

## **LOW FLOW MONITORING PLAN** **(December 17, 2009)**

### **Background Information:**

The mission of the Susquehanna River Basin Commission (Commission) is to enhance public welfare through comprehensive planning, water supply allocation, and management of the water resources of the Susquehanna River Basin (Basin). The Commission was established under the Susquehanna River Basin Compact (Public Law 91-575) in December 1970, thereby joining the federal government and the states of New York, Pennsylvania, and Maryland as equal partners in managing the Basin's resources through proper planning, development, and regulation.

The Commission manages water resources on a watershed basis and serves as an effective forum to provide coordinated management, promote communication among its member jurisdictions, and resolve water resource issues and controversies within the Basin. The Commission's leadership role in water resource planning and management is also exercised through its regulatory function, which fills the regulatory gaps that exist in each state's water resource management programs. The Commission regulates ground and surface water withdrawals, consumptive (depletive) water uses, and out-of-basin diversions, when any of these reach certain quantity thresholds. The Commission also regulates all diversions of water into the Basin.

Low flow mitigation planning has been a priority Commission activity throughout most of its existence. In the mid-1980s, the Commission prepared a series of planning reports related to the storage and release of water from Cowanesque Lake in Tioga County, Pa., and initiated a series of low flow management framework plans that were prepared for each of the Susquehanna's six major subbasins (Figure 1). Planning for potential pooled water storage from large federal and state reservoirs was continued in the 1990s and storage was obtained from Cowanesque Lake and Curwensville Lake on the West Branch Susquehanna River in Clearfield County, Pa.

In 2007, arrangements were made with the Commonwealth of Pennsylvania to provide water storage from the Barnes and Tucker abandoned mine pool in Clearfield County, Pa., in the West Branch Susquehanna Subbasin. The Commission is actively continuing to perform consumptive use mitigation planning and seek additional sources of water for release as needed during low flow periods.

In addition to the above, arrangements were made to provide low flow releases from Whitney Point Lake, which is a 1,200 acre impoundment owned and operated by the U.S. Army Corps of Engineers (USACE) for flood control and recreation in Broome County, N.Y. Modifications to permit low flow releases from the lake were completed in 2009. Baseline monitoring was performed in the lake and downstream during summer 2008. Additional monitoring will be performed annually and more frequently during low flow events to support adaptive management planning for project operations.

The Commission has performed instream flow studies with other organizations and is continuing this effort. Because of the breadth and consistency of the Commission's biological data for benthic (bottom-dwelling) macroinvertebrates (animals without backbones, such as worms, clams, and aquatic insects), The Nature Conservancy (TNC) used the Commission's monitoring data to prepare a report on the development of instream flow criteria to support ecologically sustainable water resource planning and management in Pennsylvania. The Commission currently is working with TNC and USACE on the Susquehanna Ecosystem Flows Section 729 Study, which will provide basinwide goals for river flow management. This study will implement a key element of the Commission's Consumptive Use Mitigation Plan, which calls for an assessment of ecosystem flow needs while allowing for water use demands to be met.

During periods of low flow, most stream habitats are reduced in extent and water quality, and biota can be affected. During summer months, natural low flow conditions can be exacerbated by the effects of increased water demand for agricultural, household, recreational, and energy uses. The Susquehanna River Watershed is experiencing increased demands, particularly in the energy sector, which are expected to continue to increase, potentially straining the resources of the mainstem Susquehanna River as well as its smaller tributaries. Additionally, as climate changes over time, the occurrence intervals and intensity of droughts may change in response. The Commission is interested in evaluating management actions that could potentially alleviate or ameliorate the effects of water withdrawals and consumptive water uses during low flow periods.

Low flow conditions can have a variety of differing impacts on the biotic (living) community, including reduction in habitat availability, food production, and water quality. Changes in habitat availability occur through velocity, depth, and wetted width reductions and increased sedimentation rates that can change patterns of benthic macroinvertebrate community structure, behavior, and interactions. Water quality impacts can include changes in temperature, dissolved oxygen, pH, nutrients, and conductivity. These changes, however, can be extremely subtle, and anthropomorphic and natural changes due to low flow conditions are often nearly indistinguishable. To that end, baseline conditions need to be determined and monitoring for changes in those conditions needs to be systematic and targeted.

The Commission has participated with the Pa. Fish and Boat Commission (PFBC), U.S. Geological Survey (USGS), and Pa. Department of Environmental Protection (PADEP) in meetings and workshops related to bacterial infections and die-offs of young-of-year smallmouth bass in the Basin during low flow conditions in 2005, 2007, and 2008. Many of the dead and dying fish were found to be infected with the bacterium *Flavobacterium columnare*, which is commonly found in soil and aquatic systems and often affects fish that are in a stressed condition. Field studies conducted by USGS indicated that low dissolved oxygen and high temperature conditions existed in several areas where the infections occurred. However, the exact cause of the smallmouth bass die-offs is still under investigation.

The Commission has made data available for analysis, including that collected through the Commission's sediment and nutrient monitoring program and its early warning system for public water suppliers, which collects real-time data at and upstream of several water supply

intakes in the larger rivers in the Basin. The Commission currently has the ability to collect real-time data for both temperature and dissolved oxygen at several of these sites.

Few datasets exist that document the impacts of reduced flow on water quality and biological resources during actual events in the Susquehanna River Basin. Because of the paucity of data, increased monitoring during low flow events is a high priority that will assist the Commission in assessing the effects of flow and in managing water withdrawals and consumptive uses. Both the Commission's *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* (updated in 2008) and *2009 Water Resources Program* underscore this monitoring need.

**Goal:**

The goal of this low flow monitoring plan is to complement the Susquehanna Ecosystem Flows Study and provide data to further refine management decisions on a basin- or subbasin-wide basis, as well as document actual conditions associated with low flow conditions. The Commission also will continue to monitor low flow events in the Whitney Point area, operate and expand its early warning system for public water suppliers, and work with others regarding the smallmouth bass issue.

**Conceptual Design:**

The Commission has developed a monitoring plan with a two-pronged approach, encompassing a sentinel station system throughout the Basin and a more detailed pilot project in the Juniata Subbasin. The Juniata Subbasin was chosen as a pilot watershed because it has the fewest number of permitted withdrawals and is the most unregulated system in the Basin, with the exception of Raystown Lake and a few small water supply reservoirs.

Due to the uncertainty of accurately predicting drought conditions, base flow conditions will be monitored yearly in anticipation that a drought may occur in any given year. In addition, Commission staff will devote increased attention to flow conditions when streams reach annual 90<sup>th</sup> percentile flows. A decision on the time to perform water quality and biological monitoring during low flow events will be based on those observations and the results of the Susquehanna Ecosystem Flows Study described above.

The 19 outlets of the USGS's Hydrologic Unit Code 8-digit watersheds (HUC-8) in the Basin (average area of 1488 square miles, see Figure 2) will be used as the sentinel stations, and will be monitored annually for baseline conditions. These 19 stations are located on the larger rivers and streams in the Basin and were selected due to the utilization of HUC-8 management pour-points in the low flow management study.

Twenty-five stations, based on stream order, stream type, and ecoregions, will be selected for the pilot project in the Juniata Subbasin. More detailed data collection will occur at these stations to describe how biotic and abiotic (non-living) changes occur in a more natural system, as well as smaller watersheds, in response to low flow conditions. In subsequent years, based on the outcomes of the Juniata Subbasin pilot study, a subset of stations on smaller streams may be

selected as sentinel stations to be monitored under the same conditions as the HUC-8 stations described above.

### **Sentinel Stations:**

Data collection at the larger sentinel station waterways will be fairly basic due to the increased time and expense associated with monitoring larger streams. All stations will be located close to USGS stream gaging stations at the nearest available riffle. Riffle sections will be chosen for macroinvertebrate data collection due to the higher potential for increased stress on the biota during low flow conditions in this type of habitat. Staff will collect data from the same section during both base flow and low flow conditions to reduce the potential for different habitat types to affect the results.

Macroinvertebrate data will be collected using PADEP's Rapid Bioassessment 6 D-frame protocol or New York State Department of Environmental Conservation's (NYSDEC's) Rotating Intensive Basin Survey protocol, depending on the state in which sampling occurs. Utilizing the protocols of the Commission's member states will allow the states to directly use Commission data. Quantitative measurements of macroinvertebrate density will be captured by recording the number of grids sorted during macroinvertebrate subsampling. Staff will attempt to collect macroinvertebrate data at the same time each year during base flow conditions.

Periphyton data will be collected based on U.S. Environmental Protection Agency sampling methodologies and will be used to document the extent of algal coverage and characterize the species composition of the algal community. Some previous studies during low flow conditions have noted a change in periphyton communities from diatom-based to a filamentous-algae dominated structure.

Water quality data collection will include field parameters such as temperature, dissolved oxygen, conductivity, pH, alkalinity, and acidity. Nutrient species, including total and dissolved nitrates, nitrites, nitrogen, phosphorus, and orthophosphate, as well as total suspended solids and total dissolved solids, will be analyzed at a laboratory. Additionally, in some areas that have been identified as problematic due to smallmouth bass die-offs, continuous dissolved oxygen and temperature monitors will be installed to document potential changes in those parameters.

A search for freshwater native mussels also will occur in dewatered areas and in areas less than six inches deep to determine possible stress on mussel populations. If native mussels are found, their presence will be noted on a field sheet, along with probable taxon (mussels are difficult to identify in the field), approximate size, and location in the stream channel.

Photographs documenting field conditions will be taken at each station during sampling events. Stream flow during the time of sampling will be recorded, along with anecdotal information regarding field conditions and observed impacts during low flow. Additional habitat measurements will include wetted width and depths at selected intervals across three transects within the sampling reach.

### **Pilot Study in the Juniata Subbasin:**

More detailed data collection can occur in the 25 stations to be selected in the Juniata Subbasin due to the smaller nature of these streams. Five stations will be located on the mainstem Juniata River and 20 stations will be selected in various tributaries, based on stream type, stream size, and ecoregion. Additionally, Commission staff will coordinate with PADEP staff regarding site selection.

Where USGS gaging stations are not available, discharge will be measured using a Flow Tracker and standard USGS operating procedures. Wetted width will be determined concurrently as well as substrate types and degree of sedimentation.

Macroinvertebrate, periphyton, and water quality data collection will be implemented as described in the previous section for sentinel stations. Additionally, electrofishing will occur in a 100-meter stretch of stream, with block nets placed at the upper and lower limits, to determine community structure and species composition as well as any potential changes between base flow and low flow conditions.

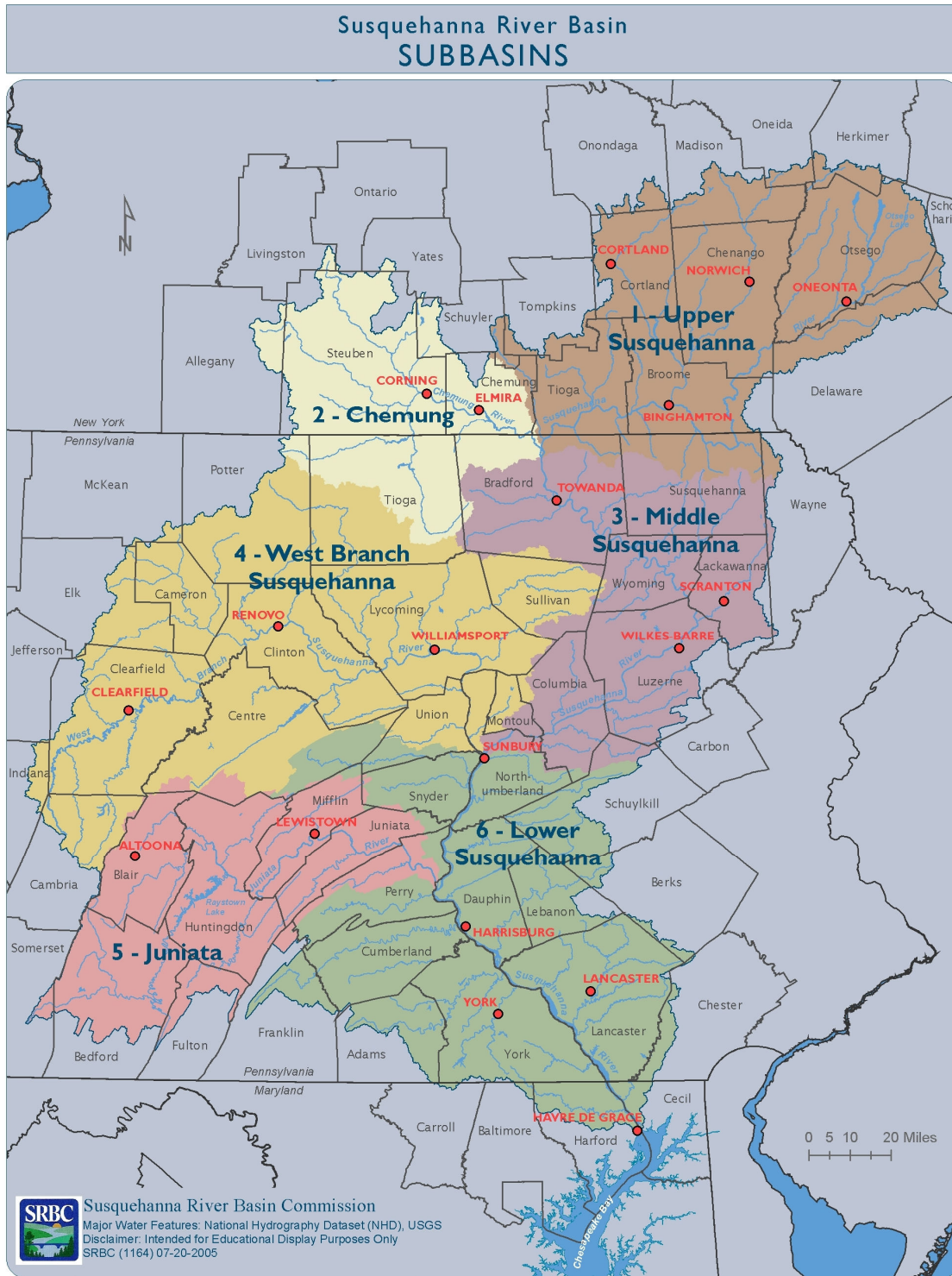
### **Recreational Impacts:**

In addition to impacts of low flow conditions on aquatic life, the Commission also is interested in low flow impacts on recreational uses. In order to determine how drought conditions impact recreational activities, staff will develop a questionnaire to post on the Commission's web site. The Commission will issue a press release following a drought declaration in the Basin, soliciting public comment regarding low flow impacts on a variety of recreational pursuits, such as fishing, kayaking, canoeing, and wildlife observation. The Commission will investigate partnering with other entities in the Basin that are interested in similar information.

### **Reporting:**

Staff will produce a yearly report on base flow conditions. During years when low flow conditions occur, a more extensive report will be developed detailing potential differences, if any, between base flow and low flow conditions for abiotic features, such as water quality and discharge, as well as biotic community structure.

Data may be used in the future to assist in making management decisions to mitigate the effects of low flows. The information collected also has the potential to assist in making decisions regarding passby flows and surface water withdrawals.



**Figure 1. Susquehanna River Basin Subbasins and Major Cities**



**Figure 2. 8-digit Hydrologic Unit Code Areas in the Susquehanna River Basin**