Susquehanna River Basin Commission

# Chemung River Subbasin Year-1 Survey

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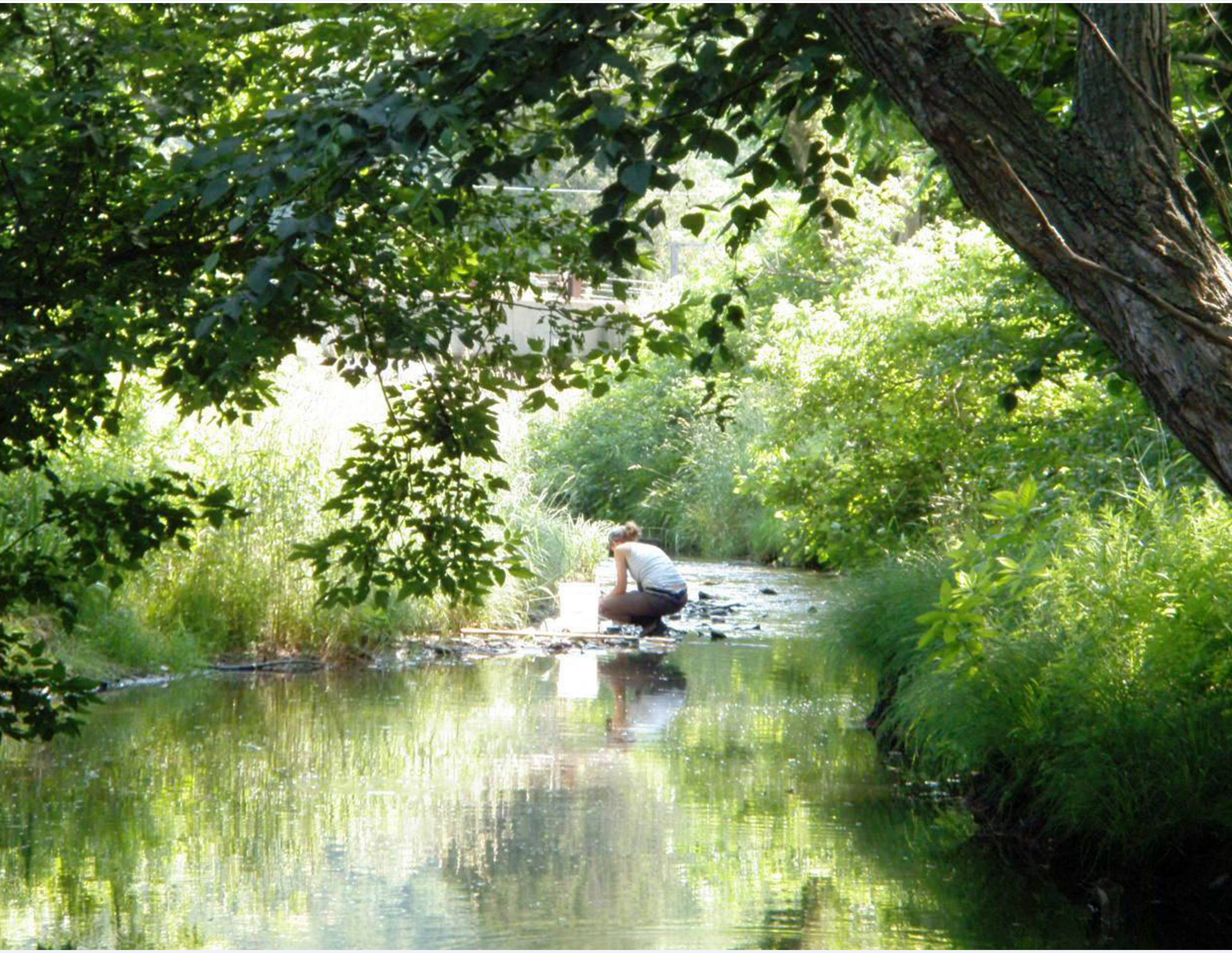

# A Water Quality and Biological Assessment

## June - July 2012

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# Introduction

The Susquehanna River Basin Commission (SRBC) conducted a survey of the Chemung River Subbasin in June and July 2012. SRBC conducted this survey through the Subbasin Survey Program, funded in part through the United States Environmental Protection Agency (USEPA). This program consists of two-year assessments in each of the six major subbasins (Figure 1) on a rotating schedule. The Year-1 survey aims to collect one-time samples of the macroinvertebrate community, habitat, and water quality at targeted sites in major tributaries and other areas of interest throughout a selected subbasin. In 2012, SRBC sampled 76 sites throughout the Chemung River Subbasin as part of the Year-1 program. SRBC conducted previous surveys of the Chemung River Subbasin in 1997 (Traver, 1998) and 2006 (Buda, 2007). This report contains the results from the 2012 study as well as a comparison of these results with the 1997 and 2006 data.

The Year-2 survey, which is a more focused, in-depth study of a specific area or issue, began in 2013 and is focusing on collecting seasonal baseline data in areas of the Chemung and Upper Susquehanna River Subbasins that could potentially be opened up for hydraulic fracturing operations in the near future. Subbasin survey information is used by SRBC staff and others to:

- evaluate the chemical, biological, and habitat conditions of streams in the basin;
- identify major sources of pollution and lengths of stream impacted;
- identify high quality sections of streams that need to be protected;
- maintain a database that can be used to document changes in stream quality over time;
- review projects affecting water quality in the basin; and
- identify areas for more intensive study.


***Figure 1. Six Major Subbasins of the Susquehanna River***

# Description of the Chemung River Subbasin

The Chemung River Subbasin is an interstate watershed that drains approximately 2,604 square miles of southcentral New York and northcentral Pennsylvania. Four major river watersheds—the Canisteo River, the Cohocton River, the Cowanesque River, and the Tioga River—combine with the drainage from the Chemung River itself to form the Chemung River Subbasin. The Chemung River Subbasin crosses Chemung, Steuben, Allegany, Schuyler, Livingston, Ontario, and Yates counties in New York, and Tioga, Bradford, and Potter counties in Pennsylvania (Figure 2). The major population centers include Hornell, Canisteo, Bath, Corning, Horseheads, and Elmira in New York, and Elkland, Mansfield, Blossburg, and Sayre in Pennsylvania. Two Level IV ecoregions, divided into four subecoregions, overlap with the Chemung subbasin (USEPA, 2012a and 2012b; Figure 2):

- Northern Allegheny Plateau (Ecoregion 60)
  - 60a: Glaciated Low Allegheny Plateau
  - 60d: Finger Lakes Uplands and Gorges
  - 60e: Glaciated Allegheny Hills
- Northern Central Appalachians (Ecoregion 62)
  - 62c: Glaciated Allegheny High Plateau

These Level IV ecoregions are more detailed than the Level III ecoregions used in the 2006 and 1997 analyses. Most of the Chemung subbasin is within Ecoregion 60, which is a combination of agriculture and forestland. Ecoregion 60 functions as a transition ecoregion between the more agricultural and urban ecoregions to the north and west and the more mountainous and forested ecoregions to the south and east. Agricultural land use in Ecoregion 60 consists of pastures and farms used to cultivate hay and grain to feed dairy cattle.

For both Ecoregion 60 and 62, the surficial geology consists of glacial till, bedrock outcrops, kame deposits, glacial lacustrine sand, and fluvial outwash sand and gravel while underlying geology consists of shale, siltstone, sandstone, and conglomerate. Wooded areas in both ecoregions consist of mostly oaks and northern hardwoods.

A small part of the southern portion of the subbasin lies in Ecoregion 62, which is more densely forested and where land use largely includes recreation, logging, and gas and mineral extraction.

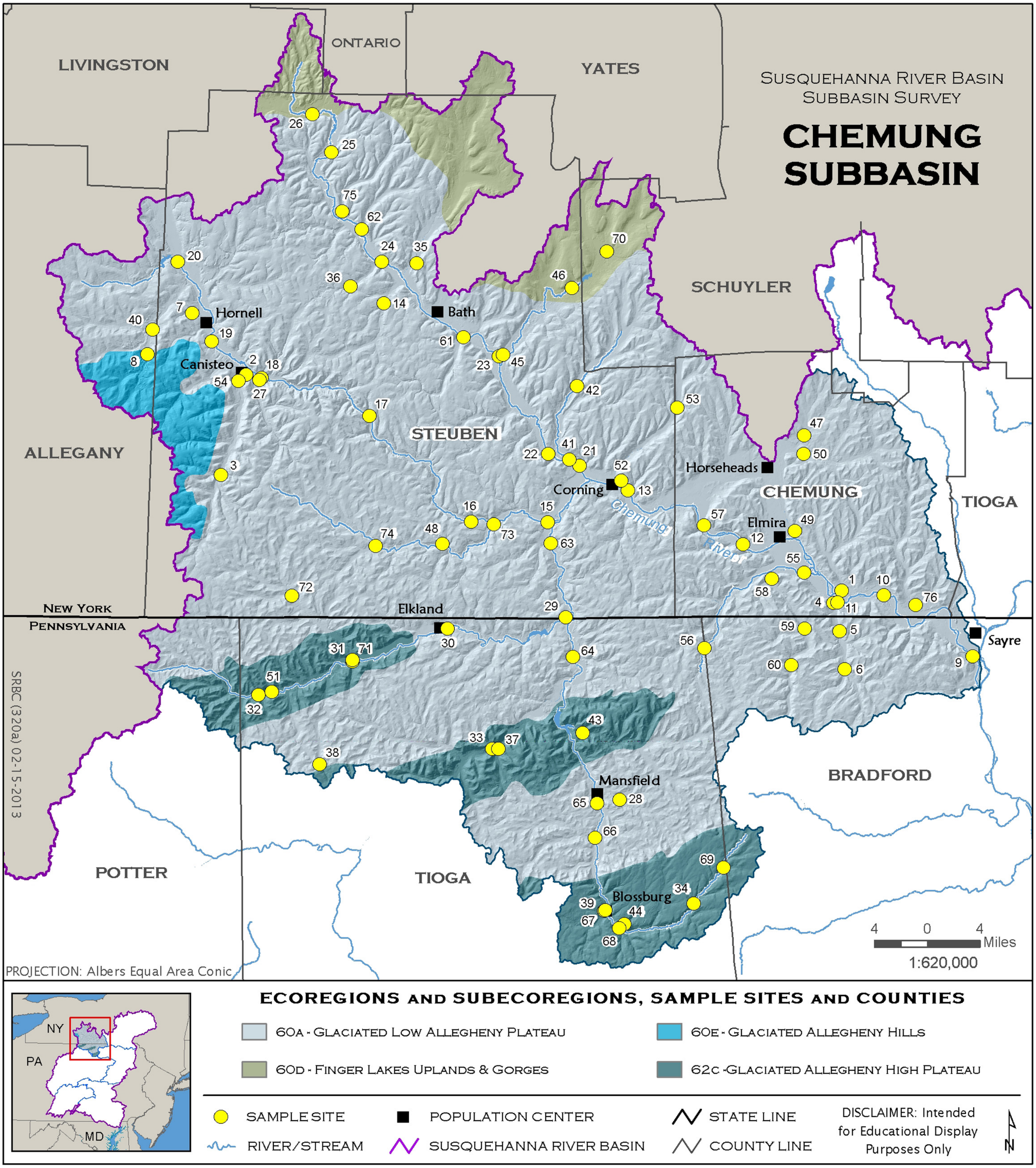



*Figure 2. Chemung River Subbasin Ecoregions and Sample Sites*

Figure 3 illustrates the land use coverage in the Chemung subbasin. The primary land uses are natural vegetated areas and cultivated land, and the largest urban center is the Horseheads/Elmira area. Approximately 1 percent of the Upper Tioga River Watershed consists of abandoned mine lands and surrounding problem areas.

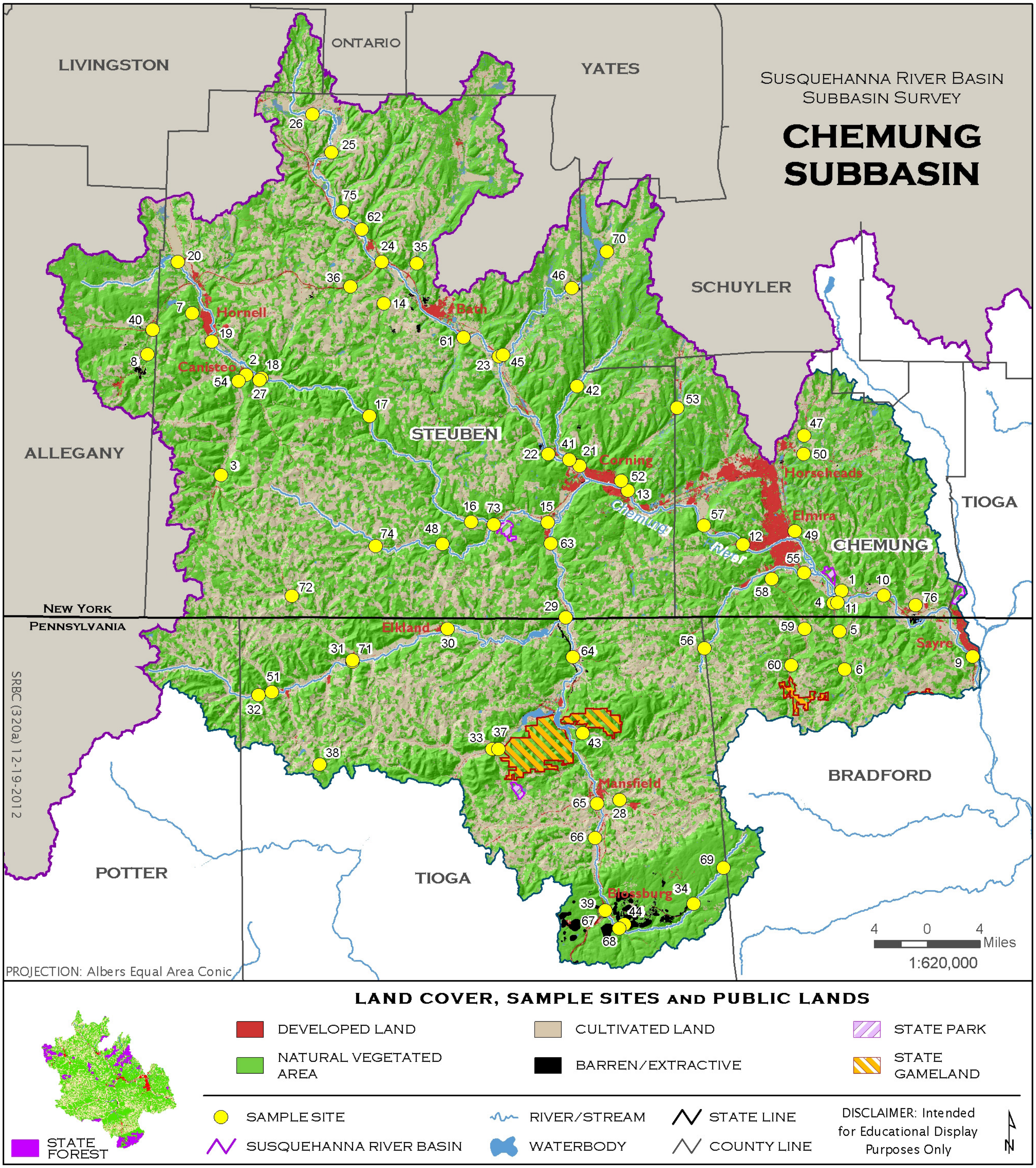



*Figure 3. Chemung River Subbasin Land Cover and Sample Sites*

## Other Subbasin Activities

Numerous watershed organizations are working in the Chemung River Subbasin to educate and involve local citizens and to restore and protect watersheds. Many other local entities, such as county conservation districts and land conservation groups, protect and conserve land and water resources in the subbasin. In February 2012, the Southern Tier Central Regional Planning and Development Board in conjunction with Southern Tier East Regional Planning and Development Board developed the Susquehanna-Chemung Action Plan, which is an ecosystem-based watershed management plan for the Chemung and Upper Susquehanna River subbasins. The economic development community cooperated with stakeholders on flood mitigation, community planning, transportation, agriculture, recreation, and other issues to develop the Action Plan, which focuses on water resources. More information on the Susquehanna-Chemung Action Plan can be found at *www.susquehanna-chemung.org*.

The New York State Department of Environmental Conservation (NYSDEC) is sampling the Chemung subbasin from 2012 through 2014 as part of the agency's Rotating Integrated Basin Studies (RIBS). More information on the RIBS program, which also involves sampling of lakes, reservoirs, and groundwater, is available at *www.dec.ny.gov/chemical/30951.html*. NYSDEC updates its Waterbody Inventory/Priority Waterbodies List (WI/PWL) based on the data collected as part of this program.

SRBC currently is engaged in four key monitoring and protection programs in the Chemung subbasin:

- Sediment and Nutrient Assessment Program (SNAP),
- Interstate Streams Program (Interstate),
- Early Warning System Program (EWS), and
- Remote Water Quality Monitoring Network (RWQMN).

SRBC conducts SNAP as part of the Chesapeake Bay Restoration Program, which involves monthly sampling of nutrients and sediment on the Cohocton and Chemung Rivers at Campbell, N.Y., and Chemung, N.Y., respectively. Data at these sites have been collected since October 2004 in the Chemung River and October 2005 in the Cohocton River and are used to calculate nutrient and sediment loads and trends and to calibrate watershed models. The data as well as additional information on the project can be found at *www.srbc.net/programs/CBP/nutrientprogram.htm*.

Since 1986, SRBC has conducted the Interstate Program along the border of New York and Pennsylvania. This program provides chemical, physical, and biological data from streams that cross the state border and are not routinely assessed by state agencies. In the Chemung Basin, SRBC sampled the macroinvertebrate community, physical habitat, and water chemistry at 22 sites once in 2012 as well as sampled fish and conducted more intensive quarterly water chemistry sampling at a small subset of these sites. As part of this program, SRBC sampled sites on eight streams that are part of the Year-1 survey, including Bentley Creek, Chemung River, Cowanesque River, North Fork Cowanesque River, Seeley Creek, South Creek, Troups Creek, and the Tioga River. More information on the Interstate Program can be found at *www.srbc.net/interstate_streams/*.

SRBC established the EWS program in 2003 in Pennsylvania to inform public water suppliers that have intakes in the Susquehanna River about possible contaminant threats. In 2009, SRBC expanded the system into the New York portion of the basin and established two stations on the Chemung River, with one station at the Elmira Water Authority site and a second station located a little farther upstream. Currently, the EWS enhances public drinking water supplies—serving about 700,000 people—and can better protect their customers by providing a monitoring network that helps minimize the impact from contaminant spills and providing data for improving day-to-day treatment operations. More information on the EWS program is available at *www.srbc.net/programs/docs/EWSInfoSheet020712.PDF*.

In January 2010, SRBC initiated the RWQMN project, which continuously measures and reports water quality conditions of smaller rivers and streams located in northern tier Pennsylvania and southern tier New York. SRBC located RWQMN stations in areas where natural gas drilling in the Marcellus shale is most active as well as in other locations where no drilling activities are planned so SRBC can collect baseline and control data. The collected data help agency officials track existing water quality conditions and provide an early detection alert for any changes on an ongoing, real-time basis. SRBC situated seven RWQMN stations within the Chemung subbasin on the following streams: Canacadea and Tuscarora Creeks in the Canisteo River Watershed, Crooked Creek and Tioga River in the Tioga River Watershed, and Sing Sing, Baldwin, and Hammond Creeks in the Chemung River Watershed. With the exception of Hammond Creek, SRBC sampled sites on all these streams for the Year-1 survey. More information on the RWQMN program is available at *mdw.srbc.net/remotewaterquality/*.

# Methods

## Data Collection

Sampling of Year-1 sites provides a point-in-time picture of stream characteristics throughout the whole Chemung subbasin. SRBC collected samples using a slightly modified version of USEPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers (RBP III) (Barbour and others, 1999).

In June and July 2012, SRBC staff sampled 76 sites throughout the Chemung subbasin. Appendix A contains a list with the sample site number, the station name (designated by approximate stream mile), the latitude and longitude, a description of the sampling location, the drainage area, and the reference designation. Based on local concerns, SRBC added CHEM 13.0 on the Chemung to the site list for the 2012 survey to capture drainage from the Chemung County landfill, which accepts drill cuttings, drill fluids, and flow-back fracturing sand from some of Pennsylvania's hydraulically fractured wells. SRBC used subecoregions to determine reference category designations and grouped sites according to drainage area sizes as described in Traver (1998). SRBC assessed physical habitat and sampled macroinvertebrates and water chemistry at all 76 sites.

## Water Quality

At each site visit, SRBC staff measured instream field chemistry while collecting water samples for laboratory analysis of parameters listed in Table 1. In light of more recent hydraulic fracturing activities within the region, SRBC began sampling parameters in 2012 that are indicators of these activities (i.e., bromide, barium, lithium, strontium, and gross alpha and beta) at select mainstem sites. Staff measured all field chemistry parameters (i.e., temperature, conductivity, pH, and dissolved oxygen) simultaneously using a multi-meter sonde. Staff rinsed the probes of all meters with distilled water and sample water prior to collecting water quality data and calibrated the sonde as detailed in the Quality Assurance Project Plan (QAPP). Staff used a FlowTracker and standard U.S. Geological Survey (USGS) procedures (Buchanan and Somers, 1969) to measure flow at stations with no USGS gage. Staff collected water samples using depth-integrated water sampling methods (Guy and Norman, 1969), placed them on ice, and delivered them to ALS Environmental, Inc., in Middletown, Pa., for analysis.

SRBC field staff measuring flow at Hills Creek at Crooked Creek, Pa. (HILL 0.2).

**Table 1. Water Quality Parameters Sampled in the Chemung Subbasin**

| | |
|---|---|
| **Field Parameters** | |
| Flow (instantaneous cfs) | Conductivity (µmhos/cm) |
| Temperature (°C) | Dissolved Oxygen (mg/l) |
| pH | |
| **Laboratory Analysis** | |
| Alkalinity (mg/l) | Total Magnesium (mg/l) |
| Total Dissolved Solids (mg/l) | Total Sodium (mg/l) |
| Total Suspended Solids (mg/l) | Chloride (mg/l) |
| Total Nitrogen (mg/l) | Sulfate (mg/l) |
| Nitrite-N (mg/l) | Total Iron (mg/l) |
| Nitrate-N (mg/l) | Total Manganese (mg/l) |
| Turbidity (NTU) | Total Aluminum (mg/l) |
| Total Organic Carbon (mg/l) | Total Phosphorus (mg/l) |
| Total Hardness (mg/l) | Total Orthophosphate (mg/l) |
| Total Calcium (mg/l) | Hot Acidity (mg/l) |
| Total Bromide (mg/l) [a] | Total Barium (mg/l) [a] |
| Total Strontium (mg/l) [a] | Total Lithium (mg/l) [a] |
| Gross Beta (pCi/l) [b] | Gross Alpha (pCi/l) [b] |

cfs = cubic feet per second

mg/l = milligram per liter

µmhos/cm = micromhos per centimeter

NTU = nephelometric turbidity units

pCi/l = picoCuries per liter

[a] only at mainstem sites along Canisteo, Chemung, Cohocton, Cowanesque, and Tioga Rivers

[b] only at mouths of Canisteo, Cohocton, Cowanesque, and Tioga Rivers and at Chemung River at West Elmira, N.Y.

## Macroinvertebrates

SRBC staff collected benthic macroinvertebrates (organisms that live on the stream bottom, including aquatic insects, crayfish, clams, snails, and worms) using a slightly modified version of RBP III (Barbour and others, 1999) and the Pennsylvania Department of Environmental Protection's (PADEP's) Semi-Quantitative RBP Method (PADEP, 2009). Staff obtained six D-frame (500-micron mesh) samples at each 100-meter reach by collecting the dislodged material loosened through disturbance of the substrate of six representative riffle/run areas. Staff composited these six D-frame samples into one sample, which was preserved in 95-percent denatured ethyl alcohol and returned to SRBC's lab for processing. Each sample was subsampled by SRBC or a contractor biologist who picked approximately 200 (± 20 percent) organisms from the sample. Each organism was identified to genus when possible, except for midges, which were identified to family, and worms, which were identified to class.

### Habitat

At each site visit, SRBC staff evaluated habitat conditions using a modified version of RBP III (Plafkin and others, 1989; Barbour and others, 1999), rating 11 physical stream characteristics pertaining to substrate, pool and riffle composition, shape of the channel, conditions of the banks, and the riparian zone on a scale of 0-20, with 20 being optimal. Staff noted any other observations regarding recent precipitation events, substrate material composition, surrounding land use, other relevant features in the watershed, and the presence of common terrestrial and aquatic invasive species at the site and surrounding area.

### Data Analysis

SRBC assessed water quality by examining field and laboratory results and comparing them to water quality levels of concern based on current state and federal regulations, background levels for uninfluenced streams, or references for approximate tolerances of aquatic life (Table 2). For each site, SRBC compared the difference between each measured result and the corresponding level of concern value from Table 2. If the measured value exceeded the level of concern value, the difference between the two was listed. If the measured value

**Table 2. Water Quality Standards and Levels of Concern**

| Parameters | Limits | Reference Code |
|---|---|---|
| **Based on state water quality standards:** | | |
| Alkalinity | ≥ 20 mg/l | a |
| Dissolved Oxygen | ≥ 4 mg/l | a |
| Gross Alpha | < 15 pCi/l | b |
| Gross Beta | 4 millirems/yr | b |
| pH | ≥ 6.0 and ≤ 9.0 | a |
| Temperature | ≤ 30.5 ºC | a |
| Total Aluminum | ≤ 0.75 mg/l | c |
| Total Barium | < 2.0 mg/l | b |
| Total Chloride | ≤ 250 mg/l | a |
| Total Dissolved Solids | ≤ 500 mg/l | d |
| Total Iron | ≤ 1.5 mg/l | a |
| Total Magnesium | ≤ 35 mg/l | d |
| Total Manganese | ≤ 1.0 mg/l | a |
| Total Sodium | ≤ 20 mg/l | d |
| Total Strontium | < 4.0 mg/l | e |
| Total Sulfate | ≤ 250 mg/l | a |
| Total Suspended Solids | ≤ 25 mg/l | a |
| Turbidity | ≤ 50 NTU | f |
| **Levels of Concern, based on background levels, aquatic life tolerances, or recommendations:** | | |
| Acidity | ≤ 20 mg/l | g |
| Calcium | ≤ 100 mg/l | g |
| Conductivity | ≤ 800 µmhos/cm | h |
| Total Bromide | < 0.05 mg/l | i |
| Total Hardness | ≤ 300 mg/l | j |
| Total Lithium | < 0.7 mg/l | k |
| Total Nitrate | ≤ 0.6 mg/l | l |
| Total Nitrite | ≤ 1 mg/l | d |
| Total Nitrogen | ≤ 1 mg/l | m |
| Total Organic Carbon | ≤ 10 mg/l | n |
| Total Orthophosphate | ≤ 0.02 mg/l | m |
| Total Phosphorus | ≤ 0.1 mg/l | j |

**Reference**

a. *www.pacode.com/secure/data/025/chapter93/s93.7.html*
b. *water.epa.gov/drink/contaminants/index.cfm*
c. *www.pacode.com/secure/data/025/chapter93/s93.8.html*
d. *www.dec.ny.gov/regs/4590.html#16132*
e. *www.pabulletin.com/secure/data/vol42/42-27/1292.html*
f. *www.dsd.state.md.us/comar/comarhtml/26/26.08.02.03-3.htm*
g. Based on archived data at SRBC
h. *www.uky.edu/WaterResources/Watershed/KRB_AR/wq_standards.htm*
i. *wilkes.edu/include/waterresearch/pdfs/waterbooklet070610.pdf*
j. *www.uky.edu/WaterResources/Watershed/KRB_AR/krww_parameters.htm*
k. *www.vdh.virginia.gov/Epidemiology/DEE/publichealthtoxicology/documents/pdf/lithium.pdf*
l. *water.usgs.gov/pubs/circ/circ1225/images/table.html*
m. *water.usgs.gov/pubs/circ/circ1225/images/table.html*
n. Hem (1970)

*Ephemerella* mayflies are a sensitive ecological indicator taxa. *Photo credit: Robert Henricks* did not exceed the level of concern value, the difference was listed as zero. SRBC then calculated an average of all the differences for each site and assigned classifications based on the following scores:

- Higher quality (score of zero, indicating no parameters exceeded limits),
- Middle quality (score between zero and one), and
- Lower quality (score greater than one).

SRBC designated reference categories for macroinvertebrate and habitat data analysis based on ecoregions and used drainage area to further classify sites located in Ecoregion 60. SRBC grouped all Ecoregion 62 sites into one reference category since all but one of the sites in Ecoregion 62 had drainage areas less than 100 square miles in size. SRBC also grouped the mainstem Chemung River sites into another separate reference category. Consequently, SRBC created five reference categories based on the sampling sites:

- '60s' (Ecoregion 60 sites with small drainage areas <100 square miles in size),
- '60m' (Ecoregion 60 sites with medium drainage areas 100 to 500 square miles in size),
- '60L' (Ecoregion 60 sites with large drainage areas >500 square miles in size),
- '62' (Ecoregion 62 sites), and
- 'River' (mainstem Chemung River sites).

The seven metrics derived from RBP III to analyze benthic macroinvertebrate samples include:

- taxonomic richness,
- modified Hilsenhoff Biotic Index,
- percent Ephemeroptera,
- percent contribution of dominant taxon,
- number of Ephemeroptera/Plecoptera/Trichoptera (EPT) taxa,
- percent Chironomidae, and
- Shannon-Wiener Diversity Index.

SRBC compared each site's metric scores to the scores at its corresponding reference site and assigned a biological condition category of nonimpaired, slightly impaired, moderately impaired, or severely impaired based on RBP III methods. SRBC then used the same reference sites to analyze the habitat scores. SRBC compared the total habitat condition score of each site, calculated a percentage score of the corresponding reference site, and then assigned a habitat condition category of excellent, supporting, partially supporting, or nonsupporting to each site based on RBP III methods.

Field staff measuring flow at Canacadea Creek south of Almond, N.Y. (CANA 6.7).

# Results/Discussion

Figure 4 depicts water quality, macroinvertebrate, and habitat conditions for each of the 76 sampling sites in the Chemung subbasin in 2012. Fifty-one percent of the sampled sites had nonimpaired macroinvertebrate communities, 29 percent had slightly impaired communities, 15 percent had moderately impaired communities, and 5 percent had severely impaired communities (Figure 5).

Twenty-four percent of the evaluated sites had excellent habitat, 45 percent had supporting habitat, 27 percent had partially supporting habitat, and 4 percent had nonsupporting habitat (Figure 6).

Fifty-one percent of the sites had no parameters that exceeded levels of concern and were designated as higher water quality (Table 3 and Figure 7). Forty-four percent of the sites were designated as middle water quality, and 5 percent as lower water quality. Sixteen percent of sites had three or more parameters exceed levels of concern. One site on Canacadea Creek (CANA 6.7) had five parameters exceed levels of concern, and the site on Morris Run (MORR 0.8) had eight parameters exceed levels of concern.

Seven sites (9 percent)—one each on the Chemung River (CHEM 39.8), Campbell Creek (CMBL 0.1), Jemison Creek (JEMI 7.7), Tobehanna Creek (TOBE 1.9), and Tioga River (TIOG 6.2), and two sites on the Canisteo River at CNST 1.0 and CNST 55.5—had the ideal combination of nonimpaired macroinvertebrate communities, excellent habitat, and higher water quality. Eleven percent of sites had nonimpaired macroinvertebrate communities, excellent habitat, and middle water quality. Nonimpaired macroinvertebrate communities, supporting habitat, and middle or higher water quality designations were found at an additional 20 percent of sites.

Total sodium concentrations were the most widespread parameter exceeding levels of concern. Twenty-eight percent of sites had elevated sodium concentrations, which can be an indicator of urbanization (Table 3), but can also be reflective of natural subsurface rock formations in select regions within the southern tier of New York (Sanford, 1995). The highest sodium concentration measured during this study was 54.7 mg/l on a site on Newtown Creek (NEWT 0.6), followed closely by a sodium measurement of 48.9 mg/l on a site on Canacadea Creek (CANA 6.7).

The Chemung subbasin also had widespread elevated nutrient concentrations. Twenty percent of sites had elevated total nitrate concentrations, and 14 percent of sites had elevated total nitrogen concentrations. Since Pennsylvania and New York have not yet developed numeric nutrient standards, SRBC set threshold values for total nitrate (0.6 mg/l) and total nitrogen (1 mg/l) based on natural background concentrations (Table 2) published by the USGS (1999). Values higher than these background levels indicate the potential presence of nitrate and nitrogen sources such as agriculture or urbanization in the watershed. One site on the Canisteo River (CNST 38.7) had the highest nitrate level (2 mg/l), while a site on Tuscarora Creek (TUSC 0.3) had the highest level of total nitrogen (4.3 mg/l), largely from total Kjeldahl nitrogen. Eleven percent of sites had elevated orthophosphate, and 3 percent of sites had elevated total phosphorus.

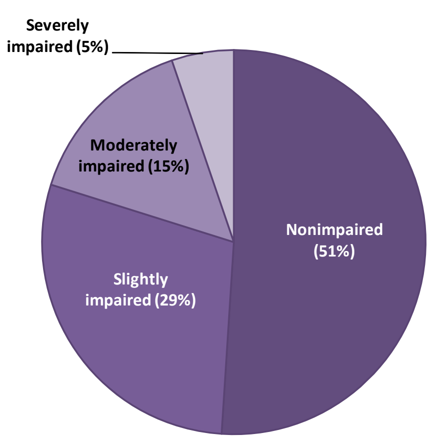



*Figure 5. 2012 Biological Condition Categories for Sampled Chemung Subbasin Sites*

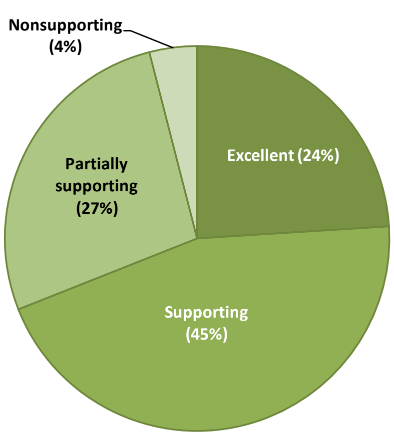



*Figure 6. 2012 Habitat Condition Categories for Sampled Chemung Subbasin Sites*

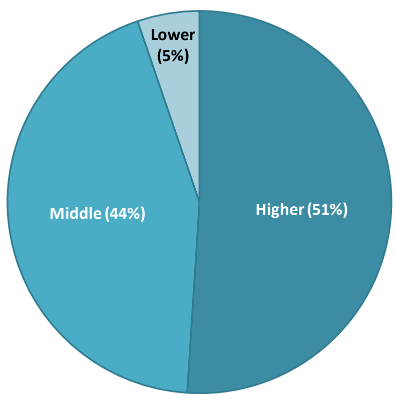



*Figure 7. 2012 Water Quality Condition Categories for Sampled Chemung Subbasin Sites*

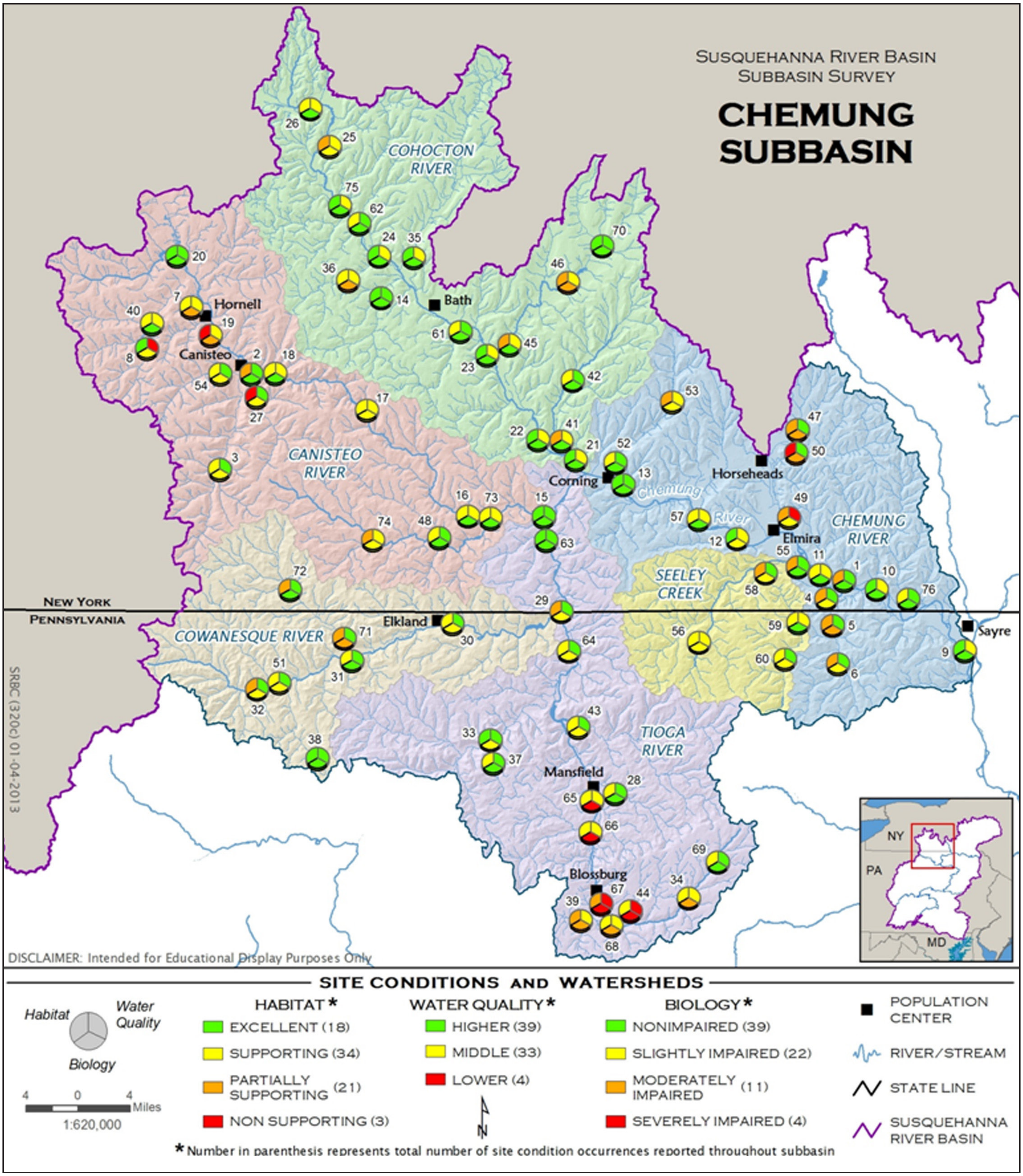



*Figure 4. Chemung Subbasin Site Conditions and Watersheds*

One site on Morris Run (MORR 0.8) in the Tioga River Watershed had the most extreme values for total aluminum, total iron, pH, acidity, and total dissolved solids. This also was the only site to have elevated conductivity, sulfate, and total magnesium.

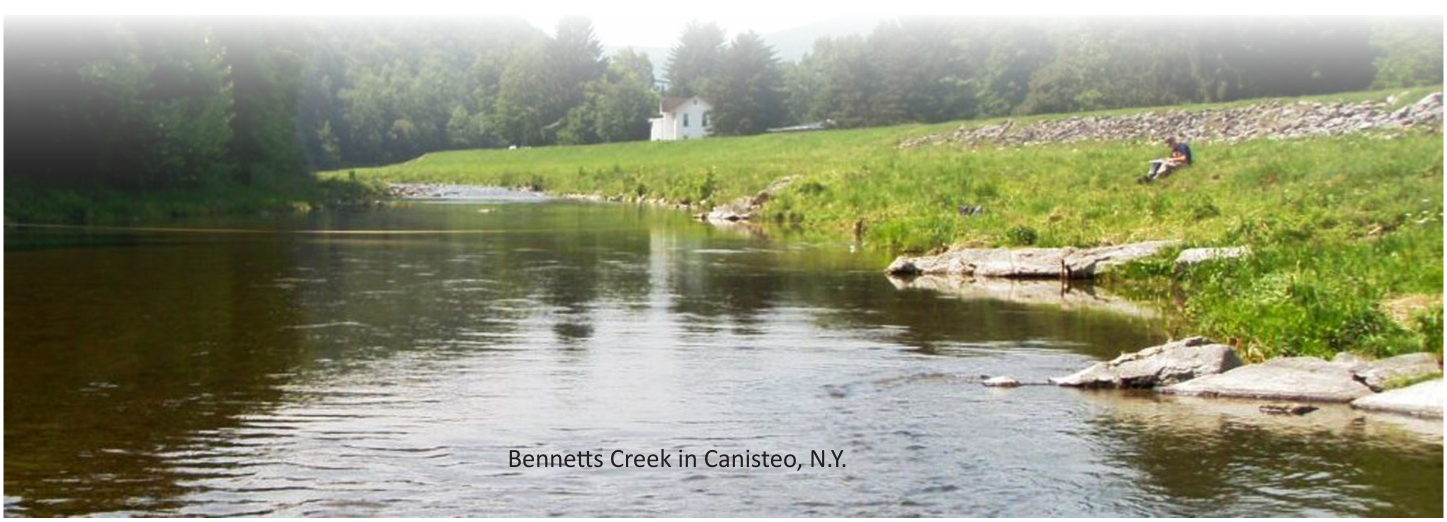
The majority of the remainder of measured parameters that exceeded levels of concern included indicators of acid precipitation and mine drainage. Eight percent of sites had elevated total aluminum, and 4 percent of sites had elevated total iron. Seven percent of sites had depressed pH, 3 percent had elevated acidity levels, and 3 percent also had depressed alkalinity levels. One site on Morris Run (MORR 0.8) in the Tioga River Watershed had the most extreme values for total aluminum, total iron, pH, acidity, and total dissolved solids. MORR 0.8 also was the only site to have elevated conductivity, sulfate, and total magnesium. Elevated conductivity and total dissolved solids were found at 1 and 3 percent of sites, respectively.

No sites had exceeding levels of total calcium, chloride, hardness, manganese, total organic carbon, total suspended solids, turbidity, dissolved oxygen, or temperature.

***Total sodium concentrations were the most widespread parameter exceeding levels of concern. Twenty-eight percent of sites had elevated sodium concentrations, which can be an indicator of urbanization, but can also be reflective of natural subsurface rock formations in select regions within the southern tier of New York (Sanford, 1995). The Chemung subbasin also had widespread elevated nutrient concentrations.***

Canisteo River near mouth in Erwins, N.Y. (CNST 55.0) was one of seven sites that had the ideal combination of nonimpaired macroinvertebrate communities, excellent habitat, and higher water quality.

SRBC sampled several parameters indicative of gas drilling activity. SRBC found elevated bromide at three of the 28 sites (11 percent), all of which were on the Chemung River and were higher than the levels observed at sites sampled as part of SRBC's RWQMN project. No sites had elevated levels of total barium, lithium, or strontium. SRBC did not find elevated gross alpha or gross beta values at any of the six sites sampled for these parameters.



Bennetts Creek in Canisteo, N.Y.

## Table 3. Chemung Subbasin Sites with Water Quality Values Exceeding Levels of Concern

| Site | pH | Conductivity | Hot Acidity | Alkalinity | Nitrate-N | Total Nitrogen | Total Orthophosphate | Total Phosphorus | Total Sodium | Total Dissolved Solids | Total Aluminum | Total Iron | Total Magnesium | Total Sulfate | Total Bromide | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -- | µmhos/cm | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | |
| CANA 1.7 | | | | | | | | | 22 | | | | | | | 1 |
| CANA 6.7 | | | | | 1.6 | 1.6 | 0.078 | | 48.9 | 528 | | | | | | 5 |
| CHEM 2.5 | | | | | | | **0.12** | | 23.9 | | | | | | | 2 |
| CHEM 13.0 | | | | | | | 0.065 | | 24.5 | | | | | | 0.098 | 3 |
| CHEM 18.5 | | | | | | | 0.071 | **0.2** | 26.4 | | | | | | 0.098 | 4 |
| CHEM 28.0 | | | | | | | | | 22.8 | | | | | | **0.099** | 2 |
| CNST 7.7 | | | | | | | | | 20.9 | | | | | | | 1 |
| CNST 22.6 | | | | | | | | | 21.3 | | | | | | | 1 |
| CNST 33.0 | | | | | 0.86 | | | **0.2** | 21 | | | | | | | 3 |
| CNST 38.7 | | | | | **2** | 2 | 0.22 | | 27.2 | | | | | | | 4 |
| COHO 0.5 | | | | | 0.9 | | 0.096 | | 36.1 | | | | | | | 3 |
| COHO 4.0 | | | | | | | 0.11 | | 33.6 | | | | | | | 2 |
| COHO 14.6 | | | | | 1.1 | 1.1 | | | 24.1 | | | | | | | 3 |
| COHO 25.0 | | | | | 1.2 | 1.2 | | | | | | | | | | 2 |
| COHO 37.5 | | | | | 1.6 | 1.6 | | | | | | | | | | 2 |
| COHO 46.3 | | | | | 1.1 | 1.1 | | | | | | | | | | 2 |
| FELL 0.1 | 4.59 | | | | | | | | | | | | | | | 1 |
| FMIL 1.1 | | | | | 1.2 | 1.2 | | | 20.4 | | | | | | | 3 |
| GOFF 3.1 | | | | | 1.4 | 1.4 | | | 28.3 | | | | | | | 3 |
| JOHN 0.1 | | | | 18 | | | | | | | | | | | | 1 |
| KARR 0.1 | | | | | | | | | 27.4 | | | | | | | 1 |
| MEAD 0.1 | | | | | 1 | | | | | | | | | | | 1 |
| MORR 0.8 | **3.08** | **1082** | **131** | | | | | | | **660** | **12.2** | **3.1** | **45.8** | **484** | | 8 |
| MUDC 1.1 | | | | | | | | | | | 0.9 | 2 | | | | 2 |
| MUDC 10.5 | | | | | | | | | 24.2 | | | | | | | 1 |
| NEWT 0.6 | | | | | 0.66 | | | | **54.7** | | | | | | | 2 |
| POST 8.8 | | | | | | | | | 22.9 | | | | | | | 1 |
| SEEL 11.4 | | | | | 0.94 | | | | | | | | | | | 1 |
| SING 0.9 | | | | | 1.2 | 1.2 | | | 27.4 | | | | | | | 3 |
| SOUT 5.9 | | | | | | | 0.065 | | | | | | | | | 1 |
| TIOG 29.8 | 4.76 | | | | | | | | | | 2.2 | | | | | 2 |
| TIOG 35.4 | 3.66 | | | | | | | | | | 2.6 | | | | | 2 |
| TIOG 39.6 | 3.47 | | 56 | | | | | | | | 3.8 | 2.2 | | | | 4 |
| TIOG 42.3 | | | | **1** | | | | | | | 0.84 | | | | | 2 |
| TUSC 0.3 | | | | | | **4.3** | | | | | | | | | | 1 |
| TUSC 12.9 | | | | | | | | | 20.2 | | | | | | | 1 |
| TWVE 0.5 | | | | | 1.1 | 1.1 | | | | | | | | | | 2 |
| **TOTAL** | **5** | **1** | **2** | **2** | **15** | **11** | **8** | **2** | **21** | **2** | **6** | **3** | **1** | **1** | **3** | |
| **% of sites *** | **7%** | **1%** | **3%** | **3%** | **20%** | **14%** | **11%** | **3%** | **28%** | **3%** | **8%** | **4%** | **1%** | **1%** | **11%** | |

Red bolded values were the most extreme values for that parameter measured during this study.

* Most parameters were collected at all 76 sites, but Total Barium was collected at only 28 sites.

## Total Maximum Daily Loads

Section 303(d) of the Clean Water Act requires a Total Maximum Daily Load (TMDL) to be developed for any waterbody designated as impaired or not meeting the state water quality standards or its designated use. Streams in Pennsylvania are being assessed as part of the State Surface Waters Assessment Program, and if they are found to be impaired, they are listed as requiring a TMDL, which would eventually be established for the watershed. In New York, NYSDEC assesses streams through its Statewide Waters Monitoring Program. Some of the watersheds in the Chemung River Subbasin have been designated as impaired for different uses and subsequently will require a TMDL to be established (PADEP, 2012; NYSDEC, 2012). The vast majority of impaired streams within the subbasin are listed for pH, metals, or a combination of both caused by mine drainage.

Since the 2006 subbasin report was published, an additional 28.4 river miles in segments along eight streams in the subbasin were listed as being impaired and will require a TMDL to be established (PADEP, 2012 and NYSDEC, 2012). All of these river miles were located in the Cowanesque and Tioga River Watersheds in Pennsylvania. The majority of these new listings were for impaired aquatic life caused by siltation, most often from an agricultural source. Two new listings on Camp Brook and Holden Creek were for impaired aquatic life caused by pathogens from unknown sources. Neither of these streams located in the Tioga River Watershed was sampled as part of this Year-1 survey.

Four of these eight streams were sampled as part of the Year-1 survey. Various segments of Cowanesque River and North Fork Cowanesque River were recently listed for impaired aquatic life caused by siltation from an agricultural source. One segment of Crooked Creek and one on Tioga River were listed for impaired aquatic life caused by siltation from upstream impoundments.

### Cowanesque River Watershed

This watershed is mostly forested and agricultural land cover with small towns and villages. The overall quality of the entire watershed was good, with 37 percent of sites having nonimpaired biological communities and 50 percent having slightly impaired communities. Thirteen percent of sites had moderately impaired communities, and no sites had severely impaired communities. Thirteen percent of the sites had excellent habitat, with supporting habitat conditions at 37 percent of sites. The remaining 50 percent had partially supporting habitat conditions. All of the sites had higher water quality designations, with no water quality parameters exceeding levels of concern.

Downstream view of the Cowanesque River at Westfield, Pa. (COWN 29.6).

#### *Tributaries to Cowanesque River*

Two sites were located on two tributaries entering the Cowanesque River headwaters— North Fork Cowanesque River (NFCR 0.1) and Jemison Creek (JEMI 7.7). These sites had either slightly impaired or nonimpaired biological communities and either supporting or excellent habitat, and both sites had higher water quality. JEMI 7.7 functioned as a 2012 reference site for the Ecoregion 62 classification. As part of the Interstate Program, SRBC sampled North Fork Cowanesque River upstream of NFCR 0.1 in 2012 and concluded similarily that the site had a nonimpaired biological community and higher water quality.

Troups Creek enters the middle of the Cowanesque River from the north, and the two sites located on this stream (TRUP 0.4 and 5.8) both have higher water quality and partially supporting habitat. The upstream site (TRUP 5.8) had a nonimpaired community, while the downstream site (TRUP 0.4) had a moderately impaired community from a dominance of Chironomidae (midges). As part of the Interstate Program, SRBC sampled Troups Creek in 2012 just downstream of TRUP 5.8 and similarly concluded the site had a nonimpaired biological community despite some water quality problems from elevated pH and iron concentrations.

#### *Cowanesque River Mainstem*

SRBC located four sites along the mainstem Cowanesque River from upstream (COWN 29.6) to downstream of Cowanesque Lake (COWN 0.1). All four sites had higher water quality. Three of the four sites (COWN 29.6, COWN 12.0, and COWN 0.1) had slightly impaired communities, and the fourth site (COWN 20.5) had a nonimpaired community. Two sites (COWN 12.0 and COWN 20.5) had supporting habitat, while the other two had partially supporting habitat. SRBC sampled COWN 0.1 in 2012 as part of the Interstate Program, and concluded similar results that the site had a nonimpaired community and supporting habitat.

### Canisteo River Watershed

This watershed had very good water quality and biological health overall. Most of the sites (50 percent) had nonimpaired biological communities, 38 percent of sites had slightly impaired communities, and 12 percent of sites had moderately impaired communities. No sites had severely impaired communities. Eighteen percent of sites had excellent habitat, 56 percent of sites had supporting habitat, and 13 percent had only partially supporting habitat. Thirteen percent had nonsupporting habitat. Half of the sites experienced middle water quality, 44 percent had higher water quality, and one site (6 percent of sites) had lower water quality.

#### *Tributaries to Canisteo River*

SRBC assessed three sites in the Canacadea Creek Watershed—two sites on Canacadea Creek (CANA 1.7 and CANA 6.7) and one site on Karr Valley Creek (KARR 0.1). The most upstream site (CANA 6.7) had a slightly impaired biological community and excellent habitat, but it had lower water quality due to elevated total dissolved solids, nitrate, nitrogen, orthophosphate, and the second highest level of total sodium. The downstream site (CANA 1.7) had a moderately impaired community, supporting habitat, and middle water quality resulting from elevated total sodium. Karr Valley Creek (KARR 0.1), which is a tributary to Canacadea Creek, had a nonimpaired biological community, supporting habitat, and middle water quality resulting from elevated total sodium. SRBC assesses Canacadea Creek near Almond, N.Y., as part of the RWQMN project and has documented high levels of sodium through monitoring as part of that project.

SRBC sampled three sites in the Tuscarora Creek Watershed, which is another major tributary to the Canisteo River. The upstream site (TUSC 12.9) had a slightly impaired community, partially supporting habitat, and middle water quality from elevated total sodium. The downstream site (TUSC 0.4) had a nonimpaired community, supporting habitat, and middle water quality resulting from the highest total nitrogen concentration (4.3 mg/l) seen in the study. One site on the North Branch Tuscarora Creek (NBTC 0.3) had a nonimpaired community, supporting habitat, and higher water quality. SRBC assesses Tuscarora Creek near Woodhull, N.Y., as part of the RWQMN project. Year-1 results at TUSC 12.9 are consistent with the results observed during RWQMN monitoring of Tuscarora Creek.

The downstream Tuscarora Creek site (TUSC 0.4) had a nonimpaired community, supporting habitat, and middle water quality resulting from the highest total nitrogen concentration (4.3 mg/l) seen in the study.

Other Canisteo River tributaries sampled as part of this survey include Bennetts Creek (BENN 8.3 and BENN 1.2), Purdy Creek (PURD 0.3), and Colonel Bill's Creek (COLB 0.8). Bennetts Creek sites were either slightly impaired or nonimpaired and had excellent water quality. While the upstream Bennetts Creek site (BENN 8.3) had supporting habitat, the presence of an upstream dam at the downstream Bennetts Creek site (BENN 1.2) affected instream habitat and flow regimes and resulted in a partially supporting rating. While Purdy Creek (PURD 0.3) and Colonel Bill's Creek (COLB 0.8) both had higher water quality and slightly impaired communities, only PURD 0.3 had supporting habitat. COLB 0.8 had nonsupporting habitat resulting from a gravel-collecting operation, which is affecting the instream and riparian integrity of the stream.

Upstream view of Canisteo River in South Hornell, N.Y. (CNST 38.7). This site also had the highest total nitrate level in the study at 2 mg/l.

#### *Canisteo River Mainstem*

Five of the six sites on the mainstem Canisteo River (CNST 55.5, CNST 33.0, CNST 22.6, CNST 7.7, and CNST 1.0) had either slightly impaired or nonimpaired communities and either excellent or supporting habitat. CNST 1.0 functioned as a 2012 reference site for the Ecoregion 60L classification. The site CNST 38.7 was located just downstream of the urban area of Hornell, N.Y., had a moderately impaired community from a dominance of pollution-tolerant midges, and had nonsupporting habitat from poor substrate quality and riparian conditions.

CNST 38.7 also had the highest total nitrate level in the study at 2 mg/l. Only two sites (CNST 1.0 and CNST 55.0) had higher water quality. The remaining sites had middle water quality resulting from elevated total sodium, orthophosphate, total nitrogen, nitrate, and/or total phosphorus. CNST 33.0 had the highest total phosphorus level in the study at 0.2 mg/l.

## Tioga River Watershed

The Tioga River Watershed had mixed results regarding water quality and had the most compromised biological communities in the study, largely resulting from mine drainage and atmospheric deposition impacts. Twenty-nine percent of the sites had nonimpaired communities, and 21 percent of the sites each had either slightly impaired or moderately impaired communities. Severely impaired biological communities were found at 29 percent of the sites. The majority of sites (72 percent) had supporting habitat, with 14 percent of sites having excellent habitat and an additional 14 percent having partially supporting habitat. Half of the sites had higher water quality, followed by middle water quality at 36 percent, and lower water quality at 14 percent.

*The Tioga River Watershed had mixed results regarding water quality and had the most compromised biological communities in the study, largely resulting from mine drainage and atmospheric deposition impacts.*

Downstream view of the Tioga River near Chases Mills, Pa. (TIOG 49.2). This site had a nonimpaired community, but the density of organisms at this site and all of the Tioga River sites was much lower than at sites on any other sampled stream within the subbasin.

### *Tributaries to Tioga River*

Mine drainage impairs much of the Tioga River Watershed because many of the watershed's headwaters overlap with abandoned mine areas (Figure 3). Numerous headwaters are also impaired for atmospheric deposition. SRBC located three sites on tributaries with mine drainage influence in this area, including Fellows Creek (FELL 0.1), Johnson Creek (JOHN 0.1), and Morris Run (MORR 0.8). Both FELL 0.1 and JOHN 0.1 had moderately impaired biological communities and middle water quality resulting from either depressed pH (FELL 0.1) or low alkalinity (JOHN 0.1). Low alkalinity indicates that a stream has reduced buffering capacity to neutralize acids. FELL 0.1 had supporting habitat as well as a lack of mayflies and low diversity. JOHN 0.1 had low diversity and a dominance of pollution-tolerant Chironomidae as well as partially supporting habitat from dredging and poor riparian conditions.

The site on Morris Run (MORR 0.8) had the most problems of all the sites in the study. MORR 0.8 had supporting habitat but also had a severely impaired biological community from extremely low diversity (only 4 taxa), lack of sensitive organisms (1 percent), and a near complete dominance of pollution-tolerant midges (97.6 percent). This site also had lower water quality from the most extreme levels seen in the study of total aluminum (12.2 mg/l), total iron (3.1 mg/l), pH (3.08), total dissolved solids (660 mg/l), and acidity (131 mg/l). MORR 0.8 was also the only site to have elevated conductivity readings (1082 mg/l), sulfate concentrations (484 mg/l), and total magnesium (45.8 mg/l).

SRBC sampled four other Tioga River tributaries in this study, including Corey Creek (CORY 1.5), Mill Creek (MILL 1.4), Crooked Creek (CRKD 8.0), and Hills Creek (HILL 0.2). All of these sites had either nonimpaired or slightly impaired biological communities, supporting or excellent habitat, and higher water quality. SRBC assesses Crooked Creek near Keeneyville, Pa., as part of the RWQMN project. Year-1 results at CRKD 8.0 are consistent with the Crooked Creek results observed during RWQMN monitoring.

### *Tioga River Mainstem*

SRBC located seven sites along the Tioga River mainstem, 24 miles of which are impaired by mine drainage (PADEP, 2012). Located above the mine drainage influence, the most upstream site (TIOG 49.2) reflected good headwater conditions including supporting habitat and higher water quality. TIOG 49.2 had a nonimpaired community, but the density of organisms at this site and all of the Tioga River sites was much lower than at sites on any other sampled stream within the subbasin.

Once mine drainage begins to influence the Tioga River, the biological communities begin to deteriorate from moderately (TIOG 42.3) to severely impaired (TIOG 39.6, TIOG 35.4, and TIOG 29.8) because of extremely low diversity, a lack of EPT taxa, and a dominance of pollution-tolerant midges. Three of these four sites had supporting habitat and middle water quality resulting from elevated total aluminum and depressed pH and alkalinity levels, including the lowest alkalinity level (1 mg/l) at

Downstream view of the Tioga River in Blossburg, Pa. (TIOG 39.6)

Upstream view of the Tioga River near Mansfield, Pa. (TIOG 29.8)

Mine drainage influences these two tributaries of the Tioga River. Extremely low diversity, lack of EPT taxa, and a dominance of pollution-tolerant midges were found in these severely impaired communities.

TIOG 42.3 seen in the study. The fourth site (TIOG 39.6) had partially supporting habitat with iron oxide-coated substrate, an upstream dam, and adjacent dredging as well as lower water quality from elevated total aluminum, total iron, and acidity as well as depressed pH.

Receiving higher water quality input from Mill Creek and Crooked Creek, conditions improved at TIOG 16.3, which had supporting habitat, higher water quality, and a slightly impaired community. The most downstream site on the Tioga River (TIOG 6.2) had a nonimpaired community, excellent habitat, and higher water quality. Results from a site upstream of TIOG 6.2 sampled by SRBC as part of the Interstate Program indicate similar higher quality results. SRBC assesses Tioga River near Fall Brook, Pa., as part of the RWQMN project. Year-1 results at TIOG 49.2 and 42.3 are consistent with the results observed during RWQMN monitoring of the Tioga River.

## Cohocton River Watershed

The vast majority (82 percent) of sites in the Cohocton River Watershed had nonimpaired biological communities, with 6 percent having slightly impaired communities, and 12 percent with moderately impaired communities. Most sites (47 percent) had excellent habitat, and 29 percent had supporting habitat. The remaining 24 percent of sites had partially supporting habitat. Most sites (71 percent) had middle water quality, while the remaining 29 percent of sites had higher water quality.

### Tributaries to Cohocton River

SRBC located 11 sites along nine tributaries to the Cohocton River as part of this study, including Twelvemile Creek (TWVE 0.5), Tenmile Creek (TENM 0.2), Five Mile Creek (FMIL 1.1), Goff Creek (GOFF 3.1), Campbell Creek (CMBL 0.1), Stocking Creek (STOK 0.3), Mud Creek (MUDC 10.5 and MUDC 1.1), Tobehanna Creek (TOBE 1.9), and Meads Creek (MEAD 11.1 and MEAD 0.1).

Twelvemile, Tenmile, and Five Mile Creeks drain the northeastern portion of the Cohocton River Watershed. All three sites had nonimpaired communities, either supporting or excellent habitat, and middle or higher water quality. Middle water quality at Twelvemile Creek (TWVE 0.5) and Five Mile Creek (FMIL 1.1) resulted from elevated nitrate and total nitrogen, but FMIL 1.1 also had elevated total sodium. TWVE 0.5 functioned as a 2012 reference site for the Ecoregion 60s classification.

Upstream view of Twelvemile Creek at Wallace, N.Y. (TWVE 0.5). Twelvemile, Tenmile, and Five Mile Creeks had nonimpaired communities, either supporting or excellent habitat, and middle or higher water quality.

Goff Creek, Campbell Creek, and Stocking Creek enter the Cohocton River from the west around its mid-point. GOFF 3.1 had a moderately impaired biological community from low EPT diversity and a dominance of pollution-tolerant midges, supporting habitat, and middle water quality from elevated total nitrate, nitrogen, and sodium. Campbell Creek (CMBL 0.1) and Stocking Creek (STOK 0.3) both had nonimpaired communities and higher water quality, while CMBL 0.1 had excellent habitat, and STOK 0.3 had supporting habitat.

Campbell Creek near Knight Settlement, N.Y. (CMBL 0.1). This site had nonimpaired communities and excellent habitat.

Mud Creek and Meads Creek drain the lower, southeastern portion of the Cohocton River. In the headwaters of Mud Creek, a site on tributary Tobehanna Creek (TOBE 1.9) had a nonimpaired biological community, excellent habitat, and higher water quality. TOBE 1.9 functioned as a reference site for the Ecoregion 60d classification. Farther downstream, Mud Creek (MUDC 10.5) had a moderately impaired community from low diversity, a lack of EPT taxa, and a dominance of midges, partially supporting habitat from poor substrate, and middle water quality from elevated total sodium. Near its confluence with the Cohocton River, Mud Creek (MUDC 1.1) had a nonimpaired community, partially supporting habitat from poor substrate and flow regimes, and middle water quality from elevated total aluminum and iron.

Both sites on Meads Creek had nonimpaired communities. While MEAD 11.1 had supporting habitat and higher water quality, MEAD 0.1 had partially supporting habitat from poor substrate and flow regime variability, and middle water quality resulting from slightly elevated total nitrate.

#### *Cohocton River Mainstem*

SRBC located six sites on the mainstem Cohocton River. Nearly all sites had nonimpaired biological communities, with the exception of COHO 37.5, which had a slightly impaired community. COHO 25.0 functioned as a 2012 reference site for the Ecoregion 60m classification. Most sites had excellent habitat, except for COHO 46.3, which had supporting habitat and COHO 37.5, which had partially supporting habitat. All sites had middle water quality, and nearly all sites had elevated levels of nitrate and total nitrogen. Three sites—COHO 14.6, COHO 4.0, and COHO 0.5—also had elevated sodium, and both COHO 4.0 and COHO 0.5 had elevated orthophosphate.

### Chemung River Watershed

The Chemung River is formed by the confluence of the Cohocton and Tioga Rivers in Corning, N.Y. Forty-eight percent of sites in the Chemung River Watershed had nonimpaired communities, with 38 percent having slightly impaired communities, and 14 percent having moderately impaired communities. Most sites (43 percent) had only partially supporting habitat, followed by supporting habitat at 33 percent of sites, and excellent habitat at 19 percent of sites. Five percent of sites had nonsupporting habitat. The majority of the sites (57 percent) had higher water quality, with 38 percent having middle water quality, and lower water quality occurring at 5 percent of sites.

#### *Tributaries to Chemung River*

SRBC set 16 sites on eight tributaries that drain directly to the Chemung River Watershed as part of this study. Sampled tributary systems draining the northern side of the length of the watershed include Post Creek (POST 8.8 and POST 0.6), Sing Sing Creek (SING 0.9), Newtown Creek (NBNC 0.6, NEWT 9.7, and NEWT 0.6), Baldwin Creek (BDWN 0.3), and Wynkoop Creek (WYNK 0.8).

The most upstream site on Post Creek (POST 8.8) had a slightly impaired biological community, partially supporting habitat from poor riparian conditions, and middle water quality resulting from elevated total sodium. Farther downstream, POST 0.6 also had a slightly impaired community but had excellent habitat and higher water quality.

Sing Sing Creek (SING 0.9), which enters the Chemung River farther to the east, had a nonimpaired community, supporting habitat, and middle water quality from elevated total nitrate, nitrogen, and sodium. SRBC assesses Sing Sing Creek near Big Flats, N.Y., as part of the RWQMN project and has documented high levels of nitrate and sodium through monitoring for that project as well.

The Newtown Creek Watershed, located east of Sing Sing Creek, had moderately impaired communities from low EPT taxa and a dominance of pollution-tolerant midges and higher water quality in its headwaters at NBNC 0.6 and NEWT 9.7. Habitat at NBNC 0.6 was partially supporting because flow regimes were affected by an upstream bridge and riparian conditions were not ideal. Habitat at NEWT 9.7 was nonsupporting because of poor substrate, flow regimes, and riparian conditions. Farther downstream, NEWT 0.6 had a slightly impaired community, partially supporting habitat, and lower water quality resulting from elevated total nitrate and the highest levels of total sodium (54.7 mg/l) seen in the study.

The sites on Baldwin Creek (BDWN 0.3) and Wynkoop Creek (WYNK 0.8) had nonimpaired communities, higher water quality, and either partially supporting or supporting habitat. SRBC assesses Baldwin Creek near Lowman, N.Y., as part of the RWQMN project. Year-1 results at BDWN are consistent with the results observed for Baldwin Creek during RWQMN monitoring.

Sampled tributary systems draining the south-central portion of the watershed include South Creek (SOUT 9.1, SOUT 5.9, and SOUT 2.0), Seeley Creek (SEEL 11.4 and SEEL 2.8), and Bentley Creek (BNTY 5.7, BNTY 2.5, and BNTY 0.4). The upstream site on South Creek (SOUT 9.1) had a slightly impaired community, supporting habitat, and higher water quality. Farther downstream, SOUT 5.9 had a nonimpaired community, excellent habitat, and middle water quality from slightly elevated orthophosphate. Near the mouth of South Creek where it enters Seeley Creek, SOUT 2.0 had a slightly impaired community, partially supporting habitat from compromised riparian conditions and substrate embeddedness, and higher water quality.

In the headwaters of Seeley Creek, SEEL 11.4 had a slightly impaired community, supporting habitat, and middle water quality from elevated total nitrate. Located below the confluence with South Creek, SEEL 2.8 had a nonimpaired community, partially supporting habitat from poor riparian conditions, and higher water quality. SRBC sampled upstream reaches of both South Creek and Seeley Creek in 2012 as part of the Interstate Program and saw similar results.

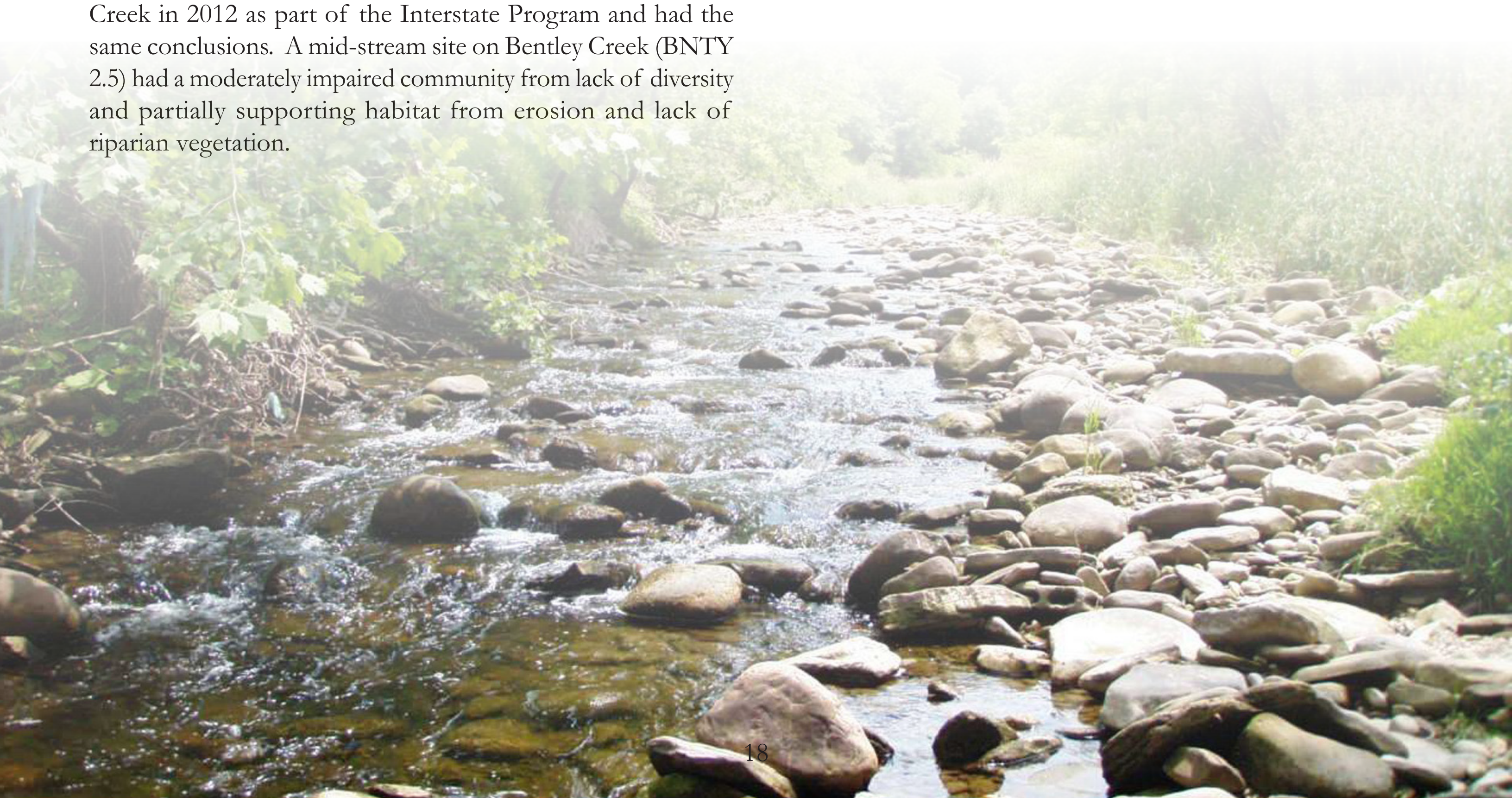
All three sites on Bentley Creek had higher water quality. The most upstream (BNTY 5.7) and downstream (BNTY 0.4) sites had slightly impaired communities and partially supporting habitats. SRBC also sampled a downstream site on Bentley Creek in 2012 as part of the Interstate Program and had the same conclusions. A mid-stream site on Bentley Creek (BNTY 2.5) had a moderately impaired community from lack of diversity and partially supporting habitat from erosion and lack of riparian vegetation.

### *Mainstem Chemung River*

SRBC located five sites along the mainstem of the Chemung River. Just below the Post Creek confluence and Corning, N.Y., CHEM 39.8 had a nonimpaired biological community, excellent habitat, and higher water quality. Farther downstream of the Sing Sing Creek drainage and upstream of Elmira, N.Y., CHEM 28.0 had a slightly impaired biological community, excellent habitat, and middle water quality from elevated total sodium and the highest concentration of total bromide (0.099 mg/l) observed within the study.

Located downstream of Elmira, N.Y., and receiving drainage from Seeley and South Creeks, CHEM 18.5 had a nonimpaired community, supporting habitat, and middle water quality from elevated orthophosphate, sodium, bromide, and the highest level of total phosphorus (0.2 mg/l) seen in the study. Located a bit farther downstream from the Chemung County landfill, CHEM 13.0 had a nonimpaired community, excellent habitat, and middle water quality from elevated orthophosphate, total sodium, and total bromide. SRBC sampled a site on the Chemung River just downstream of CHEM 13.0 in 2012 as part of the Interstate Program. Those results, consisting of a moderately impaired community and partially supporting habitat, differ from those just upstream at CHEM 13.0. These differences might result from comparisons of results to different reference sites used by the two projects.

Located a few miles above the confluence with the Susquehanna River, CHEM 2.5 had a nonimpaired community, excellent habitat, and middle water quality resulting from elevated sodium and the highest level of orthophosphate (0.12 mg/l) observed in the study. CHEM 2.5 functioned as a 2012 reference site for the River classification.



# Comparison to Historical Data

## Condition Categories

SRBC compared the data collected from the Chemung River Subbasin in 2012 with the data collected in 1997 and 2006. The 2012 study consisted of six more sites than in 2006 and about 20 more sites than in 1997. Figures 8 through 10 depict the results for biological, habitat, and water quality conditions for these three years. Table 4 shows how condition categories have changed throughout these surveys. Overall, a large percentage of biological, habitat, and water quality condition categories remained stable in the six years since the last subbasin survey.

### Biology

Overall, the 2012 biological results improved from those observed in 2006 (Figure 8). From 1997 to 2012, the percentage of nonimpaired sites continually increased while the percentage of slightly impaired sites steadily decreased. The percentage of moderately impaired sites was only slightly less than what was observed in 2006, but both of these values are higher than in 1997. Conversely, the percentage of severely impaired sites remained about the same as was observed in 2006, but both 2006 and 2012 percentages were much lower than that observed in 1997.

SRBC compared 2012 biological condition categories to those determined in the previous sampling event (either 1997 or 2006) for each site (Table 4). Throughout the Chemung River Subwatershed, approximately 46 percent of sites demonstrated no change in biological condition categories. Fifty-seven percent of the sites in the Tioga River Subwatershed remained biologically stable, followed by Canisteo and Chemung (both at 50 percent of sites). Overall, 35 percent of sites showed improvement, with the greatest percentage of sites seeing improvement (53 percent of its sites) occurring in the Cohocton River Subwatershed. Throughout the subbasin, 19 percent of sites showed degradation in biological condition categories, with the most degradation occurring in the Cowanesque subwatershed (37.5 percent of its sites) from compromised habitat.

Classifications for nearly all sites that changed shifted only one category in either direction. Only one site, COHO 46.3 (Cohocton River), increased two category classification categories from moderately impaired in 2006 to nonimpaired in 2012. Three sites dropped two category classifications in 2012—NEWT 9.7 (Newtown Creek), JOHN 0.1 (Johnson Creek), and TRUP 0.4 (Troups Creek)— from nonimpaired in 2006 to moderately impaired in 2012. The drops in condition categories at all three sites may be correlated to the shifts to nonsupporting habitat conditions observed at those sites in 2012 resulting from observed stream and channel disturbance. Moderately impaired classifications at JOHN 0.1 were assigned in both 1997 and 2012, with nonimpaired conditions noted in 2006 from the presence of some mayfly and stonefly taxa.

All severely impaired sites identified in 2006 retained that classification in 2012. Likewise, the severely impaired conditions at TIOG 29.8 (Tioga River) reflect similar conditions found at that site in 1997, despite the moderately impaired conditions determined in 2006.

***Overall, a large percentage of biological, habitat, and water quality condition categories remained stable in the six years since the last subbasin survey.***

### Habitat

Throughout the basin, the percentage of sites having excellent habitat continually decreased from 1997 through 2012 while the percentages of sites with supporting habitat continually increased from 1997 to 2012 (Figure 9). The total percentages of sites with combined excellent and supporting habitat in 2012 (69 percent) was less than the 77 and 78 percent observed in 1997 and 2006, respectively. The percentage of partially supporting habitat steadily increased from 1997 to 2012. The percentage of sites with nonsupporting habitat was highest in 1997 before dropping to levels seen in both 2006 and 2012. Making comparisons between habitat assessments between sampling event years is difficult due to inherent variability in scoring judgments.

**Table 4. Percent of Sites with a Change in Condition Categories**

| Subwatershed | Percent of sites with a change in Condition Categories (1997, 2006, and 2012 data) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Biology | | | Habitat | | | Water Quality | | |
| | Improved | Degraded | No Change | Improved | Degraded | No Change | Improved | Degraded | No Change |
| Canisteo | 44 | 6 | 50 | 25 | 19 | 56 | 19 | 13 | 69 |
| Chemung | 25 | 25 | 50 | 15 | 50 | 35 | 19 | 0 | 76 |
| Cohocton | 53 | 12 | 35 | 29 | 18 | 53 | 29 | 6 | 65 |
| Cowanesque | 25 | 37.5 | 37.5 | 0 | 75 | 25 | 13 | 0 | 75 |
| Tioga | 21.5 | 21.5 | 57 | 0 | 43 | 57 | 21 | 0 | 79 |
| **Overall** | **35** | **19** | **46** | **16** | **37** | **47** | **22** | **4** | **74** |

SRBC compared 2012 habitat condition categories to those determined in the previous sampling event for each site in the subbasin. Forty-seven percent of sites showed no change in habitat classification from the previous year's assessment. Both the Tioga and Canisteo subwatersheds had the greatest percentages of sites that showed no change (57 and 56 percent, respectively), followed closely by Cohocton at 53 percent of sites. Overall, 37 percent of sites throughout the basin showed degraded habitat, with most of the degraded conditions continuing to occur in the Cowanesque (75 percent of sites) and Chemung (50 percent of sites) subwatersheds. Of the 16 percent of sites showing improving conditions, most were located in the Cohocton and Canisteo subwatersheds.

A total of six sites experienced shifts in habitat classification of at least two condition categories. COHO 25.0 (Cohocton River) shifted from partially supporting to excellent habitat. Three sites, BDWN 0.3 (Baldwin Creek), SOUT 2.0 (South Creek), and JOHN 0.1 (Johnson Creek), dropped habitat classifications from excellent in 2006 to partially supporting in 2012. Another site, NEWT 9.7 (Newtown Creek), had its habitat classification drop from supporting in 2006 to nonsupporting in 2012. Both JOHN 0.1 and NEWT 9.7 experienced stream and channel disturbance.

## Water Quality

SRBC's use of some water quality standards and levels of concern changed since the 2006 study, most notably for total aluminum and temperature. The New York water quality standard for aluminum is 0.1 mg/l (NYSDEC, 2012), and Pennsylvania's standard is 0.75 mg/l. Since the majority of the Susquehanna River Basin is located within Pennsylvania, for the purposes of basin-wide comparative analysis, the Pennsylvania water quality standard for aluminum was used for the 2012 Chemung analysis. The previous Pennsylvania temperature criterion of 25°C maximum has been replaced by a maximum of 30.5°C (PADEP, 2012).

As a result of these changes, SRBC reanalyzed the 1997 and 2006 data using these newer standards and levels to allow data to be compared across the three study periods. In addition, the additional lab analysis for Marcellus shale parameters (barium, bromide, lithium, strontium, and gross alpha and beta) occurred

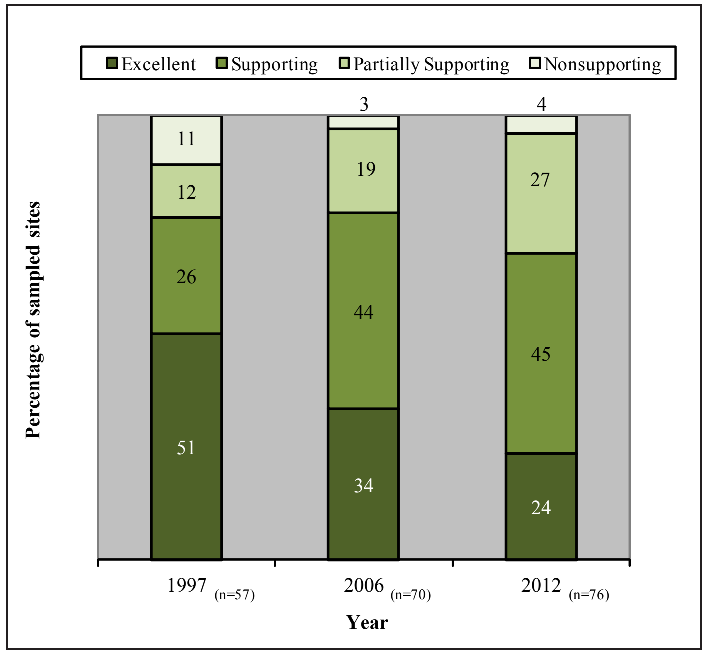



*Figure 9. Historical Habitat Condition Categories Among Sampled Sites in the Chemung Subbasin Surveys*

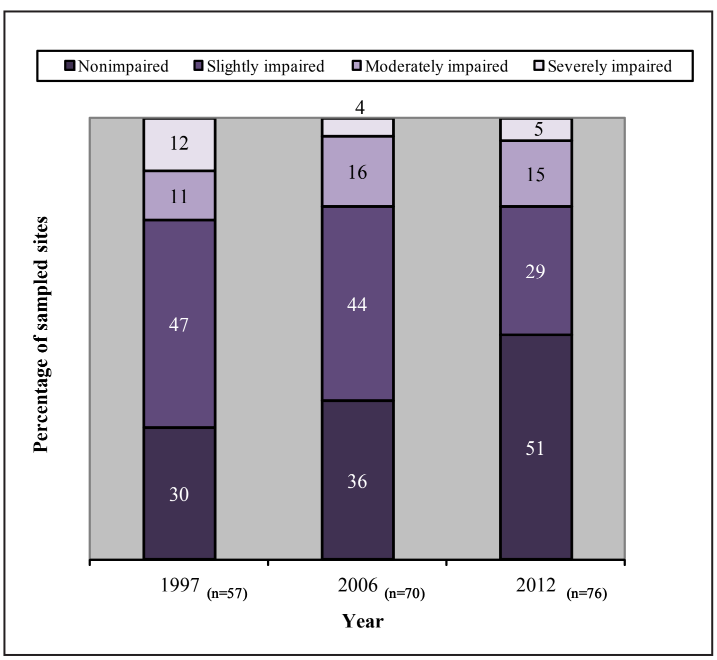



*Figure 8. Historical Biological Condition Categories Among Sampled Sites in the Chemung Subbasin Surveys*

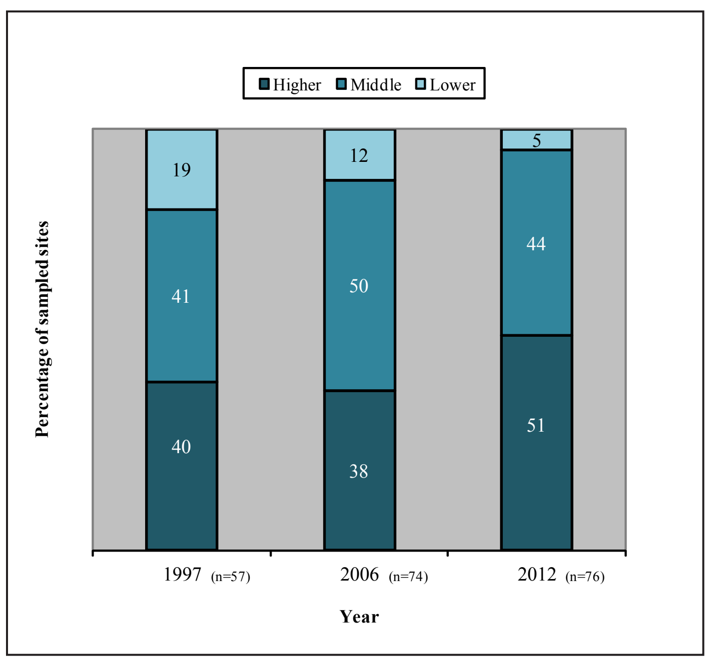



*Figure 10. Historical Water Quality Categories Among Sampled Sites in the Chemung Subbasin Surveys*

only in 2012 at select mainstem sites. Trends in water quality condition categories are illustrated in Figure 10.

Overall, water quality in the Chemung River Basin continually improved over the years. The percentage of sites with higher water quality in 2012 exceeded the percentages observed in 2006 and 1997. In contrast, the percentage of sites with lower water quality continually decreased from 1997 to 2012. The percentage of sites with middle water quality in 2012 fell between the percentages observed in 2006 and 1997.

SRBC compared water quality conditions in 2012 with conditions determined from the previous sampling event (either 1997 or 2006) for each site (Table 4). Similar to the trends mentioned above, 74 percent of sites overall showed no change in condition category, while 22 percent showed an improvement. Only 4 percent of sites showed a degradation in water quality condition categories. Stable conditions ranged from 65 percent (Cohocton River Subwatershed) to 79 percent of sites (Tioga River Subwatershed). The Cohocton River Subwatershed had the greatest percentage of sites with improved condition categories (29 percent), while the Cowanesque River Subwatershed had the lowest (13 percent). The only two subwatersheds to experience degradation in water quality condition categories were the Cohocton (6 percent of sites) and Canisteo (13 percent of sites). Two sites—BNTY 5.7 (Bentley Creek) and TIOG 49.2 (Tioga River)—experienced improvement of two classification categories from lower to higher water quality.

### *Water Chemistry*

SRBC analyzed water quality data from the last three surveys (1997, 2006, and 2012) and compared results to isolate the parameters that consistently cause problems and to identify sites that have chronic issues (Table 5). Of all parameters, sodium exceeded levels of concern most frequently, followed by orthophosphate, nitrate, and total nitrogen. Consistent with these patterns, 17 sites had consistently elevated sodium. Constantly elevated nutrients such as nitrate (11 percent of sites), total nitrogen (8 percent of sites), orthophosphate (7 percent of sites), and total phosphorous (2 percent of sites) were found throughout the Canisteo, Chemung, and Cohocton Subwatersheds. Sites that consistently experienced depressed alkalinity and pH, total aluminum, iron, acidity, conductivity, and sulfate were isolated to the Tioga River Subwatershed.

***Overall, water quality in the Chemung River Basin continually improved over the years.***

Most of the five sites previously discussed as having four or more parameters exceeding levels of concern in 2012 had consistent issues with at least one parameter in past surveys. In the Tioga River Subwatershed, Morris Run (MORR 0.8) has regularly had issues with acidity, aluminum, iron, magnesium, sulfate, pH, and conductivity. The Tioga River headwaters have had consistent issues with acidity, aluminum, iron, and pH. In the Canisteo River Subwatershed, Canacadea Creek (CANA 6.7) has consistently elevated nitrate, orthophosphate, total nitrogen, and sodium. The headwaters of the Canisteo River at CNST 38.7 has regularly had issues with sodium. The Chemung River at CHEM 18.5 has had issues with orthophosphate, total phosphorus, and sodium.

Data collected at the six Year-1 sites that are located on streams that are monitored through the RWQMN—Canacadea, Tuscarora, Crooked Creek, Tioga, Sing Sing, and Baldwin—are consistent with the continuous data and grab sample results documented as part of the RWQMN project.

**Table 5. List of Sites with Parameters Chronically Exceeding Levels of Concern (1997, 2006, and 2012 Data)**

| Parameter | | Number of Exceeding Measurements | | | | Number of Sites with Chronic Issues | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | Value | | | Total | Within each subwatershed | | | | |
| | | | Minimum | Maximum | Median | | Canisteo | Chemung | Cohocton | Cowanesque | Tioga |
| Total Sodium | mg/l | 61 | 20.2 | 92.3 | 26.2 | 17 | 7 | 7 | 3 | 0 | 0 |
| Total Orthophosphate | mg/l | 49 | 0.018 | 0.96 | 0.042 | 7 | 2 | 3 | 2 | 0 | 0 |
| Nitrate-N | mg/l | 45 | 0.62 | 2 | 1.05 | 11 | 2 | 3 | 6 | 0 | 0 |
| Total Nitrogen | mg/l | 42 | 1.03 | 4.3 | 1.39 | 8 | 1 | 1 | 6 | 0 | 0 |
| Alkalinity | mg/l | 17 | 0 | 18 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| pH | -- | 16 | 2.3 | 4.8 | 3.83 | 5 | 0 | 0 | 0 | 0 | 5 |
| Total Aluminum | mg/l | 16 | 0.79 | 17 | 3.449 | 4 | 0 | 0 | 0 | 0 | 4 |
| Total Phosphorus | mg/l | 9 | 0.105 | 0.69 | 0.149 | 2 | 1 | 1 | 0 | 0 | 0 |
| Total Iron | mg/l | 9 | 2 | 11 | 2.42 | 2 | 0 | 0 | 0 | 0 | 2 |
| Hot acidity | mg/l | 9 | 26 | 186 | 48 | 2 | 0 | 0 | 0 | 0 | 2 |
| Conductivity | µmhos/cm | 5 | 807 | 1322 | 870 | 1 | 0 | 0 | 0 | 0 | 1 |
| Sulfate | mg/l | 3 | 410 | 779 | 484 | 1 | 0 | 0 | 0 | 0 | 1 |
| Total Magnesium | mg/l | 3 | 35.3 | 66.6 | 45.8 | 1 | 0 | 0 | 0 | 0 | 1 |

# Conclusions

SRBC is careful to point out that the sampling for this survey, as with all Subbasin Year-1 assessments, was based on a one-time sampling event at sites that were chosen for ease of access. For this reason, replicate and more representative sampling along additional segments in watersheds would be needed to truly identify and isolate problems in these watersheds, and statistically valid inferences of the Chemung River Subbasin as a whole cannot be accurately stated from the results of this survey.

In general, the streams sampled during the 2012 survey of the Chemung subbasin had good biological, habitat, and water quality conditions, but problems persist in certain locations. The vast majority of sites sampled (80 percent) had benthic macroinvertebrate communities that were either nonimpaired or slightly impaired, with 5 percent of sites having severely impaired communities. Most sites (69 percent) also had excellent or supporting habitat, and only 4 percent of sites had nonsupporting habitat. The slight majority of sites had higher water quality (51 percent), with 5 percent of sites having lower water quality.

Cohocton River north of Cohocton, N.Y. (COHO 37.5). This site is an example of poor vegetation along the banks, which are mowed nearly to the water's edge. Many of the poor habitat ratings in this survey resulted from inadequately vegetated riparian zone widths.

Three general areas in the Chemung subbasin have impaired conditions that need improving. Through previous subbasin reports, SRBC has consistently documented impaired biological conditions and lower water quality throughout the headwaters of the Tioga River, which are affected by mine drainage, and the headwaters of the Canisteo River, which have compromised habitat and lower water quality at some sites. SRBC also identified lower water quality and poor habitat along Newtown Creek in the headwater system of the Chemung River, north of Elmira, N.Y.

Most of the impacts in the Chemung subbasin were due to degraded habitat conditions, mine drainage, or elevated levels of nutrients and sodium. Many of the poor habitat ratings resulted from inadequately vegetated riparian zone widths. A lack of riparian vegetation can increase streambank erosion and sediment in downstream reaches, affect the temperature of the stream and associated dissolved oxygen levels, and reduce the input of organic material into the stream that organisms require as a food source.

Mine drainage effects were constrained to specific regions and included elevated acidity, conductivity, dissolved solids, metals, and sulfate. Elevated nitrate and nitrogen may result from too much fertilizer used on agricultural fields and residential lawns, uncontrolled barnyard runoff, direct access of livestock to streams, increased loads from point sources, leaking septic tanks, outdated sewage treatment plants, or combined sewer overflows.

Sodium levels were high in numerous larger streams, which may result from increased urbanization or documented natural sources. Habitat assessments of many streams indicated problems with compromised riparian vegetation and bank conditions.

SRBC did not observe elevated parameters indicative of hydraulic fracturing activities at most sampled sites, with the exception of slightly elevated total bromide concentrations at three Chemung River mainstem sites (CHEM 13.0, CHEM 18.5, and CHEM 28.0). Gross alpha and gross beta levels at sites on the Chemung River downstream of the Chemung County landfill, which accepts drill cuttings, drill fluids, and flow-back fracturing sand from some of Pennsylvania's hydraulically fractured wells, were either nondetectable or within the range of background levels. As mentioned previously, seven RWQMN stations are located in the Chemung subbasin, and real-time measurements for temperature, dissolved oxygen, pH, conductivity, and turbidity can be found at *mdw.srbc.net/remotewaterquality/monitoring_parameters.aspx*.

Downstream view of the Canisteo River near Addison, N.Y. (CNST 7.7).

Some of the highest quality watersheds in this survey included Campbell Creek, Tobehanna Creek, Jemison Creek, and Hills Creek. In addition to the regions previously mentioned, some of the more degraded watersheds included Bentley Creek, Canacadea Creek, Colonel Bill's Creek, Johnson Creek, Morris Run, Mud Creek, and Newtown Creek.

Efforts should be made to restore the most degraded watersheds and protect the higher quality ones within this subbasin. Information on agricultural best management practices and other conservation methods to limit the impacts associated with farming operations can be obtained from county conservation district offices (*www.pacd.org and www.nyacd.org/districts.html*). County conservation district offices can also provide information on mine drainage remediation technologies, and Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (*www.orangewaternetwork.org*) offers grant opportunities to alleviate mine drainage impacts.

Low impact development and incorporating groundwater recharge areas can help minimize urban stormwater problems. Both the Center for Watershed Protection's Urban Subwatershed Restoration Manual series (*www.cwp.org*) and the PADEP's Pennsylvania Stormwater Best Management Practices Manual (PADEP, 2006) provide more information on remediating urban pollution.

While hydraulic fracturing for natural gas in shale has been occurring in Pennsylvania since 2008, New York currently remains under a moratorium on the use of this methodology. Once the moratorium is lifted, hydraulic fracturing could be allowed on an experimental basis in the three southern tier counties of Chemung, Tioga, and Broome, located in the Chemung River Subbasin and Upper Susquehanna River Subbasin. SRBC began collecting intensive baseline data in streams that are located in this tri-county area before drilling occurs. Consequently, SRBC will combine the Chemung subbasin Year-2 study, which would normally occur in 2013, with its next Upper Susquehanna subbasin Year-2 study, which would normally occur in 2014. By combining the Chemung and Upper Susquehanna Year-2 assessments, SRBC will undertake two years of collecting water quality samples quarterly, assessing macroinvertebrate communities seasonally, and evaluate fish communities annually at 22 sites. Collection of data began in April 2013 and will run through November 2014, and a final report will be available in 2015. More information on this project is available from SRBC.

# Appendix: Sample Site List

| Sample Site # | Station Names | Location Description | Latitude | Longitude | Drainage (miles²) | Designation |
|---|---|---|---|---|---|---|
| 1 | BDWN 0.3 | Baldwin Creek at Rt. 60 bridge in Lowman, N.Y. | 42.030 | -76.719 | 39.6 | 60s |
| 2 | BENN 1.2 | Bennetts Creek at community park in Canisteo, N.Y. | 42.267 | -77.602 | 95.6 | 60s |
| 3 | BENN 8.3 | Bennetts Creek at bridge near Rock Creek south of Bennetts, N.Y. | 42.156 | -77.638 | 40.6 | 60s |
| 4 | BNTY 0.4 | Bentley Creek at Wellsburg, N.Y. | 42.017 | -76.732 | 55.3 | 60s |
| 5 | BNTY 2.5 | Bentley Creek at Mobile Acres Trailer Park, Pa. | 41.986 | -76.723 | 49.3 | 60s |
| 6 | BNTY 5.7 | Bentley Creek at Bentley Creek, Pa. | 41.944 | -76.715 | 32.4 | 60s |
| 7 | CANA 1.7 | Canacadea Creek at gage at Rt. 21 bridge in Hornell, Steuben Co., N.Y. | 42.335 | -77.683 | 57.5 | 60s |
| 8 | CANA 6.7 | Canacadea Creek at Rt. 42 bridge south of Almond, N.Y. | 42.289 | -77.748 | 16.7 | 60s/(60E) |
| 9 | CHEM 2.5 * | Chemung River at Tozer's Landing in Athens, Pa. | 41.957 | -76.526 | 2577.3 | 60R |
| 10 | CHEM 13.0 | Chemung River near Lowman, N.Y. | 42.025 | -76.657 | 2515.9 | 60R |
| 11 | CHEM 18.5 | Chemung River at Ashland Tollbridge Park in Wellsburg, N.Y. | 42.018 | -76.726 | 2450.3 | 60R |
| 12 | CHEM 28.0 | Chemung River at Rt. 225 bridge in West Elmira, N.Y. | 42.082 | -76.865 | 2145.6 | 60R |
| 13 | CHEM 39.8 | Chemung River at Denison Park in South Corning, N.Y. | 42.141 | -77.035 | 2040.4 | 60R |
| 14 | CMBL 0.1 | Campbell Creek downstream of Sinclair Creek near Knight Settlement, N.Y. | 42.347 | -77.398 | 32.6 | 60s |
| 15 | CNST 1.0 * | Canisteo River at bridge near mouth in Erwins, N.Y. | 42.106 | -77.153 | 550.7 | 60L |
| 16 | CNST 7.7 | Canisteo River at Addison, N.Y. | 42.106 | -77.267 | 390.1 | 60m |
| 17 | CNST 22.6 | Canisteo River along Rt. 432 at gage at West Cameron, N.Y. | 42.223 | -77.418 | 339.8 | 60m |
| 18 | CNST 33.0 | Canisteo River just upstream of Colonel Bills Creek downstream of Canisteo, N.Y. | 42.264 | -77.578 | 309.7 | 60m |
| 19 | CNST 38.7 | Canisteo River at bridge in South Hornell, N.Y. | 42.304 | -77.653 | 168.1 | 60m |
| 20 | CNST 55.5 | Canisteo River above Arkport, N.Y. | 42.391 | -77.704 | 30.8 | 60s |
| 21 | COHO 0.5 | Cohocton River at park upstream of Painted Post, N.Y. | 42.168 | -77.106 | 596.6 | 60L |
| 22 | COHO 4.0 | Cohocton River at Main Street Bridge in Coopers Plains, N.Y. | 42.181 | -77.153 | 521.5 | 60L |
| 23 | COHO 14.6 | Cohocton River at West Lamoka Ave Bridge in Savona, N.Y. | 42.289 | -77.226 | 377 | 60m |
| 24 | COHO 25.0 * | Cohocton River at Rt. 415 crossing at fishing access downstream of Avoca, N.Y. | 42.392 | -77.401 | 192 | 60m |
| 25 | COHO 37.5 | Cohocton River at Rt. 371 crossing and fishing access north of Cohocton, N.Y. | 42.513 | -77.476 | 42.6 | 60s |
| 26 | COHO 46.3 | Cohocton River at Parks Road bridge west of Atlanta, N.Y. | 42.554 | -77.506 | 26.7 | 60D |
| 27 | COLB 0.8 | Colonel Bill's Creek at mouth near Canisteo Center, N.Y. | 42.262 | -77.581 | 27.7 | 60s |
| 28 | CORY 1.5 | Corey Creek at Route 549 bridge in Mansfield, Pa. | 41.801 | -77.047 | 15.3 | 60s |
| 29 | COWN 0.1 | Cowanesque River at Rt. 15 bridge near Lawrenceville, Pa. | 42.001 | -77.127 | 300.1 | 60m |
| 30 | COWN 12.0 | Cowanesque River at Rt. 49 bridge in Elkland, Pa. | 41.989 | -77.301 | 244.7 | 60m |
| 31 | COWN 20.5 | Cowanesque River along Rt. 249 west of Knoxville, Pa. | 41.952 | -77.441 | 132 | 62C |
| 32 | COWN 29.6 | Cowanesque River upstream of North Fork at Westfield, Pa. | 41.914 | -77.580 | 48.2 | 62C |
| 33 | CRKD 8.0 | Crooked Creek at railroad bridge at Crooked Creek, Pa. | 41.856 | -77.235 | 83.4 | 62C |
| 34 | FELL 0.1 | Fellows Creek at first bridge up from mouth near Chases Mills, Pa. | 41.686 | -76.938 | 6.3 | 62C |
| 35 | FMIL 1.1 | Five Mile Creek upstream of Rt. 53 north of Kanona, N.Y. | 42.391 | -77.349 | 66.3 | 60s |
| 36 | GOFF 3.1 | Goff Creek at Rt. 69 crossing north of Towlesville, N.Y. | 42.365 | -77.448 | 20.4 | 60s |
| 37 | HILL 0.2 | Hills Creek upstream of SR4039 at Crooked Creek, Pa. | 41.856 | -77.226 | 16.2 | 62C |
| 38 | JEMI 7.7 * | Jemison Creek near Azelta, Pa. | 41.838 | -77.489 | 2.1 | 62C |
| 39 | JOHN 0.1 | Johnson Creek at park in Blossburg, Pa. | 41.678 | -77.069 | 17.4 | 62C |
| 40 | KARR 0.1 | Karr Valley Creek at mouth near Almond, N.Y. | 42.316 | -77.741 | 27.7 | 60s |
| 41 | MEAD 0.1 | Meads Creek upstream of Rt. 415 bridge near Coopers Plains, N.Y. | 42.175 | -77.121 | 69.9 | 60s |

# Appendix: Sample Site List

| Sample Site # | Station Names | Location Description | Latitude | Longitude | Drainage (miles$^2$) | Designation |
|---|---|---|---|---|---|---|
| 42 | MEAD 11.1 | Meads Creek at Rt. 26 bridge downstream of Meads Creek, N.Y. | 42.256 | -77.110 | 37.4 | 60s |
| 43 | MILL 1.4 | Mill Creek at gate on State Game Lands No. 37 near Painter Run, Pa. | 41.874 | -77.102 | 75.1 | 62C |
| 44 | MORR 0.8 | Morris Run along SR 2014 at pipeline crossing near Blossburg, Pa. | 41.663 | -77.040 | 6.8 | 62C |
| 45 | MUDC 1.1 | Mud Creek at Rt. 415 bridge in Savona, N.Y. | 42.291 | -77.220 | 80.7 | 60s |
| 46 | MUDC 10.5 | Mud Creek at Rabbit Road downstream of Bradford, N.Y. | 42.364 | -77.118 | 47.8 | 60D |
| 47 | NBNC 0.6 | North Branch Newtown Creek upstream of Vargo Road near Slabtown, N.Y. | 42.201 | -76.774 | 15.9 | 60s |
| 48 | NBTC 0.3 | North Branch Tuscarora Creek at Old State Road near South Addison, N.Y. | 42.082 | -77.309 | 31.5 | 60s |
| 49 | NEWT 0.6 | Newtown Creek at Rt. 352 bridge in Elmira, N.Y. | 42.096 | -76.789 | 78.5 | 60s |
| 50 | NEWT 9.7 | Newtown Creek along Rt. 233 southeast of Slabtown, N.Y. | 42.181 | -76.775 | 31.3 | 60s |
| 51 | NFCR 0.1 | North Fork Cowanesque River near mouth at Westfield, Pa. | 41.918 | -77.560 | 21.7 | 62C |
| 52 | POST 0.6 | Post Creek at railroad bridge near mouth in Corning, N.Y. | 42.152 | -77.045 | 34.3 | 60s |
| 53 | POST 8.8 | Post Creek at Rt. 414 bridge in Post Creek, N.Y. | 42.232 | -76.962 | 17.3 | 60s |
| 54 | PURD 0.3 | Purdy Creek at bridge near mouth at Canisteo, N.Y. | 42.260 | -77.613 | 22.7 | 60s |
| 55 | SEEL 2.8 | Seeley Creek near Rt. 427 bridge at Southport, N.Y. | 42.050 | -76.775 | 143.5 | 60m |
| 56 | SEEL 11.4 | Seeley Creek at Bradford/Tioga county line upstream of Mosherville, Pa. | 41.968 | 76.922 | 11.8 | 60s |
| 57 | SING 0.9 | Sing Sing Creek at Route 352 near Harris Hill Manor, west of Elmira, N.Y. | 42.103 | -76.922 | 35.8 | 60s |
| 58 | SOUT 2.0 | South Creek at Rt. 26 bridge near Elmira, N.Y. | 42.044 | -76.823 | 43.5 | 60s |
| 59 | SOUT 5.9 | South Creek at Rt. 14 bridge in Fassett, Pa. | 41.989 | -76.774 | 22.4 | 60s |
| 60 | SOUT 9.1 | South Creek at Thompson Hill Road in Gillett, Pa. | 41.949 | -76.794 | 15.6 | 60s |
| 61 | STOK 0.3 | Stocking Creek at Eagle Valley Road bridge south of Bath, N.Y. | 42.310 | -77.279 | 26.9 | 60s |
| 62 | TENM 0.2 | Tenmile Creek upstream of Rt. 7 north of Avoca, N.Y. | 42.428 | -77.431 | 17.9 | 60s |
| 63 | TIOG 6.2 | Tioga River at Presho, N.Y. | 42.083 | -77.149 | 790.8 | 60L |
| 64 | TIOG 16.3 | Tioga River at Tioga Junction, Pa. | 41.958 | -77.116 | 442.5 | 60m |
| 65 | TIOG 29.8 | Tioga River upstream of Rt. 6 and Ellen Run near Mansfield, Pa. | 41.796 | -77.080 | 152.7 | 60m |
| 66 | TIOG 35.4 | Tioga River upstream of Route 660 bridge north of Covington, Pa. | 41.758 | -77.083 | 109.4 | 60m |
| 67 | TIOG 39.6 | Tioga River at park in Blossburg, Pa. | 41.678 | -77.068 | 85 | 62C |
| 68 | TIOG 42.3 | Tioga River near Blossburg, Pa. | 41.658 | -77.048 | 53.3 | 62C |
| 69 | TIOG 49.2 | Tioga River at T433 bridge near Chases Mills, Pa. | 41.725 | -76.894 | 7.6 | 62C |
| 70 | TOBE 1.9 * | Tobehanna Creek at Lamoka Lake Road near Tyrone, N.Y. | 42.404 | -77.066 | 16.5 | 60D |
| 71 | TRUP 0.4 | Troups Creek at mouth at Knoxville, Pa. | 41.953 | -77.442 | 67.8 | 62C |
| 72 | TRUP 5.8 | Troups Creek along Rt. 36 north of South Troupsburg, N.Y. | 42.024 | -77.532 | 39.1 | 60s |
| 73 | TUSC 0.4 | Tuscarora Creek at bridge in Addison, N.Y. | 42.104 | -77.233 | 128.3 | 60m |
| 74 | TUSC 12.9 | Tuscarora Creek upstream of South Branch at Woodhull, N.Y. | 42.079 | -77.408 | 31 | 60s |
| 75 | TWVE 0.5 * | Twelvemile Creek upstream of Rt. 415 at Wallace, N.Y. | 42.448 | -77.460 | 25.3 | 60s |
| 76 | WYNK 0.8 | Wynkoop Creek at Rotary Road near Chemung, N.Y. | 42.014 | -76.610 | 34.6 | 60s |

| |
|---|
| Station sampled in 1997, 2006, and 2012 |
| Station sampled only in 1997 and 2012 |
| Station sampled only in 2006 and 2012 |
| New station in 2012 |
| * Sites serve as ecoregion reference sites for the 2012 study. |

# REFERENCES


Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Buchanan, T.J. and W.P. Somers. 1969. Discharge Measurements at Gaging Stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A8, Washington, D.C. 65 pp.

Buda, S.R. 2007. Chemung Subbasin Survey: A Water Quality and Biological Assessment, June-August 2006. Susquehanna River Basin Commission (Publication No. 251), Harrisburg, Pennsylvania. www.srbc.net/pubinfo/techdocs/Publication_251/techreport251.htm.

The Commonwealth of Pennsylvania. 2010. The Pennsylvania Code: Title 25, Chapter 93: Water Quality Standards, Water Quality Criteria. www.pacode.com/secure/data/025/chapter93/s93.7.html and www.pacode.com/secure/data/025/chapter93/s93.8c.html.

Guy, H.P. and V.W. Norman. 1969. Field Methods for Measurement of Fluvial Sediment. U.S. Geological Survey Techniques of Water Resources Investigation, Book 3, Chapter C2 and Book 5, Chapter C1. Washington, D.C.

Hem, J.D. 1970. Study and Interpretation of the Chemical Characteristics of Natural Water. 2nd Ed. Geological Survey Water-Supply Paper 1473. United States Department of the Interior. United States Government Printing Office, Washington, D.C. water.usgs.gov/pubs/wsp/wsp2254/.

Kentucky Natural Resources and Environmental Protection Cabinet. 2003. Kentucky River Basin Assessment Report: Water Quality Standards. www.uky.edu/WaterResources/Watershed/KRB_AR/wq_standards.htm.

_____. 2003. Kentucky River Basin Assessment Report: Water Quality Parameters. www.uky.edu/WaterResources/Watershed/KRB_AR/krww_parameters.htm.

New York State, Department of Conservation. 1999. Regulations, Chapter X, Part 73: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations. www.dec.ny.gov/regs/4590.html.

New York State Department of Environmental Conservation (NYSDEC). 2012. 2012 New York State Section 303(d) List of Impaired/TMDL Waters. www.dec.ny.gov/chemical/31290.html.

Pennsylvania Department of Environmental Protection (PADEP). 2012. 2012 Pennsylvania Integrated Water Quality Monitoring Assessment Report. www.portal.state.pa.us/portal/server.pt/community/water_quality_standards/10556/integrated_water_quality_report_-_2012/1127203.

____. 2009. A Benthic Index of Biotic Integrity for Wadeable Freestone Riffle-Run Streams in Pennsylvania. Division of Water Quality Assessment and Standards, Harrisburg, Pennsylvania.

_____. 2006. Pennsylvania Stormwater Best Management Practices Manual. Document Number 363-0300-002. Bureau of Watershed Management, Harrisburg, Pennsylvania.

Plafkin, J.L., M.T. Barbour, D.P. Kimberly, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89/001. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Sanford, K.F. 1995. New York State Department of Environmental Conservation, Division of Mineral Resources. Solution Salt Mining in New York. www.dec.ny.gov/docs/materials_minerals_pdf/ssmny96.pdf.

State of Maryland, Department of the Environment. 2010. 2010 Code of Maryland Regulations (COMAR) 26.08.02.03-3: Water Quality Specific to Designated Uses (Code of Maryland Regulations. www.dsd.state.md.us/comar/comarhtml/26/26.08.02.03-3.htm.

Traver, C.L. 1998. Water Quality and Biological Assessment of the Chemung Subbasin. Susquehanna River Basin Commission (Publication No. 198), Harrisburg, Pennsylvania.

U.S. Environmental Protection Agency. 2012a. Level III and IV Ecoregions of New York. www.epa.gov/wed/pages/ecoregions/ny_eco.htm.

____. 2012b. Ecoregions of EPA Region 3: Delaware, Maryland, Pennsylvania, Virginia, and West Virginia. www.epa.gov/wed/pages/ecoregions/reg3_eco.htm.

U.S. Geological Survey. 1999. The Quality of Our Nation's Waters: Nutrients and Pesticides. Circular 1225. U.S. Department of the Interior, Reston, Virginia. water.usgs.gov/pubs/circ/circ1225/images/table.html.

Morris Run near Blossburg, Pa. (MORR 0.8).

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*Cover Photo:* SRBC field staff processing a macroinvertebrate sample at Tenmile Creek north of Avoca, N.Y. (TENM 0.2).

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Canisteo River at West Cameron, N.Y. (CNST 22.6)