre-eclampsia

**Laboratory Animal**
- Primary effects in lab animals are liver, developmental and immune toxicity

**Ecological Effects**
- National WQC for aquatic life not derived
- Long chain PFAS bioaccumulate and biomagnify
- Many PFAS are persistent (short and long chain)
- Moderately acute and slightly chronically toxic to aquatic organisms (survival, growth and reproduction)
- PNEC for PFOS 0.6 to 6.6 ug/L (Qi et al. 2011)
- PNEC for PFOA 1,250 ug/L (Hoke et al. 2015)
- PNEC for PFHxA 199 ug/L (Hoke et al. 2015)
- Sublethal effects observed (e.g., histopathology and endocrine function)
PFAS Monitoring

- **Surface water samples**
  - Six sites in tidal for 2007, 2008, 2009
  - Fifteen sites in tidal for 2015
  - Four non-tidal in 2016

- **Fish Species samples**
  - Nine sites in tidal and non-tidal in 2004 ~ 2015

- **Sediment samples**
  - Thirty sites in 2016

**For surface water**

- **Longer Chain**
  - C11, C10 and C9 decreasing

- **Shorter Chain**
  - C7 and C6 decreasing
  - C6 and C5 highest PFAS conc. In 2015
Questions?

Contact Information:  [WWW.DRBC.GOV](http://WWW.DRBC.GOV)

Namsoo Suk, Ph.D.

Director of Science and Water Quality Management

E-Mail:  [Namsoo.Suk@drbc.gov](mailto:Namsoo.Suk@drbc.gov)

Phone:  (609) 477-7235