USGS Monitoring in Chester County

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USGS Chester County History

• Cooperative Program since 1969
• Stream Gages
• Rain Gages
• Water-Quality Monitors
• Biological Sampling
• Sediment-Turbidity relation
• GW monitoring Network
• Various SW/GW projects
USGS/Chester County Monitoring

• 17 stream flow stations
  – 6 sediment monitoring sites
  – 5 bacteria monitoring sites
  – 10 precipitation gages
  – 13 QW monitoring sites

• 27 annual biological and chemical sampling locations

• 27 observation wells measured monthly

• Dozens of water resources studies
Current Stream gages

- Schuylkill River at Pottstown
- French Creek near Phoenixville
- Valley Creek near Valley Forge
- E. Br. White Clay at Avondale
- White Clay near Strickersville
- Red Clay near Kennett Square
- W.Br. Brandywine nr Honey Brook
- Birch Run near Wagontown
- W. Br. Brandywine at Coatesville
- W. Br. Brandywine at Modena
- Broad Run at Northbrook
- Marsh Creek near Glenmoore
- Marsh Creek near Downingtown
- E. Br. Brandywine Cr. below Downingtown
- Brandywine Cr. at Chadds Ford
- East Branch Big Elk Creek at Forestville
Current Bacteria Monitoring Sites in Chester County

- French Cr NR Phoenixville (01472157)
- West Br Brandywine at Modena (01480617)
- East Br Brandywine Below Downingtown (01480870)
- Brandywine Creek at Chadds Ford (01481000)
- White Clay Cr near Strickersville (01478245)
Precipitation gages

- Schuylkill River at Pottstown
- Perkiomen Creek at Graterford
- Valley Creek near Valley Forge
- Schuylkill River at Norristown
- W. Br. Brandywine nr Honey Brook
- W. Br. Brandywine at Modena
- Broad Run at Northbrook
- E. Br. Brandywine Cr. below Downingtown
- Brandywine Cr. at Chadds Ford
QW Monitoring Sites

- Schuylkill River at Vincent Dam
- French Creek near Phoenixville
- Valley Creek near Valley Forge
- E. Br. White Clay at Avondale
- White Clay near Strickersville
- W. Br. Brandywine nr Honey Brook
- Birch Run near Wagontown
- W. Br. Brandywine at Coatesville
- W. Br. Brandywine at Modena
- E. Br. Brandywine Cr. below Downingtown
- Brandywine Cr. at Chadds Ford
- East Branch Big Elk Creek at Forestville
Sediment Monitoring

- Upgrade USGS stream gaging stations with water-quality monitors
- Collect suspended sediment samples over the range in hydrologic conditions
- Develop regression equations using collected samples and sensor values
- Estimate concentrations from the regression equations and loads from continuous data
Current Sediment Sites in Chester County

• French Cr NR Phoenixville (01472157)

• West Br Brandywine NR Honey Brook (01480300)

• West Br Brandywine at Modena (01480617)

• East Br Brandywine Below Downingtown (01480870)

• Valley Cr at Turnpike Br. At Valley Forge (01473169)

• White Clay Cr near Strickersville (01478245)
Estimated Suspended-Sediment Loads and Yields in the French and Brandywine Creek Basins, Chester County, Pennsylvania, Water Years 2008–09
Data Availability

- pa.water.usgs.gov and chesco.org
  - Access to the USGS data base (NWIS)
  - Chester County monitoring networks
  - USGS and Chester County publications
Stream Conditions of Chester County Biological Monitoring Network (CCWRA and USGS)
Annual Assessment of Water-Quality Conditions

• Provides year to year updates of current stream conditions.
• Helps to locate new or temporary stream-quality concerns.
• Documents current conditions.
• Document changes in stream-quality and relate them to land use changes.
• Determine over time which streams are functioning as healthy streams and which are not.
Data Uses

• USGS Projects – Data has been used in at least 12 reports and is currently being used in new projects.
• CCWRA – Uses annual data and historical data for management purposes.
• PaDEP – compliments the States sampling program
• Watershed associations / Volunteer Groups
Sampling

• Benthic-macroinvertebrates are used as the primary water-quality indicator.
• Water chemistry and physical habitat data are used to help interpret the biological data.
• Samples are collected in October-November.
Clean Water Indicators

- Not tolerant of pollution
- High Oxygen levels
- Low organic matter
- Stable habitat
- Cold water temps
- Low toxics, nutrients

- Examples include EPT taxa (mayflies, stoneflies, and caddisflies), riffle beetles.
Moderately Tolerant Organisms

- Can survive in moderately polluted water.
- Water may contain elevated levels of nutrients and organic matter.
- Can withstand low oxygen levels temporarily.

Examples include dragonflies, crayfish, filter-feeding caddisflies, and black flies.
Tolerant Organisms

• Tolerant of low oxygen waters.
• Can live almost anywhere.
• Can survive in high nutrient/sewage discharge.

• Examples include midges, worms, leeches.
Stream-Quality Assessment

• Based on the type (tolerance) and abundance of organisms.
• Produces an assessment of overall stream-quality conditions.
• Habitat, chemical, and physical data help to interpret the biological data.
Biological Evaluation of Stream-Quality

• Different metrics measure various structure or functions within the community.
• We use a combination of metrics to give as complete a picture as possible.
• IBI – Index of Biotic Integrity
  – Combines 6 metrics into a single score that is related to “reference conditions”
Chester County Index of Biotic Integrity (IBI)

- Uses 6 individual metrics to provide a single IBI score 0-100 scale.
- IBI score is scaled to local condition found in Chester County.
- Based on the same IBI metrics used by PaDEP.

Figure 5. Percentage of samples by CC-IBI score categories from 231 samples collected at 18 fixed-location sites in the Stream Conditions of Chester County Biological Monitoring Network, Chester County, Pa. 1998-2009.
Water Chemistry

• Water quality sample collected with every biological sample.
• Analyzed for nutrients, major ions, and selected metals.
• All analysis done at USGS laboratory in Denver, Co.
Habitat Evaluation

- Visual habitat assessment is done during each bio sampling effort.
- Based on EPA –RBP habitat assessment
- 12 categories scored on a 0-20 scale.
- Evaluates in-stream (sediment-bottom composition) and riparian characteristics.
Sampling

- 27 sites collected annually
- 18 fixed location sites
  - Long term monitoring of trends
- 9 miscellaneous sites
  - Spatial coverage – local determination of water quality conditions. Synoptic investigations

Figure 14. Chester County Index of Biotic Integrity (CC-IBI) and dissolved orthophosphate concentrations from West Branch Red Clay Creek near Kennett Square, Pa. (Site 55-01479700) from 1998 to 2009.
Miscellaneous Sites 1998-2009
Benthic Macroinvertebrate Results

- 4 sites had a mean score above 80 (French, Pigeon, Buck, EB Brandywine-Glenmoore).
- 6 sites had a mean IBI below 50 (Valley, EB Chester, WB Red Clay, WB Brandywine (2 sites), and Big Elk.)
IBI trends 1998-2009

• Increasing IBI
  – Pigeon Creek
  – West Branch Red Clay
  – Buck Run
  – East Branch Brandywine at Glenmoore and below Downingtown
  – East Branch Octoraro

• Decreasing IBI
  – Ridley Creek.

• All other sites had no significant trend.
Miscellaneous sites

- Wide range of scores due to various sized streams.
- Many miscellaneous sites were located near each other.
Nitrate

Nitrate is related to farming activities, urban lawn applications and wastewater discharge. High nitrate can result in excessive algae growth.
Nitrate Trends 1998-2009

• 4 sites with increasing trends.
  – Valley Creek
  – West Branch Red Clay
  – West Branch Brandywine at Honey Brook and Modena

• 3 of the 4 sites are near wastewater discharges.
• All 4 sites has a mean CCIB score below 50.
Phosphate

- Phosphate is related to farming activities, urban lawn applications and wastewater discharge.
- High phosphate can result in excessive algae growth.
Phosphate

- Sites with phosphate above 0.05 mg/L were associated with sites that had IBI values below 60.
- All sites with phosphate above 0.05 mg/L were associated with sites that received wastewater discharges.

Figure 13. Relation between mean Chester County Index of Biotic Integrity (CC-IBI) and mean dissolved orthophosphate concentrations from samples collected at 18 fixed-location sites in the Stream Conditions of Chester County Biological Monitoring Network, Chester County, Pa. 1998-2009.
Phosphate Trends 1998-2009

- West Branch Red Clay was the only site with a negative trend in orthophosphate concentration.
- Reduction related to upgrade at wastewater plant.
- Phosphate trends at all other sites had no significant trend.
Figure 14. Chester County Index of Biotic Integrity (CC-IBI) and dissolved orthophosphate concentrations from West Branch Red Clay Creek near Kennett Square, Pa. (Site 55-01479700) from 1998 to 2009.
Chloride

- Generally increases with urban land use or point discharges.
- Does not directly affect inverts but represents chemical disturbance.

Figure 10. Relation between percent of basin area in urban land use and mean dissolved chloride concentrations from samples collected at 18 fixed-location sites in the Stream Conditions of Chester County Biological Monitoring Network, Chester County, Pa. 1998-2009.
Chloride Trends 1998-2009

- 16 of 18 sites had a increasing trend in chloride concentrations.
- Chloride concentrations can be related to agriculture and urban run off, wastewater discharge, road treatments.

- West Branch Brandywine Creek at Honey Brook and Modena had no trend in chloride.
- Both sites are near wastewater discharges.
CCIBI and Chloride

- IBI values are negatively related to chloride concentrations.
CCIBI scores and Habitat

- Poor habitat can reduce cover and available “living space” for organisms.
- Increase predation
- Change physical conditions (temp-DO-pH)
- Allow increased infiltration of pollutants.

Figure 16. Relation between mean Chester County Index of Biotic Integrity (CC-IBI) and mean total habitat score from samples collected at 18 fixed-location sites in the Stream Conditions of Chester County Biological Monitoring Network, Chester County, Pa. 1998-2009.
Habitat Categories

Sediment deposition, embeddedness, and bank stability had the highest percentage of sites rated as sub-optimal.

Channel alteration, flow status, and frequency of riffles had the highest percentage of sites rated as optimal.
CCIBI values and Habitat parameters.

- CCIBI values were positively related to high habitat values of;
  - Embeddedness
  - Sediment deposition
  - Riparian zone width
  - Vegetative protection
Sediment and Erosion
Riparian Area
Land use and CCIBI scores

- CCIBI scores increased with increasing forested land use.
- CCIBI scores decreased with increasing urban land use.
- Little relation between agricultural or residential land use
Summary

• IBI values at most sites are stable. Increasing trends at 6 sites and decreasing at 1 site.

• Major habitat issues are related to sediment erosion and deposition along with riparian and bank vegetation.

• Nitrate values were increasing at 4 sites and stable at the other 14 sites. Ortho-P was stable at 17 of the 18 sites and decreasing at W. Br. Red Clay.

• Increasing or high chloride values are present at all 18 sites.
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Thank You

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