

**COMPREHENSIVE PLAN
FOR THE WATER RESOURCES
OF THE SUSQUEHANNA RIVER BASIN**

**Susquehanna River Basin Commission
4423 North Front Street
Harrisburg, PA 17110**

December 2013

As amended, June 2018

SUSQUEHANNA RIVER BASIN COMMISSION

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In 1971, the Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact* among the states of Maryland, New York, and the Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to coordinate the planning, conservation, management, utilization, development and control of the basin's water resources among the public and private sectors.

**Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).*

Cover photo: Juniata River south of Newport, Perry County, Pa.

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Vision Statement

The Commission's vision for the Susquehanna River Basin is healthy ecosystems that provide groundwater and surface water of sufficient quality and in adequate supply to support abundant and diverse populations of aquatic, riparian, and terrestrial organisms, as well as human uses and enjoyment.

Through enlightened planning for and management of the basin's water resources, the health, safety and welfare of its citizens are safeguarded during times of flooding and drought, a vibrant economy is sustained, the Chesapeake Bay's water quality and living resources are improved, and an informed public is involved in resolving water resource issues. The Commission provides the necessary leadership and coordination of efforts among its member jurisdictions and with the private sector to make this vision a reality.



RESOLUTION NO. 2013-13

A RESOLUTION of the Susquehanna River Basin Commission (the Commission) adopting an updated *Comprehensive Plan for the Water Resources of the Susquehanna River Basin*.

WHEREAS, under Article 3, Section 3.3 (1) and Article 14, Section 14.1 of the Susquehanna River Basin Compact, Pub. L. 91-575, (Compact), the Commission is directed to “develop and adopt, and from time to time review and revise, a comprehensive plan for the immediate and long range development and use of the water resources of the basin;” and

WHEREAS, by Resolution 2008-08 of December 4, 2008, the Commission adopted a substantially revised comprehensive plan; and

WHEREAS, Resolve No. 4 of the said Resolution 2008-08 directs the Commission staff to conduct periodic review of the comprehensive plan and propose appropriate revisions to the Commission to ensure its continued timeliness and relevance and to maintain its quality and utility; and

WHEREAS, the 2008 comprehensive plan called for an update to the plan every five years to help ensure it is current and of long term value and usefulness; and

WHEREAS, in accordance with this five-year directive, the staff has produced and presented this day to the Commission an updated comprehensive plan dated December 2013; and

WHEREAS, a draft of the updated plan was the subject of a public hearing held on August 15, 2013, at Harrisburg, Pennsylvania; and

WHEREAS, the Commission also accepted written comments on the draft plan during a 60-day comment period ending August 26, 2013; and

WHEREAS, the Commission has carefully considered the comments offered at the public hearing and in writing, and has, where appropriate, modified the contents of the proposed updated comprehensive plan.

NOW THEREFORE BE IT RESOLVED THAT:

1. The Commission hereby adopts an updated *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* as presented by staff, dated December 12, 2013.

2. Staff is directed to distribute copies of the plan in printed or electronic form to interested parties and government officials, and to make the contents of the plan available on the Commission’s website.

3. Staff is further directed to file copies of this 2013 updated comprehensive plan with the Federal Energy Regulatory Commission pursuant to Section 10(a) of the Federal Power Act, 16 U.S.C. Section 803(a).

4. This resolution incorporates the provisions of any and all previous resolutions or actions of the Commission regarding its comprehensive plan, unless such provisions conflict with the contents of this revised comprehensive plan, in which case they shall be superseded.

5. This resolution shall be effective immediately.

Dated: December 12, 2013

A handwritten signature in blue ink, appearing to read 'J. R. Jordan, III', written over a horizontal line.

Col. J. Richard Jordan, III, Chairman
United States

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	v
PART I - INTRODUCTION	1
A. The Susquehanna River Basin Commission	1
1. History	1
2. Membership.....	2
3. Mission.....	2
4. Duties and Powers.....	4
5. Goals	4
B. The Comprehensive Plan.....	5
1. Authority	5
2. 1973 and 1987 Comprehensive Plans	5
3. Current Comprehensive Plan	6
C. The Susquehanna Basin.....	7
1. General Description	7
2. Rivers in the Basin	15
3. Physiography.....	16
4. The Climate of the Basin.....	16
5. Hydrology	16
6. Floods.....	19
7. Droughts.....	19
8. Groundwater.....	19
9. Soils.....	20
10. Land Use/Land Cover	20
11. Mineral Resources.....	22
D. Water Resource Projects and Programs in the Basin.....	22
1. Flood Damage Reduction.....	22
2. Water Supply.....	24
3. Wastewater Treatment Facilities	24
4. Recreation	24
5. Power Production	26
6. Water Diversions.....	26
7. Migratory Fish Passage	29
8. Mine Drainage.....	29
9. Projects, Plans and Other Actions Incorporated into the Comprehensive Plan	32
PART II - ASSESSMENT OF WATER RESOURCE NEEDS IN THE BASIN.....	34
A. Sustainable Water Development.....	35
B. Water Quality.....	37
C. Flooding.....	37
D. Ecosystems	38
E. Chesapeake Bay.....	39
F. Coordination, Cooperation, and Public Information.....	40
PART III - PRINCIPLES, GUIDANCE, AND STANDARDS	41
A. General Principles.....	41
B. Project Guidance.....	42
C. Project Standards	43
PART IV - PRIORITY MANAGEMENT AREAS	45
A. Sustainable Water Development.....	45
1. Desired Result	45

2. Discussion of Issues	45
3. Goals	48
B. Water Quality.....	52
1. Desired Result	52
2. Discussion of Issues	52
3. Goals	56
C. Flooding.....	59
1. Desired Result	60
2. Discussion of Issues	60
3. Goals	61
D. Ecosystems	64
1. Desired Result	64
2. Discussion of Issues	64
3. Goals	65
E. Chesapeake Bay.....	68
1. Desired Result	68
2. Discussion of Issues	68
3. Goals	70
F. Coordination, Cooperation and Public Information.....	73
1. Desired Result	73
2. Discussion of Issues	73
3. Goals	74
PART V - AREAS OF SPECIAL INTEREST.....	79
A. Mine Drainage	79
1. Background	79
2. Management Activities	81
3. Future Direction	82
B. Climate Change	82
1. Background	82
2. Management Activities	83
3. Future Direction	84
C. Consumptive Use Mitigation.....	84
1. Background	84
2. Management Activities	85
3. Future Direction	86
D. Drought Coordination.....	87
1. Background	87
2. Management Activities	87
3. Future Direction	88
E. Economic Development, Recreation and Other Public Values	88
1. Background	88
2. Management Activities	89
3. Future Direction	90
F. Emerging Contaminants	91
1. Background	91
2. Management Activities	92
3. Future Direction	92
G. Energy Production and Development.....	92
1. Background	92
2. Management Activities	98
3. Future Direction	99

H. Flood Forecast and Warning.....	100
1. Background.....	100
2. Management Activities.....	101
3. Future Direction.....	101
I. Invasive Species.....	103
1. Background.....	103
2. Management Activities.....	104
3. Future Direction.....	104
J. Fisheries Monitoring and Restoration.....	105
1. Background.....	105
2. Management Activities.....	105
3. Future Direction.....	106
K. Potentially Stressed Areas and Water Challenged Areas.....	107
1. Background.....	107
2. Management Activities.....	107
3. Future Direction.....	108
L. Water and Wastewater Infrastructure.....	109
1. Background.....	109
2. Management Activities.....	110
3. Future Direction.....	110
M. Relationship of Areas of Special Interest and Priority Management Areas.....	111
PART VI – DESIRED RESULTS, GOALS AND ACTIONS.....	113
A. Desired Results and Goals.....	113
B. Development of the Actions.....	113
PART VII - IMPLEMENTING ACTIONS IN THE COMPREHENSIVE PLAN.....	129
A. Implementation Process.....	129
B. Roles and Responsibilities.....	129
C. Progress Assessment Process.....	130

FIGURES

Figure 1. Susquehanna River Basin.....	8
Figure 2. Upper Susquehanna Subbasin.....	9
Figure 3. Chemung Subbasin.....	10
Figure 4. Middle Susquehanna Subbasin.....	11
Figure 5. West Branch Susquehanna Subbasin.....	12
Figure 6. Juniata Subbasin.....	13
Figure 7. Lower Susquehanna Subbasin.....	14
Figure 8. Physiographic Provinces.....	17
Figure 9. Typical flow pattern for the basin as recorded for the Susquehanna River at Harrisburg, Pa.....	18
Figure 10. Land Use/Land Cover, 2006.....	21
Figure 11. Location of Flood Damage Reduction Projects and River Forecast Points.....	25
Figure 12. Major Power Plants.....	28
Figure 13. Migratory Fish Passage Conditions.....	31
Figure 14. Potentially Stressed and Water Challenged Areas.....	47
Figure 15. Impaired Waters.....	54
Figure 16. Abandoned Mine Lands and AMD Impaired Streams.....	80
Figure 17. Projected Change in Consumptive Water Use in the Susquehanna River Basin.....	85
Figure 18. Occurrence of Natural Gas Shales in the Susquehanna River Basin.....	95
Figure 19. Gages and Forecast Points.....	1022

TABLES

Table 1. Major Subbasins	7
Table 2. U.S. Army Corps of Engineers Reservoirs	23
Table 3. Major Power Plants in the Susquehanna River Basin that Use Water Resources to Operate.....	27
Table 4. Power Plant Data	29
Table 5. Diversions from the Susquehanna River Basin	29
Table 6. Population of the Susquehanna River Basin (1,000's of people)	36
Table 7. Summary of Consumptive Use and Water Withdrawals for Unconventional Natural Gas Industry.....	96
Table 8. Relationship of Areas of Special Interest and Priority Management Areas	112
Table 9. Summary of Desired Results, Goals, and Actions.....	114

APPENDICES

Appendix 1 – Susquehanna River Basin Compact
Appendix 2 – Projects, Plans and Other Actions Incorporated into the Comprehensive Plan
Appendix 3 – Susquehanna River Basin Commission Water Resources Program

EXECUTIVE SUMMARY

The Susquehanna River Basin Compact (Compact) was enacted in December 1970 as Public Law 91-575 and joined the federal government and the states of New York, Pennsylvania, and Maryland as equal partners for a period of 100 years to manage the Susquehanna basin's water resources through proper planning, development and regulation. The Compact created the Susquehanna River Basin Commission (Commission) as the single administrative agency to develop, effectuate, coordinate and adopt plans, policies, and programs related to water resources of the basin. In January 1971, the Compact took effect and the Commission was officially established. As equal partners, the member jurisdictions each appoint a commissioner who serves as the spokesperson for the jurisdiction that he represents. Under the leadership of the Executive Director, technical, administrative, and public information personnel support the daily operations of the Commission.

The mission of the Susquehanna River Basin Commission is to enhance public welfare through comprehensive planning, water supply allocation, and management of the basin's water resources. The Commission is neither a federal agency nor a state agency. Rather, as a federal-interstate compact body, its jurisdiction is defined by the natural boundaries of the river basin rather than the political boundaries of the member states. As such, the Commission serves as a forum to provide coordinated management, promote communication among its members, and resolve water resource issues and controversies within the basin. The Commission's leadership role in basin water resource planning and management is also exercised through its regulatory function, which fills in the regulatory gaps that exist in each state's water resource management program. The Commission regulates ground and surface water withdrawals, consumptive water uses and out-of-basin diversions, when any of these reach certain quantity thresholds, and all in-basin diversions.

The Compact authorizes and requires the Commission to formulate and adopt a comprehensive plan for the immediate and long-range development and use of the water resources of the basin. This *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* (Comprehensive Plan or the Plan) provides an overarching framework for the Commission to manage and develop the basin's water resources and serves as a guide for all Commission programs and activities. The Plan supports the goals set forth in the Compact and provides a basis for achieving desired results, meeting goals, and taking actions. It is further intended to be a useful resource for the Commission's member jurisdictions, water resource managers, private sector interests and others in the basin.

This Comprehensive Plan was initially prepared in 2008 and replaced the previous plan adopted in 1987. This 2013 edition of the Plan resulted from an update of the 2008 Plan to make it current by incorporating new information thereby increasing its value and utility. The Commission actively sought public input to the updated Plan by releasing a draft for public review and comment, and holding a public hearing. All comments received were considered and many resulted in changes being incorporated into the final updated Plan.

The Susquehanna River Basin has more than 49,000 miles of waterways and drains 27,500 square miles spread over parts of New York, Pennsylvania, and Maryland. The population of the basin was more than 4.1 million people in 2010. The Susquehanna River is the largest river lying entirely in the United States that drains to the Atlantic Ocean. The river is the largest tributary of the Chesapeake Bay and provides nearly one-half of the freshwater flow to the Bay.

Major water resource issues include flooding, droughts, poor water quality in some areas, and sustainable water development. The basin is one of the most flood prone areas in the nation with recorded major devastating floods occurring ten times since 1889. Significant droughts have occurred in portions of the basin 14 times since 1900, with drought emergencies declared for the more recent events. Poor water quality is present in 8,400 miles of impaired streams in the basin with mine drainage, agriculture, and urbanization being key sources of impairment.

Sustainable water development is a high priority with the Commission, particularly in view of increasing demands for water supplies and energy production and development.

There are many important existing projects and programs that address various aspects of water resources in the Susquehanna River Basin. These measures deal with flood damage reduction, water supply, wastewater treatment, recreation, energy production, migratory fish passage, and mine drainage. Actions taken over a number of years by many entities to address water resource issues or use of the resources in the basin include implementation of multipurpose reservoirs, local flood protection projects, water supply systems, wastewater treatment plants, recreation facilities, power plants, water diversions, migratory fish restoration projects, and mine drainage projects.

While recognizing the beneficial impact of numerous existing projects and programs, a series of six broad water resource needs have been identified based on the particular water management challenges present in the basin. The six categories of needs identified in this updated Comprehensive Plan fall within the programs and responsibilities of the Commission and they are: (1) sustainable water development; (2) water quality; (3) flooding; (4) ecosystems; (5) Chesapeake Bay; and (6) coordination, cooperation, and public information. To assess the needs and determine potential actions necessary to address them, a set of criteria was developed to provide a management and legal framework for the work. The criteria include general principles, project guidance, and project standards.

A vision statement of future conditions is included in the Comprehensive Plan and is based on the belief that water resource management in the basin will be effective and successful. The vision statement serves as a focused objective for the Commission's efforts in addressing the needs and meeting desired results over the long term. The Commission's vision for the Susquehanna River Basin includes: (1) healthy ecosystems that provide groundwater and surface water of sufficient quality and in adequate supply; (2) enlightened planning for and management of the basin's water resources to safeguard the health, safety and welfare of its citizens during floods and droughts, to sustain a vibrant economy, to improve the Chesapeake Bay's water quality and living resources, and to inform the public; and (3) leadership and coordination of efforts by the Commission among its member jurisdictions and with the private sector necessary to make this vision a reality.

By virtue of the Compact, the Commission has powers and authorities to act on a broad range of water resource issues. Over the years, the Commission has chosen to focus on and prioritize its resources within management areas that effectively allow the Commission to accomplish its mission and meet its responsibilities. The Commission carefully considers its actions to give deference to the member jurisdictions' responsibilities and to avoid duplicating actions of the existing offices and agencies of its member jurisdictions. For the purposes of this Comprehensive Plan, the Commission has grouped its focused management responsibilities into the six key water resource needs and has identified them as "priority management areas"; they are (1) sustainable water development; (2) water quality; (3) flooding; (4) ecosystems; (5) Chesapeake Bay; and (6) coordination, cooperation, and public information.

Each of the six priority management areas covers desired results, goals, ongoing Commission activities and the actions needed to meet the goals. In total, 29 goals have been established with 84 actions identified as being necessary to meet the goals. The Commission has lead responsibility for many of the actions. Some of the actions are to be taken by member jurisdictions and other groups and organizations, with the Commission providing support, assistance or encouragement. In these cases, the other entities have the responsibility to lead and manage the work, with the Commission working collaboratively with them in a spirit of full cooperation. Achieving the goals and taking the actions are, of course, dependent on the resources available to the Commission and others over the long term. Part IV, Priority Management Areas, discusses the desired results, goals, ongoing Commission activities and actions needed in detail.

While the priority management areas – with their goals and actions – serve as the primary vehicle for meeting the basin's water resource needs, the Commission also recognizes the benefits of highlighting other important water resource topics. These selected topics were designated as "areas of special interest" by the Commission, and they

are a mix of both long-standing and emerging programs and problems of interest to many sectors in the Susquehanna basin. Unlike the priority management areas, the areas of special interest do not have specific Commission goals and actions, but they are discussed in terms of their impact on water resources and initiatives underway or needed to address them. The 12 areas of special interest are: (1) mine drainage; (2) climate change; (3) consumptive use mitigation; (4) drought coordination; (5) economic development, recreation and other public values; (6) emerging contaminants; (7) energy production and development; (8) flood forecast and warning; (9) invasive species; (10) fisheries monitoring and restoration; (11) potentially stressed areas and water challenged areas; and (12) water and wastewater infrastructure. The Commission believes these areas of special interest need to be addressed by the combined efforts of all levels of government, the private sector and the Commission.

It is important that the actions identified in Part IV, Priority Management Areas, be taken by the Commission and others in order to progress toward the goals set. The Commission's ongoing activities will require continuing emphasis to ensure they remain viable and productive. New actions will require integration into the Commission's work program with appropriate resources and priorities assigned. The process to implement the identified actions began with approval of the Comprehensive Plan in 2008 by the commissioners and continues with this updated Plan as approved in 2013.

The Compact requires the Commission to adopt an annual water resources program, based upon the Comprehensive Plan, and consisting of the projects and facilities to be undertaken by the Commission and others during the ensuing six years or other reasonably foreseeable period. Accordingly, the Commission's annual Water Resources Program (WRP) is to serve as the implementation document for the actions identified in this Comprehensive Plan. The time period considered for actions in the WRP is two years in order to have a "reasonably foreseeable" forecast of needs, workload, priorities, project schedules and resource availability. The current WRP is included in Appendix 3 and will be updated annually as changes to the WRP are made.

The true value of this Comprehensive Plan is measured by the degree to which its goals are met through the combination of ongoing Commission activities and taking the identified actions. An annual assessment of progress in meeting goals has been made by the Commission when preparing its annual Water Resources Program and will continue. Also annually, the Plan has incorporated new approved projects, plans and other actions (see Appendix 2) and the current version of the Water Resources Program (see Appendix 3). This practice will also continue.

The 2008 Comprehensive Plan called for updates of the Plan every five years to help ensure the Plan is current and of long term value and usefulness. The first update is embodied in this 2013 Plan with the next five-year update due in 2018. A complete revision of the Plan every 15 years was also identified and is due in 2023.

The 2008 Comprehensive Plan was amended in December 2009, June 2011, and June 2012 by incorporating various Commission-approved water use projects, plans and other actions, and the annual Water Resources Program. In 2013, the Comprehensive Plan was updated to include current information to enhance its value and utility. The 2013 Comprehensive Plan was amended in June 2014, September 2015, June 2016, June 2017, and June 2018 by incorporating Commission-approved water use projects, plans and other actions (see Appendix 2), and the annual Water Resources Program (see Appendix 3).

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PART I - INTRODUCTION

A. The Susquehanna River Basin Commission

1. History

In the early 1960s, citizen concern regarding water resource problems in the Susquehanna River Basin – flooding, drought, and water pollution – stimulated the formation of the Susquehanna River Basin Association, a citizens' organization. This association and other groups, including all levels of government, expressed the need for comprehensive river basin studies to develop solutions to water resource problems in the basin. In addition, it was considered desirable that a regional government institution be created to deal with water resource problems and implement management measures on a basinwide basis.

The Congress of the United States recognized a national interest in the Susquehanna River Basin and, in 1962, authorized a comprehensive study of the water resources of the basin. The U.S. Army Corps of Engineers led this study, which was completed in 1970. In 1963, citizen and state activities led to the creation of an Interstate Advisory Committee for the Susquehanna River Basin, with membership derived from New York, Pennsylvania and Maryland. This Committee concluded that a regional approach to development issues of the basin was advisable, feasible and urgently needed. The Committee drafted a federal-interstate Compact for the comprehensive planning, management, development, use and conservation of the water resources of the basin, and recommended that the Compact be adopted by the member states and the federal government.

The President of the United States signed the Susquehanna River Basin Compact (Compact) into law (P.L. 91-575) on December 24, 1970, subsequent to its approval by Congress and the prior approval of the three states. It joined the federal government and the three states as equal partners for a period of 100 years to manage the Susquehanna basin's water resources through proper planning, development and regulation. The Compact created the Susquehanna River Basin Commission (Commission) as the single administrative agency to develop, effectuate, coordinate and adopt plans, policies, and programs related to water resources of the basin. In January 1971, the Compact took effect and the Commission was officially established. The Compact is provided as Appendix 1 to the Comprehensive Plan.

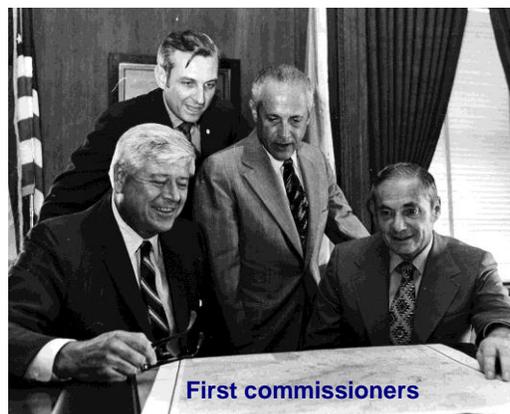
The Commission, as an agency created by a federal-interstate compact among the states of New York, Pennsylvania, and Maryland, and the United States of America, is not the agency of any single one of its member jurisdictions. Rather, the Commission is collectively the agency of all of its member jurisdictions, which exercise their sovereign powers jointly through the Commission.

The Supreme Court of the United States, in *Hess v. Port Authority Trans-Hudson Corp.*, 513 U.S. 30, 40 (1994), noted that agencies created by interstate compacts occupy a different position in our federal system. No single member of a compact exercises dominion over that compact. Compacts are therefore power sharing arrangements and the political accountability of a compact agency is diffuse. Because compact members share power through a compact rather than exercise power wholly over them, compact agencies should not be considered "state or federal agencies" in the conventional sense. It logically follows that any special federal or state requirements or procedures, such as those under the National Environmental Policy Act (NEPA) or the Endangered Species Act, should not be extended to a compact agency, lest confusion reign over which members' laws and requirements apply. In addition, the enforcement mechanism for NEPA is the U.S. Administrative Procedures Act, an act from which the Commission is specifically exempted by the terms of the federal reservations to the Compact (See Federal Reservation 1).

2. Membership

As equal partners, the member jurisdictions of New York, Pennsylvania, Maryland and the federal government each appoint a commissioner to the Commission who serves as the spokesperson for the jurisdiction that he or she represents. The commissioners from the member states are the governors or their designees. The governor of New York also appoints an alternate commissioner(s) while the Pennsylvania and Maryland commissioners appoint their alternates.

In the case of the federal government, the U.S. Army Corps of Engineers is designated by law (Public Law 105-18, the FY 1997 Omnibus Appropriations Act) as the federal representative, with the North Atlantic Division Commander as the commissioner and an alternate(s) appointed by him. Under the leadership of the Executive Director, technical, administrative, and clerical personnel support the daily operations of the Commission.



3. Mission

The Commission's mission, which is defined in the Compact, is to enhance public welfare through comprehensive planning, water supply allocation, and management of the water resources of the Susquehanna River Basin. To accomplish this mission, the Commission works to: reduce damages caused by floods; provide for the reasonable and sustained development and use of surface and groundwater for municipal, agricultural, recreational, commercial and industrial purposes; protect and restore fisheries, wetlands and aquatic habitat; protect water quality and instream uses; and ensure future availability of flows to the Chesapeake Bay. The Commission strives to fulfill its commitments in the manner reflected in its mission statement, its motto "Protecting Your Watershed for Today and Tomorrow", and its values of teamwork, professionalism, and quality. This *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* (Comprehensive Plan or the Plan) is formulated in accordance with these guiding commitments.

The Commission is uniquely qualified to carry out its mission. As a federal-interstate compact body, its jurisdiction is defined by the natural boundaries of the river basin rather than the political boundaries of the member states. As such, the Commission serves as a forum to provide coordinated management, promote communication among its members, and resolve water resource issues and controversies within the basin.

Inherent in this process is the coordination of planning and management efforts of others affecting water resources, stimulation of public awareness, and implementation of related action programs. The Commission serves as an agent for water resource project development, management and operation, as it determines necessary. Also, as the need is demonstrated, it coordinates and manages the funding and conduct of public works programs and projects in the basin. The Commission seeks to integrate planning done at the federal, state and local levels of government with that done by the private sector. It also provides opportunities for all interested groups to express their views and to reconcile differences when possible.

The Commission's leadership role in basin water resource planning and management is also exercised through its regulatory function, which fills in the regulatory gaps that exist in each state's water resource management program. There is an ongoing interface between the Commission and state regulatory programs to ensure each meets its objectives with no duplication of work or inconsistencies. In general, the Commission regulates ground and surface water withdrawals of 100,000 gallons per day or more (peak 30-day average), consumptive water uses and out-of-basin diversions of 20,000 gallons per day or more (peak 30-day average), and all in-basin diversions. The main purposes of the regulations are to:

- Avoid conflict among water users
- Protect public health, safety and welfare
- Manage and protect stream quality
- Consider economic development factors
- Protect fisheries and aquatic habitat
- Protect the Chesapeake Bay

Projects and proposals for development, use and management of the water resources of the basin are evaluated in terms of their compatibility with the objectives, goals, standards and criteria set forth in the Comprehensive Plan, and on the basis of public input regarding project impacts. Public input is sought through public hearings, informal contacts, and through views formally expressed to the Commission.

Every project, independent of the industry or entity from which the application originates, is evaluated solely upon its technical merits and the scientific and engineering information upon which the application is based. Only projects supported by sound technical information and which pose no threat to other waters or the basin's environment are approved by the Commission.

The role of the Commission in any given endeavor varies according to the extent others act to meet water resource management needs within the basin. Where the Commission determines that existing programs of others do not meet identified needs, it first encourages the appropriate member or members to take actions needed. If justified, the Commission also acts directly to meet needs through the exercise of powers granted to it by the Compact.

It is well recognized constitutionally that power is reserved to the states, absent pre-emptive federal legislation, to manage and control the development of their own natural resources. The states did not delegate this broader authority to the Commission in the Susquehanna River Basin Compact. Notwithstanding the potential impact of such activity on the water resources of the basin, the states did not delegate the authority to regulate coal mining, oil and gas extraction, timber harvesting, quarrying, or sand and gravel operations to the Commission.

These forms of natural resource extraction have the potential to cause impacts to the water resources of the basin. The Commission and its member jurisdictions are fully cognizant of that fact. However, the Commission's responsibilities associated with such activities relate to the proper allocation of water and the mitigation of consumptive losses associated with it; and its members have the primary role in establishing the suite of appropriate rules and standards necessary to have that activity occur in a manner consistent with the public interest.

Some non-governmental parties have proposed that the Commission impose a moratorium on shale gas development in the basin. In light of the above, the Commission believes that any form of moratorium imposed by it would be an inappropriate usurpation of an individual state's exercise of its own sovereign powers. It is the Commission's position that each of its members uses its own discretion to determine if, and under what conditions, an activity proceeds where it has the sovereign authority to so decide. To do otherwise, such as in this case, would be an inappropriate intrusion on the sovereignty of the Commission's member states. Accordingly, the Commission will continue to manage water allocation and mitigation of consumptive water losses related to these extractive industries, monitor water quality impacts, and advise its member states of impacts if and when they arise.

4. Duties and Powers

The duties of the Commission, as set forth in the Compact, are to:

- a. Develop and effectuate plans, policies, and projects relating to water resources; adopt, promote, and coordinate policies and standards for water resource conservation, control, utilization, and management; and promote and implement the planning, development, and financing of water resource projects.
- b. Undertake investigations, studies, and surveys, and acquire, construct, operate, and maintain projects and facilities relating to the water resources of the basin whenever it is deemed necessary to do so to achieve any of the provisions of the Compact.
- c. Administer, manage, and control water resources in all matters determined by the Commission to be interstate in nature or to have a significant effect on the basin's water resources and their management.
- d. Assume jurisdiction in any matter affecting water resources whenever it determines, after investigation and public hearing upon due notice given, that the Comprehensive Plan or the Compact so requires. If the Commission finds upon subsequent hearing requested by an affected signatory party that the party will take the necessary action, the Commission may relinquish jurisdiction.
- e. Investigate and determine if the requirements of the Compact or the rules and regulations of the Commission are complied with. If non-compliance is found or if satisfactory progress has not been made, the Commission may institute an action or actions in its own name in any state or federal court of competent jurisdiction to compel compliance with any and all Compact provisions or any of the Commission rules and regulations adopted pursuant to the Compact.

The necessary authority to act on these duties is delegated to the Commission by the Compact signatories, as are such other and different powers which are necessary or convenient to carry out its express purposes, or purposes which may be reasonably implied from the Compact. The Compact clearly states that the authority granted the Commission is conditioned to preserve and utilize the functions, powers and duties of existing offices and agencies of the signatory parties to the extent consistent with the Compact.

5. Goals

The goals of the Commission are (as defined in the Commission's 1993 Mission Statement):

- a. To be responsive to water resource management needs of the Commission's signatory members;
- b. To provide excellent service to the public;
- c. To coordinate management of interstate water resources and serve as an effective forum for resolution of water resource issues and controversies within the basin;
- d. To be a leader in issues concerning the conservation, utilization, allocation, development, and management of water resources within the Susquehanna River Basin;
- e. To encourage excellence in Commission staff by affording opportunities for professional growth and development and by providing a stimulating work environment for all Commission employees; and
- f. To provide public information and education about the water resources of the basin.

B. The Comprehensive Plan

1. Authority

Sections 3.3 and 14.1 of the Compact authorize and require the Commission to formulate and adopt a Comprehensive Plan for the immediate and long-range development and use of the water resources of the basin. The Commission may adopt a Comprehensive Plan or any revision thereof in such parts as it deems appropriate. This authority is conditioned to require consultation with water users, interested public bodies and public utilities. Also the Commission must, prior to adoption or revision of the plan or any part thereof, conduct public hearings, and consider and give due regard to the findings and recommendations of the signatory parties and interested groups.

2. 1973 and 1987 Comprehensive Plans

After the Compact went into effect in January 1971, the Commission organized a staff and, in compliance with the terms of the Compact, made the adoption of a comprehensive plan a top priority. There was a strong belief among the Commission members that the Comprehensive Plan would form the foundation upon which the Commission would carry out all of its water management responsibilities. At the monthly meetings during 1972 and 1973, the staff regularly reported to the Commission on the progress made in completing the plan.

After a series of basinwide hearings, the Commission adopted its first *Comprehensive Plan for the Water Resources of the Susquehanna River Basin* on December 13, 1973. The plan consisted of three parts: Part I - Introduction; Part II - The Plan; and Part III - General Information.

Part II - The Plan - formed the heart of the 1973 Comprehensive Plan. A set of planning objectives was established for the use and development of the basin's water resources. The objectives included careful consideration of national economic development, environmental quality, social well being and regional development, with reasoned choices made among them when they conflicted. The public trust responsibilities of the Commission and its member jurisdictions over the water resources of the basin were also emphasized. Program objectives and goals for water resource management were established for: (1) Flood Plain Management and Protection; (2) Water Supply; (3) Water Quality; (4) Recreation, Fish and Wildlife; (5) Watershed Protection and Management; and (6) Cultural, Visual and Other Amenities. The objectives and goals were reinforced by a set of "Guidelines and Criteria" that outlined "a sound basis for rational, well-considered decisions among alternatives or competing uses of basin water resources." Indeed, the Commission has relied heavily on the water management principles set forth in the "Guidelines and Criteria" in carrying out its regulatory functions. Finally, Part II set forth an "Early Action Program" to provide a five-year perspective on priority programs and projects to meet the needs and demands identified in the program objectives. It also identified responsibilities of both the Commission and its member jurisdictions.

In 1987, the Commission approved an overall revision of the 1973 Comprehensive Plan. This revision retained the basic structure and content of the 1973 plan. However, many changes and updates were made to the text, and items that had been adopted piecemeal by the Commission since 1973 were added. This included such things as the goals for restoration of migratory fish to the river system and the commitment to acquire water storage and release facilities. The "Guidelines and Criteria" Section of Part II was also expanded from 23 entries to 32 entries, with the language of several of the entries also being strengthened. A separate appendix was added for projects that had been included in the plan and completed, as opposed to projects in the early action program that awaited completion.

3. Current Comprehensive Plan

a. Purpose

The Comprehensive Plan provides an overarching framework for the Commission in regard to management and development of the water resources of the Susquehanna River Basin, and serves as a guide for all Commission programs and activities, thus facilitating the achievement of its mission to enhance the public welfare through comprehensive planning, water supply allocation, and management of the water resources of the basin. The Plan supports the broad goals set forth in the Compact and provides a basis for achieving desired results, meeting specific goals, and taking actions necessary to meet the goals. The Plan is further intended to be a useful resource for the Commission's member jurisdictions, water resource managers in the basin, private sector interests, and others. It can serve as a guide for water resource planning done by local interests and the states.

b. Scope

The Comprehensive Plan includes the following key elements: (1) an assessment of water resource needs in the basin; (2) principles, guidance, and standards necessary to effectively and efficiently execute the Commission's responsibilities; (3) desired results, goals, ongoing Commission activities and actions for the Commission's priority management areas; (4) recognition of water resource areas of special interest to the Commission; and (5) documentation of projects incorporated into the Plan which are required, in the judgment of the Commission, for the optimum planning, development, conservation, utilization, management and control of the water resources of the basin to meet present and future needs. The Plan incorporates the provisions of any and all previous resolutions or actions of the Commission regarding its comprehensive plan, unless such provisions conflict with the contents of this Plan, in which case they shall be superseded. The Plan is envisioned to be a dynamic document that includes effective use of GIS products. Annually, the Plan will incorporate new approved projects, plans and other actions (Appendix 2) and include the current version of the Water Resources Program (Appendix 3). An update of the full Plan will be made every five years with a complete revision of the Plan made every 15 years to ensure its usefulness and applicability.

This document is a five-year update of the 2008 Comprehensive Plan and replaces it as the Commission's current Comprehensive Plan.

c. Public Input

The Commission actively sought public input to the 2008 Comprehensive Plan through a public review and comment process, press releases, an e-mail distribution to citizens, groups, and agencies, website posting, and public hearings. Public input was sought for the 2013 update of the Comprehensive Plan through a similar process, including a 60-day public review and a public hearing.

C. The Susquehanna Basin

1. General Description

The Susquehanna River is the largest river lying entirely in the United States that drains into the Atlantic Ocean. The Susquehanna and its hundreds of tributaries constitute more than 49,000 miles of waterways and drain 27,500 square miles, an area nearly the size of Massachusetts, Vermont, Delaware and New Jersey combined spread over parts of New York, Pennsylvania, and Maryland. The river flows 444 miles from its origin at the outlet of Otsego Lake at Cooperstown, N.Y., until it empties into the Chesapeake Bay at Havre de Grace, Md. See Figure 1 for a map of the basin, major subbasins, and population centers, and Figures 2 through 7 for more detailed maps of each major subbasin. Table 1 includes drainage area information for the basin and the six major subbasins.

Table 1. Major Subbasins

Subbasin	Drainage Area (Sq. Mi.)
1 - Upper Susquehanna	4,944
2 - Chemung	2,594
3 - Middle Susquehanna	3,771
4 - West Branch Susquehanna	6,978
5 - Juniata	3,404
6 - Lower Susquehanna	5,809
Total Susquehanna River Basin	27,500

Other basin and river information includes:

- The Susquehanna River Basin covers half the land area of Pennsylvania, portions of New York and Maryland and includes all or portions of 66 counties.
- The basin comprises 43 percent of the Chesapeake Bay's drainage area and the river provides nearly one-half of the freshwater flow to the Bay, with an average flow of 18 million gallons per minute at Havre de Grace.
- The Susquehanna River Basin has more than 49,000 miles of waterways – rivers, streams, creeks, brooks, runs, etc. (*data source: National Hydrography Dataset*)
- The basin is made up of 62.5 percent forest lands. (*data source: 2006 Chesapeake Bay land use*)
- The Susquehanna basin has a population of more than 4.1 million.
- The river is almost a mile wide at Harrisburg, Pa. and flows about 20 miles on an average summer day.
- The river is the nation's longest, commercially non-navigable waterway.
- The basin is one of the most flood prone areas in the nation, with a major devastating flood occurring every 13 years on the average.

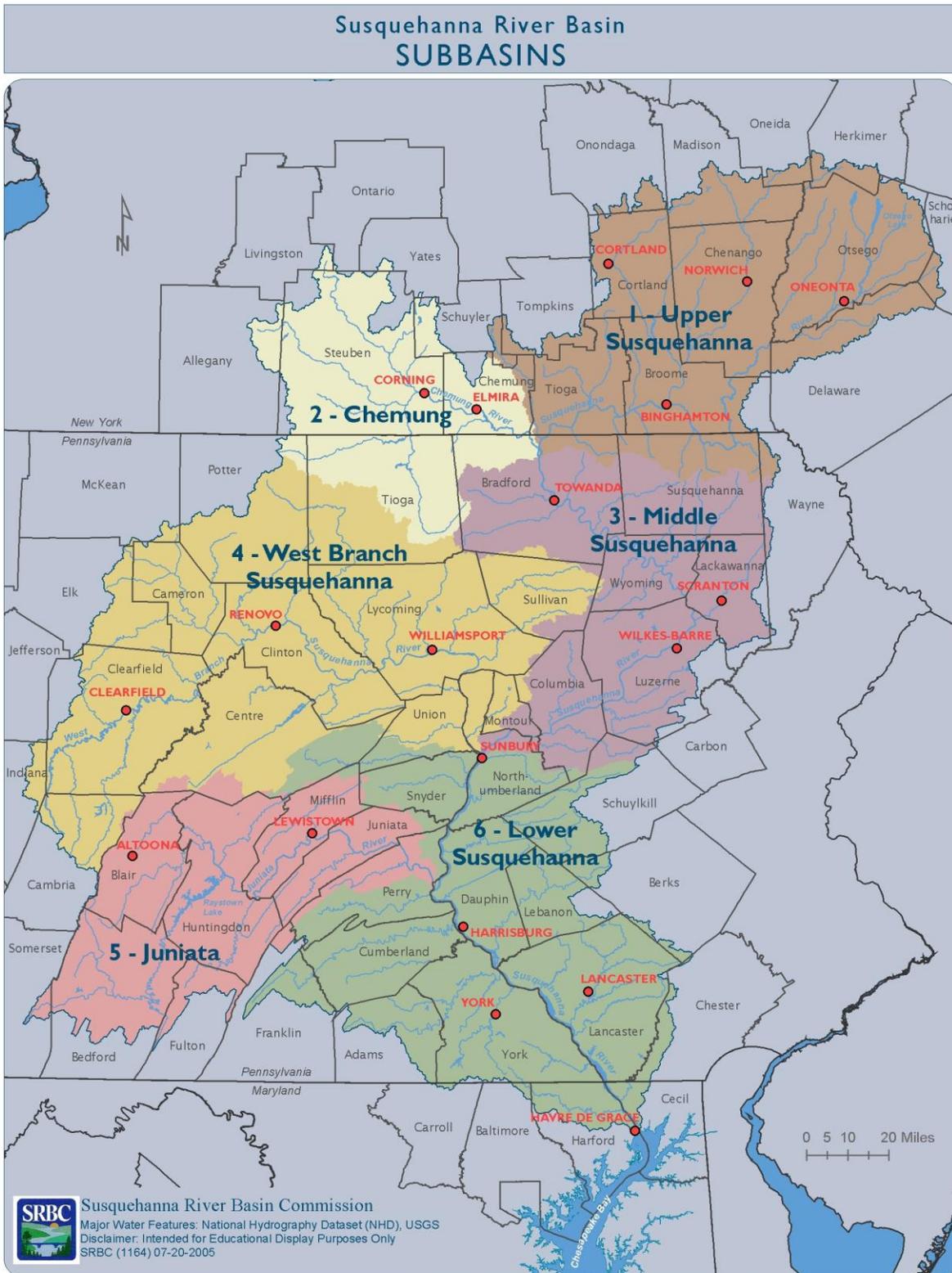


Figure 1. Susquehanna River Basin

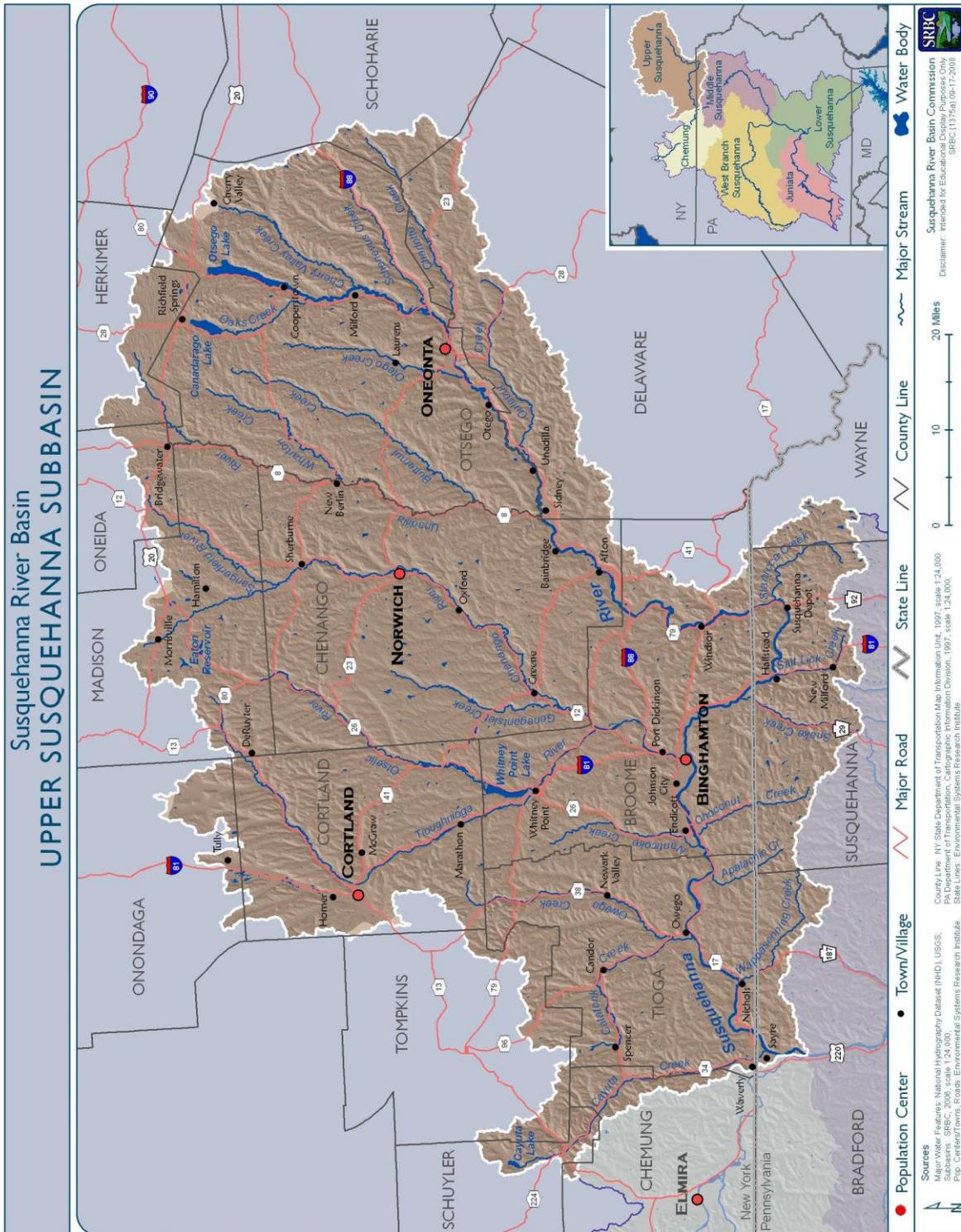


Figure 2. Upper Susquehanna Subbasin

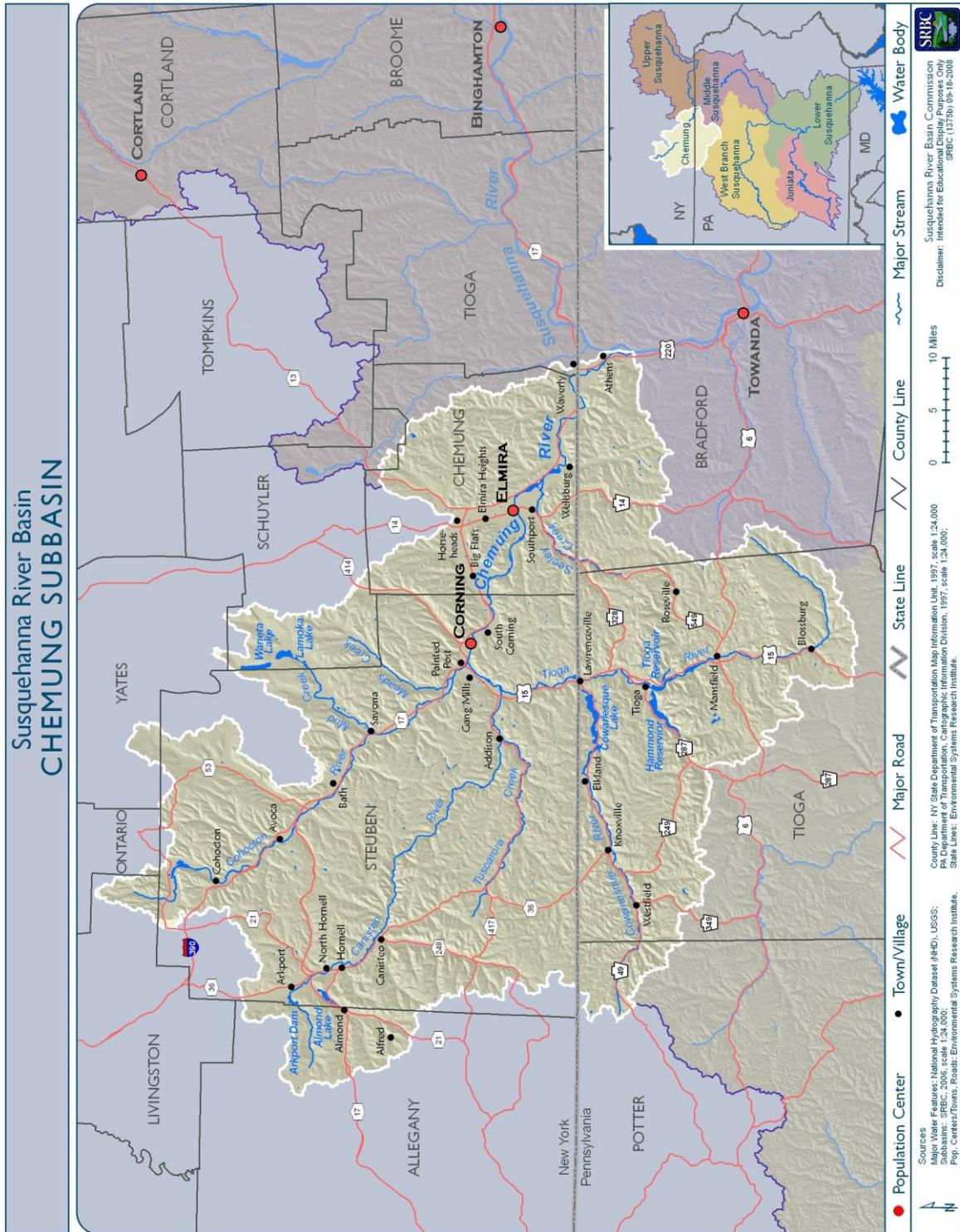


Figure 3. Chemung Subbasin

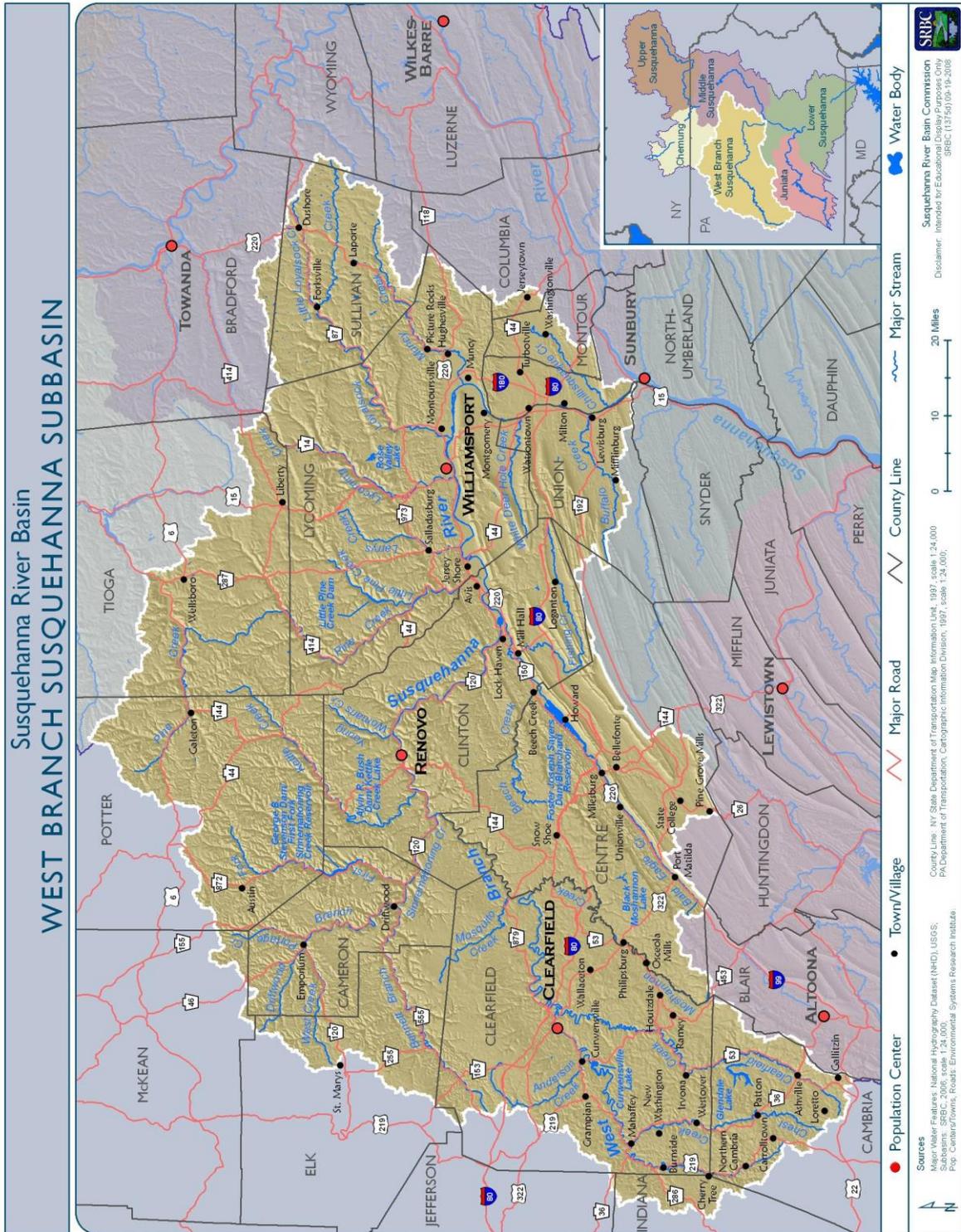


Figure 5. West Branch Susquehanna Subbasin

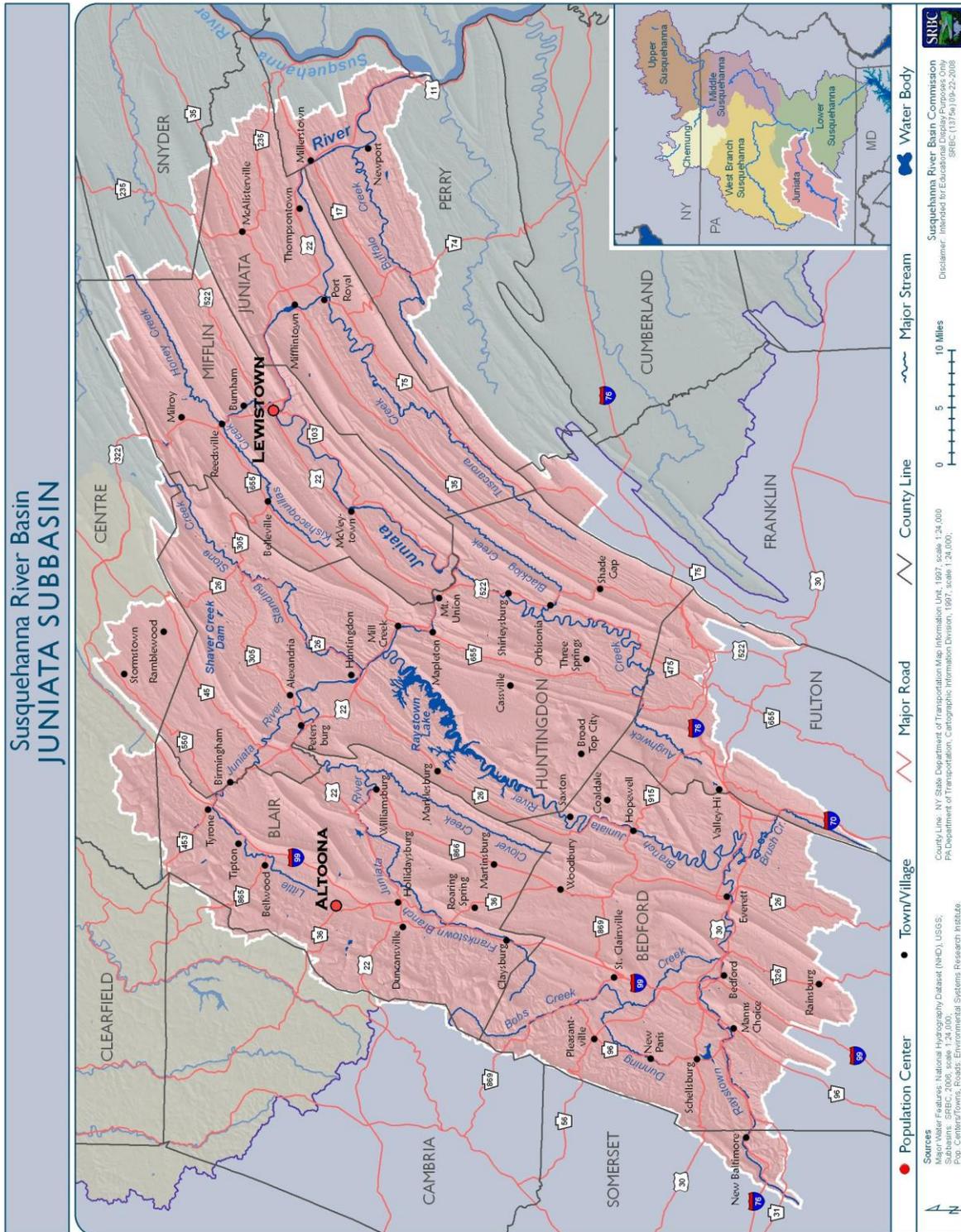


Figure 6. Juniata Subbasin

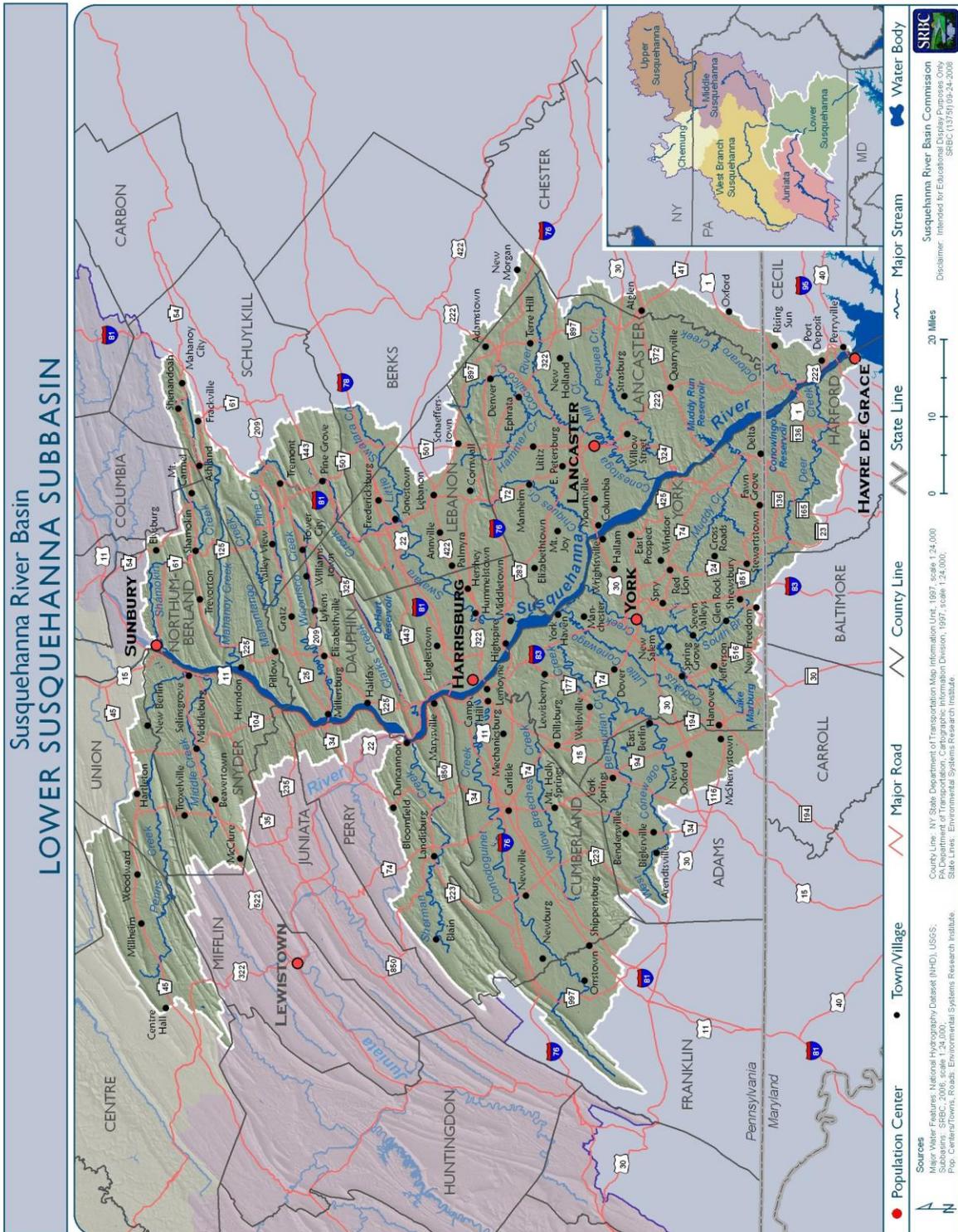
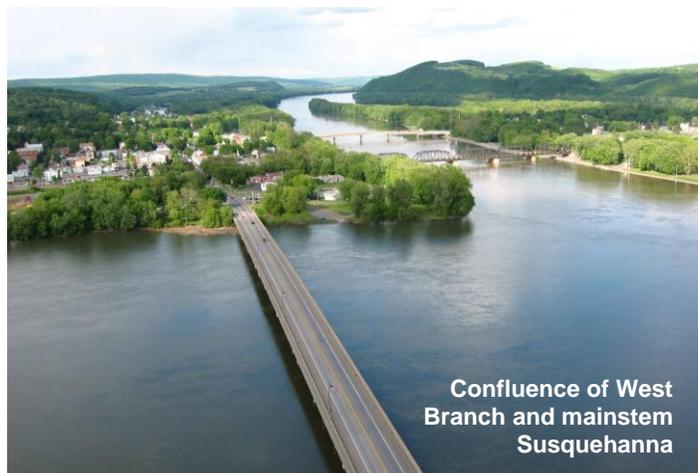


Figure 7. Lower Susquehanna Subbasin

2. Rivers in the Basin

The Susquehanna River starts as a small stream flowing from Otsego Lake and continues southward into Pennsylvania around the "Great Bend" and back into New York, then westward through Binghamton to be joined by the Chemung River at Athens, Pa. From this point, the river meanders southeastward into Pennsylvania until it is met by the Lackawanna River near Wilkes-Barre, where it turns southwestward to its confluence with the West Branch Susquehanna River at Sunbury.



Confluence of West Branch and mainstem Susquehanna

The Chemung River is formed by the confluence of the Cohocton and Tioga Rivers west of Corning, N.Y. The West Branch of the Susquehanna rises in the western part of the basin and flows north then east past Williamsport, where it turns south to its junction with the Susquehanna River at Sunbury. The Juniata River joins the Susquehanna at Duncannon, 38 miles downstream from Sunbury.

Below its junction with the Juniata, the Susquehanna becomes an impressive river nearly a mile wide. Just below Harrisburg, it flows through a series of gorges now dammed by hydroelectric power facilities. From the Maryland-Pennsylvania border, the river continues southeastward for 14 miles, passing one more major dam, until it mingles its waters with the tidal Chesapeake Bay at Havre de Grace.



Susquehanna River near Marietta, Pa.

SRBC Map and Data Atlas

The Commission developed a Geographic Information Systems (GIS)-based Map and Data Atlas as a resource for water resource professionals and the public to access a wide variety of maps and datasets for the Susquehanna River Basin. The atlas provides a wealth of information on existing conditions in the basin and is periodically updated. Examples of the information in the atlas include watersheds, land use, average annual precipitation, toxic release inventory, flood insurance coverage, public lands and boat access points, and specific water resource projects. The Map and Data Atlas is available on the Commission's website at <http://www.srbc.net>.

3. Physiography

The Susquehanna River Basin includes three major physiographic provinces: the Appalachian Plateau, the Valley and Ridge, and the Piedmont Provinces. A very small part of the Blue Ridge Province also extends into the basin. Differences in topography and geology form a basis for these natural subdivisions, although the whole area has a similar geologic history and related geological features. These differences form a basis, too, for the settlement patterns of the basin (see Figure 8).

- Appalachian Plateau Province. This province occupies 56 percent of the Susquehanna drainage area in New York and Pennsylvania. This region is characterized by high, flat-topped hills and deep valleys cut by the Susquehanna and its tributaries.
- Valley and Ridge Province. This province is a mountainous region that covers approximately 32 percent of the basin and contains ridges, which rise from 500 to 1,600 feet above the surrounding valleys. In the eastern part, the folding of the rocks created the distinctive anthracite coal fields of the Lackawanna and Wyoming Valleys. Transportation routes and settlement have followed the valleys and the gaps in the ridges.
- Piedmont and Blue Ridge Provinces. About 11 percent of the basin is in the Piedmont and Blue Ridge Provinces. Maximum relief in the Piedmont Province ranges from 400 to 600 feet, with the Blue Ridge Province having a somewhat greater relief. This comparatively low relief allows a denser and more even population distribution than in the more mountainous parts of the basin.

4. The Climate of the Basin

The Susquehanna River Basin has a continental type of climate, modified somewhat by the moisture periodically entering the area from the Gulf of Mexico and the Atlantic Ocean. As a result, precipitation is greater and temperature less extreme than would otherwise be the case.

The average annual temperature in the basin ranges from about 47 degrees in the northern part of the basin to about 50 degrees in the southern part. Average January temperatures range from 17 to 34 degrees and average July temperatures range from 59 to 82 degrees. Extreme high temperature of 107 degrees and low temperature of 39 degrees below zero have been recorded in the basin.

Average annual precipitation is about 42 inches over the entire basin and ranges from 41 inches in the northern part of the basin to 43 inches in the southern part. In the extreme years, more than 50 inches of rainfall have been recorded in various places. In 2011 a record total of 73.73 inches of rainfall was recorded at Harrisburg. Drought years have seldom recorded less than 25 inches at any station.

Climate change has the potential to affect the basin's temperature range and annual precipitation. More information on climate change is contained in Part V, Section B, of the Plan.

5. Hydrology

Since the average annual rainfall in the basin is about 40 inches per year, this means that more than 50 billion gallons of water per day, on the average, falls in the basin. An average of 26 billion gallons of water per day flows from the mouth of the Susquehanna into the Chesapeake Bay. Naturally, this flow varies from day-to-day and from year-to-year. Of particular interest are the extreme low flows and high flows, the droughts and the floods, and the flows that can be depended upon most of the time. Since the Susquehanna River experiences considerable variations in flow over periods of years and during any one year, resource management for the best utilization of the basin's water is a challenging task.

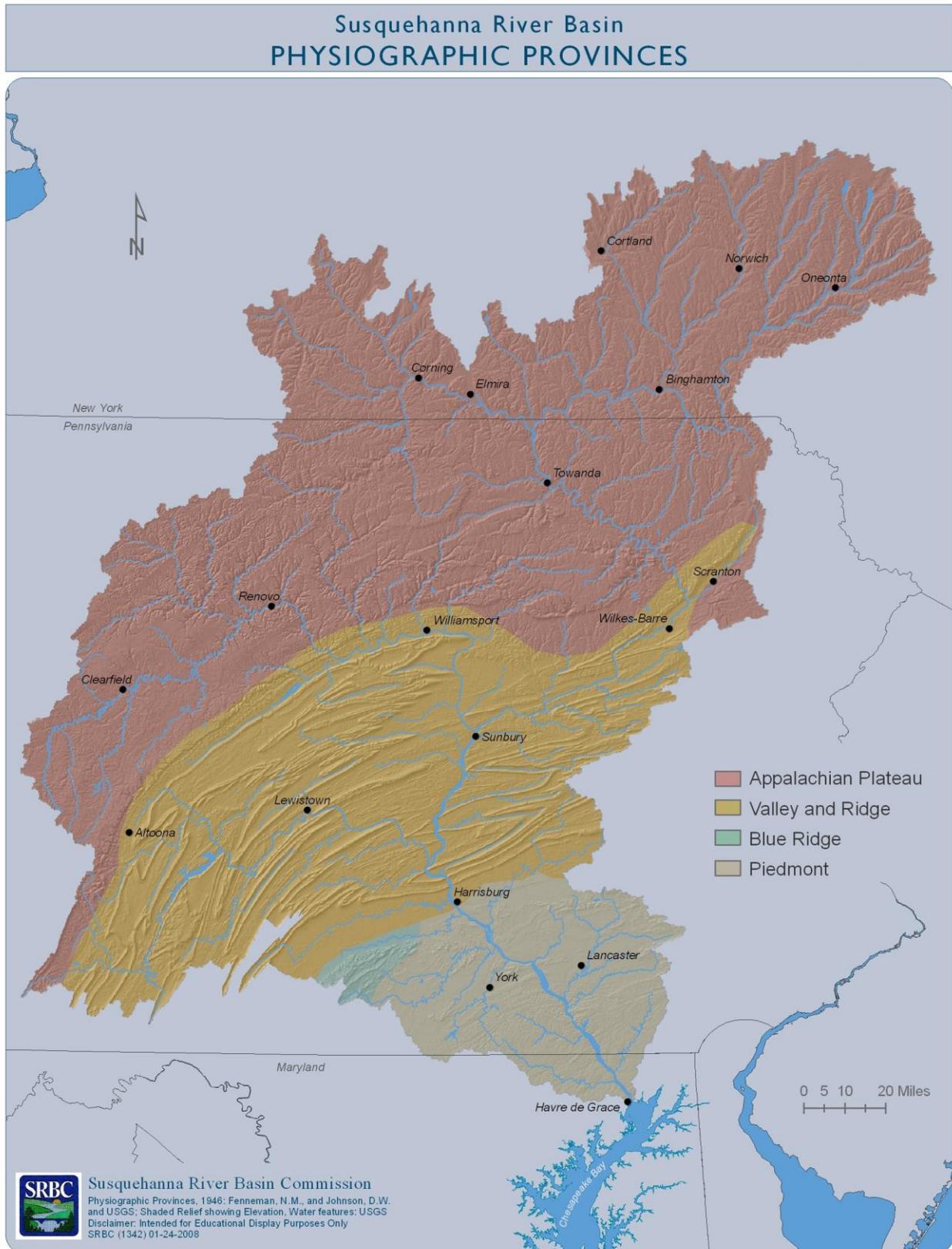


Figure 8. Physiographic Provinces

Total runoff varies from year-to-year and from location-to-location. Average yearly precipitation rates generally result in 52 percent of the total water being lost to evapotranspiration and 48 percent resulting in surface water runoff and groundwater infiltration. Land use, soil, and the type of vegetative cover affect surface runoff and evapotranspiration rates. For instance, in urban areas with large portions of their areas paved or covered with buildings, surface runoff can approach 100 percent; in heavily forested areas, surface runoff is much lower and evapotranspiration is correspondingly higher.

In terms of seasonal variations in average stream flow, virtually all the major streams experience their highest flows in March, April, and May, when melting snows combine with spring rains. These three months account for about one-half of the yearly runoff. Flows are lowest in these streams during the summer and early fall months, with most streams hitting their lowest levels in September. Figure 9 shows a typical flow pattern for the basin as recorded, from 1890 to the present, for the Susquehanna River at Harrisburg, Pa. with a peak day flow of 954,000 cubic feet per second (cfs) in June 1972 and a minimum low flow of 1,700 cfs in September 1964. The average daily flows at Harrisburg range from 11,970 cfs in August to 217,000 cfs in April.

Average flow data are collected over long periods of time for locations throughout the basin. The data, however, do not reveal periods of drought when, for a year or more, rainfall and runoff were below these averages; and they do not reveal floods that occurred on the major streams after severe regional storms, or flooding of small tributaries because of local storms. It is possible for one portion of the basin to be flooded while another is experiencing a drought.

Climate change may have a significant effect on the basin’s hydrology, particularly in terms of flow extremes and seasonal variations in flow. More information on the potential impacts of climate change is contained in Part V-B of the Plan.

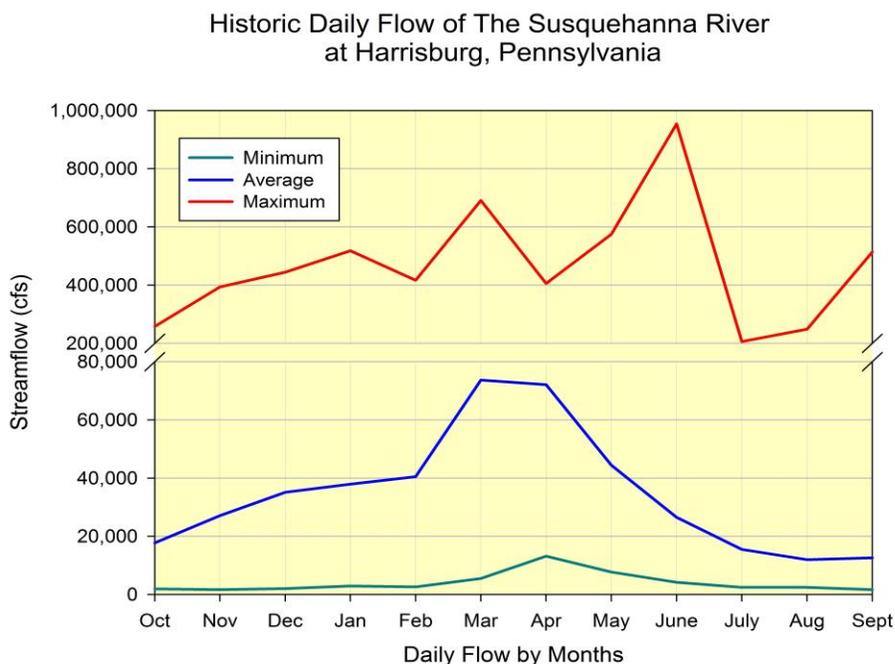


Figure 9. Typical flow pattern for the basin as recorded for the Susquehanna River at Harrisburg, Pa.

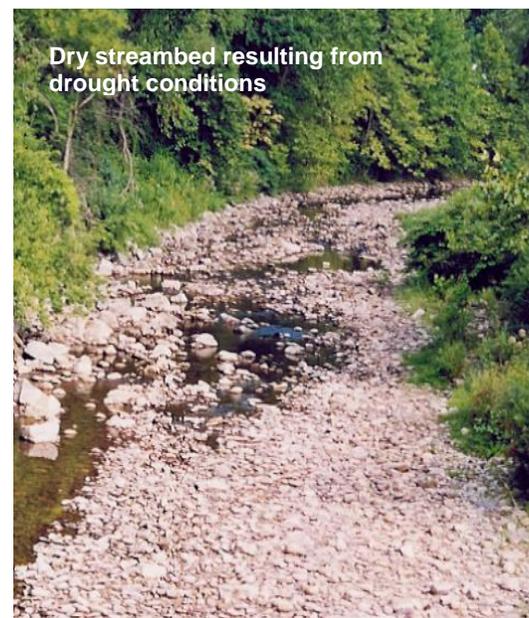
6. Floods

With more than 49,000 miles of waterways, the Susquehanna River Basin is one of the country's most flood prone areas. Generally, floods occur each year somewhere in the basin, and major floods can occur in all seasons of the year. The more frequent flooding, however, occurs in early spring, usually in March. Major floods have occurred as the result of heavy rainfall on top of heavy snowfall and as a result of heavy rainfall on previously saturated ground. Occasionally, local flooding is caused by ice jams. Flooding from high intensity summer storms is often aggravated by saturated ground conditions from previous storms, and flash flooding over small drainage areas also results from thunderstorms during the summer months. Hurricanes, or their remnants, passing through the basin have caused major floods. Record floods have occurred at most localities in the Susquehanna River Basin on one or more of the following dates: June 1889, July 1935, March 1936, May 1946, June 1972, September 1975, January 1996, September 2004, June 2006, and September 2011.



7. Droughts

While many droughts have occurred in parts of the basin at different times, the two most severe occurred in the 1930-1934 period and the 1962-1965 period. The drought of the 1930s left many streams dry, and water for domestic use had to be transported to many places. The drought of the 1960s was even more severe, in terms of intensity and greater demands on water resources. Agriculture suffered, municipalities had to restrict water use drastically, and many streams were dry or were left with poor quality water. A measure of drought conditions is the occurrence of "Q7-10," which is the low flow statistically expected to occur for a seven-day duration once in ten years. An indication of the severity of the 1930s and 1960s droughts is the fact that more than 70 percent of the daily occurrences of flows below "Q7-10" at Harrisburg, from 1890 to 2007, took place during those two events. Significant droughts have also occurred in portions of the basin in 1900, 1908, 1910, 1913, 1941, 1980, 1991-1992, 1995, 1999, 2002, 2010, and 2011 with drought watch, warning, or emergency declarations being issued for the more recent events.



8. Groundwater

The surface water and groundwater resources of the Susquehanna River Basin are interrelated and must be considered jointly. Existing groundwater conditions in the basin result from a number of factors, including climate, physiography, land use, groundwater quality, and groundwater use. Groundwater maintains the base flow of perennial streams during periods of little or no precipitation and constitutes an average of 50 percent of the flow of most streams at other times. When groundwater is withdrawn and used consumptively (not returned), stream flows may be reduced.

The use of groundwater resources within the basin is extensive. In particular, groundwater plays a critical role in supplying drinking water and maintaining economic viability. Outside of the major population centers, drinking water supplies are heavily dependent on groundwater wells. For use as water supply, groundwater is sometimes preferable to surface water because of its relatively uniform temperature, quantity, and quality throughout the year. In addition, groundwater often requires fewer resources for treatment. Approximately 42 percent of the basin population is served by public water suppliers that use groundwater as a source.

9. Soils

Soil types in the basin vary largely within the predominant physiographic provinces. In the glaciated portion of the Appalachian Plateau Province, the deep soils on the sloping uplands are developed in glacial till and are moderately well to poorly drained. Most of the soils contain considerable amounts of coarse fragments, frequently have stones on the surface, and are in woodland. The stream valleys contain deep deposits of glacial valley fill materials and are predominantly deep and well drained (sand and gravel deposits) or poorly drained (finely textured deposits). In the unglaciated part of the plateau, soils formed in materials weathered from sandstone and shale are deep and well to poorly drained.

In the Valley and Ridge Province, soils of the ridges are mostly moderately deep to deep, well drained, and very stony. Soils of the shale valleys are mostly moderately deep to shallow, well to moderately well drained, and feature moderate to steep slopes. Soils of the limestone valleys are predominantly deep, well drained, productive, and often in cropland.

Soils of the Piedmont Province are formed in parent materials weathered from a wide variety of rocks, including red shale, schist, gneiss, quartzite, diabase, and greenstone. The ridge soils are mostly deep, well drained, and very stony. Soils formed over shales and other softer rocks are moderately deep to deep, well to poorly drained, and generally very fertile.

10. Land Use/Land Cover

A map showing land uses and land cover in the basin is included as Figure 10. The Lower Susquehanna Subbasin contains the greatest concentration of agricultural activity and development, with major population centers located around the cities of Harrisburg, York, and Lancaster. Other population centers include the area between Scranton and Wilkes-Barre in the Middle Susquehanna Subbasin, Williamsport in the West Branch Susquehanna Subbasin, Lewistown in the Juniata Subbasin, and Binghamton and Elmira in the Upper Susquehanna and Chemung Subbasins, respectively.

Approximately 46.3 percent of the basin consists of deciduous forest, with mixed forest and evergreen forest consisting of 11.3 percent and 4.9 percent of the basin, respectively. About 27.5 percent of the basin consists of cultivated land, about 4.2 percent of the basin is developed and 5.8 percent of the basin has other land uses and cover. (*data source: 2006 Chesapeake Bay land use*)

Public lands and boat access points are found throughout the basin, with the greatest concentration of state forest land being found in the West Branch Susquehanna Subbasin, as well as in areas to the north. Additional maps depicting public lands, boat access points, water trails, and other basin features are included in the Map and Data Atlas on SRBC's web site. Additional water use information is also included on the web site, along with SRBC's 2013 State of the Susquehanna Report.

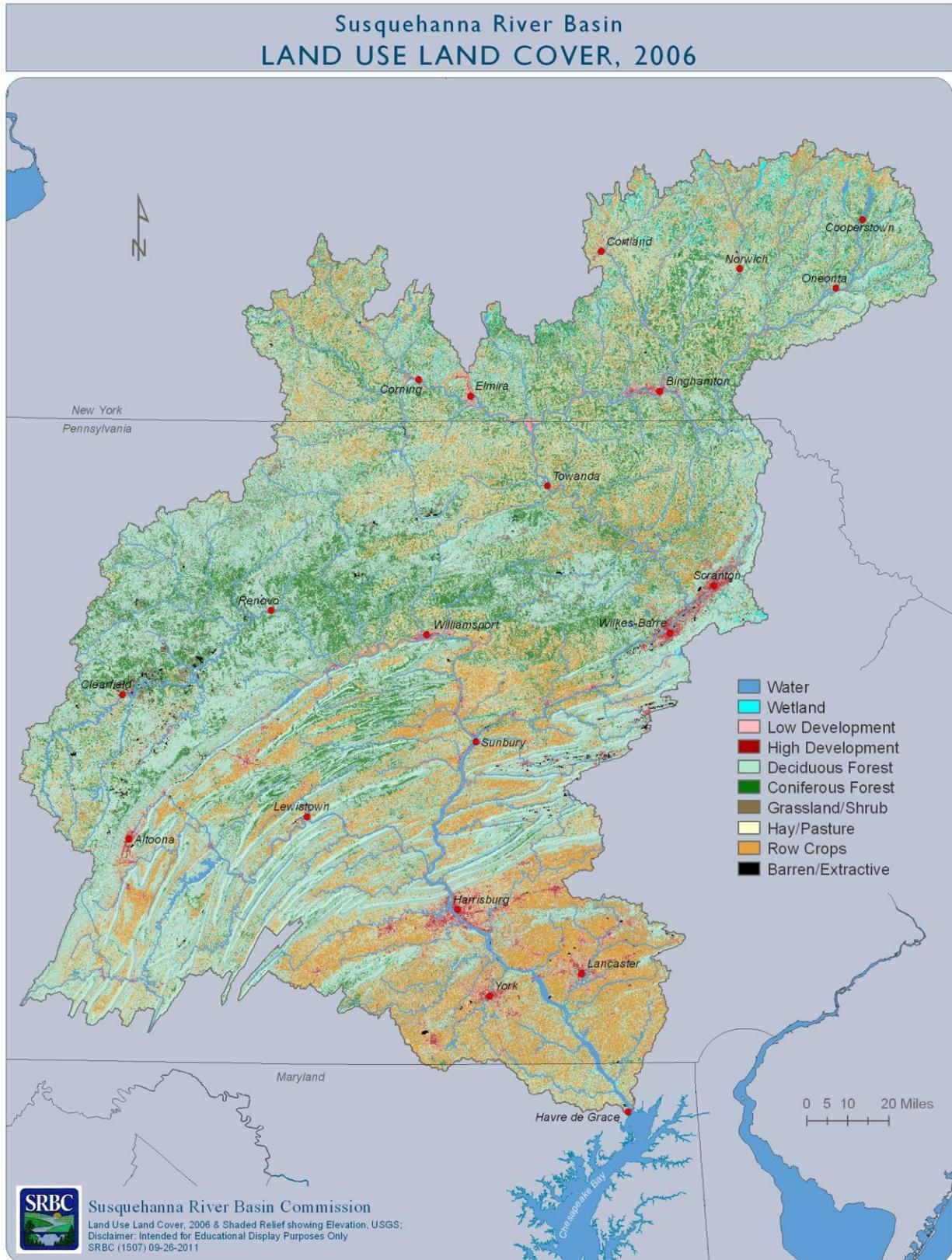


Figure 10. Land Use/Land Cover, 2006

11. Mineral Resources

Coal has been, and continues to be, a significant mineral resource in the Susquehanna basin. There are nearly 850 active coal mines in the basin and over 2,100 square miles (surface area) of coal fields. Some of the towns and cities in the basin were built for the single purpose of coal mining. While coal provided a livelihood for thousands over many decades, the operators worked without regard to environmental impacts until the 1970s. The land was stripped, deep mine wastes were left in enormous piles, and mine drainage flowed into waterways and groundwater. Since the 1970s, many of the previously mined areas have been either abandoned or reclaimed. See Parts I-D8 and V-A of the Comprehensive Plan for more detailed information on the effects of mine drainage and actions taken to manage and mitigate these effects. Another very significant mineral resource in the basin is the natural gas captured in certain shale formations. See Part V-G, Energy Production and Development, for more detailed information on natural gas extraction in the basin. Large reserves of both coal and natural gas are present in the basin and will be important sources of energy production for decades. Other important mineral resources of the basin include glass sand, lime, clay, trap rock (an aggregate deposit also known as “Diabase” that is a very hard durable material), sand and gravel and stone.

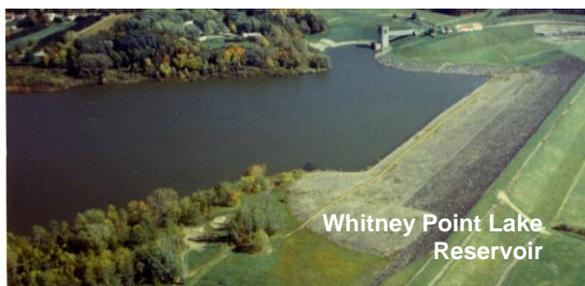
D. Water Resource Projects and Programs in the Basin

There are many important projects and programs that address various aspects of water resources in the Susquehanna River Basin. This part of the Comprehensive Plan provides an overview of existing projects and programs that deal with flood damage reduction, water supply, wastewater treatment, recreation, electric power production, water diversions, migratory fish passage and abandoned mine drainage. Also discussed are the projects, plans and other actions that the Commission has incorporated into the Comprehensive Plan. The overview is meant to provide an insight to existing conditions in the basin, but it does not attempt to address all existing projects or ongoing activities.

1. Flood Damage Reduction

The existing federal, state and local flood damage reduction projects in the basin have provided significant benefits for many years. The projects include reservoirs, local flood protection projects (levees, floodwalls, channel modifications, pumping stations), and flood forecast and warning systems. Without these valuable projects, damages in the flood prone areas of the basin would be much higher than what actually occurs.

The U.S. Army Corps of Engineers (USACE) operates and maintains a system of 13 dams and multipurpose reservoirs which are located in all six major subbasins. For the purpose of flood damage reduction, USACE also regulates the operation of a Commonwealth of Pennsylvania reservoir (George B. Stevenson) in the West Branch Susquehanna Subbasin. These 14 projects provide most of the floodwater storage in the basin, with over 940,000 acre-feet of storage available for reducing flood damages. Table 2 contains a listing of the 13 USACE reservoirs. The federal Natural Resources Conservation Service and the Commonwealth of Pennsylvania have constructed other reservoirs in the basin that reduce flood damages. These projects are generally smaller in scale than most of the USACE reservoirs, but provide important local benefits.



There are approximately 100 local flood protection projects in the basin that were constructed by federal and state agencies and local interests. These projects are well distributed throughout the basin and provide varying levels of protection, depending on the flow or flood level used for design purposes. The operation and maintenance responsibilities for the projects are typically at the local level. An example of an effective local

program is the Sunbury, Pa. Municipal Authority's operation and maintenance of the federally constructed local flood protection project at Sunbury. Figure 11 is a basin map showing the locations of the major flood damage reduction projects discussed above. The map provides a visual display of the distribution of these projects throughout the basin.

The Susquehanna Flood Forecast and Warning System (SFFWS) is a comprehensive system that has provided significant value to basin residents, communities, and businesses in reducing flood damages. The SFFWS is an automated state-of-the-art system utilizing advanced technology, including radar and streamflow and rainfall gages, to provide data used by the National Weather Service to forecast stream levels and issue timely and accurate early warnings. The early warnings allow all flood-prone interests to secure their property and move people and property to a safe location. A federal and state interagency committee coordinated by the Commission, oversees the SFFWS. There are also locally-operated flood warning systems, such as the one in Lycoming County, Pa., that complement the basinwide system with more specific watershed and local warning information. Figure 11 also shows the locations of the river forecast points used under the SFFWS. The map provides a visual display of the distribution of these forecast points throughout the basin. Unfortunately, funding for the SFFWS was last provided in FY-2010, which has resulted in decreased services.



The National Flood Insurance Program and effective floodplain management at the state and local level have also played important roles in reducing long term flood damages.

Table 2. U.S. Army Corps of Engineers Reservoirs

Reservoir or Dam Name	Subbasin Location	County and State
Almond Lake	Chemung	Steuben, N.Y.
Arkport Dam	Chemung	Steuben, N.Y.
Aylesworth Lake	Middle Susquehanna	Lackawanna, Pa.
Alvin R. Bush Dam	West Branch Susquehanna	Clinton, Pa.
Cowanesque Lake	Chemung	Tioga, Pa.
Curwensville Lake	West Branch Susquehanna	Clearfield, Pa.
East Sidney Lake	Upper Susquehanna	Delaware, N.Y.
Indian Rock Dam	Lower Susquehanna	York, Pa.
Raystown Lake	Juniata	Huntingdon, Pa.
Foster J. Sayers Dam	West Branch Susquehanna	Centre, Pa.
Stillwater Lake	Middle Susquehanna	Susquehanna, Pa.
Whitney Point Lake	Upper Susquehanna	Broome, N.Y.
Tioga-Hammond Lakes	Chemung	Tioga, Pa.

2. Water Supply

More than 1,150 public water supply systems currently exist in the basin, including municipal and commercial (e.g., trailer park) facilities. Of this total, 335, 829, and 9 public systems are in the New York, Pennsylvania, and Maryland portions of the basin, respectively. The water supplies for the public systems include more than 233 surface water intakes and 2,346 groundwater wells.

In addition to the public systems, there are many self-supplied water supply sources in the basin. It is estimated that more than 1.7 million of the basin's residents and more than 2,500 commercial and industrial businesses depend on self-supplied sources for their water.

There are currently more than 500 active Commission-approved withdrawals from surface and groundwater sources in the Susquehanna basin serving the consumptive water use needs of more than 350 individual commercial, industrial, municipal and institutional facilities. In addition, over the past five years the Commission has also approved the consumptive use of water for hydraulic fracturing to release natural gas at more than 2,000 well pad locations.

As part of its water supply management efforts, the Commission owns more than 29,000 acre-feet of water storage at Cowanesque and Curwensville Lakes. This storage provides mitigation (i.e. low flow augmentation) for a portion of the consumptive water use in the basin during certain low flow conditions.

3. Wastewater Treatment Facilities

There are nearly 1,700 existing wastewater treatment plants in the basin. Based on information compiled from state datasets, 1,594 plants are in Pennsylvania with 84 and 10 plants located in the New York and Maryland portions of the basin, respectively. These data include facilities for municipalities, schools, mobile home parks, prisons, and subdivisions. A number of large industrial facilities provide their own on-site wastewater treatment.

4. Recreation

The basin's resources provide residents and visitors with excellent opportunities for outdoor, water-based or oriented recreation. Fishing, waterfowl hunting, boating, swimming, hiking, camping, and bird watching are among the activities that can be enjoyed. Recreational features include 79 state parks available for use on approximately 181 square miles (115,562 acres) of public lands having an estimated 397 miles of streams. More than 522 public boat launches along the Susquehanna River and its major tributaries offer excellent access to the waterways. There are 12 designated "Water Trails" in the basin having a total length of 984 miles. A total of 42 moderate to large lakes in the basin offer nearly 57,000 acres of surface area. In addition to parks, waterway access and lakes, there are 154 public forests and 154 game lands in the basin, encompassing a total of almost 4500 square miles of land, respectively. There is an estimated 6,500 miles of streams within the public forests and game lands.



Photo: courtesy PEC

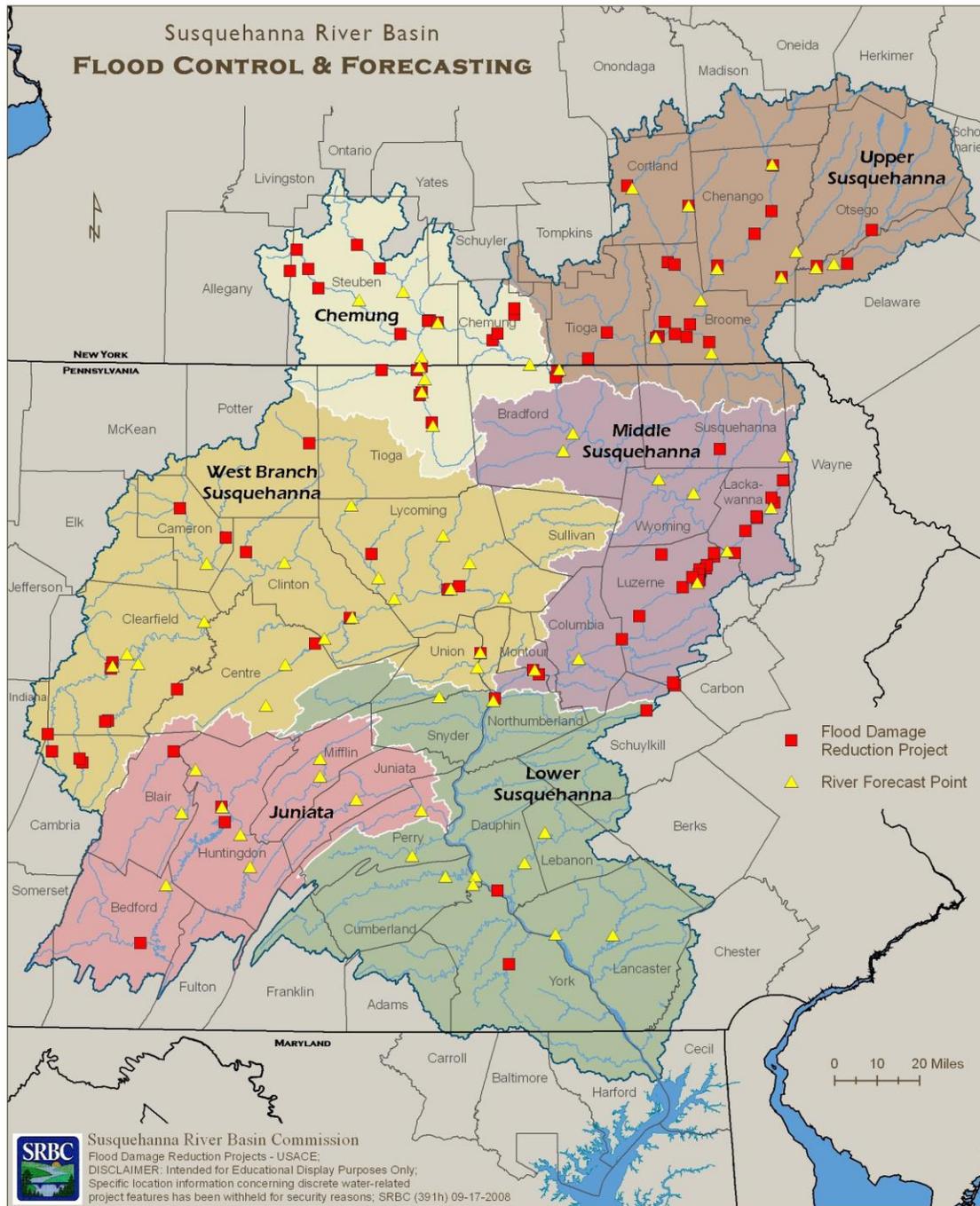
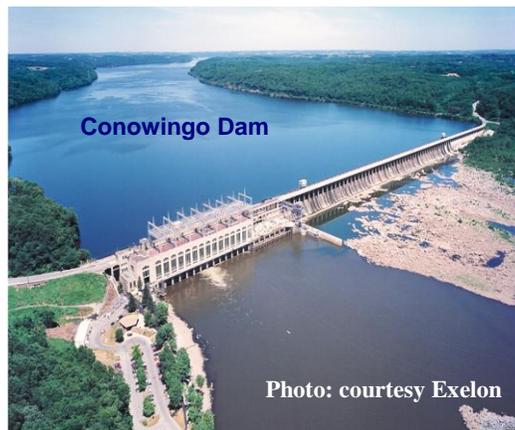


Figure 11. Location of Flood Damage Reduction Projects and River Forecast Points

5. Power Production

There are 23 major electric power generating plants located in the Susquehanna River Basin that use water resources in their operation. The major plants are listed in Table 3 in alphabetical order. Table 4 summarizes the facilities by state, type of operation (i.e., hydropower, fossil fuel or nuclear), capacity and water use data. The power production of the large plants is fed into the electric power grid for widespread residential, commercial and industrial use. There are additional facilities in the basin that generate electric power, but have limited power production and related water use. The small facilities primarily produce power for local use with relatively minor excess power fed into the electrical power grid. For comparison purposes, the 23 large plants have a total power capacity of 15,370 megawatts (MW). The general location of the 23 major power plants is shown in Figure 12.



A new nuclear power plant with an expected capacity of 1,600 MW is also being considered in the Pennsylvania portion of the basin with potential implementation by 2016-2018. Other proposals for new plants and upgrades of existing plants are expected to occur over time and will increase the total power production capacity and water use in the basin.

6. Water Diversions

Water that is transported by man-made means (e.g., pumping) from the Susquehanna River Basin for use outside the basin is considered an out-of-basin diversion. Table 5 lists the existing out-of-basin diversions and their authorized rates. Unless otherwise noted, the diversions were approved by the Commission under its regulatory program. There are also three small in-basin diversions that are approved under regulatory authority to import a maximum of .7 million gallons daily into the Susquehanna River Basin. There are other existing in-basin diversions that did not require the regulatory approval of the Commission.

All water diverted from the basin is considered a consumptive use. Out-of-basin diversions and power plants consumptively use approximately 470 MGD as approved by the Commission. This represents about 65 percent of the consumptive water use for projects approved by the Commission since 1971. All other types of approved consumptive water uses including golf courses, natural gas extraction, manufacturing, mining, educational facilities and other categories total approximately 250 MGD or 35 percent of the total amount approved.

Table 3. Major Power Plants in the Susquehanna River Basin that Use Water Resources to Operate

Power Plant Name	Subbasin	County and State
1. AES Westover Generating Station	Upper Susq.	Broome, NY
2. Allegheny Energy Supply Hunlock Creek Unit - 4	Middle Susq.	Luzerne, PA
3. Archbald Power Station	Middle Susq.	Lackawanna, PA
4. Brunner Island Steam Electric Station	Lower Susq.	York, PA
5. Conowingo Hydroelectric Station	Lower Susq.	Harford, MD
6. Holtwood Hydroelectric Station	Lower Susq.	Lancaster, PA
7. Hunlock Creek Energy Center	Middle Susq.	Luzerne, PA
8. John B. Rich Memorial Power Station	Lower Susq.	Schuylkill, PA
9. Montour Steam Electric Station	West Br. Susq	Montour, PA
10. Muddy Run Pumped Storage Facility	Lower Susq.	Lancaster, PA
11. Peach Bottom Atomic Power Station	Lower Susq.	York , PA
12. PPL Ironwood CCGT Power Plant	Lower Susq.	Lebanon, PA
13. River Hill Power Generation Facility	West Br. Susq	Clearfield, PA
14. Rock Springs Generation Facility	Lower Susq.	Cecil, MD
15. Safe Harbor Hydroelectric Station	Lower Susq.	Lancaster, PA
16. Shawville Generating Station	West Br. Susq	Clearfield, PA
17. St. Nicholas Coal Project	Lower Susq.	Schuylkill, PA
18. Sunbury Generation Facility	Lower Susq.	Snyder, PA
19. Susquehanna Steam Electric Berwick	Middle Susq.	Luzerne, PA
20. Three Mile Island Generating Station	Lower Susq.	Dauphin, PA
21. Westwood Generation	Lower Susq.	Schuylkill, PA
22. York Energy Center	Lower Susq.	York, PA
23. York Haven Hydroelectric Station	Lower Susq.	York , PA

¹Shawville Generating Station is set to deactivate in 2015.

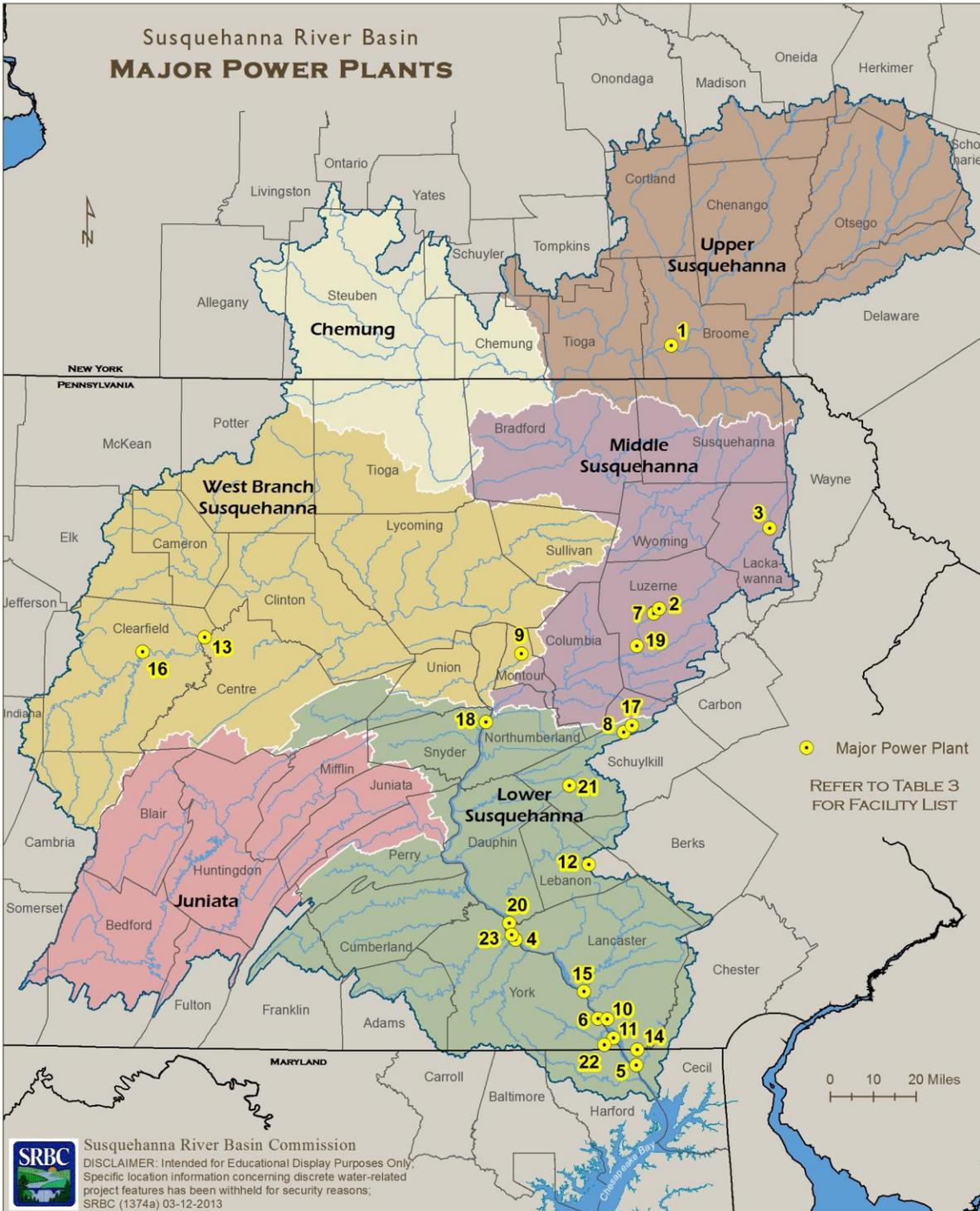


Figure 12. Major Power Plants

Table 4. Power Plant Data

State	Hydro	Fossil	Nuclear	Total	Capacity (MW) ¹	Water Withdrawal Approvals (MGD) ²	Consumptive Water Use (MGD) ³
NY	0	1	0	1	84	97.3	2
PA	4	13	3	20	13,589	3,154	201
MD	1	1	0	2	1,697	1.9	0.3
Total	5	15	3	23	15,370	3,253.2	203.3

¹ Capacity information from U.S. Energy Information Administration, 2012 data; www.eia.gov/beta/state/

² Water use at hydropower plants is not included in totals.

³ Consumptive water use (CU) values are comprised of peak day consumptive use approved by the Commission and estimated peak design consumptive use for plants exempt from Commission regulation. The peak day or design values are therefore greater than the actual CU reported for those plants subject to SRBC regulation.

7. Migratory Fish Passage

Several species of migratory fish (e.g., American shad, blueback herring, and American eel) were once important recreational and commercial resources throughout the Susquehanna River Basin. Construction of the four major power dams on the lower Susquehanna River in the early 1900s ended migratory fish movement into the river system. Modern efforts to restore migratory fish to the Susquehanna River Basin began in the 1950s and continue today. The Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) has set a goal of restoring all migratory fish species in the basin. Major accomplishments toward meeting this goal include installation of fish passages at Conowingo, Holtwood, Safe Harbor, and York Haven Dams located below Harrisburg, Pa. on the lower Susquehanna River, and construction of a shad hatchery along the Juniata River. As a result of the modifications at the dams below Harrisburg, the lower Susquehanna River and much of the Juniata River have been opened to migratory fish passage. The removal of small dams on tributary streams and modifications of other small dams for fish passage are other actions that have taken place in the basin. Figure 13 displays the main river areas that are open to migration and the areas of the basin that are closed due to a number of main stream blockages.



8. Mine Drainage

Coal mining has been an important part of the economy in the basin since the 1800s but has caused many environmental problems. Mine drainage continues to be a significant cause of stream impairment in the Pennsylvania portion of the basin, with close to 2,000 miles of streams negatively impacted. Since the 1960s, significant efforts have been made to treat mine drainage and reclaim abandoned mine lands. Pennsylvania's Operation Scarlift was active from 1968 to 1995 and resulted in more than 500 mine drainage projects. The federal Surface Mining Control and Reclamation Act was enacted in 1977, under the auspices of the Office of Surface Mining, and has resulted in significant funding to address mine drainage treatment and reclamation work.

Table 5. Diversions from the Susquehanna River Basin

Names & Locations of Diversions	Waterbodies or Basins Involved	Authorized Diversions
1. City of Aberdeen, Md.	Deer Creek to Chesapeake Bay	3.0 MGD, but limited to 1.8 MGD as of 2008
2. AES Ironwood, Lebanon, Pa.	Swatara Creek to Delaware basin	4.5 MGD
3. Aqua Pennsylvania – SCI Waymont, at Waymont, Pa.	Middle Susquehanna subbasin to Delaware basin	0.494 MGD
4. City of Baltimore, Md.	Susquehanna River to Chesapeake Bay	250 MGD originally authorized. ¹ Diversion is limited to lesser amounts during certain low flow conditions. ²
5. Berlin Borough, Pa.	Juniata subbasin to Potomac basin	0.498 MGD
6. Chester, Pa. Water Authority	a. Susquehanna River to Delaware basin b. Octoraro Creek to Delaware basin	30 MGD ^{Error! Bookmark not defined.} 30 MGD ^{Error! Bookmark not defined.}
7. City of Dubois, Pa.	West Branch Susquehanna River tributary to Allegheny basin	3 MGD ^{Error! Bookmark not defined.}
8. Franklin County, Pa. General Authority	Conodoquinet Creek to Potomac basin	1.4 MGD
9. Morgantown Properties, L.P., New Morgan Borough, Pa.	Conestoga River to Delaware basin	0.04 MGD
10. New York State Canal Corp. near Bouckville, N.Y.	Chenango watershed to Mohawk basin	18.4 MGD ^{Error! Bookmark not defined.}
11. New York State Canal Corp. near DeRuyter, N.Y.	Tioughnioga watershed to Mohawk basin	4.3 MGD ^{Error! Bookmark not defined.}
12. PA American Water Authority, Coatesville, Pa.	West Branch Octoraro Creek to Delaware basin	2.0 MGD ^{Error! Bookmark not defined.}
13. Town of Perryville, Md.	Susquehanna River to Chesapeake Bay	1 MGD

¹ These diversions pre-date the Commission and were originally authorized by various state actions.

² As set forth in a 2001 Settlement Agreement between the Commission and the City of Baltimore, the diversion is limited to a maximum of 64 MGD (measured as a 30-day average) and 107 MGD on any one day when established trigger flows occur at the Marietta, Pennsylvania gage.

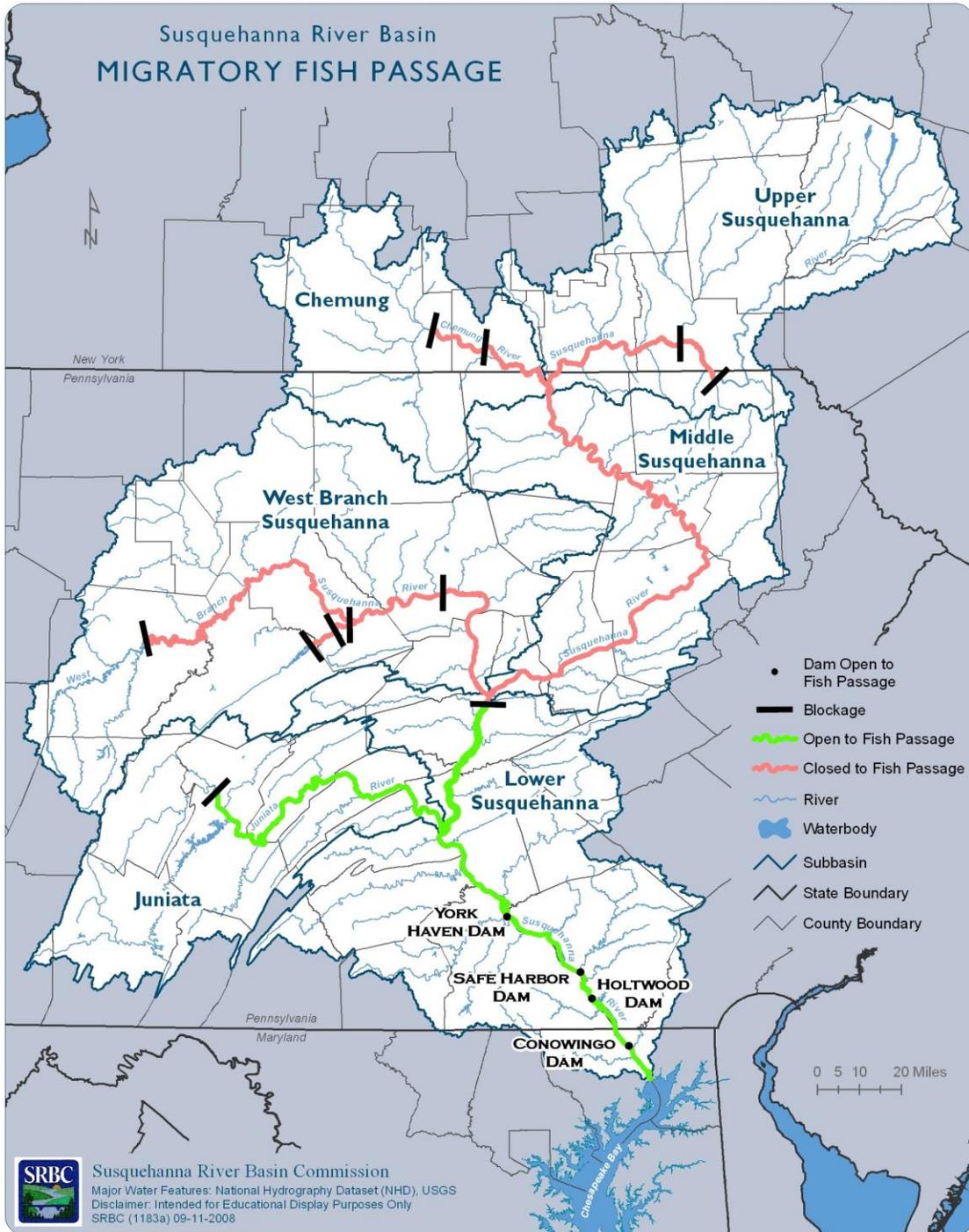


Figure 13. Migratory Fish Passage Conditions

In 1998, Pennsylvania began an initiative called Reclaim PA, which emphasized reclamation and re-mining of abandoned mine lands. The Pa. Department of Environmental Protection has played a major lead role in mine drainage actions in the basin. In addition, several federal agencies, watershed organizations, the Eastern and Western Pennsylvania Coalitions for Abandoned Mine Reclamation, and the coal mining industry have played important roles in reducing mine drainage impacts. As a result of the combined efforts of all parties, a significant number of mine drainage projects and measures have been implemented and stream water quality has been improved. More recently in 2012-13, both the Commission and Pa. Department of Environmental Protection have enacted policies encouraging the use of mine drainage and lesser quality waters by industry and others, and are exploring the possible beneficial reuse of mine pool water for consumptive use mitigation.



9. Projects, Plans and Other Actions Incorporated into the Comprehensive Plan

The Commission has incorporated certain projects, plans and other actions into its Comprehensive Plan since the 1970s. Actions to incorporate measures into the Plan were taken by resolutions, approval of dockets, or other formal means by the commissioners in public sessions. All projects, plans and other actions were reviewed by Commission staff before being recommended to the commissioners for approval. During preparation of the 2008 Comprehensive Plan, a review of all projects and other actions previously incorporated was made. Most of the measures were retained but some were identified for deletion from the Plan, primarily because (1) they had not been implemented as planned, (2) had become inactive for a substantial time, or (3) were modified for a subsequent new incorporation action.

Appendix 2 contains lists of the projects, plans and other actions that have been incorporated into the Comprehensive Plan from 1971 through 2013, but not including those deleted items as discussed above. The historical record is organized by lists of (1) federal and state projects, (2) plans, policies, programs and regulations and (3) Commission-approved water use projects.

Future projects, plans and other actions will be incorporated into the Comprehensive Plan in two ways. First, the Commission will incorporate all water use projects approved under its regulatory program. Unless otherwise determined by the Commission, projects approved under the regulatory program will be incorporated by reference into the Plan. Separate and specific actions will be taken to incorporate those projects that the Commission determines should not be incorporated by reference.

Second, other water resource projects, plans, and other actions (e.g., policies, programs, and regulations) will be considered for incorporation by the Commission on a case-by-case basis. Measures can be proposed for incorporation into the Plan by project proponents, member jurisdictions, or the Commission itself. During review of proposed measures, consideration will first be given to their scope and significance. If warranted, a more in-depth consideration of key factors will be made. The factors include:

- Immediate and long-range beneficial management and development of the water resources of the basin.
- Optimum planning, development, conservation, utilization, management, and control of the water resources of the basin to meet present and future needs.

- Findings and recommendations of the signatory members, their political subdivisions, and interested groups.
- Effect of the project upon receiving waters of the Chesapeake Bay.
- The planning objectives of national economic development, environmental quality, social well-being and regional development.
- Integration of water resource planning and development actions with land use planning.
- Inherent public rights attached to all waters of the basin held in public trust.

More detailed information on the evaluation of proposed projects is contained in Part III, Section B, of the Plan. Based upon the results of the review, a decision will be made on whether to incorporate a proposed measure into the Comprehensive Plan.

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PART II - ASSESSMENT OF WATER RESOURCE NEEDS IN THE BASIN

Water is an essential need for all life and can both enhance and detract from quality of life. Dependable water supplies and good water quality are important, for example, to public health and welfare, economic development, and environmental protection. Sustained low flows, poor water quality, and serious flooding have adverse effects on the public, economy, and environment. Effective water resource management requires a balanced approach to maintain or improve the dependable quantity and quality of water and to reduce the impact of flow extremes.

Important considerations in water resource management in the Susquehanna River Basin are certain key public values to include recreation, tourism, economic viability, and historic, scenic and other natural amenities. The Commission considers issues identified during the evaluation of projects and proposals for development, use and management of the water resources of the basin. The potential for incompatibility of a proposed project with a public value(s) in the locality for which they are planned is an example of an issue that could be considered.

Sustainable practices, including those that replicate natural function, are needed to provide the right amount of clean water at the right times to communities, activities, and ecosystems throughout the basin. Where possible, sustainable practices are considered and incorporated into the goals and activities described in this Comprehensive Plan (See Part IV – Priority Management Areas), to help provide sustainable water supplies, improve the quality of those supplies, and improve resiliency to flood events.

This portion of the Comprehensive Plan provides an overview of the water resource needs in the Susquehanna River Basin that fall within the programs and responsibilities of the Commission. The basin needs have been organized into six categories related to: (1) sustainable water development, (2) water quality; (3) flooding; (4) ecosystems; (5) the Chesapeake Bay; and (6) coordination, cooperation, and public information. A discussion of each category of needs and the issues addressed by the Commission follows.

A. Sustainable Water Development

The water resources of the Susquehanna River Basin are abundant and renewable, due to an average annual precipitation of 42 inches. Normally, there are ample groundwater and surface water resources available for drinking water, freshwater inflow to the Chesapeake Bay, agricultural and industrial activity, power generation, recreational opportunities, and ecological diversity. Even with a natural abundance of water, the resource is neither limitless nor always distributed across the basin in time, location, and quantity commensurate with existing and future demands. In addition, infrastructure problems (e.g., leakage and water delivery issues) can exacerbate water supply problems.



A growing population in the basin will require more water and major industrial water users, such as power generation companies, will continue to look to basin water resources in order to increase their production output. In addition, there are growing demands for water to be diverted from the basin to meet out-of-basin water supply needs. Current examples of out-of-basin needs are those for Aberdeen and Baltimore, Md., and Gettysburg, Pa. The demand for water associated with natural gas extraction is expected to continue to be active. Preliminary

estimates suggest that the total quantity of water consumptively used for hydrofracturing will eventually reach approximately 30 million gallons per day. As the demand for water increases, so does the challenge of managing the resource to avoid shortages and conflicts, including water use efficiencies. This challenge is particularly difficult during drought periods which occur periodically in the basin and may become even more extreme due to climate change. Estimates of population for the basin in 1990, 2000, and 2010 were made using census data and projections to 2030 were made using best available information. Table 6 summarizes the population information by time period for the six major subbasins and the entire basin.

Table 6. Population of the Susquehanna River Basin (1,000's of people)

Major Subbasin	1990 ¹	2000 ¹	2010 ¹	2030 ²	Change – 2010 to 2030	
					Number	Percent
Upper Susquehanna	499	489	490	481	-9	-1.87
Chemung	231	225	223	208	-15	-7.2
Middle Susquehanna	708	697	703	689	-14	-2.0
West Branch Susquehanna	455	475	488	493	+5	+1.0
Juniata	306	313	315	305	-10	-3.3
Lower Susquehanna	1,613	1,762	1,934	2,167	+233	+10.8
Basin Totals	3,812	3,961	4,153	4,343	+190	+4.4

The projected increase from 2010 to 2030 for the basin of 190,000 people is due to the increase of 233,000 in the Lower Susquehanna Subbasin. This subbasin is the most densely populated area of the basin and is forecast to contain nearly one-half of the basin's population by 2030. Clearly, water supply demands in the Lower Susquehanna Subbasin will require close management attention to balance the needs, environmental protection, and economic development. All other subbasins will also have areas of growth that will require close attention. A particular concern is for areas which are now potentially stressed due to the demand for water resources approaching or exceeding the sustainable limit. Part IV-A2 discusses potentially stressed areas, many of which are in the Lower Susquehanna River Subbasin.

Based on an average daily use of 100 gallons per capita, an increase in the basin of 190,000 people would result in an increased need of 19 million gallons (MGD) of water supply per day. Most of this water (90% +/-) will be returned to the basin and not consumptively used. In comparison, existing power plants use an estimated 3,253 MGD with 203 MGD being consumptively used (see Table 4). Increased population can also impact other water resource needs related to water quality, flooding, ecosystems, and the Chesapeake Bay. However, it is believed effective water resource management and regulation by federal, state, and local interests as well as the Commission will minimize increased adverse impacts in these areas.

¹ 1990, 2000, and 2010 data are based on census block information prorated by geographic area of census blocks contained in each major subbasin.

² 2030 data are based on county population projections from the New York State Data Center (Empire State Development), Pennsylvania State Data Center (Pennsylvania State University), and Maryland State Data Center (Maryland Department of Planning) applied to 2010 census block information prorated by geographic area of census blocks contained in each major subbasin.

The particular water development needs that have been identified for the Commission to consider are: (1) sustainability of water supply for various uses in the basin, (2) equitable allocations of water for various uses, including protecting instream flows and the receiving waters of the Chesapeake Bay, (3) mitigation of drought impacts, (4) management of water diversions to avoid resource impacts, (5) management of consumptive water use to avoid resource impacts, and (6) effective regulatory compliance measures.

B. Water Quality

Good water quality is needed for all facets of life and is essential to well balanced watershed management. The vast majority of surface and groundwater sources in the basin exhibit good water quality as well as varied and extensive biological activity. However, degraded quality in some of these waters limits their use and requires costly treatment to make withdrawals from them acceptable for use. Mine drainage, agriculture, and urbanization are the leading causes of surface water impairment in the basin, with localized problems resulting from transportation activities, malfunctioning septic systems, and other sources. Groundwater quality issues in portions of the basin include elevated iron, manganese, nitrates, organic, and microbial contaminants.



Susquehanna River near Windsor, N.Y.

The overall water quality need in the basin is the achievement of established water quality standards so that water bodies can meet their designated uses over the long term. Examples of designated uses are warm water aquatic ecosystems, public water supply, recreational fishing, and exceptional value and high quality. The Commission does not have a regulatory responsibility in the area of water quality, but can and does play an important role. First, water quality impacts of projects are considered in regulatory decisions involving water withdrawals, consumptive water use, and out-of-basin diversions. Second, Article 5 (Section 5.2) of the Compact mandates a primary coordination role for the Commission. Section 5.2 states: “In order to conserve, protect, and utilize the water quality of the basin in accordance with the best interests of the people of the basin and the states, it shall be the policy of the Commission to encourage and coordinate the efforts of the signatory parties to prevent, reduce, control, and eliminate water pollution and to maintain water quality as required by the Comprehensive Plan.”

The particular water quality needs that have been identified for the Commission to consider are: (1) support for and coordination of the member jurisdiction’s water quality efforts, (2) monitoring and assessment of the quality of the basin’s waters to support restoration and protection efforts, (3) development, support, and implementation of measures to remediate and enhance the basin’s water quality, (4) protection of the basin’s biological resources and sources of public drinking water supply, and (5) enhancement of the water quality data program.

C. Flooding

The Susquehanna River Basin is one of the most flood prone watersheds in the country. The basin is susceptible to the impacts of tropical weather systems, intense thunderstorms, snowmelt and ice jams, and has a varied topography that creates rapid runoff scenarios. Floods are natural events whose effects often, and dramatically, result from the vulnerability of public and private development on the basin’s flood plains. Tremendous flood damages occurred in several historical events, including the March 1936 flood, and the Tropical Storm Agnes flood in June 1972 that left an unprecedented trail of destruction behind. In the past decade, two major flooding events were the June 2006 flood along the Susquehanna River in New York State, and the September 2011

flood caused by the remnants of Tropical Storm Lee in the Chemung Subbasin and the Upper, Middle and Lower Susquehanna Subbasins. Both floods resulted in record flood crests in portions of the basin. The substantial record of past flood destruction, together with the reality of future floods, clearly demonstrates the need for additional and improved flood hazard mitigation in the basin.

Numerous structural flood control projects, such as dams and levees, have been developed within the Susquehanna River Basin. These projects have saved lives and prevented many millions of dollars in flood damages. Nonstructural measures to foster flood preparedness, response, and recovery have also been developed and include public education and outreach, flood forecasting and warning, the National Flood Insurance Program, and floodplain regulations. Despite these efforts, the potential in the basin for extensive flood damage remains high. Implementation issues for additional major structural projects, including high costs and environmental impacts, mean they will receive limited application in the future. However, the proper application of additional nonstructural flood damage reduction measures can result in further reduction in flood losses at a much lower cost with little or no environmental impact.



The particular flood hazard mitigation needs that have been identified for the Commission to consider are: (1) continued operation, maintenance and enhancement of the Susquehanna Flood Forecast and Warning System, (2) protective flood plain management activities by member jurisdictions, (3) improvements in community flood preparedness, and (4) reduction of man-made debris in the basin's waterways and into the Chesapeake Bay.

D. Ecosystems

Healthy ecosystems in the Susquehanna River Basin are needed to support a vast array of water resource needs in the basin to include sustainable water supply, good water quality, biological productivity and species diversity, recreation, and the ecological health of the Chesapeake Bay. Water quantity and quality are interdependent and equally important to the health of aquatic ecosystems. Ecosystems in the basin range in size from relatively small areas such as individual forests or wetlands to much larger areas such as major streams and watersheds. Humans are one of the most influential living components of most ecosystems.

The overall need in the basin is the achievement of healthy ecosystems that provide groundwater and surface water of sufficient quality and in adequate supply to support abundant and diverse populations of aquatic, riparian, and terrestrial organisms, and provide resources for human use. Existing, healthy ecosystems warrant protection, while degraded ecosystems should be restored to healthy status. In general, it is far more cost-effective to maintain and protect healthy systems than to take corrective action after degradation has occurred. The particular ecosystem needs that have been identified for the Commission to consider are: (1) monitoring and assessment of ecosystems to provide data needed for effective watershed management, (2) protection and restoration of biological resources in the basin, and (3) restoration of populations of migratory fish throughout the Susquehanna River system.

Susquehanna basin wetland



E. Chesapeake Bay

The Chesapeake Bay is the largest estuary in the United States and supports a wide array of habitat types and aquatic life. The Bay's living resources are also economically important, supporting the regional economy as a major source of seafood, with an annual harvest worth \$1 billion. Other activities dependent on a healthy Bay and its fish and wildlife resources are vast recreational opportunities and tourism.

The ecology of the Bay is both important and complex, with a major contributor being the Susquehanna River, which provides about 50 percent of the total freshwater inflow into the Bay. Low flow and consumptive water use management in the Susquehanna basin are important to ensure the adequacy of river flows into the Upper Bay. The Commission plays a key role in this management effort by regulating withdrawals and consumptive uses of water in the Susquehanna basin. The Compact states, "The comprehensive plan shall take into consideration the effect of the plan or any part thereof upon the receiving waters of the Chesapeake Bay."



Photo: M. House

Restoration of the Chesapeake Bay encompasses a large program involving all levels of government, the private sector and citizens. The particular needs related to Chesapeake Bay that have been identified for the Commission to consider are: (1) identification of the minimum freshwater inflows needed from the Susquehanna River, (2) development and implementation of measures to address the minimum flow requirements, and (3) support for the sediment and nutrient reduction strategies developed for the Susquehanna River Basin..

F. Coordination, Cooperation, and Public Information

Water resource use, development and management in the Susquehanna River Basin involve the administration of programs of a large number of governmental agencies. This can result in a splintering of authority and responsibility, an inefficient use of scarce governmental resources, and inconsistent treatment of water users. Effective communications, coordination, and cooperation among these entities are desirable to minimize causes of potential controversy and resolve conflicts.

The Commission was established as a chief agency to foster coordination in the basin, but the member jurisdictions remain as the chief stewards of their own natural resources. In order to do so in the most efficient and effective manner, the offices and agencies of the jurisdictions need to work together under the coordinative oversight of the Commission. However, the Commission may assume jurisdiction in any matter affecting water resource whenever it determines the effectuation of the comprehensive plan or the implementation of the Compact so requires. Providing an effective program for disseminating water resource information to the public is also a key responsibility of the Commission.

There are continuing needs for good coordination and cooperation among the many entities involved in the basin's water resources and for providing information to the public. The particular needs that have been identified for the Commission to consider are: (1) use of interagency committees and ad hoc committee mechanisms, (2) use of memoranda of understandings with member jurisdictions, (3) support for uniform water management policies and standards, (4) coordination of major interagency efforts such as flood forecasting and warning, drought management, and hydropower license renewal, (5) providing information on basin water resource matters to legislators and policy makers, (6) effective means to inform the public, and (7) enhanced public access to Commission information and public comment on Commission activities.

PART III - PRINCIPLES, GUIDANCE, AND STANDARDS

The Commission executes its mission in accordance with a set of general principles, project guidance, and project standards that are essential for effective water resource planning and management. These considerations jointly form the basis for Commission programs and activities that are consistent, equitable and well founded. Furthermore, they better enable the Commission to meet its duties and responsibilities and advance the goals of the Compact.

A. General Principles

The Commission employs a number of important principles in its management of the water resources of the Susquehanna River Basin. These principles give direction to both Commission efforts and those of others in planning for the conservation, management, development, and use of the water resources of the basin. The principles are:

1. Watersheds should be utilized and promoted as the best units for water resource planning and management.
2. There are inherent public rights attached to all waters of the basin held in public trust for navigation, recreation, and protection of the fishery resources, and preservation of the natural, scenic, historic and aesthetic values of the environment without undue restriction, disruption or degradation by other uses; provided however, that nothing herein shall be construed as affecting or intending to affect or in any way to interfere with the law of the respective member jurisdictions to the Compact relating to riparian rights.
3. The optimum use or combination of uses of the basin's water and related natural resources should be promoted to address foreseeable immediate and long-range demands in a balanced, efficient and timely manner under sustainable development principles.
4. The multiple planning objectives of economic development, environmental quality, and social welfare should be considered so as to facilitate reasoned, balanced choices.
5. Surface and groundwater resources should be managed as an integrated unit, recognizing that the chemical, biological and physical aspects of ground and surface water systems are interrelated; that natural processes and human activities affect these interactions; and that ground and surface waters are inextricably linked parts of the same resource and cannot be managed separately.
6. The water resources of the basin should be managed on an integrated basis and with a recognition of the interrelationship between land and water resources, that those resources are finite, and that their development and utilization on a sustainable basis is vital to the basin's ecological, economic and social well-being.
7. Decision-making should be based on sound scientific principles and policies, consistent with requirements in law and regulations, with due regard to both water quantity and water quality considerations.
8. Public input and involvement in the water resource planning and management process should be actively sought and encouraged.
9. Water resource planning and management efforts should be coordinated with local, state, and federal agencies and with the private sector.
10. Coordination and cooperation among the member jurisdictions in matters of water resource management should be promoted so as to avoid or minimize conflicts related to the basin's water resources and foster amicable solutions when conflicts do arise.
11. The Commission should utilize the offices and agencies of its member jurisdictions in the effectuation of this Plan so as to preserve and benefit from their function, powers and duties.
12. The development of long-term local capability to foster local stewardship of water resources should be encouraged and promoted.
13. All users of water and water-related facilities should be afforded equal and uniform treatment without regard to political boundaries.

14. The drought management activities of member jurisdictions should be coordinated to enhance their effectiveness and minimize adverse impacts during droughts.
15. Sound water conservation practices and policies should continue to be integrated into the Commission's regulatory program and their use should be promoted with all water users throughout the basin.
16. Proper management of floodplains and stream corridors is integral to effective water resource management, to protection of the health and safety of persons and property in the basin, and to protection and restoration of natural and beneficial stream and floodplain functions.
17. Flood mitigation efforts, both structural and nonstructural, are essential to reducing the impacts of flooding in the basin, including preventing loss of life and minimizing future flood damages.
18. The efforts of the member jurisdictions to minimize flood-related impacts through effective flood plain management, including restrictions on development and relocation of existing development, and the regulation of encroachments should be encouraged and coordinated.
19. For planning purposes only, diversions existing prior to the effective date of the Compact should be recognized and identified in the Comprehensive Plan; provided, however, that such recognition should not in any way be construed as limiting the review and approval authority of the Commission under the Compact or Commission regulations.
20. The diversion of water from the basin should be discouraged in order to conserve, protect and utilize the water resources of the basin in accordance with the best interests of the people of the basin and the Commission's signatory members. Any diversion of water into the basin that may result in the introduction of invasive species or water quality degradation should likewise be discouraged.

B. Project Guidance

While the general principles give overall, broad direction to both Commission efforts and those of others in dealing with the water resources of the basin, more specific guidance is needed for the development and implementation of projects. The project guidance listed below outlines a sound basis for rational, well-considered decisions among alternatives or competing uses of basin water resources, and forms major considerations upon which the Commission will evaluate project proposals of federal, state, local and private sectors.

1. Projects should provide for beneficial water resource management and development.
2. Proposed projects and programs should consider appropriate combinations of nonstructural and structural measures with due regard given to the benefits accruing to natural functions of streams/rivers and their watersheds.
3. Proposed projects should consider the potential impact on upstream and downstream areas and uses.
4. Development and use of water resources should be planned and managed to assure that such actions do not adversely affect the quantity and quality of flow in such a manner as would disrupt seasonal salinity, circulation patterns and biological productivity of the Upper Chesapeake Bay.
5. The average annual base flow (recharge) available in the contributing watershed during a 1-in-10-year average annual drought should be considered to be the sustainable limit of groundwater development.
6. The conjunctive use of water sources to meet water supply needs should be encouraged. Conjunctive use is the combined use of two or more sources to optimize availability and minimize adverse impacts.
7. The demonstration of need for proposed increases in water supply allocations should include: a) the allocation shall not exceed reasonably foreseeable future maximum day demands, and b) the amount of system water loss is reasonable and in conformance with the Commission's water conservation regulations. The least costly means for meeting water supply needs consistent with environmental quality and resource conservation objectives and goals should be given the highest consideration.
8. Water supply allocations should not be granted which exceed the available yield of the source, and where demand is projected to exceed such yield in the future, project sponsors should be required to develop adequate additional sources by the projected date when demand will exceed the current available yield.
9. In any area of the basin where demand for water supply has developed or threatens to develop to such a degree as to create a water shortage or impair or conflict with the requirements or effectuation of this

Comprehensive Plan, the Commission may designate such area as a protected area, as provided for in the Compact, and may establish special regulatory standards for the utilization of water in such areas.

10. Provisions should be made for preservation of long-term natural hydrologic variability of streams through ecosystem-based flow goals for normal stream maintenance; for protection of aquatic species, natural communities, and habitat and key ecological processes; and for other purposes. A comprehensive approach to meeting environmental flow protection objectives should include such streamflow protection measures as passby flows, conservation releases and withdrawal limits.
11. Proposed projects that include withdrawals from surface water or groundwater should be limited to the amount (quantity and rate) of water that can be withdrawn without causing long-term progressive lowering of groundwater levels or streamflow, rendering competing supplies unreliable, causing water quality degradation that may be injurious to any existing or potential ground or surface water use, affecting fish, wildlife or other living resources or their habitat, causing permanent loss of aquifer storage capacity, or having substantial impact on low flows of perennial or intermittent streams.
12. Project proposals should recognize the high public value of wild and scenic river reaches, scenic and historic areas, headwaters, open space, other natural amenities, and recreational use of waters while also addressing preservation of any valued resources potentially impacted.
13. Migratory fish passage is an essential element of migratory fish management and restoration planning, and should be incorporated, where appropriate, into projects in a manner consistent with such management and planning objectives.
14. Dredging or other human alterations of stream banks, channels and wetlands which may adversely affect the quantity or quality of surface or groundwater, fish and wildlife habitat or other environmental or cultural values should be carefully planned and controlled to minimize their adverse effect and be avoided whenever possible.
15. New proposals for installation of hydropower should consider the potential for both peaking and non-peaking operations, and should provide sufficient information to evaluate the tradeoff between the value of the power and the environmental impacts of both types of operation.
16. New proposals for installation of hydropower facilities at existing dams should identify both the costs and benefits of reallocation of storage as well as costs and benefits based on existing storage allocations and operations, unless the operation is run-of-river at all streamflows.
17. As part of relicensing with the Federal Energy Regulatory Commission, hydroelectric facilities should be required to enhance recreation, including boating opportunities, fish passage, fishery access and portage provisions, and other navigational concerns.
18. Thermoelectric facilities should be required to evaluate the costs, benefits, trade-offs and drawbacks of various cooling and water conservation techniques, and fully evaluate options for providing effective consumptive use mitigation.

C. Project Standards

Project standards are the requirements set forth in Commission regulations or those otherwise applicable to projects as a matter of policy, including the following:

1. Projects shall be developed and operated consistent with the policies of the Commission and this Comprehensive Plan, and in compliance with all conditions of approval and all regulations of the Commission.
2. No allocation of waters made by the Commission shall constitute prior appropriation of the waters of the basin or confer any superiority of right in respect to the use of those waters.
3. The provisions of 18 CFR Part 801, including any amendments thereto hereafter made, are hereby incorporated by reference into this Comprehensive Plan.
4. The provisions of 18 CFR Parts 806-808, including any amendments thereto hereafter made, are hereby incorporated by reference into this Comprehensive Plan.

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PART IV - PRIORITY MANAGEMENT AREAS

The mission of the Susquehanna River Basin Commission – covered in Part I – is to enhance public welfare through comprehensive planning, water supply allocation, and management of the water resources of the Susquehanna River Basin. By virtue of the Compact, the Commission has powers and authorities to act on a broad range of water resource issues, provided that the actions taken do not duplicate those of the existing offices and agencies of its member jurisdictions.

Over the years, the Commission has focused its resources to effectively accomplish its mission and meet its responsibilities. For the purposes of this Comprehensive Plan, the Commission has grouped its management responsibilities into six key water resource needs that have been identified as “priority management areas.” These management areas are: (1) sustainable water development; (2) water quality; (3) flooding; (4) ecosystems; (5) Chesapeake Bay; and (6) coordination, cooperation, and public information.

Actions taken by the Commission in these priority management areas are carefully considered so that deference is given to the member jurisdictions’ responsibilities, as appropriate. This management approach has been used by the Commission since its inception in 1971 and has proven to be mutually beneficial to the Commission, its member jurisdictions, and the citizens of the basin.

A vision of future conditions in the basin has been developed based on the belief that water resource management in the basin will be effective and successful. The vision statement serves as a focused objective for the Commission’s efforts in addressing the needs and meeting desired results over the long term. The statement is contained in the Comprehensive Plan preceding the executive summary.

Each of the six priority management areas covers desired results, goals, and both ongoing Commission activities and actions needed to meet the goals. The ongoing activities are currently being accomplished in the work programs of the Commission. An example of an ongoing activity that is common to all of the priority management areas is the utilization of new technology to collect and analyze data, disseminate information, improve systems, etc. Actions needed are those items that are new or require additional emphasis by the Commission. Achieving the goals and taking the actions are, of course, dependent on the resources available to the Commission over the long term. A good faith effort will be made to succeed in all priority management areas and resources will be allocated accordingly.

A. Sustainable Water Development

1. Desired Result

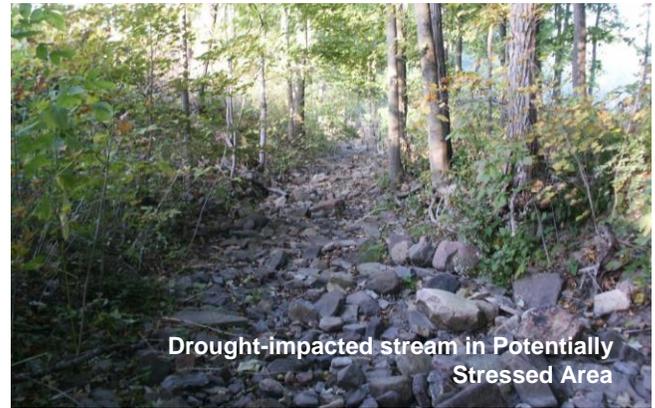
To regulate and plan for water resources development in a manner that maintains economic viability, protects instream users, and ensures ecological diversity; and meets immediate and future needs of the people of the basin for domestic, municipal, commercial, agricultural and industrial water supply and recreational activities.

2. Discussion of Issues

Ensuring sustainable development of water supplies involves a number of key principles including: (1) water supplies or combinations of supplies must be reliable, (2) impacts to instream needs must be minimized, (3) appropriate flows to the Chesapeake Bay must be maintained, (4) water supplies must be adequate during droughts to obviate the need for emergency intervention by the Commission or its member jurisdictions, (5) potential natural water supply shortages must be recognized, (6) long-term flow reductions

due to consumptive water use, loss of groundwater recharge and increased surface runoff must be mitigated, and (7) a basin-wide compliance and enforcement program committed to the judicious enforcement of Commission regulatory requirements must be in place.

The Susquehanna River Basin is considered largely water-rich with ample groundwater and surface water resources that are important for drinking water, freshwater inflow to the Chesapeake Bay, industrial activity, power generation, recreational opportunities, and ecological diversity. The water resources, however, are neither limitless nor equally distributed across the basin, resulting in some areas being identified as Potentially Stressed Areas or as Water Challenged Areas by the Commission (see Figure 14 and Part V-K). In Potentially Stressed Areas, the demand for and use of water resources are potentially approaching or have exceeded the sustainable limit. Such areas may exhibit diminishing water levels and expanding dry stream reaches. To address these and other emerging areas of concern, water managers must recognize and plan for the possibility of shortages related to droughts and competing uses. Water Challenged Areas have natural conditions that strongly limit the amount of water resources available and will support very little water resource development without significant adverse impacts. As such, these areas should be identified for potential applicants for consideration of alternatives in their planning process and be actively managed for sustainability of all water uses.



Drought-impacted stream in Potentially Stressed Area

Projections for the basin indicate a growing population that will require more water for domestic and economic needs, while the energy sector – the largest consumer of water in the basin – continues to look to basin water resources for use in generating more power and extracting fuels. Drilling for natural gas presents an immediate need. The rapid development of wells and water withdrawal sites, along with their locations – often in heretofore undeveloped and ungaged areas – necessitates considerable expenditure of staff effort for review of withdrawals to meet the water demand. Based on communications with gas companies, land owners and mining agencies, Commission staff expects the demand for water associated with gas extraction to continue to be active. Preliminary estimates suggest that the total quantity of water consumptively used for hydrofracturing will eventually reach approximately 30 million gallons per day.

As the demand for water increases across all sectors, so too does the challenge of managing the resource to avoid shortages and conflicts. There are four principal causes of water availability shortages: (1) natural drought, (2) oversubscription of a watershed's supply, (3) reduction of natural flows due to consumptive water use, and (4) loss of groundwater recharge. While droughts are part of the natural hydrologic cycle and cannot be controlled, proper planning and allocation to avoid overuse can help a watershed's supply withstand the impacts of droughts. Climate change is another factor that appears to be an increasing reality, with the potential to cause extreme weather swings and severe droughts.

It is incumbent upon water managers to mitigate for consumptive water use and loss of groundwater recharge to sustain instream flows and appropriate flows to the Chesapeake Bay. The failure to plan for sustainable water supplies increases the potential for insufficient supply during droughts to meet system demands, maintain minimum releases and consumptive loss compensation requirements. This may result in deficiencies for other purposes, including maintenance of water quality.

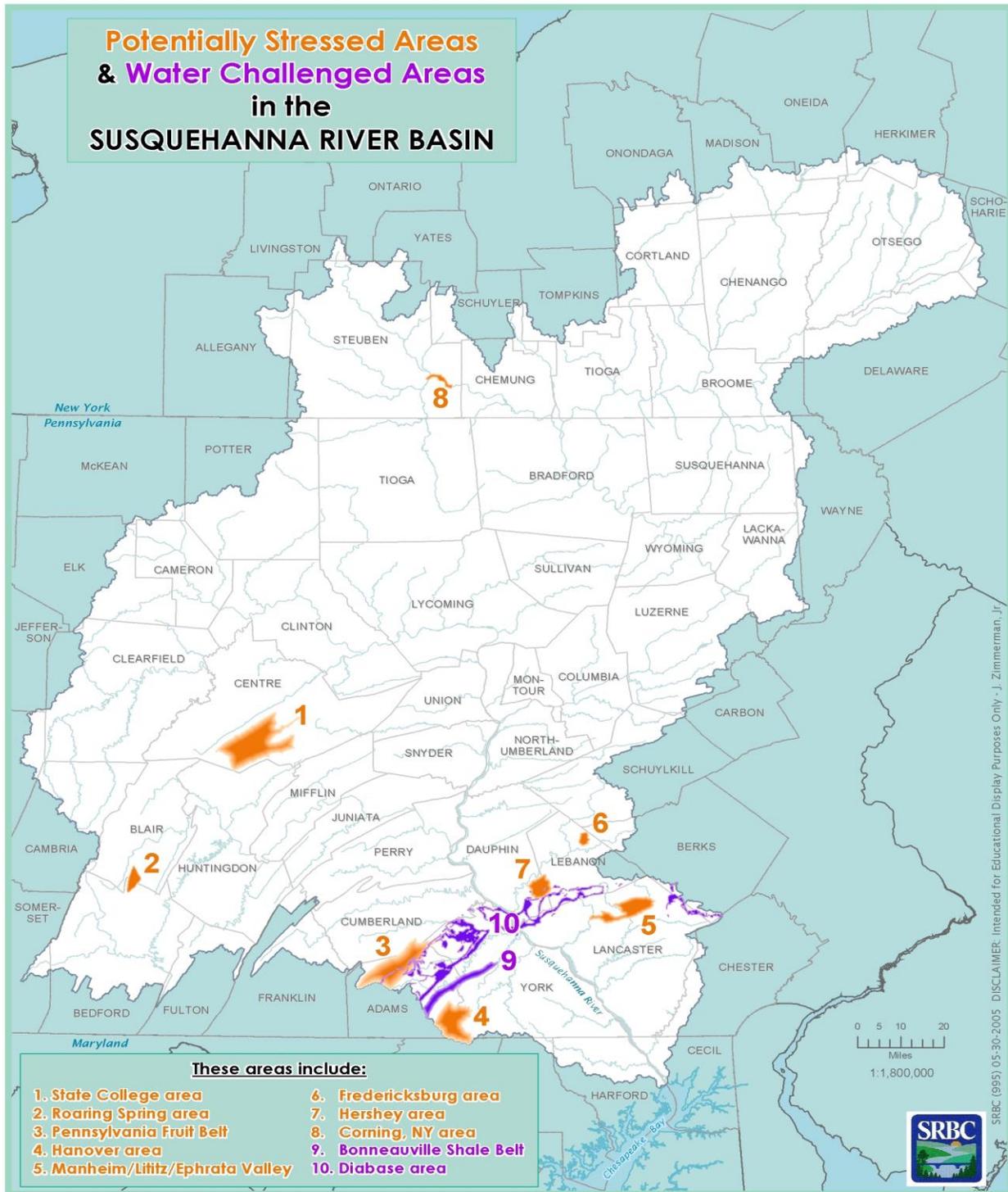


Figure 14. Potentially Stressed and Water Challenged Areas

The Commission is actively engaged in the completion of a cumulative water use and availability study of the entire basin. This study addresses the direct and cumulative effects of water withdrawals and consumptive uses associated with all water users including the shale gas industry. In addition, the Commission continues to conduct a wide array of studies that involve the ongoing monitoring of water quality within the basin as described under Priority Management Area B – Water Quality. Some of the ongoing water quality studies were specifically designed to monitor potential impacts associated with shale gas development.

The Commission does not have the responsibility to regulate or assess the potential impacts of shale gas development on the land, wildlife, or drinking waters of the basin. That responsibility rests with the Commission’s member jurisdictions, and is being addressed by those jurisdictions. This limitation of Commission authority was an intentional decision by the framers of the Susquehanna River Basin Compact to avoid duplication of governmental efforts.

3. Goals

Seven goals have been established to achieve the desired results and are discussed below. For each goal, ongoing Commission activities and actions needed are identified.

Goal a. Support and encourage the sustainable use of water for domestic, industrial, municipal, commercial, agricultural, and recreational activities in the basin.

Through planning and regulatory actions, the Commission should strive to manage water resources beginning at the watershed level, based on a 15-year planning horizon, to assure short-term resource availability and long-term balance between healthy ecosystems and economic viability. Commission programs should also serve to promote sustainability in all water uses, including recreation, with the goal of establishing drought-resistant systems. Recreational water use promotes public appreciation for healthy waters and serves as a catalyst to encourage protection and restoration.

Because of the decentralized and water intensive nature of the natural gas industry, the Commission continually pursues refinements to regulations and policies in response to water use demands and trends. Challenges include the targeting of headwater and high quality streams, availability of multiple competing sources, intermittent usage, and the assessment of foreseeable demands.

Ongoing Commission Activities:

1. Support the sustainable use of water through the Commission’s regulatory project review and planning activities, through public education and outreach efforts, and through solicitation of the necessary guidance from the Water Resources Management Advisory Committee.
2. Assess the potential for climate change to impact the hydrology of the basin and the potential implications to the basin’s water availability and the occurrence and severity of floods and droughts.

Actions Needed:

1. Complete a Cumulative Water Use and Availability Study to comprehensively evaluate cumulative consumptive water use, determine water availability at varying spatial scales, consider establishment of locally sustainable limits for water use, and assess alternatives for avoiding, minimizing or mitigating potential impacts to the water resources of the basin.
2. Determine water availability through water budget assessments (analysis of demand increases and expected base flow levels) to establish local sustainable limits for water use development.
3. Protect healthy ecosystems and instream flow needs, including recreation.

4. Identify additional Potentially Stressed Areas, address incidental distribution losses of water in approved projects, and implement the recommendations contained in the 2005 Groundwater Management Plan.
5. Assess potential impacts of increased water use and the potential to temper increases through conservation and water reuse, particularly in Potentially Stressed Areas, and otherwise manage water resources for sustainability.
6. Support efforts by member jurisdictions to safeguard groundwater recharge by preserving recharge contributing areas.

Goal b. Maintain an equitable system for allocating water for various uses, including the protection of instream flows and receiving waters of the Chesapeake Bay.

The Commission was created by a federal-interstate compact, with signatories to the Compact recognizing their combined interests in the coordinated management of the water resources of the Susquehanna River Basin. The agency is charged with continually balancing water resource needs to enable economic growth while protecting the environment. The Commission's regulatory program provides statutory requirements to evaluate water resource needs and make determinations that maintain this delicate balance, and staff is required to review any changes to the purpose or quantity of approved uses. (Also discussed in the Chesapeake Bay priority management area.)

Ongoing Commission Activities:

1. Perform periodic evaluation of the Commission's regulatory program to determine the efficacy and consistency of the program.
2. Evaluate the need for new and amended regulatory requirements, policies and guidelines to enhance management of the basin's resources and improve the efficiency of the regulatory program.
3. Enforce regulations and conditions of approvals to ensure fair and equitable management of water resources among all users.
4. Continue implementation of the Commission's Low Flow Protection Policy and related instream flow protection measures.

Action Needed:

1. Evaluate Potentially Stressed Areas to determine if special protection status is warranted, for the purpose of preventing or addressing water shortages that would conflict with requirements of the Comprehensive Plan, and to allow sustainable development of water resources in the area.

Goal c. Ensure sustainability of water sources by improving systems and managing water resources more efficiently.

Efficient use of water helps to ensure long-term sustainability of water resources by reducing water supply demand during low flow periods, providing aquifer recharge during high flow periods, and minimizing ecological impacts to water resources overall. While efficiency alone cannot be relied on to provide sustainable water resources, the judicious use of water is an important component of water resource management and should be encouraged.

In order to efficiently evaluate numerous requests and consider the needs of the natural gas industry while maintaining appropriate oversight and management controls, the Commission has acted responsively by adopting review protocols and rules that encourage conservative approaches and sharing of centralized sources, incentivizing withdrawals from viable sources, affording greater scrutiny to proposed water diversions, and limiting withdrawal rates to sustainable levels.

The review and approval of water withdrawals and consumptive uses by the natural gas industry has not been a rubber stamp process, nor will it be so in the future. Each project is evaluated based upon its technical merits and the scientific and engineering information upon which the application is based.

Ongoing Commission Activities:

1. Support and coordinate efforts of member jurisdictions in oversight of public water suppliers to incorporate system improvements, including the use of multiple sources, metering and pricing, recycling, and other conservation practices.
2. Encourage conjunctive use of water sources, where appropriate.
3. Continue making refinements to the Commission’s water use databases and associated analytical tools.
4. Improve coordination and exchange of water use data among member jurisdictions.
5. Proactively engage project sponsors to facilitate regulatory compliance and reduce burdensome demands on public and private resources.

Actions Needed:

1. Review and adjust Commission-approved withdrawal rates, as needed and in accordance with existing regulations, to ensure sustainability and protection of water quality and to reflect demonstrated needs.
2. Encourage and incentivize water conservation and recycling by water suppliers, industry, and the public through education and application of regulatory requirements.

Goal d. Mitigate drought impacts through coordination and use of drought emergency powers.

The Susquehanna River Basin has experienced many droughts, which have prompted the imposition of various levels of water-use restrictions. The Commission, as well as its member jurisdictions, has certain drought emergency authorities. The exercise of those authorities and various stages of droughts are coordinated through the Commission’s Drought Coordinating Committee. Article 11, Section 11.4, of the Compact directs the Commission, upon declaration of drought emergency or other natural or manmade emergency that causes an immediate shortage of water supply, to “direct increases or decreases in any allocations, diversions, or releases previously granted.”

Ongoing Commission Activities:

1. Support drought-related actions of the Commission’s member jurisdictions, as appropriate.
2. Implement the Commission’s drought emergency powers under Section 11.4 of the Compact, as appropriate.

Action Needed:

1. Revise the Commission’s Drought Coordination Plan in consultation with the Drought Coordinating Committee.

Goal e. Manage diversions to avoid impacts to the basin’s water resources.

There are currently a number of out-of-basin diversions that provide drinking water to populations outside of basin boundaries. While diversions into the basin are scrutinized for water quality impacts, diversions of water out of the Susquehanna River Basin are regulated as consumptive water uses. Out-of-basin diversions, in particular, require special attention and more detailed analyses, because they reduce streamflow and have potential to impact the Chesapeake Bay. Though out-of-basin diversions are generally

discouraged because they provide no benefits to the basin, there may be instances where, because of legitimate public welfare considerations, approval of out-of-basin diversions is appropriate.

Ongoing Commission Activities:

1. Evaluate potential impacts of out-of-basin diversions and investigate conjunctive use alternatives in Commission actions; include and enforce protective conditions for approved diversions.
2. Assess potential adverse impacts and benefits of proposed diversions into the basin, including their potential to compensate for other diversions or consumptive water use.

Actions Needed:

1. Periodically review the criteria for review of out-of-basin diversions to ensure that adequately protective standards are in place.
2. Monitor the ecosystem effects of diversions of water to and from the basin and transfers of water from one waterbody to another within the basin, including water quality requirements.

Goal f. Manage consumptive water use to mitigate impacts to the basin's water resources.

Increasing consumptive use, and the cumulative impact, will reduce streamflows and adversely affect instream uses, riparian rights, and flows to the Chesapeake Bay. Commission regulations with respect to consumptive water provide three options for projects to mitigate their consumptive water use: (1) provide storage of the quantity of water necessary to offset a project's consumptive water use during low flow periods, (2) discontinue consumptive use during low flow periods, or (3) pay a consumptive use fee to the Commission that is, in turn, used by the Commission to provide mitigation to replace water consumptively used. The intent of mitigation is to protect and maintain instream flows and flows to the Chesapeake Bay; however, an important basis of this intent is the mitigation of man-made consumptive use, rather than the prevention of naturally occurring low flows. Growth in water use for power generation will constitute a major component of future mitigation needs. It is likely that the best opportunities for new mitigation will be through additional water supply storage.

Ongoing Commission Activities:

1. Monitor consumptive water use in the basin and periodically revise projections for needed mitigation.
2. Periodically review consumptive water use fees paid to the Commission to ensure that this mitigation option is commensurate with the real costs of acquiring and managing sources of mitigation.

Actions Needed:

1. Implement recommendations of the Commission's Consumptive Use Mitigation Plan (see Part V-C). Key recommendations include, among others: a) the evaluation of existing U.S. Army Corps of Engineers and other reservoirs for the potential to enhance current release operations; b) the evaluation of the ability of abandoned mines and quarries to supply water for releases during droughts; and c) the assessment of specific needs for instream flows to meet riparian, water supply, water quality, habitat and recreational uses.
2. In the absence of adequate water for local mitigation, restrict new water use to avoid impacts to vulnerable watersheds.

Goal g. Maintain and enhance strong, visible and effective regulatory compliance measures.

The Commission manages the water resources of the basin through the imposition of regulations and facility specific controls and restrictions. In order for the management strategy to be most effective, both the regulated and unregulated water users of the basin must be assured that these protective restrictions are implemented and maintained as required.

Ongoing Commission Activities:

1. Conduct visible compliance and enforcement measures that enhance the public reputation of the Commission. The Sayre, Pennsylvania office will continue to be adequately staffed as a key element in ensuring the measures are accomplished.
2. Encourage voluntary compliance by project sponsors.
3. Enforce Commission requirements through the judicious imposition of penalties and settlements. As prescribed in the Compact, penalties of up to \$1000 per day for each violation of a regulation can be imposed. The Commission may also suspend or revoke approval to withdraw or consume water, issue a Cease and Desist Order in the event of an ongoing violation, and seek further injunctive relief from the federal courts to halt violations.

Actions Needed:

1. Reduce the backlog of unsatisfied post-approval conditions through increased staff efficiency and improved strategies.
2. Increase the presence of compliance staff throughout the basin.
3. Establish better coordination with member jurisdictions.

B. Water Quality

1. Desired Result

To support the existing and designated uses of all water bodies by achieving water quality that meets or exceeds standards.

2. Discussion of Issues

Article 5 of the Susquehanna River Basin Compact emphasizes that the states have the primary role in managing water quality within the basin. Although the Commission does not regulate water quality, it does support and coordinate the efforts of its member jurisdictions as explained under Water Quality Goal a below.

Each waterbody has a designated use assigned to it by the state in which the waterbody occurs – keeping in mind that groundwater and surface water are part of the same resource, with groundwater providing the base flow of streams. Water quality standards are established so that waterbodies can meet those designated uses over the long term. (The terms "waterbody," "designated use," and "water quality standard" are used in the federal Clean Water Act.) Good water quality refers to chemical, physical, and biological conditions that achieve or exceed water quality standards.

Monitoring and assessments are necessary to determine if water quality standards are being met, and to support restoration and protection efforts. The ultimate goal is to protect water quality and, where possible, improve it over time.

Good water quality is essential to sustainable watershed management, and is needed for all facets of life. Although the majority of surface and groundwater sources in the basin exhibit good water quality, some areas are affected by pollution which limits water use, requiring either costly treatment or making water unfit for certain uses. The leading sources of surface water impairment in the basin are agriculture, mine drainage, and urbanization, although there are a number of other sources that cause impairment in the basin to a lesser extent (see Figure 15). Increased urbanization in the basin has the potential to increase stormwater runoff and cause impacts associated with water quality, flooding, and aquatic habitat. Specific groundwater quality issues in portions of the basin include elevated iron, manganese, nitrates, organic, and microbial contaminants. Following is an expanded discussion of the six essential areas requiring good water quality in the Susquehanna basin.

a. Drinking Water Supply

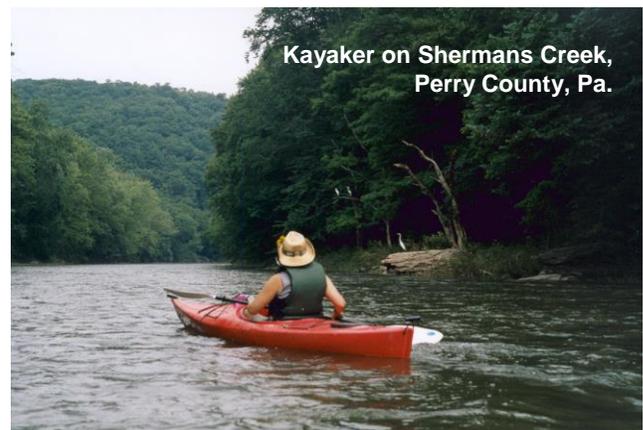
Public drinking water suppliers rely on surface water and groundwater sources. Individual homeowners, without access to public water, rely upon wells. In addition to the sources of impairment identified above, spills and other accidental discharges of contaminants can adversely affect drinking water. Source assessment and protection plans, which consider the vulnerability of public water supplies to contamination, were prepared for both surface and groundwater sources in all three of the Commission's member states. These plans outline the sustainable management measures that are needed to protect source waters over the long term. However, there is additional work needed to implement these protection plans. Also, improvements can be made to spill response and coordination activities, including in the area of early warnings for specific pollutant events to allow suppliers to adjust operations to protect public health and safety.

b. Agricultural, Industrial, and Commercial Use

Water quality requirements for these water uses may be less stringent, or in some cases more stringent, than those for drinking water. The quality of wastewater returned to streams and rivers can affect downstream water withdrawals and instream uses, especially if the volume and quality of water in the receiving stream are inadequate to assimilate the return flows. Thermal discharges from fossil fuel and nuclear generating facilities also can impact downstream users, especially in streams with poor water quality or limited flow.

c. Recreation

Bacteria and other pathogens can render water unfit for water contact recreation, including fishing, boating, swimming, hunting, bird watching, and eco-tourism. Periods of high rainfall can wash pathogens, nutrients, road runoff, and other contaminants into streams and rivers, resulting in sanitary septic and combined sewer overflows in urban areas. Increased turbidity (cloudy water) can impact recreational use during high flow events, and often is associated with increased bacteria and contaminant levels. Low flow conditions can lead to elevated water temperatures and increased algal growth that also can impact recreational use.



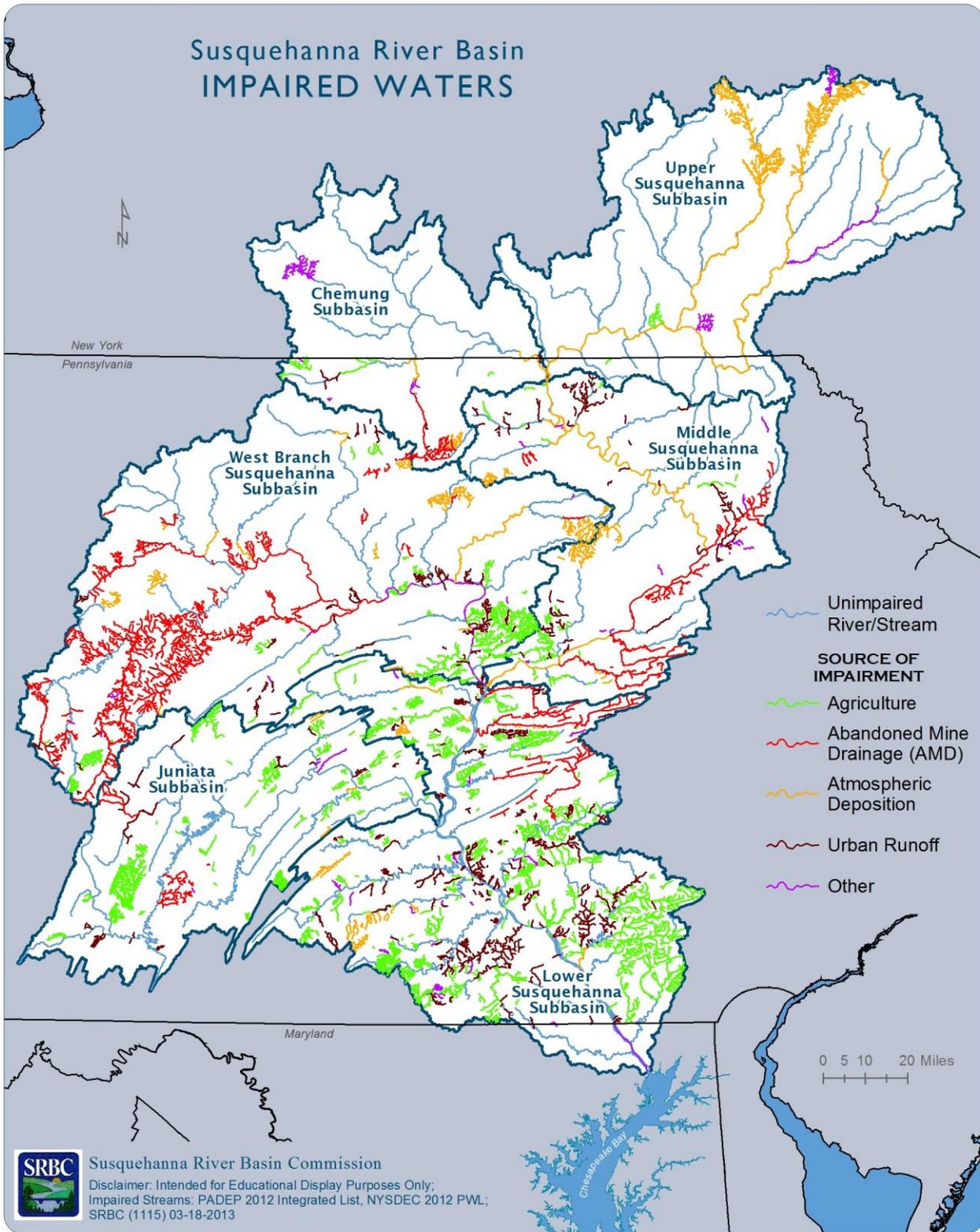


Figure 15. Impaired Waters

d. Fish and Wildlife, Including Natural Species Diversity

Water quality affects the abundance and diversity of fish and water-dependent wildlife and wetland and aquatic vegetation, plankton, and other organisms that are components of aquatic food webs. Biologists and water quality managers often use benthic macroinvertebrates (aquatic insects, worms, snails, and other animals without backbones) as indicators of long-term water quality. Also, invasive species can compete with native flora and fauna, and may upset natural species diversity and aquatic food webs. Some invasive species, such as zebra mussels, can also cause significant impacts on water quality.



e. Quality of Life and Public Health

Good water quality improves the aesthetics associated with water-based recreation and can enhance the desirability and value of land, projects, and activities associated with a waterbody. In addition to the public health hazards associated with pathogens and traditional pollutants having established water quality criteria, other, less well-known contaminants such as many pharmaceuticals and personal care products, also are causes for concern. Relatively little is known regarding the ecological and human health effects of these products, which are used by the public and then discharged to local streams and rivers through wastewater treatment plants. Some pharmaceuticals and personal care products are suspected of causing endocrine-disrupting and reproductive effects in fish and amphibians, and the extensive use of antibiotics and anti-bacterial products also may contribute to the development of antibiotic resistant bacteria in local waterbodies.

f. Ecological Health of the Chesapeake Bay

The need for good water quality extends to the Chesapeake Bay. New York, Pennsylvania, and Maryland are actively participating in the Bay restoration effort and have pledged to meet and maintain specific reductions in nitrogen, phosphorus, and sediment loads delivered by the Susquehanna River to the Bay. Nutrients and sediment affect the levels of dissolved oxygen, water clarity, and chlorophyll a (a measure of algal activity) that are needed to restore underwater grasses, blue crabs, oysters, fish, and other biological resources in the Bay. Water quality monitoring in the basin allows the Commission and others to determine trends in sediment and nutrient loading, target areas where work is needed most, and document progress in the Bay restoration effort.



3. Goals

Five goals have been established to achieve the desired results and are discussed below. For each goal, ongoing Commission activities and actions needed are identified.

Goal a. Support and coordinate the efforts of the Commission's member jurisdictions in managing the basin's water quality.

Although the primary regulatory role in water quality management is given to the U.S. Environmental Protection Agency (USEPA) and the Commission's member states, the Susquehanna River Basin Compact (Compact) directs the Commission to coordinate water quality management activities, encourage cooperation and uniform water quality management policies among its member jurisdictions, and recommend the establishment and amendment of water quality standards.

The Commission also considers water quality and supports USEPA and state efforts during its regulatory review of water withdrawal and consumptive water use projects. For example, when reviewing applications associated with natural gas development from the Marcellus and other shale formations, the Commission evaluates impacts on stream ecology and water quality that would result due to withdrawal and consumptive water use. The states and USEPA are responsible for ensuring that the brine and other waste materials withdrawn from the well are properly evaluated, treated and disposed. In this way, the Commission's work complements that of its member jurisdiction and does not duplicate efforts.

Ongoing Commission Activities:

1. Review and seek interstate compatibility of impaired waterbody listings, Total Maximum Daily Load (TMDL) development activities, and point and nonpoint source pollution control activities.
2. Coordinate basinwide activities related to the protection of public water sources, in particular those systems that depend on the main stem of the Susquehanna River.
3. Coordinate basinwide water quality activities through the Commission's Water Quality Advisory Committee as well as state and interstate advisory committees and workgroups.
4. Consider physical, chemical, and biological water quality impacts during the regulatory review of applications for water withdrawals and consumptive water uses.
5. Coordinate with member jurisdictions incentivizing the use of lesser quality waters to improve downstream water quality conditions.

Actions Needed:

1. Complete comparative study of water quality data collection methods with member jurisdictions to enable direct comparison/use of datasets regardless of the jurisdiction within which the data were collected.

Goal b. Monitor and assess the biological, chemical, and physical quality of the basin's waters to support restoration and protection efforts.

Monitoring and assessment are core Commission water quality activities that complement state and federal programs and provide a consistent approach for management of the basin's water resources across state lines. Monitoring provides the raw data for assessments, which identify problem areas as well as areas with pristine water quality and biological resources. Monitoring and assessment are essential for the development of appropriate restoration plans, as well as plans to provide appropriate protection of high and exceptional value resources for future generations. Post-project monitoring and assessment provide measures of success for constructed projects and are valuable in planning new restoration projects.

The Commission regularly performs water quality, aquatic habitat, benthic macroinvertebrate, and fish monitoring for a range of projects throughout the basin. In addition, the Commission monitors sediment and nutrients and calculates loads and trends at a network of sites for the Chesapeake Bay restoration effort. More recently, the Commission has greatly expanded its continuous water quality monitoring capabilities with a total of 70 stations in operation. These stations measure dissolved oxygen, conductance, temperature, pH, and turbidity in a range of settings and watershed sizes, including several on the main stem of the Susquehanna River. The continuous water quality monitoring assists with both tracking conditions in areas experiencing shale gas development, as well as providing water suppliers with valuable source water data.

The Commission and others use stream flow gages to determine when to perform water quality sampling during both low and high stream flow events. Flow data are required for the calculation of pollutant loads, TMDL development, evaluation of Watershed Implementation Plans (WIPs) for restoration of the Chesapeake Bay, and for many other water quality management activities.

Ongoing Commission Activities:

1. Maintain and improve core monitoring and assessment activities such as the Subbasin Survey, Interstate Streams, Low Flow, and Large River Assessment programs.
2. Perform monitoring and data analysis to support Chesapeake Bay restoration activities.
3. Continue to operate and maintain efforts associated with the collection and analysis of data through the continuous water quality monitoring station network, with emphasis on any issues related to specific conductance and turbidity/sediment in small watersheds undergoing development.
4. Maintain and improve stormwater monitoring efforts within select urban settings.
5. Maintain and improve the Susquehanna River Drinking Water Early Warning System.
6. Provide monitoring support to member jurisdictions' efforts in developing TMDLs.
7. Perform assessments under Section 305(b) of the Clean Water Act, and provide the results to USEPA, the Commission's member states, and the public.

Actions Needed:

1. Enhance monitoring design for the Subbasin Survey Program to improve methods of assessing basin health.
2. Monitor and assess waters for bacteria, pharmaceuticals and personal care products, and other emerging contaminants of concern.
3. Monitor for zebra mussels and other invasive species.
4. Expand the number of continuous water quality stations, as well as add additional parameters, for enhanced protection of aquatic life and public water supplies in the basin.
5. In partnership with the member jurisdictions, establish several monitoring stations in the basin to track changes in climatic conditions.

Goal c. Develop, support, and implement plans and projects to remediate and enhance the basin's water quality.

The Compact allows the Commission to undertake water quality investigations and to acquire, construct, operate, and maintain projects to manage the basin's water quality whenever the Commission determines that this is necessary to implement any of the provisions of the Compact. The Commission has supported water quality planning of its member jurisdictions by performing studies such as the watershed assessment and remediation strategy for mine drainage in the upper Tioga River Watershed and the remediation strategy for the West Branch Susquehanna Subbasin. The Commission also has constructed a number of demonstration projects for wetland establishment, stream restoration, and stormwater management, and has provided funding for operation and maintenance of the Barnes and Tucker mine

drainage treatment project to provide mitigation for agricultural consumptive water use and improve water quality in the West Branch Susquehanna River.

The Commission has worked with the Paxton Creek Watershed and Education Association on a three-year project to develop an innovative and cooperative stormwater management approach for Pennsylvania communities, using the Paxton Creek Watershed as a demonstration model. The watershed is a 27-square-mile area encompassing parts of the City of Harrisburg and surrounding communities in Dauphin County, Pa. The project included demonstration projects focusing on stormwater management scenarios for public, residential, and commercially controlled lands. Emphasis has been placed on project transferability to other areas in Pennsylvania and the basin to improve water quality through more effective stormwater management. Additionally, through partnerships with the Alliance for the Chesapeake Bay, Lancaster and Cumberland Counties, the Center for Watershed Protection, and several local Pennsylvania municipalities, the Commission has supported stormwater retrofit assessments and implementation of local projects in the Lower Susquehanna Region for installing improved stormwater management practices using bioretention and other “green” infrastructure measures. These demonstration projects, which have served as examples for other groups to follow to reduce the negative effects of stormwater in local communities, reduced impervious surfaces and increased beneficial filtration/infiltration of stormwater through the use of natural vegetation.

Ongoing Commission Activity:

1. Support the Commission's member jurisdictions in controlling discharges from point and nonpoint sources, including upland activities, with particular emphasis on the states' efforts to implement their Chesapeake Bay Watershed Implementation and Source Water Protection plans.
2. Encourage and support restoration planning as part of the Commission's Year-2 Subbasin Survey Program and TMDL development activities for waterbodies impaired by mine drainage, urban, agricultural, and other nonpoint sources, with the goal of removing impaired waterbodies from state lists established under Section 303(d) of the Clean Water Act.
3. Encourage and support implementation of the recommendations outlined in the West Branch Susquehanna Subbasin and Anthracite Region mine drainage remediation strategies.
4. Promote the use of green infrastructure and stormwater management approaches that mimic natural hydrologic regimes.

Actions Needed:

1. Encourage public and private support, maintenance, and upgrades of the infrastructure needed for drinking water withdrawal, treatment, and distribution; wastewater collection and treatment; on-lot septic treatment; stormwater management projects; combined sewer overflows; sanitary septic overflows; and other projects needed for the maintenance and improvement of water quality.
2. Seek water quality improvements to complement water quantity mitigation provided for water withdrawal and consumptive water use projects.
3. Support county and municipality efforts to develop/implement regional stormwater management plans in the Lower Susquehanna Region.

Goal d. Protect the quality of the basin's biological resources and sources of public drinking water supply.

Many state and federal activities associated with the Clean Water Act have focused on the restoration of impaired waterbodies. The protection of existing resources with good water quality also is important, and often is more cost effective than the restoration of waters that have been impaired.

Climate change will be a major influence on future conditions of aquatic ecosystems, producing physical changes in water temperature, hydrological cycles, and the number of degree-days. Temperature changes will influence levels of dissolved oxygen, pH, and the solubility of dissolved materials in the water column. Physical changes in the environment are expected to alter growing seasons, produce shifts in the distribution and abundance of aquatic and terrestrial species, and affect nutrient cycling. Increased opportunities are expected for colonization by invasive species. Changes in precipitation, groundwater recharge, and stream flow will affect the waste assimilation capability of waterbodies, as well as the quality and quantity of aquatic habitat.

Ongoing Commission Activities:

1. Encourage the protection of threatened and endangered aquatic species and natural biological diversity in the basin.
2. Support further research on the effects of climate change on water quality in the basin, and support efforts to mitigate those effects. (See related climate change ongoing activity under Goal a. for Sustainable Water Development priority management area.)
3. Identify waterbodies with exceptionally high quality water, habitat, and biological resources, based on monitoring results.
4. Provide increased protection for headwater areas and watersheds with existing good water quality.
5. Develop regional source water protection plans for drinking water supply systems.

Actions Needed:

1. Provide educational materials regarding the spread of aquatic invasive species in the basin and downstream to the Chesapeake Bay.
2. Provide enhanced tracking of aquatic invasive species in the basin.
3. Expand monitoring for drinking water parameters of concern for the main stem of the Susquehanna River and major tributaries.
4. Establish a Susquehanna Source Water Partnership to work with public water suppliers and other stakeholders to protect drinking water supplies.

Goal e. Organize, maintain, and distribute water quality data to facilitate basinwide water quality improvement and protection activities.

The Commission has developed a water quality database to store and share information from Commission monitoring projects and has provided information to USEPA's Storage and Retrieval (STORET) database and USEPA's new Water Quality Exchange (WQX) database. Additionally, the Commission fulfills numerous data requests each year.

The Commission also has expanded its Geographic Information Systems (GIS) capability and has developed basinwide GIS data layers using data from its monitoring, assessment, protection, TMDL, and drinking water activities. There is a continuing need to develop datasets and GIS layers that are compatible across state lines, and to facilitate the sharing of data among the Commission's member jurisdictions and others involved in water quality assessment, restoration, and protection activities.

Ongoing Commission Activities:

1. Maintain and enhance the Commission's water quality databases and provide data for inclusion in appropriate USEPA databases.
2. Make data available to the public via the Commission's website and other electronic means.
3. Encourage exchange of data at the local, state, and federal level.

4. Develop consistent basinwide datasets and GIS layers, and enhance existing geospatial and tabular datasets.
5. Enhance and improve the sharing of information contained in water quality databases maintained by the Commission and its member jurisdictions.

Actions Needed:

No new actions identified.

C. Flooding

1. Desired Result

To prevent loss of life and significantly reduce future damages from floods within the basin through an integrated system of structural and nonstructural flood damage reduction measures.

2. Discussion of Issues

The Susquehanna River Basin is one of the most flood prone watersheds in the country due to its geography and physiographic features. The basin is susceptible to the impacts of tropical weather systems, intense thunderstorms, snowmelt and ice jams, and has a varied topography that creates rapid runoff scenarios. Tropical storm Agnes in 1972 caused the worst recorded widespread flooding in the basin. The flooding caused 72 deaths and \$2.8 billion in damage. Flood levels exceeded the previous record levels by as much as six feet in some places. It was the nation's most costly natural disaster until Hurricane Andrew hit Florida in 1992. More recently, catastrophic floods in 2006 and 2011 have resulted in hundreds of millions of dollars in damages.

The June 2006 flood impacted 48 out of 66 counties in the basin, with the most severe flooding occurring in the Upper Subbasin, causing more than \$227 million in damages to New York alone. Tropical Storm Lee in 2011 displaced nearly 100,000 residents and caused an estimated \$1 billion in damages for Pennsylvania and New York, with record flood crests at 13 of the basin's flood forecast points, including 10 along the Susquehanna River's main tributaries.

The basin experiences damages in excess of \$150 million on average every year, and 1,160 of the 1,400 communities (more than 80 percent) in the river basin have some residents who live in flood-prone areas. For these residents, flood warning and flood management and protection are of utmost concern. While a number of flood damage reduction projects are in place to protect the basin's citizens, studies have determined the best way to further reduce flood damages in the Susquehanna basin is through nonstructural measures such as flood forecasting and warning systems.

Flood hazard mitigation measures, whether structural or nonstructural, are undertaken to reduce flood damages and prevent loss of life. Structural flood hazard mitigation measures are designed to slow or



decrease flooding in a targeted area, and include dams, levees, building elevations and modifications, and stream channel modifications. Nonstructural flood hazard mitigation measures provide citizens and communities with information and other tools to assist them in flood preparedness, response, and recovery, and include public education and outreach, flood forecasting and warning, the National Flood Insurance Program, and local floodplain regulation. The simplest and most straightforward mitigation strategy is to prevent further floodplain encroachment and to reclaim and restore natural floodplain and wetland functions.

Floods are natural and frequent occurrences in the basin and cannot be prevented. However, with appropriate mitigation planning, the impacts of flooding on the basin's infrastructure and the risk to life and property can be minimized. To date, the primary role assumed by the Commission is the coordination of improvements to forecasting and flood preparedness.

3. Goals

Four goals have been established to achieve the desired results and are discussed below. For each goal, ongoing Commission activities and actions needed are identified.

Goal a. Ensure continued operation, maintenance, and enhancement of the Susquehanna Flood Forecast and Warning System (SFFWS).

Since mid-1980s, the Commission has led an interagency partnership of federal and state agencies dedicated to operating, maintaining and enhancing the SFFWS to provide timely and accurate flood forecasts. The Commission is joined by the National Weather Service (NWS), U.S. Geological Survey (USGS) and USACE as the federal partners and the environmental and emergency management agencies from New York, Pennsylvania, and Maryland. Pennsylvania is also represented on the committee by its community and economic development agency. The SFFWS is composed of an integrated network of gages, sensors, and data transmitters, and has been a model of coordination and cooperation. Managers of the SFFWS continually strive to improve forecast lead time, with the goal of reducing flood damages and protecting human life.

Ongoing Commission Activities:

1. Coordinate SFFWS committee meetings and activities.
2. Answer media requests for information before, during and after flood events.
3. Compile information on major flood events and damage summaries.
4. Support annual SFFWS funding and sustainable funding sources for the gage network.
5. Coordinate ice monitoring.
6. Maintain the SFFWS website and information portal.
7. Work with system partners to maintain a state-of-the-art observation network.
8. Endorse, promote and develop new technologies to increase lead-time and improve forecast accuracy.
9. Conduct education and outreach activities to promote awareness of forecast services and their proper use.

Actions Needed (also see Part IV-F, Goal d., Action 4):

1. Evaluate new partnerships and technologies to support more sustainable long-term funding.
2. Develop, in cooperation with SFFWS partners, a high-resolution observational network.
3. Develop the infrastructure necessary to provide high-resolution flash flood forecasts.
4. Develop, in cooperation with SFFWS partners, new forecast points and flood forecast maps for priority damage locations.

5. Develop Commission capability to operate and maintain rain and stream gages to provide data of sufficient quality to support flood forecast and warning needs.

Goal b. Promote protective floodplain management practices.

Local communities have primary responsibility for effective floodplain management and flood hazard mitigation but rely on support from federal and state government to implement regulations, improve infrastructure, and recover from disaster. The Federal Emergency Management Agency (FEMA) conducts flood analyses, accredits flood protection projects, and administers the National Flood Insurance Program, through which it provides local communities the opportunity to participate in and benefit from the program.

The Commission has the unique ability to work across all levels of government and can play a pivotal coordination role in promoting practices to offset flood risk. At the municipal level of government the Commission can offer technical expertise, through training and outreach, related to the community's flood risk, and provide input regarding optimal ordinances for the community to employ. The Commission will continue to work to strengthen and enhance existing ties among the numerous governmental entities.

Ongoing Commission Activities:

1. Improve public understanding of flood risk management.
2. Support FEMA flood disaster recovery efforts.
3. Maintain and distribute community flood insurance maps.
4. Participate in professional state and national floodplain management organizations.
5. Work cooperatively with municipalities, private interests, and the Commission's member jurisdictions to identify and encourage potential stormwater management projects.
6. Support and publicize local community efforts to encourage development practices with low impacts to flood risk and water quality, and to discourage new development in floodplains.
7. Evaluate the effects of climate change on the nature of flooding in the basin.

Actions Needed:

1. Assist in the evaluation of need and implementation of flood damage reduction alternatives for high-risk communities.
2. Assist local and county flood managers in planning efforts and assessments of floodplain reclamation projects.
3. Continue to participate in improved assessment and mapping of flood risks.
4. Provide public education regarding flood risk management strategies, including the need for personal responsibility.
5. Promote riparian and floodplain management practices that protect naturally beneficial floodplain functions.
6. Provide technical assistance to local governments to implement proactive floodplain management programs that surpass minimum federal standards.

Goal c. Improve community flood preparedness to ensure adequate and appropriate response by emergency managers before, during and after a flood event.

Floodplain managers at all levels of government must remain diligent and up-to-date with a clear understanding of specific flood hazards and opportunities available for flood hazard mitigation. Various agencies provide information about hydrologic conditions, floodplain zoning, flood insurance, emergency response and disaster mitigation, but it is not always accessible to community leaders. A program to

coordinate the dissemination of pertinent information and assist communities in understanding and using the information will better prepare vulnerable areas for future flooding.

Ongoing Commission Activities:

1. Provide technical assistance to communities for flood warning or mitigation programs.
2. Advocate participation in the Community Rating System of FEMA’s National Flood Insurance Program to incentivize communities to implement flood damage reduction measures and receive discounted flood insurance premiums.
3. Provide technical support to Pennsylvania’s Emergency Operations Center during flood events.
4. Coordinate, encourage and develop basinwide education and training programs regarding importance of flood warnings and offer information on flood insurance programs.
5. Support activities of Silver Jacket teams within the basin.

Actions Needed:

1. Conduct post-flood assessments to identify information needs, educational opportunities, lapses in forecast coverage, and other measures that can assist communities in reducing flood damages.
2. Develop a flood inundation mapping program, including a training component, for communities in the basin. These maps delineate areas of flooding corresponding to various river stages, designate evacuation routes, locate major buildings for potential mass evacuation shelters, and list general flood response procedures.
3. Advocate for and effectuate plans to maintain the baseline gage network necessary to provide flood forecast and warning to at risk communities.

Goal d. Assist the Commission's member jurisdictions, as appropriate, in reducing the introduction of man-made debris into the waters of the Susquehanna River Basin and, ultimately, Chesapeake Bay.

Water borne debris reaches rivers and streams from natural sources as well as the intentional, careless, or inadvertent actions of humans. Woody debris and leaf litter naturally fall into streams from riparian vegetation. This material often enhances instream habitat for fish and wildlife, and serves as a source of energy that is cycled naturally through aquatic systems.

Problems arise when humans use streams or their flood plains as disposal sites for trash, grass clippings, cut tree limbs, tires, plastic, barrels, and other debris. Storage of floatable materials on flood plains also contributes to the problem. When flooding or high flows occur, this material clogs the river system, creates unsightly conditions and public health problems, and accumulates behind power dams on the lower Susquehanna River. The hydropower companies routinely remove and dispose of significant quantities of this debris. However, high flow events make removal operations impossible and the material then must be passed through and over the dams and into the tidal portion of the Susquehanna River and the Chesapeake Bay. Here, the material causes the same problems as in upstream areas, damages nets and fishing gear, causes a hazard to navigation, and interferes with marina operations.

Ongoing Commission Activities:

1. Encourage the enforcement of existing laws dealing with the deposit of debris into the basin's streams and rivers.
2. Encourage public and private land owners to reduce the amount of debris and man-made materials stored adjacent to stream banks and in flood plains where they are vulnerable to removal by flood waters.

Action Needed:

1. During dam relicensing, advocate for the continued removal of material from behind power dams on the lower Susquehanna River.
2. During the review and approval of water use projects, assess the potential for the project to result in the storage of man-made debris within the floodplain and take necessary action to offset resulting hazards.

D. Ecosystems

1. Desired Result

To achieve healthy ecosystems that provide groundwater and surface water of sufficient quality and in adequate supply to support abundant and diverse populations of aquatic, riparian, and terrestrial organisms, as well as human use.

2. Discussion of Issues

Ecosystems range in size from relatively small areas such as individual forests, wetlands, or streams to much larger areas such as oceans, continents, or even the entire earth, and are composed of living things as well as non-living components of the environment. Relationships among the living, also known as biotic, components of the environment and the non-living, or abiotic, components are interdependent and complex. Humans are one of the most influential biotic components of most ecosystems, whether at a local, regional, or even global scale.



Environmental assessments are the foundation for restoration and protection activities. Monitoring provides the data for environmental analysis. Metrics, or evaluation parameters, are used to evaluate the data to determine which ecosystems and ecosystem components are healthy and which are degraded or under stress. Monitoring data also are valuable in identifying the cause of environmental degradation.

By performing assessments through time, it is possible to identify the trend for various parameters and determine whether the overall health of an ecosystem is improving or becoming worse. Healthy systems warrant protection, while degraded systems should be restored to a healthy status. In general, it is far more cost-effective to maintain healthy systems than to take corrective action after degradation has occurred.

Healthy ecosystems are important in maintaining the quality of life for the basin's residents. They are needed to support sustainable water supply, good water quality, biological productivity and species diversity; domestic, industrial, municipal, commercial, agricultural, and recreational use; and ecological health of the Chesapeake Bay.

Water quantity and quality are interdependent and equally important to the health of aquatic ecosystems. This priority management area discussion, therefore, is interwoven with components of both the Water Supply and Water Quality priority management areas, necessitating the overlapping of some goals and objectives within each of the three management areas. When managed properly, healthy streams and rivers should provide adequate quantities of good quality water for water withdrawals and instream recreational use. In addition to providing local benefits, healthy ecosystems within the Susquehanna basin and its six major subbasins support the ecological health of the Chesapeake Bay. Stormwater management and protection of critical recharge areas can benefit the quantity and quality of groundwater supplies, and help maintain stream flow during times of low water availability. Water conservation and reuse of water, when possible, also can benefit groundwater levels and stream flow during water-short periods.

Groundwater is an important source for domestic, industrial, municipal, commercial, agricultural, and recreational use, and provides the base flow for most streams during low flow periods. Flowing water is a key component of river and stream systems. Adequate streamflow is required for natural sediment transport, maintenance of stream morphology, good water quality, fish and wildlife habitat, and for the maintenance of aquatic food webs.

Wetland and riparian plant communities can be impacted by lowered groundwater levels and reduced flow. Riparian vegetation provides shade to help moderate daily fluctuations in water temperature. Leaf litter and other detritus from riparian vegetation serve as important food sources for aquatic insects and other fish-food organisms. Both wetland and riparian vegetation help regulate biogeochemical cycles, influence water quality, help dampen the duration and magnitude of flooding, and provide food, cover, nesting sites, and migration corridors for a variety of fish and wildlife species.



As discussed under Goal d. of the Water Quality Priority Management Area, climate change will be a major influence on future conditions of aquatic ecosystems, affecting both the physical and biological components of aquatic ecosystems. The distribution and abundance of species will be affected in ways that are not yet thoroughly understood.

3. Goals

Three goals have been established to achieve the desired results and are discussed below. For each goal, ongoing Commission activities and actions needed are identified.

Goal a. Perform ecosystem monitoring and assessment to provide data needed for effective watershed management.

Water quantity and quality monitoring provide data to assess the health of aquatic systems and support planning activities for the protection and restoration of aquatic resources. Unlike state and most federal programs, the Commission monitors water quality, aquatic habitat, and stream biota on a consistent basis throughout the entire basin, crossing both state lines and EPA regions. This monitoring, some of which has been performed since the 1980's, provides data for water quality and aquatic life community assessments, Total Maximum Daily Load (TMDL) development, drinking water protection, restoration activities, and the evaluation of impacts associated with water withdrawals and consumptive water uses.

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 macroinvertebrates (described below), these data were used by The Nature Conservancy (TNC) to prepare a report on the development of instream flow criteria in Pennsylvania to support ecologically sustainable water resource planning and management. In December 2012, the Commission adopted a new Low Flow Protection Policy that provides implementation guidance on the criteria, methodology, and process used in the Commission's review of withdrawal applications to evaluate and add conditions to avoid potential adverse impact to

streams during low flow conditions. The Policy specifies passby flow and conservation release thresholds according to Aquatic Resource Class criteria to ensure greater protections are afforded to headwater and small stream systems recognizing their limited water availability and propensity to be of higher quality.

Because of the need for additional, supporting water quality and quantity data, increased monitoring during low flow events continues to be a high priority that will assist the Commission in assessing the effects of flow and in managing water withdrawals and consumptive uses.

Ongoing Commission Activities:

1. Perform water quantity and quality monitoring, and require appropriate monitoring for projects subject to the Commission's regulatory program.
2. Maintain programs to monitor and assess impacts occurring during low flow events.
3. Continue to monitor water quality and biological conditions near select withdrawal locations in order to track any potential adverse impacts.
4. Monitor and assess the health of fish, wildlife, and other biological resources.

Actions Needed:

1. Encourage the maintenance of critical stream gaging stations in the basin.
2. Perform additional instream flow studies to provide scientifically-based estimates of the amount of water needed for fish, wildlife, and recreational use.
3. Develop basinwide methods for assessing fish community health.
4. Assist member jurisdictions with monitoring efforts associated with assessing the health of smallmouth bass, as well as other high value species such as hellbenders.

Goal b. Protect and restore biological resources throughout the basin and in each of the major subbasins.

Biological resources such as aquatic macroinvertebrates (insects, worms, snails, and other animals without backbones) and fish serve as indicators of water quality and reflect the ecological health of aquatic systems. Fish and wildlife support a wide range of outdoor recreation activities such as hunting, fishing, trapping, nature study, wildlife photography, bird watching, and eco-tourism.

Property values and less tangible factors such as aesthetics and quality of life for humans are enhanced by the presence of diverse and abundant fish and wildlife populations and the habitat that supports them. Invasive species such as zebra mussels and emerging contaminants such as pharmaceuticals and personal care products (PPCPs) pose increased threats to the biological integrity of the basin and warrant further consideration for management action.

Government funding for fish and wildlife conservation is provided by a variety of mechanisms, including hunting, fishing, and trapping license fees. In Pennsylvania, additional funding is provided through the State Wildlife Grants Program, which is driven by Pennsylvania's Comprehensive Wildlife Conservation Strategy. Protection of biological resources can be enhanced significantly with the assistance of conservation, fishing, and hunting organizations (e.g. Sierra Club, Trout Unlimited, Ducks Unlimited, and others) that promote and have a stake in outdoor recreational pursuits.

Ongoing Commission Activities:

1. Provide protection to wetlands, aquatic life, and downstream water users by requiring aquifer testing, passby flows, wetland monitoring, and conservation releases through the Commission's regulatory project review and approval process.

2. Participate in activities of the Mid-Atlantic Panel on Aquatic Invasive Species and disseminate pertinent information to the public regarding aquatic invasive species.
3. Identify streams/watersheds that support high quality, diverse biological communities, and encourage/promote protection efforts.

Actions Needed:

1. Consider the potential spread of invasive species when evaluating project review applications for diversions and transfers of untreated water from one waterbody to another.
2. Collect and disseminate information regarding the effects of emerging contaminants on the biological resources of the basin.
3. Provide information on the biological resources of the basin and promote fishing, boating, hunting, outdoor photography, eco-tourism, bird watching, and other water-based outdoor recreation through the Commission's website and appropriate links to other websites.

Goal c. Restore populations of migratory fish throughout the Susquehanna River system.

American shad and blueback herring as well as alewife and hickory shad ascend rivers to spawn in the spring and the young fish migrate to brackish and salt water in the fall. American shad and blueback herring were once important recreational and commercial resources throughout the basin, with shad ranging at least as far north in the Susquehanna River as Binghamton, N.Y. Although less information is available for blueback herring, evidence indicates that they also traveled as far north as Binghamton. Substantial shad fisheries existed on the West Branch Susquehanna River between Lewisburg and Lock Haven, Pa., as well as throughout the main stem of the Susquehanna River. Historically, shad were reported as far upstream as Hollidaysburg, Pa., on the Juniata River, but most commercial fisheries on the Juniata River were located downstream of Lewistown, Pa.

Striped bass and white perch are also important commercial and recreational species that live in salt or brackish water, but do not travel as far upstream as the other species discussed above. Both use the lower Susquehanna River as spawning habitat. The Chesapeake Bay provides some of the most important spawning and nursery habitat for striped bass on the east coast of North America and is important in helping to sustain the entire east coast fishery.

American eels were once an important commercial and recreational resource throughout the basin. Although American shad, blueback herring, and related species spawn in fresh water and live most of their adult lives in salt water (anadromous species), American eels do the reverse. American eels (catadromous) spawn in deep ocean waters south of Bermuda. After hatching, immature eels ride the Gulf Stream north and enter North American rivers to live their adult lives in fresh water. Downstream migration of adults occurs during the fall. Because the triggers and characteristics of eel migration are very different from those of shad and herring, eels have different requirements for successful upstream and downstream movement past dams.

In addition to providing direct ecosystem and recreational benefits, American eels serve as the intermediate host for immature *Elliptio complanata*, a freshwater mussel. The immature mussels (called glochidia) are host-specific for American eels, to which they attach and are carried upstream, where they drop off into the stream substrate to mature into adults. The adult mussels filter water and thereby improve stream water quality. Populations of *Elliptio complanata* are currently at very low levels in the basin upstream of Conowingo Dam, but could potentially be increased if improved fish passage were provided for American eels.

Migratory fish passage was hindered in the basin by the construction of mill dams on tributaries, as well as construction of feeder dams for canal systems during the mid-1800s. Construction of the four major power dams on the Susquehanna in the early 1900s virtually ended migratory fish movement in the Susquehanna River system. Significant restoration activities have occurred during recent years, and passage for American shad is now provided at the four major hydropower facilities on the lower Susquehanna River below Harrisburg, Pa. (see Figure 13 under Part I-D.7.).

Areas of poor water quality in streams, such as that caused by mine drainage, can also constitute blockages to fish passage. The removal of blockages can provide benefits to both migratory and local, non-migratory fish populations by re-connecting fragmented habitat.

Ongoing Commission Activities:

1. Serve as a member of the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) and work with dam owners and operators and others to restore populations of American shad, hickory shad, blueback herring, alewife, striped bass, and other anadromous fish to the Susquehanna River system.
2. Implement and periodically update SRAFRC's Migratory Fish Management and Restoration Plan for the Susquehanna River Basin.

Actions Needed:

1. Work with SRAFRC, dam owners and operators, sportsmen groups, conservation organizations, and others to implement the Migratory Fish Management and Restoration Plan for the Susquehanna River Basin which was approved by the SRAFRC Policy Committee in November 2010, and adopted by the Commission in March 2011.
2. With assistance of SRAFRC and others, support studies of eel migration and implement restoration plans to reestablish a fishable population of American eel in the Susquehanna River system and restore adult recruitment from the river to help rebuild spawning stocks for the east coast eel fishery.
3. Support preservation and restoration of tributary streams that provide habitat for migratory fish, including the removal of obstacles to upstream movement and remediation of streams that are impaired by mine drainage.
4. Require viable upstream and downstream migratory fish passage as part of relicensing activities for power dams on the lower Susquehanna River.

E. Chesapeake Bay

1. Desired Result

To manage the water resources of the Susquehanna River Basin to assist in restoring and maintaining the Chesapeake Bay so it meets or exceeds applicable water quality standards and supports healthy populations of living resources, including oysters, crabs, fish, waterfowl, shore birds, and underwater grasses.

2. Discussion of Issues

The Chesapeake Bay is the largest estuary in the United States and supports a wide array of habitat types and aquatic life. By the middle of the twentieth century, the health of the Bay had deteriorated due to excess nutrients and sediment, releases of toxic pollutants, lost or degraded aquatic habitat, and over-harvesting of commercial fishery resources.

A number of key agreements between the early 1980s and early 2000s are the basis for programmatic actions initiated by the Commission’s member jurisdictions to restore the Chesapeake Bay. Those agreements



include: the 1983 agreement among Pennsylvania, Maryland, Virginia, the District of Columbia, the USEPA, and the Chesapeake Bay Commission to reduce excess nitrogen and phosphorus; the 1987 agreement by the same entities to achieve a 40 percent reduction in controllable nutrient loads to the Bay by the year 2000; and the June 2000 agreement by the same entities to “continue efforts to achieve and maintain the 40 percent nutrient reduction goal agreed to in 1987 and correct the nutrient- and sediment-related problems in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of its tributaries from the list of impaired waters under the Clean Water Act by 2010.”

With the jurisdictions failing to meet the 2010 goals, the Chesapeake Bay TMDL, a comprehensive “pollution diet”, was established in December 2010 based largely on implementation plans prepared by Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, West Virginia. In 2012, each of the jurisdictions submitted Phase II Watershed Implementation Plan (Phase II WIP) designed to outline the needed cleanup strategies, as well as identify and involve local partners. Progress reports are to be submitted to USEPA every two years. The Bay TMDL requires 60 percent of the pollution reduction practices to be in place by 2017, with all pollution control measures needed to fully restore the Bay in place by 2025.

More scientific studies have been performed on the Chesapeake Bay than nearly any other estuary on earth. Public policy and state-of-the-art science both led to the development of sediment, nitrogen, and phosphorus load allocations from the Susquehanna River designed to meet and maintain water quality conditions that will restore and protect biological resources in the Bay. To restore conditions in the Bay, the basin’s water resources must be managed to provide both the quality and quantity of water needed. The basin also must be managed to provide adequate habitat for migratory fish and to limit the amount of man-made, floating debris that is carried from the river to the Bay.

The Susquehanna River Basin Compact specifically recognized the importance of the Bay – Section 14.1 states, “The comprehensive plan shall take into consideration the effect of the plan or any part thereof upon the receiving waters of the Chesapeake Bay.” Water from the Susquehanna River Basin plays a significant role in the restoration effort because the Susquehanna River provides 50 percent of the Bay’s total freshwater inflow. However, it is not currently known how much reduction of inflows to the Chesapeake Bay, if any, is tolerable.

The Commission regulates withdrawals and consumptive uses of water in the Susquehanna basin, and both of these are increasing. Because of the interrelationships between water quantity and quality, the Commission believes that low flow and consumptive use management in the Susquehanna basin must be part of the Bay restoration effort.

The ecology of the Chesapeake Bay is both important and complex. The Bay provides habitat for more than 500 species of fish and shellfish, more than 2,700 plant species, and 29 species of waterfowl. The Bay is a major feeding and resting stop for migratory birds and also provides wintering habitat for a number of migratory species. The Bay’s living resources are economically important, supporting the regional economy as a major source of seafood, with an annual harvest worth \$1 billion.

The Bay also provides a wide range of recreational opportunities such as fishing, boating, waterfowl hunting, crabbing, swimming, bird watching, and nature study. Many of these activities are dependent on the ecological health of the Bay and its fish and wildlife resources. Bay-related tourism provides the regional economy with billions of dollars in revenue each year.

Excessive amounts of nutrients, namely nitrogen and phosphorus, in the Chesapeake Bay and tidal regions of its tributaries have aggravated a number of water quality conditions producing excessive algal growth, low concentrations of dissolved oxygen, and reduced water clarity. The increased algae concentrations and reduced water clarity inhibit growth of the Bay's submerged aquatic vegetation (SAV), which provides important habitat for fish, wildlife, and blue crabs, which are one of the most economically important species in the Bay. SAV also provides food for ducks and other waterfowl, absorbs nutrients, reduces suspended sediment, helps stabilize substrate, and produces oxygen in the water. Significant progress has been made in recent years toward meeting the SAV goals for the Upper Chesapeake Bay. Only 29 percent of the 14,978-acre SAV restoration goal for the Upper Bay was met in 1991, while 87 percent of the goal was met in 2007.

Fish and other forms of aquatic life have specific dissolved oxygen requirements for survival. Algal blooms, when not eaten by fish and shellfish, deplete dissolved oxygen in the Bay, making some of its deeper waters uninhabitable for some species.

The effects of excessive nutrient loading on water quality show considerable variation according to season and the particular region of the Bay. Generally, problems related to low levels of dissolved oxygen are greatest in the deeper portions of the upper Bay during the summer. The restoration target values developed for nutrients relate to this issue, although dissolved oxygen problems may occur in other areas on a periodic basis.

The results of best management practices, sewage treatment plant upgrades, and other restoration activities in the basin will first be seen in the chemical and physical quality of local streams and rivers, followed by the biological response in the Bay.

Mine drainage carrying metals is a major concern in portions of the Susquehanna River Basin, although specific load allocations have not been set for metals provided to the Bay from its major tributaries. Mine drainage degrades normal biological processes and reduces the ability of streams to assimilate nutrients, with increased amounts being transported downstream and delivered to the Chesapeake Bay. The air-borne transport and deposition of acid rain, nitrogen, sulfur, and toxins into the Bay watershed area also are of concern.

More recently, the role of several reservoirs in the lower reaches of the Susquehanna River has come under greater scrutiny with regards to their influence on water quality in the Bay. For decades, the lower reservoirs served as best management practices for the Bay, trapping large amounts of sediment and nutrients behind the dams. The single biggest contributor to trapping these sediments and nutrients has been Conowingo Reservoir, the largest and most downstream impoundment. Based on a recent USGS study (2012), Conowingo Reservoir is at a transitional stage where their sediment trapping capacity is approaching steady-state. When this point is reached, Conowingo Reservoir will no longer serve as an effective trapping mechanism. Additionally, in cases of high flow events, the data indicate that sediment and nutrient loads have already started to increase as a result of scouring under certain conditions. In light of the USGS and other studies, and other monitoring results, the issue of sediment behind the dams will remain a critical piece in restoration of the Bay's health.

3. Goals

Three goals have been established to achieve the desired results and are discussed below. For each goal, ongoing Commission activities and actions needed are identified.

Goal a. Identify the minimum freshwater inflows needed from the Susquehanna River to assist in restoring and maintaining the ecological health of the Chesapeake Bay, while also identifying opportunities for enhancement.

Low flow maintenance planning has been a priority activity at the Commission 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 six major subbasins in the basin. 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. Also, arrangements were made to provide low flow releases from Whitney Point Lake in Broome County, N.Y. In 2007, arrangements were made with the Commonwealth of Pennsylvania to provide water storage from the Barnes and Tucker mine pool in Clearfield County, Pa. The Commission is actively continuing to perform consumptive use mitigation planning and seek additional sources of water for release during low flow periods.

In 1996, the Commission published the *Chesapeake Bay Low Flow Strategy Study*, which was prepared by the Commission and the University of Maryland's Horn Point Environmental Laboratory. The purpose of the study was to develop a general strategy to study and manage the impacts of low freshwater inflows from the Susquehanna River on the salinity, water quality, available habitat, and living resources of the Bay.

The study analyzed the hydrology of the Susquehanna River, provided an extensive review of the available literature related to flow impacts on the Bay, and included the results of an opinion survey directed toward agencies and researchers involved with living resources and flow issues. A summary of pertinent issues was included in the study report, as well as a summary of activities conducted at a workshop conducted in 1995. As discussed previously, climate change will alter the ecology of the Susquehanna River system, which will also have downstream effects on the Chesapeake Bay.

The study's literature review indicated potentially significant impacts of low flows and consumptive uses on salinity, water quality, and living resources and provided 10 major recommendations for development of a strategy, as well as a list of 29 issues for further consideration.

Ongoing Commission Activity:

1. Plan and implement low flow water management activities. (Also discussed under the Sustainable Water Development Priority Management Area)

Actions Needed:

1. Work with USEPA's Chesapeake Bay Program, the USACE, the State of Maryland, and others to support the process to determine flow regimes under which the ecological health of the Bay can be restored and sustained.
2. Continue working with agency/stakeholder partners to develop ecosystem flow needs and goals for the lower Susquehanna River and upper Chesapeake Bay as part of the FERC relicensing of Conowingo Hydroelectric Station.
3. Plan any additional studies and modeling efforts that are needed and seek appropriate funding and implementation.

Goal b. Develop and implement plans to address the flow requirements in Goal a. above.

The Commission will need to determine the amount of water and costs associated with providing the amount of water needed for the ecological health of the Bay. Planning, implementation, and reevaluation also will need to be performed over the long term.

Ongoing Commission Activity:

1. See Goal a. above.

Actions Needed:

1. Assess the feasibility of providing recommended flow regimes to the Bay.
2. Continue to update and review progress in providing the flows needed for the Bay.
3. Continue working with agency/stakeholder partners to develop, negotiate and ultimately memorialize and implement a revised flow management plan for Conowingo Hydroelectric Station as part of FERC relicensing.

Goal c. Support the Chesapeake Bay restoration effort, including sediment and nutrient reduction strategies developed by each of the Commission's member states.

The Compact directs the Commission to consider the effects of its Comprehensive Plan on the receiving waters of the Chesapeake Bay. The Commission has participated on a number of Chesapeake Bay Program committees and subcommittees, has performed sediment and nutrient monitoring in support of Bay restoration activities since the mid-1980's, and chaired a sediment task force that studied the accumulations of sediment behind dams on the lower Susquehanna River and recommended specific actions for the management of sediment in the basin. The Commission serves on the Water Quality Goal Implementation Team (formerly the Chesapeake Bay Water Quality Steering Committee), which is chaired by USEPA's Chesapeake Bay Program and was responsible for the planning process leading to the establishment of new water quality criteria for the Bay and the development of target loads for sediment and nutrients delivered to the Bay from its major tributaries, including the Susquehanna River. Although previous actions related to the Chesapeake Bay cleanup have been largely voluntary, the Bay TMDL USEPA established in 2010 requires states to revise permits and perform a wide array of other implementing activities to achieve the desired results.

Maryland, Pennsylvania, and New York each developed and adopted state tributary strategies to achieve and maintain the load allocations developed for the Susquehanna River and each state. All three states used a variety of approaches to reduce loads from point source discharges such as sewage treatment plants and industrial facilities, as well as from nonpoint sources such as agricultural and urban runoff. The focus of each state tributary strategy varied depending on the magnitude of loading from various sources and the tools available to control those loads. These strategies were refined in 2012 through the development of the states' Phase II WIPs, in response to the more rigorous implementation plans called for in the TMDL. Significant efforts are under way to implement the strategies in all three of the Commission's member states.

Outside of the Phase II WIP efforts, there has been concern about sediment and nutrient loads increasing from the Susquehanna River as a result of the diminished trapping capacity of the lower reservoirs, and in particular the Conowingo Reservoir. As mentioned earlier in this plan, due to the loss of sediment storage, studies indicate the Conowingo is transitioning from a sediment sink to a sediment source. As a result, the U.S. Army Corps of Engineers and the State of Maryland, along with U.S. EPA, the Nature Conservancy, and the Commission, have initiated a study focused on strategies for managing

sediment and nutrient delivery to the Bay, with additional focus on the role of the lower reservoirs. The study, named the Lower Susquehanna River Watershed Assessment, is a 3-year effort that started in 2011.

Ongoing Commission Activities:

1. Perform sediment and nutrient monitoring in the basin to help refine the Chesapeake Bay watershed model, support restoration activities, identify water quality trends, and document progress in meeting sediment and nutrient reduction goals established for the Susquehanna River.
2. Promote adequate funding and support tributary strategies and Phase II WIPs developed by each of the Commission's member states, and participate on committees and workgroups to advance restoration and protection efforts.
3. Support studies to determine the remaining sediment trapping efficiency of dams on the lower Susquehanna River and determine if and how trapping capability may be retained.
4. Continue participation in the Lower Susquehanna River Watershed Assessment, led by USACE and MDE, to comprehensively forecast and evaluate sediment and associated nutrient loads to the system of hydroelectric dams located on the lower Susquehanna River and consider structural and non-structural strategies to manage these loads to protect water quality and aquatic life in the Chesapeake Bay.
5. Assist member jurisdiction efforts in preparing strategies for managing sediment stored behind the dams in the Lower Susquehanna.
6. Promote the installation of best management practices for point and nonpoint sources, including stormwater and agricultural runoff.

Actions Needed:

1. Perform trend analyses for additional sediment and nutrient monitoring sites as sufficient data are accumulated.
2. Coordinate, encourage and support implementation efforts to manage sediment within the basin, including legacy sediments from mill dams and sediment that has accumulated behind dams on the lower Susquehanna River.
3. Promote water quality infrastructure improvement for point sources in the Susquehanna River Basin to benefit local water quality improvement and the Bay restoration effort.

F. Coordination, Cooperation, and Public Information

1. Desired Result

To maximize available human resources and achieve common and complementary management objectives by the Commission, its member jurisdictions and others; to promote the planning and management of the basin's water resources in the most efficient manner possible; to inform the public on the Commission's water management responsibilities; and to enhance the public's access to Commission information and in commenting on Commission activities.

2. Discussion of Issues

This priority management area includes: (1) meeting the water management needs of the Susquehanna basin by utilizing government resources – both personnel and financial – in the most effective and efficient manner, (2) making the public aware of the basin's priority needs and the programs and activities in place by the Commission and its member jurisdictions to meet those priority management needs, and (3) ensuring access to all sectors and the general public to Commission information and procedures and encouraging the public's participation in commenting on Commission activities, particularly as they relate to proposed policies, guidances, rules, plans and studies.

As stated in the preamble of the Compact, the water resources of the basin are subject to the duplicating, overlapping, and uncoordinated administration of a large number of governmental agencies that exercise a multiplicity of powers. This can result in a splintering of authority and responsibility, an inefficient use of scarce governmental resources, and inconsistent treatment of water users.

The Commission's member jurisdictions and their political subdivisions are engaged in many water resource management activities that have basinwide impacts and effects on the Chesapeake Bay. Examples include stream classifications, water quality standards, water withdrawal regulations, flood damage reduction, and waste treatment. It is therefore critical that there be some overarching mechanism that promotes communication and coordination among these entities. Communication and cooperation among the member jurisdictions are likely to preemptively remove causes of potential controversy before they rise to the level of open conflicts.

While the Commission is established as the chief agency to foster coordination, the Compact specifically declares that it is the intention of the member jurisdictions to preserve and utilize the existing offices and agencies of government. The member jurisdictions should remain as the chief stewards of their own natural resources. However, to do so in the most efficient and effective manner, those offices and agencies need to be working together under the coordinative oversight of the Commission.

With respect to public information, a basic purpose of the Compact is to manage the basin's waters in the public interest. The Compact preamble recognizes in its very first declaration that management of the basin's water resources under comprehensive multipurpose planning will bring the greatest benefits and produce the most efficient public service in the public interest. Also, Goal No. 6 of the Commission's Statement of Mission calls on the Commission "To provide public information and education about the water resources of the basin."

As required by its Compact and regulations, the Commission seeks public input to the greatest extent possible on regulatory, planning and other programmatic areas. For the public to provide meaningful input, it must be informed of the relevant water management issues. Only through a public information and outreach effort by the Commission can this be accomplished.

3. Goals

Seven goals have been established to achieve the desired results and are discussed below. For each goal, ongoing Commission activities and actions needed are identified.

Goal a. Continue use of interagency committees and ad hoc committee mechanisms to gather input from member jurisdictions and to encourage consistent interstate water management policies and actions.

Over the years, the Commission has relied upon and productively utilized various interagency and citizen/interest group committees of both a permanent and ad hoc nature to accomplish important water management objectives. Successes include the implementation of a basinwide flood forecasting and warning system, management of severe droughts, promulgation of important regulations, consideration of agricultural issues and oversight of water quality monitoring and assessment efforts. The Commission should continue to build on these successes and look for additional opportunities to utilize committees.

Ongoing Commission Activity:

1. Continue to participate in member jurisdiction water resource planning efforts and support the enhanced federal agency coordination activities of the USACE Baltimore District.

Actions Needed:

1. Consult the Commission’s established advisory committees such as the Water Resources Management Advisory Committee and Water Quality Advisory Committee and, as needed, activate ad hoc committees to address special issues or projects.
2. Facilitate interagency and interstate committees to deal with selected water management topics.

Goal b. Execute, review, and update memoranda of understanding (MOUs) with member jurisdictions to coordinate regulatory or other programs that overlap.

The Commission exercises its regulatory and programmatic authority concurrently with numerous state and federal agencies, although statutory authorities and respective regulations of the various agencies are not identical in terms of scope, standards or procedure. Section 806.7 of the Commission’s project review regulations states that “to avoid duplication of work and to cooperate with other government agencies, the Commission may develop administrative agreements or other cooperative arrangements...with appropriate agencies of the member jurisdictions regarding joint review of projects.” Although the Commission coordinates with various water resource agencies of its member jurisdictions, administrative agreements serve to formalize and facilitate the coordinated review of water withdrawal projects, memorialize a process for communication and action, promote program consistency and to generally allow for the efficient use of agency resources to assure the overall protection of water resources of the basin. The Commission has had a project review MOU in effect with the Pennsylvania Department of Environmental Protection (PADEP) since 1999 and seeks opportunities to update that MOU as needed to continue improving coordination between the two agencies. There are currently no other member state MOUs in effect. In its early years, the Commission had an MOU in effect with the Federal Energy Regulatory Commission (FERC) on concurrent review of hydroelectric projects. In addition, Commission executed an MOU with USACE in August 2008 to enable USACE to provide technical services to and funded by the Commission, along with another MOU with USACE in March 2010 regarding emergency water withdrawals or releases from Corps’ reservoirs. Additional opportunities for MOUs with state and federal agencies should be evaluated and appropriately considered.

Ongoing Commission Activity:

1. Review existing MOUs with federal agencies and evaluate the benefits of executing new MOUs with other federal agencies.

Action Needed:

1. Keep the Commission-PADEP MOU current and consider amendments that address both substantive and procedural mechanisms to ensure effective implementation of Commission regulatory standards, including sustainable development of the resource while preventing significant adverse impacts to the environment. Explore possibilities of executing similar MOUs with the federal government or establishing an alternate procedure for coordination and exchange of information on project approvals and other work programs.
2. Develop cooperative agreements and/or MOUs with New York and Maryland that will govern the review and application of water withdrawal regulations in those portions of the basin.
3. Enhance and improve the sharing of information related to regulated projects in databases maintained by the Commission and its member jurisdictions.

Goal c. Support uniform water management policies and standards in areas such as water quality, stream classification, flood plain management, instream flow protection, stream passby requirements and aquifer protection.

A stated purpose of the Compact is to “apply the principle of equal and uniform treatment to all users of water and of water-related facilities without regard to political boundaries.” “Uniform” water management standards do not mean that such standards must be identical. Instead, standards should be complementary and mutually supportive, aiming toward the achievement of the common management objectives established under this comprehensive plan.

Ongoing Commission Activity:

1. Continue to participate in national water organizations such as the Interstate Council on Water Policy and the Association of State and Interstate Water Pollution Control Administrators, where common management problems and solutions can be more readily identified.
2. Continue coordination with member states to implement low flow protection in a way that is consistent with the states’ policies.

Actions Needed:

1. Determine the need for uniform standards in such areas as aquifer testing, water conservation, and flood plain management, evaluate existing frames for uniform standards and implement appropriate standards through the drafting of guidance, adoption of policies, or development of regulations.
2. As appropriate, assemble special interagency and interstate task force committees to address special water management topics and the development of uniform water management policies or standards.

Goal d. Coordinate major interagency efforts such as flood forecasting and warning, drought emergency management, water conservation, and hydro power license renewal.

The Compact recognizes the Commission as the “single administrative agency...essential for effective and economical direction, supervision, and coordination of water resource efforts and programs of federal, state, and local governments and of private enterprises.” In this oversight capacity, it is appropriate that the Commission be a leader in addressing water management issues of critical importance to the basin.

Ongoing Commission Activity:

1. As discussed in Priority Management Areas A, C, and F respectively, continue coordination and cooperative activities in the following areas: (1) the Interagency Drought Coordination Committee, (2) the basinwide flood forecast and warning system, and (3) Chesapeake Bay Program committees and related bay organizations.

Actions Needed:

1. Develop basinwide water conservation standards in cooperation with member states.
2. Facilitate interagency coordination of post-flood actions for the purpose of improving emergency response, technical information and flood damage reduction.
3. Expand leadership role and advocacy for the collection of water quality and quantity data for science, including the maintenance of an effective and sustainable stream and rain gage network.
4. Evaluate the establishment of a Susquehanna River Basin Monitoring Council.

Goal e. Inform legislators and executive branch policy makers on important issues related to the basin's water resources.

The efficacy of the Commission's work in the management of the basin's water resources is directly linked to financial and policy support from the Commission's member jurisdictions. The Commission should therefore develop a written strategy for better informing legislators and executive branch policy makers about relevant water management issues.

Ongoing Commission Activities:

1. Enhance the manner in which the Commission informs state and federal legislators of its work in managing the basin's water resources and related legislative priorities.
2. Maintain contact with policy makers in the executive branches of the member jurisdictions to retain their support for the Commission's work.

Actions Needed:

No new actions recommended under this goal.

Goal f. Inform the public on matters affecting the basin's water resources and utilize current tools, methods and strategies to effectively reach the public.

By requiring the Commission to take its actions in public meetings and hearings, by placing significant emphasis on the issuance of public notifications, and by requiring the public issuance of Commission documents including the annual report, annual Water Resources Program and the Comprehensive Plan, it is clear that the drafters of the Susquehanna Compact recognized the importance of an informed citizenry. Over the years, the commissioners and Commission managers have supported and further strengthened the Commission's public information initiatives, including producing and disseminating various publications, working with the media and disseminating information through the Internet. In addition to applying traditional methods of disseminating public information, in a time of ever-changing communication technologies, the Commission must strive to keep current on the tools, methods and strategies for educating and informing the public.

Ongoing Commission Activities:

1. Continue to rely on the Commission's web site as one of the primary public information tools, produce and disseminate publications, produce and disseminate television and radio public service announcements, and periodically conduct workshops on specific water resource topics.
2. Routinely disseminate information to the media using the full range of available communication options.
3. Incorporate GIS maps and other tools to the greatest extent possible to enhance public information products.
4. Organize and distribute to the public water resource data maintained by the Commission.

Action Needed:

1. Periodically evaluate existing and emerging communication technologies and methods to determine their potential application and benefits to the Commission's public information program and strategies.

Goal g. Enhance public access to Commission information and encourage public involvement in commenting on Commission activities.

The Commission, as a government agency and a steward of public resources, functions in the public domain. It is important that information be readily available to the public in the most effective and efficient manner and that the public is encouraged to be involved in the Commission's decision making and policy setting procedures. At the same time, the need to safeguard security related and confidential information in restricted files and data bases should be clearly recognized.

Ongoing Commission Activity:

1. Provide timely notice of Commission meetings and hearings via newspapers, when required, legal notice publications and the Commission's web site, and provide direct notice and other information electronically to individuals and organizations who have expressed an interest in a particular matter before the Commission.
2. Continue existing communications and contacts with non-governmental organizations on a range of water resource management issues.

Actions Needed:

1. Utilize currently available technologies to make information readily available through electronic means, including non-restricted files and records requested by interested parties to eliminate the need to physically visit the Commission's headquarters building.
2. Identify, assess, and consider a range of options for enhancing access to the Commission by the public and stakeholder groups to facilitate input to ongoing and emerging issues and programmatic matters; options for consideration could include holding periodic topical meetings or public forums, forming a general advisory committee, and using the Commission's web site more effectively for direct public input. Implement options that enhance opportunities for public and stakeholder input.
3. Expand on existing relationships with non-governmental organizations to maximize the beneficial use of their resources and expertise in the management of the basin's water resources, and consider their input on ongoing and emerging issues and programmatic matters.
4. Identify opportunities to collaborate with academic institutions to maximize resources and scientific knowledge.
5. Provide opportunities for non-governmental organizations' involvement in Commission activities and, through coordination efforts, encourage communication on activities/issues of mutual interest including ongoing and emerging issues.
6. Coordinate with trade associations related to the various types of water use in the basin to promote sustainable water use in conjunction with economic development.

PART V - AREAS OF SPECIAL INTEREST

While Part IV-Priority Management Areas – with its goals, ongoing Commission activities, and actions – serves as the primary vehicle for meeting the basin’s water resource needs, the Commission also recognizes the benefits of highlighting other essential water resource topics. The selected topics that warrant this separate discussion were designated as “areas of special interest” by the Commission, and they are a mix of both long-standing and emerging programs and problems. The Commission believes the selected topics are of interest to many interested parties in the Susquehanna basin.

The areas of special interest do not include Commission goals and actions as with the priority management areas. Rather, they provide an overview of their impact on water resources and present initiatives underway or needed to address them. The 12 areas of special interest are:

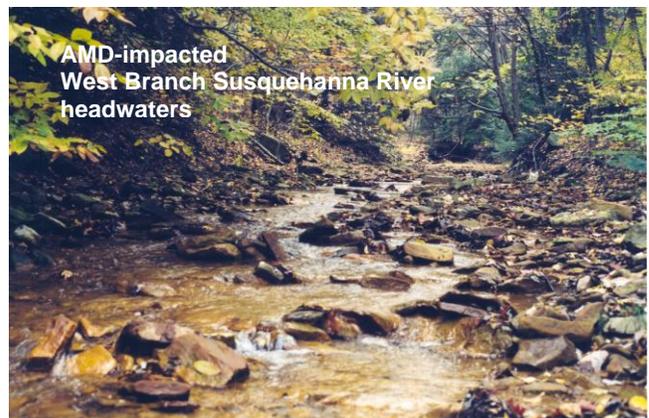
- A. mine drainage;
- B. climate change;
- C. consumptive use mitigation;
- D. drought coordination;
- E. economic development, recreation and other public values;
- F. emerging contaminants;
- G. energy production and development;
- H. flood forecast and warning;
- I. invasive species;
- J. fisheries monitoring and restoration;
- K. potentially stressed areas and water challenged areas; and
- L. water and wastewater infrastructure.

The Commission believes these areas of special interest need to be addressed by the combined efforts of all levels of government, the private sector and the Commission. Both Commission activities and those of others in the areas of special interest are discussed. Part V-M provides a matrix displaying the relationship of the areas of special interest with the priority management areas.

A. Mine Drainage

1. Background

The Susquehanna basin contains areas with both bituminous (soft) and anthracite (hard) coal. Bituminous coal is most prevalent in areas draining into the West Branch Susquehanna, Juniata, and Tioga Rivers, while most anthracite coal is in areas draining to the main stem of the Susquehanna River from the east.



Mine drainage pollution is formed when mining operations expose coal and bedrock containing pyrite (iron sulfide) to water and oxygen. Sulfuric acid and iron hydroxide are produced through both chemical and biological processes, and water containing acidity, iron, manganese, aluminum, and other metals can result. In addition to the toxic effects associated with mine drainage, iron and aluminum compounds are precipitated out of solution to coat the bottom of streams, making habitat unsuitable for most bottom-dwelling aquatic life. Coal fines may affect human health through airborne exposure, and can be eroded into streams to degrade aquatic

habitat. Studies are currently underway to determine whether metals in mine drainage may contribute to human neurodegenerative diseases.

Mine drainage is a significant cause of stream impairment in the basin (see Figure 16). Of the basin's total 49,350 stream miles, more than 8,400 miles are impaired, with more than 2,000 of them impaired due to mine drainage. All of the basin's mine drainage-impaired streams are located in Pennsylvania, with about 62 percent located in the West Branch Susquehanna Subbasin, 16 percent in the Middle Susquehanna Subbasin, 13 percent in the Lower Susquehanna Subbasin, 5 percent in the Juniata Subbasin, and 4 percent in the Chemung Subbasin (including the Tioga River Watershed).

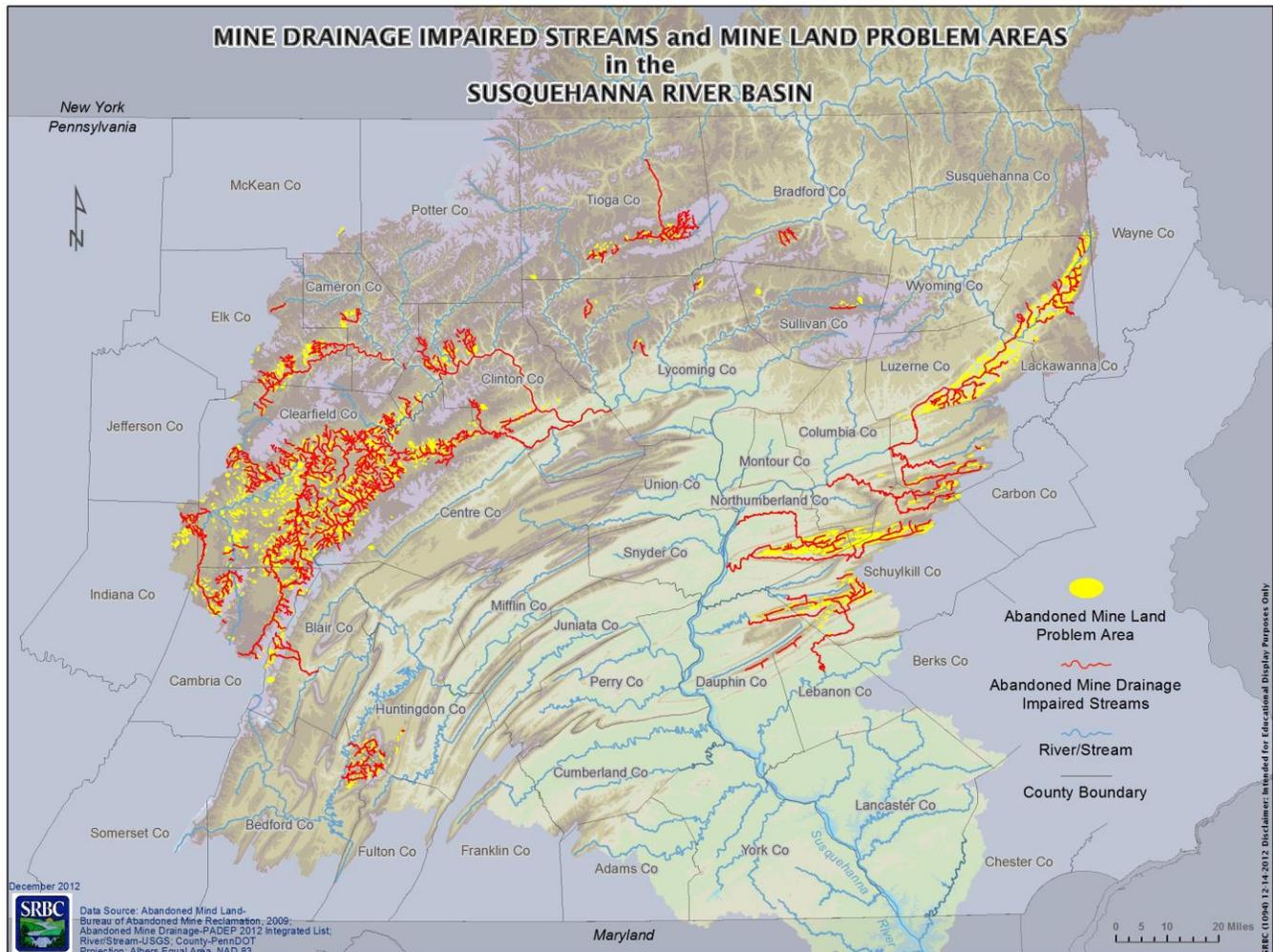


Figure 16. Abandoned Mine Lands and AMD Impaired Streams

Most mine drainage in Pennsylvania is the result of operations that ceased prior to enactment of the 1964 amendment to the Commonwealth's Clean Streams Law, which required mine operators to treat mine drainage. In the early 1980s, the ability to predict mine drainage water quality impacts improved significantly. The success rate for avoiding mine drainage impacts increased in 1984, when permit applicants were first required to submit scientific data to assess the potential for mine drainage production. Today, only a small percentage of mining permits results in post-mining discharges significant enough to require treatment, and most of these are easily treated.

2. Management Activities

In 1945, Pennsylvania passed the Bituminous Coal Open Pit Mining Conservation Act, requiring coal operators to register their mines, post bonds, cover exposed coal, round off refuse banks, and revegetate the land. The bonding was to insure that money would be available for the Commonwealth to complete reclamation if the mine operator did not do so. Pennsylvania adopted similar reclamation standards for anthracite mines in 1947.

Pennsylvania amended its Clean Streams Law in 1945 to make it unlawful to discharge mine drainage into clean waters devoted to public use. In 1963, Pennsylvania passed legislation to increase bonding rates, require bituminous mine operators to obtain a license and permit before mining, and require anthracite mine operators to backfill mine pits. Amendments to the Clean Streams Law in 1965 classified mine drainage as an industrial waste product and required operators to obtain a permit.

Pennsylvania passed the Land and Water Conservation and Reclamation Act in 1968, providing \$120 million for Operation Scarlift to prevent and control mine drainage and construct 524 mine drainage projects. The last Operation Scarlift funds were spent in 1995.

In 1998, Pennsylvania launched its Reclaim PA initiative to enhance reclamation efforts by mine operators, volunteers, and the Pennsylvania Department of Environmental Protection (PADEP). An important component of Reclaim PA is to provide incentives for the active mining industry to re-mine abandoned mine lands. In Pennsylvania, the amount of abandoned mine land reclaimed by the coal industry far exceeds the amount reclaimed by government projects.

The 1977 Surface Mining Control and Reclamation Act (SMCRA) is the primary federal law dealing with mine reclamation activities. In 2006, SMCRA was reauthorized for another 15 years, increasing reclamation funding to Pennsylvania by three to four times over a period of years. The amended SMCRA law will provide nearly \$1.4 billion to Pennsylvania to reclaim many of its Priority I and II health and safety abandoned mine land sites, as well as provide up to 30 percent funding for future mine drainage remediation efforts and operation and maintenance of existing state-funded mine drainage treatment systems. Although funding is directed primarily toward Priority I and II sites with health and safety issues, a 30 percent set-aside provision (an increase from 10 percent) is available to fund staff, projects, and other activities associated with treatment of mine drainage. The federal Office of Surface Mining provides SMCRA funding to PADEP, which has the option of determining whether or not to use the set-aside provision within SMCRA.

Under the federal Clean Water Act, the U.S. Environmental Protection Agency (USEPA) works with the states to regulate water quality activities. The Commission provides a supporting role, as discussed in Priority Management Area B - Water Quality. The U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE) also have performed various monitoring and planning activities related to mine drainage in the basin. Also, the federal Office of Surface Mining has been providing a considerable amount of funding for the construction of mine drainage treatment systems through what was once called the Appalachian Clean Streams Initiative and is currently called the Watershed Cooperative Agreement Program.

The Eastern and Western Pennsylvania Coalitions for Abandoned Mine Reclamation (EPCAMR and WPCAMR), as well as watershed organizations such as Tioga County Concerned Citizens Committee and Catawissa Creek Restoration Association, have played a key role in constructing mine drainage remediation projects in the basin. EPCAMR has been working within the Susquehanna River Basin for over a decade, taking a lead role to create partnerships and build coalitions to seek out funding for the assessment of mining-impacted watersheds leading to the successful implementation of many watershed restoration plans, river conservation plans, and the construction of fully functional mine drainage treatment systems. Pennsylvania has

provided considerable funding for this work through its Growing Greener grant program. Additional information is available on the EPCAMR and WPCAMR web sites.

The Commission has helped coordinate mine drainage issues in the basin and has performed mine drainage monitoring and assessments, total maximum daily loads, and planning studies such as the Watershed Assessment and Remediation Strategy for Abandoned Mine Drainage in the Upper Tioga River Watershed and the West Branch Susquehanna Subbasin Abandoned Mine Drainage Remediation Strategy. The Commission has also worked to restore the Bear Run Watershed in Indiana/Cambria counties through the installation of several mine drainage treatment systems, returning the stream to a viable trout fishery. In addition, the Commission is providing operation and maintenance funding for the Lancashire 15 Abandoned Mine Drainage (AMD) Treatment Plant in Cambria County, PA, for mitigation of agricultural consumptive water use in the Pennsylvania portion of the basin, and is studying the capability of other mine pools to provide low flow augmentation for consumptive use mitigation, provided releases meet applicable water quality standards.

3. Future Direction

Several action items under Priority Management Area B – Water Quality relate to mine drainage. Goal c of Priority Management Area D – Ecosystems also discusses mine drainage with regard to migratory fish passage. The discussion of issues under Priority Management Area E – Chesapeake Bay discusses mine drainage with regard to the assimilation of nutrients.

The Commission is particularly interested in continuing mine drainage remediation planning and implementation in the West Branch Susquehanna Subbasin, and in implementing recommendations from the Anthracite Region Abandoned Mine Drainage Remediation Strategy in the Susquehanna River Basin. The Commission also plans to strengthen working relationships with the Eastern and Western Pennsylvania Coalitions for Abandoned Mine Reclamation, Trout Unlimited, and other groups involved in restoring waters impaired by mine drainage. EPCAMR continues to be a critical partner in working with the Commission in the anthracite region of the basin.

The increase in SMCRA funding will provide additional reclamation and mine drainage remediation opportunities in Pennsylvania. The Commission's Year 1 and 2 Subbasin Survey work will continue to help provide additional data to support local remediation plans and projects.

B. Climate Change

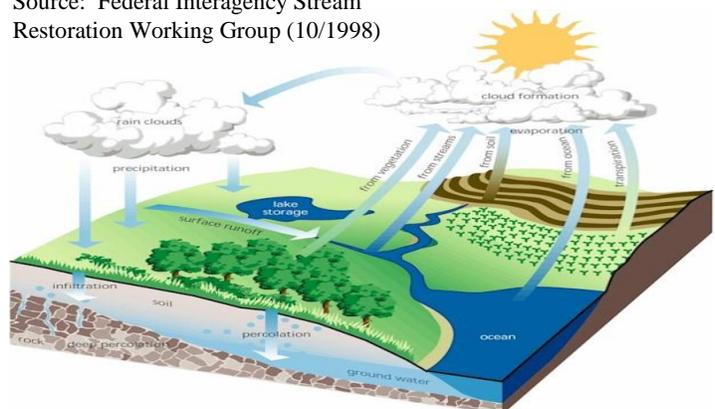
1. Background

More and more information is becoming available about potential climate changes associated with carbon dioxide and other greenhouse gases. Water resources are obviously an integral part of the earth's climate, and any changes to the mid-Atlantic's climate could, likewise, have implications for basin water resources. The Pennsylvania State Climatologist has reported climate trends observed over the past 100 years, with changes to both temperature and rainfall.

Specifically, there has been a slight increase in winter temperatures of 1.2 degrees Fahrenheit, a slight decrease of 0.5 degrees in summer temperatures, and an increase in rainfall of up to 8 inches per year.

Hydrologic Cycle Diagram

Source: Federal Interagency Stream Restoration Working Group (10/1998)



Predictions for changes in Pennsylvania over the next 100 years include increases in winter and summer temperatures of up to 12 and 14 degrees, respectively, and a 23 percent increase in average annual precipitation, from 40.4 inches to 49.7 inches. Predictions also include an increase in the frequency and severity of heavy rainfall – raising the likelihood of flooding – and, at the opposite extreme, an increase in the frequency of summer droughts. It is important that the Commission’s water resource managers know how such changes are affecting long-term hydrologic patterns. (Also discussed in the Flooding priority management area.)

Aside from hydrologic changes, there are also implications concerning the reliability of hydrologic data. When planning for water resources, water managers typically rely heavily upon streamflow records stretching back 100 years or more. However, if climatic patterns are shifting, water managers can no longer be certain that those records still reliably reflect current conditions or expected changing conditions. An investigation of streamflow records at several long-term gages in the Susquehanna River Basin already shows a distinct difference in patterns pre- and post-1970. It is not yet known whether the shift is in response to climate change or to some other cause. (Also discussed in the Water Supply priority management area.)

Whatever the cause, the implications for water resources could be extensive, and management, planning and protection cannot occur without a good understanding of what the new natural patterns are, or how they are expected to change. Also, although most focus has been on water quantity, there is the potential for impacts to management of water quality as well. For example, the Chesapeake Bay Phase II WIPs for New York, Pennsylvania, and Maryland will be implemented using assumptions about the entry of nutrients into streams and how they interact with natural systems, but those assumptions may vary depending on factors such as average flows and water temperatures. (Also discussed in the Water Quality and Chesapeake Bay priority management areas.)

There are studies indicating that the Chesapeake Bay is already showing the first signs of impact from climate change, specifically from increased air and water temperatures. Since the 1960s, water temperatures in the Chesapeake have warmed by about 2 degrees. As the Bay's water warms, some existing problems could be aggravated and new problems could emerge. Increased water levels in the Bay also pose threats. In the last century, Bay water levels have risen by more than a foot.

Likely implications of climate change to the Chesapeake Bay include expansion of the oxygen-depleted dead zones, die-off of critical habitat grasses, increased runoff carrying more nutrients and sediments, increases in algae blooms and diseases, higher and more destructive storm surges associated with tropical systems, loss of tidal wetlands and their pollutant-filtering capacity, changes to salinity patterns, changes in the timing of breeding and migrations, and the loss of native species and establishment of non-native species as they adjust to changing conditions in the Bay and surrounding waters. (Also discussed in the Chesapeake Bay priority management area.)

2. Management Activities

The potential effects of climate change will impact Commission programs both directly and indirectly. Most immediately and directly, shifts in rainfall patterns that cause more floods and more droughts will require the Commission to dedicate more resources to its already active flood and drought coordination programs. In addition to increased response activities, there will likely be interest in Commission participation in cooperative long-term planning and management for the mitigation of increased flood and drought hazards.

Other impacts of climate change will be less direct, but could actually have more far-reaching implications for Commission programs. Because climate change could significantly shift temperatures and the delivery of precipitation, the very nature and design of hydrologic resources and regimes in the Susquehanna basin could be altered. Such an alteration has the potential to render invalid many of the assumptions underlying basic Commission programs, including consumptive use mitigation, flood and drought planning, development of total maximum daily loads, trends in nutrient and sediment loading from storm runoff, instream flow protection, water availability studies, and Chesapeake Bay protection and restoration efforts.

3. Future Direction

The magnitude and frequency of streamflows in the Susquehanna River Basin are used by the Commission and other agencies for water quality and quantity planning and management. Traditionally, by using streamflow statistics, streamflow data series are implicitly assumed to be stationary in water resources planning and management. However, with increasing scientific evidence, the assumption of stationarity may not be valid. Therefore, the impact of climate change on the basin’s hydrologic cycle needs to be examined thoroughly. The long term trend, and pattern of the trend, in streamflows and groundwater levels would need to be investigated. Furthermore, the Commission needs to keep track of the development of emerging methodologies that are not strictly based on the stationarity assumption and explore their applicability in water resources planning and management.

C. Consumptive Use Mitigation

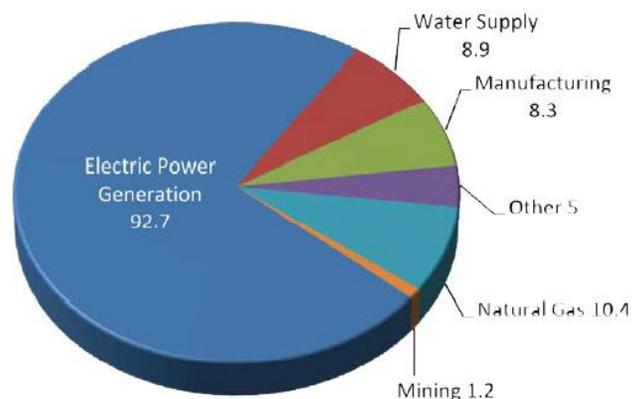
1. Background

Commission regulations require mitigation for consumptive use of water. Consumptive use is broadly defined to be the loss of water due to a variety of processes by which the water is not returned to the waters of the basin undiminished in quantity. As discussed in Priority Management Area A – Sustainable Water Development, consumptive use is one of the principle causes of water availability shortages in the basin.



The chart to the right depicts reported consumptive use, in million gallons per day (MGD), by major industry type for calendar year 2011. The data provide insight into the current, typical consumptive use profile for the Susquehanna River basin. Electric power generation (92.7 MGD) is dominant, followed by natural gas (10.4 MGD), water supply (8.9 MGD), manufacturing (8.3 MGD), mining (1.2 MGD) and other uses. It is important to note that actual, reported consumptive use can be somewhat less than approved consumptive use quantities for certain industry types. Examples of this include the golf course industry, which typically does not irrigate outside of the summer months, and the natural gas industry, which typically does not need their entire approved quantities on a continual basis.

2011 Reported Consumptive Use (MGD) By Major Industry Type



The Commission’s consumptive use regulation, as adopted in 1976, required project sponsors to provide mitigation for their consumptive use during low flow events. Sponsors were expected to comply with the regulations by providing compensatory water or discontinuing consumptive use during low flow events. In

1986 and 1994, the Commission contracted with the USACE for releases of water stored at Cowanesque and Curwensville Lakes, respectively, for the purpose of consumptive use mitigation. The storage in Cowanesque is almost entirely dedicated to mitigation for the nuclear power plants at Berwick and Three Mile Island. Releases at both facilities are currently tied to Q7-10 conditions at one or more main stem Susquehanna River gages. Q7-10 is the 7-day average low flow expected to occur at a 1-in-10-year frequency and has a 10 percent chance of occurring in any year, on average.

While a few power companies were able to make the financial investments to secure water storage at the USACE facilities and Lake Chillisquaque for compensatory purposes, this option proved impractical for most sponsors, and discontinuation of consumptive use was largely impractical for facilities. In response, the Commission made provision in 1993 for project sponsors to pay a consumptive use fee to the Commission in lieu of providing actual mitigation. The payment of fees was intended to allow the Commission to undertake additional large-scale storage projects to provide low flow mitigation for consumptive use projects paying the fee. The Commission has performed several storage project studies and hydrologic investigations over the past decade, culminating in a proposed plan for achieving necessary consumptive use mitigation. In 2008, the Commission adopted the Consumptive Use Mitigation Plan (CUMP) that presented the state of consumptive use in the Susquehanna basin, identified low flow mitigation needs, presented various mitigation trigger thresholds, and set forth recommendations for mitigating existing and projected consumptive use.

2. Management Activities

The intent of the Commission's consumptive use mitigation program is to replace regulated consumptive use during low flow periods, not to maintain critical flow levels. As a result, manmade impacts caused by regulated consumptive use during low flows are targeted for mitigation, allowing the hydrologic regime to follow a natural declining pattern without being aggravated by consumptive use. The CUMP reported a total of more than 450 million gallons per day of consumptive use in the basin having active mitigation in the form of Commission-owned water storage, self-supplied storage, other compensation releases, or agreements to cease or reduce usage during droughts. Figure 17 displays changes in consumptive water use, including that which is mitigated and the portion that requires mitigation per the 2008 CUMP.

Phase I of that study included an Ecosystem Flow Study led by The Nature Conservancy (TNC) in cooperation with USACE, the Commission and federal/state resource agencies. The study culminated in the preparation of the "Ecosystem Flow Recommendations for the Susquehanna River Basin" report in 2010. In the report, TNC presented a set of recommended flows to protect the species, natural communities, and key ecological processes within the various stream and river types in the basin. One of the most critical findings of the study is that seasonal flow recommendations are preferred to year-round flow recommendations as ecosystem flow needs are naturally seasonal. These recommendations were also memorialized in the USACE and Commission's "Susquehanna River Basin Ecological Flow Management Study Phase I" report in 2012. The flow recommendations, based on the Susquehanna River Basin ecosystem, are one of the original motivations that triggered revisions to the Commission's existing policies related to instream flow protection.

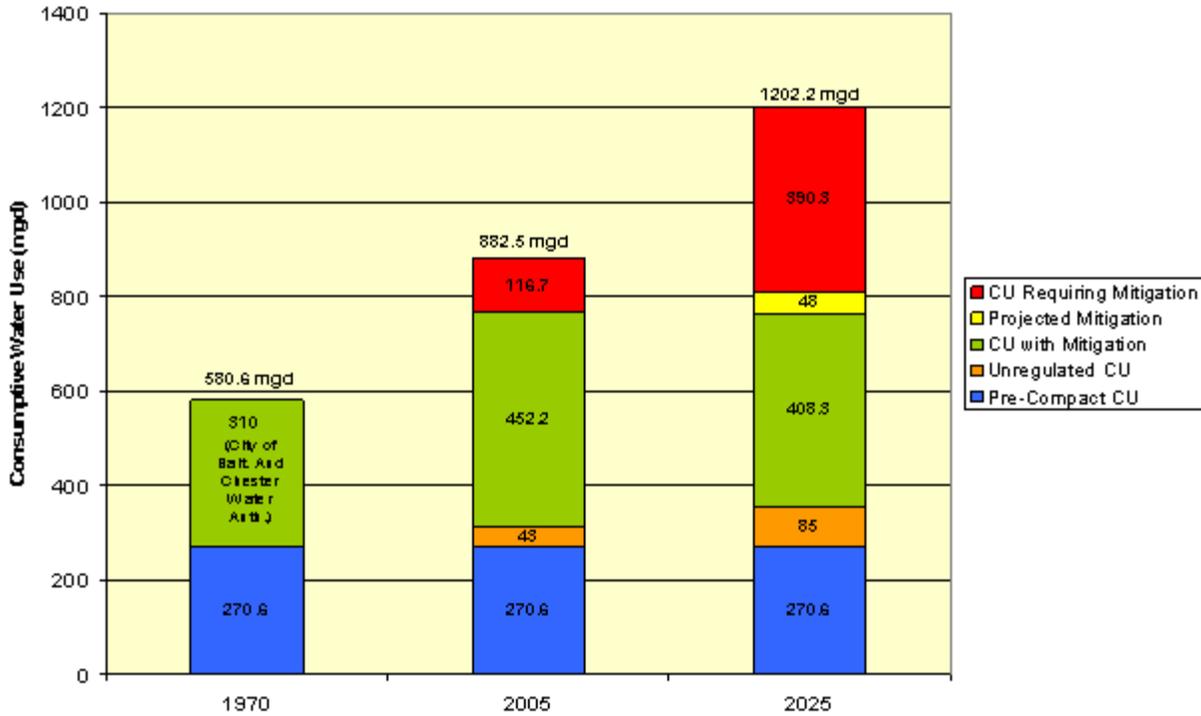


Figure 17. Projected Change in Consumptive Water Use in the Susquehanna River Basin (CUMP, 2008)

3. Future Direction

The critical low flow recommendation cited in the TNC report for mainstem rivers is no change to the monthly P95 flow. “P95” is the flow that is exceeded 95 percent of the time, during a given month, at certain stream gages and is based on monthly flow regimes which vary during the year. Based on technical studies to optimize use of Commission-owned water supply storage at Cowanesque and Curwensville Lakes, the Commission made application to USACE in May 2012 for revised low flow operations at these projects. The preferred alternative identified in the application entails monthly P95 consumptive use mitigation release triggers, consistent with the TNC flow recommendations, at mainstem USGS gages during the low flow months of July through November. USACE is expected to act on SRBC’s applications in the near future. Other recent Commission consumptive use mitigation project efforts have also focused on implementing monthly P95 triggers. These include Lancashire 15 AMD Treatment Plant in Cambria County, Pa., planning/feasibility studies of other mine pool storage projects, and agreements established with PA DCNR and PFBC to optimize proposed releases from state-owned impoundments during low flow conditions.

The CUMP projected that nearly 400 MGD in additional mitigation will be needed by 2025 based on approved consumptive use quantities. The Commission does not currently have adequate storage to provide mitigation to meet the projected need; nor is there likely to be sufficient funding readily available to procure as much as 400 MGD in additional storage. Because addressing the issues and mitigation goals described above will require changes to the way the Commission manages both its existing and new storage, it will be necessary to continue undertaking various analyses including: (1) revised low flow operations for Commission storage at Cowanesque and Curwensville reservoirs; (2) an evaluation of modified operations at existing federal, state and private reservoirs; (3) an assessment of the potential for mitigation storage at innovative locations such as underground mine pools; and (4) consideration of modifications to the consumptive use fee and the fee structure. In addition, an analysis is currently underway that leverages the Commission’s robust reported water use records and compares them to the generally higher approved consumptive use quantities. It is anticipated

that the results will provide valuable insight for further refining the mitigation target for approved projects relying on water storage acquired by the Commission or made available through modified operations. Setting mitigation target(s) more closely aligned with actual reported consumptive use, and developing processes to more closely align approved and reported consumptive use quantities, could prove to be a more sustainable approach to addressing consumptive use mitigation basinwide.

D. Drought Coordination

1. Background

The Susquehanna River Basin is susceptible to extended drought due to varied topography, geology, and climatic influences. In the northern and western portions of the basin, climate is influenced by Great Lakes and Midwest weather patterns, while the southern and eastern portions experience Atlantic coastal weather conditions. Situated at the interface of these climatic influences, basin weather patterns can lock into extended periods of dryness, followed by violent storm events. As discussed in Priority Management Area A – Sustainable Water Development, drought is a principal cause of water availability shortages in the basin.



Steep topography, particularly within the Appalachian Plateau and Ridge and Valley Provinces, and complex geology produce rapid runoff in watersheds, which, when deprived of winter snowpack, offers little opportunity for groundwater recharge. This condition results in depletion of aquifer storage during drought events as groundwater moves towards stream channels to maintain base flow. At these times, the basin must rely primarily on available surface and groundwater storage to meet its water supply needs until nature again provides a replenishment of the resource.

Shortly before the formation of the Commission, the extended drought of the mid-1960s set the benchmark for drought planning, and many drought operation plans are still based on recurrence of 1964 conditions. Following the adoption of the Susquehanna River Basin Compact, severe droughts occurred in 1980-81, 1985, 1991-92, 1995, 1998-99, and 2001-03. Several other years also exhibited significantly dry conditions.

2. Management Activities

As part of its coordination responsibilities, the Commission monitors the hydrologic conditions throughout the basin and informs the public of emerging drought conditions. The Commission also coordinates activities of its member jurisdictions to deal with drought conditions. If conditions reach established thresholds, the Commission has the authority to declare a drought emergency.

In response to drought emergency conditions spreading across nearly the entire basin in 1999, the Commission coordinated the development of the Susquehanna River Basin Drought Coordination Plan with its member jurisdictions. The plan details methodologies for monitoring hydrometeorological variables and includes recommendations for relating and combining these data to indicate the onset and termination of drought and drought severity. The drought indicators are precipitation deficit, streamflows, groundwater levels, soil moisture, reservoir storage depletion, and evidence of problems at public water supplies. During a drought event, the Commission relies on the Drought Coordinating Committee, comprised of representatives from the

Commission, the States of Maryland and New York, the Commonwealth of Pennsylvania, and the federal government, to review data and recommend appropriate response actions.

The potential for drought conditions is also recognized in the Commission’s regulatory program. Any project requesting withdrawal of water is subject to analysis of the ability of the proposed source to sustain the withdrawal during times of drought. If the source is deemed unable to meet the demand without posing the threat of adverse impacts, the applicant is required to implement protective measures or develop an alternate source. Similarly, consumptive water users are required to provide mitigation for their consumptive use during droughts, or pay the consumptive use fee to the Commission. Funds collected through payment of the fee enable the Commission to identify, develop and operate mitigation projects on behalf of the water users.

3. Future Direction

Current climatic trends, loss of groundwater recharge, and ever-increasing water usage require vigilant planning and preparedness exercises with respect to drought coordination. Drought contingency planning should be at the forefront of public water supply planning. In addition, the Commission should carefully weigh the impacts of proposed diversions to in-basin water uses during times of drought and emphasize the importance of mitigation of the diversions. The Commission should be more aggressive in ensuring that public water purveyors promote water use efficiency within their systems and that all water users have sound water conservation plans in place.

E. Economic Development, Recreation, and Other Public Values

1. Background

The framers of the Compact clearly recognized the importance of developing water-related recreational opportunities (Article 8), conserving and managing water resources for economic development as well as for enhancing quality of life through tourism and preservation of historic and scenic amenities (Article 9), and developing and facilitating the transmission of hydroelectric power (Article 10).

The Commission combined the focus of those three Compact provisions into one area of special interest because over time they have become very much inter-related and inseparable. For example, tourism is one of the leading contributors to economic development in the Susquehanna basin, and water-based recreation and sporting activities, historic and scenic preservation, and riverfront community revitalization are among the top tourism activities. Also, while the four hydroelectric power facilities located in the lower Susquehanna basin (York Have, Safe Harbor, Holtwood, and Conowingo) clearly have commercial benefits and one (Conowingo) also has water supply benefits, they are all renowned for providing major water-based and land-based recreational activities, including boating, water-skiing, kayaking, fishing, biking, hiking, bird-watching, and outdoor interpretive learning, as well as their enormous contribution to recreation through their migratory fish passage facilities (see I. Migratory Fish Restoration area of special interest). The USACE’s flood control reservoirs previously discussed herein also provide multipurpose benefits, including Raystown Lake, which is often referred to as a “jewel” in the basin.



In recent decades, there have been dramatic growths in the following:

- River trails and greenways development, such as the Susquehanna Greenway, the Chemung River Basin Trail, and the Lower Susquehanna Heritage Greenway;
- Riverfront community revitalization projects;
- Designation of heritage, historical and cultural areas, such as the Lancaster-York Heritage Region, the Lumber Heritage Region, and the Tioughnioga River Trail Project; and
- Designation of natural areas and other destination points such as PA Wilds.

There has also been increasing interest in and consideration of preserving or restoring open spaces not only for recreational and conservation purposes but as part of an evolving trend to restore floodplains. Example projects focusing on the restoration of floodplains within the Susquehanna basin include the U.S. Department of Agriculture's Conservation Reserve Enhancement Program (CREP) and the Pennsylvania Tree Vitalize program. CREP is a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard groundwater and surface water. The Pennsylvania Department of Conservation and Natural Resources' (PADCNR's) Tree Vitalize program focuses on the revegetation of riparian corridors in all settings, including urban areas. The use of open spaces for these purposes also enhances an area's economics by reducing damages and losses suffered during flood events.

2. Management Activities

Numerous federal, state, regional, county and local agencies and non-governmental agencies are involved and interested in the management of the resources that support the basin's economic development, recreational and other public values. As an example of multi-agency cooperation in this regard, the Commission has joined forces with a core working group led by the Chesapeake Conservancy to "Envision the Susquehanna". The core group includes the Susquehanna Heartland Coalition, Wildlife Management Institute, PADCNR, Foundation for Pennsylvania Watersheds, Susquehanna Greenway Partnership, and the Chesapeake Bay Commission and intends to sustain and enhance the Susquehanna River's position as a major economic, recreational, wildlife and tourism asset for the nation. Envision the Susquehanna is a collaborative initiative that invites communities and individuals to get involved in creating a common vision for the Susquehanna River that focuses on environmental integrity through habitat conservation and restoration, economic development through heritage and river-based tourism, cultural engagement through online and community-based education and art, and outdoor experience through recreational trails and river access.

As previously discussed herein, the Commission is involved and strongly encourages the sustainability of the water resources of the basin. To that end, the Commission regulates surface water and groundwater withdrawals and consumptive uses to help maintain adequate flows for aquatic habitat, recreational uses, and business entities that rely on sustainable water supplies. The Commission, in carrying out its water resource responsibilities, must weigh proposed projects not solely upon their technical merits and feasibility, but also upon their compatibility with the public values inherent in the locality and member jurisdiction for which they are planned. To that end, the Commission must evaluate every project and proposal for water resource development, use and management in terms of its compatibility with the principles, guidance and standards set forth in the Comprehensive Plan, the sustainability of the resource upon which it relies, and on the basis of public input regarding project impacts.

The Commission also has a regulatory interest in and involvement with the power utilities and other energy producers, including those that operate the hydroelectric dams and those that develop fossil fuels such as those found in natural gas-containing geologic formations like the Marcellus Shale. As shown on Table 4, power utilities are very intensive users of the basin's water resources in terms of consumptive use (for cooling water), and when combined with natural gas development account for approximately 70 percent of the total

consumptive water use reported within the basin. This intensive water use often results in immediate local impact (via thermal discharge or flow alteration). These power facilities – using nuclear, fossil fuel, pumped storage and conventional hydropower techniques – provide enormous benefits to the local region and the basin as a whole. However, given their impact on the basin’s water resources, power companies also have more obligations to promote and honor the public values entrusted to their stewardship. New and existing power facilities should be expected to foster and protect the inherent public rights attached to all waters of the basin.

Previously, the largest public values involvement by the Commission came in connection with the relicensing of the four major hydroelectric projects in the lower Susquehanna River in the late 1970s and early 1980s. Leading a consortium of state and federal resource agencies at that time, the Commission advocated several relicensing planks that would enhance the use and enjoyment of the impounded and upstream reaches of the Susquehanna River including: (1) the installation of fish passage facilities to accommodate restored runs of migratory fish; (2) the installation of a broader range of recreational facilities for swimming, fishing and boating; and (3) the establishment of debris removal programs. These same issues remained the primary focus by the Commission during recent Federal Energy Regulatory Commission relicensing efforts on three hydroelectric facilities located on the lower Susquehanna River (Conowingo, Muddy Run, and York Haven). Upon future relicensing or proposed license amendments, the Commission anticipates playing a leading role in addressing critical issues for consideration in proceedings by the Federal Energy Regulatory Commission and through the Commission’s own regulatory process.

The Commission strongly believes that the development of natural gas within the basin and the continued recreational uses and values of those uses within the basin are not mutually exclusive. The regulations governing water withdrawals undertaken by the gas industry are based upon sound science. These science-based regulations afford adequate protection of the aquatic ecosystems upon which various water-based recreational uses have and will continue to rely, including boating, canoeing, and fishing.

The Commission is, to a lesser extent, involved in greenways and water trails, riverfront revitalization and other conservation activities. The conservation of natural resources and promotion of recreation have historically been managed and regulated by numerous resource agencies at all levels of government, including the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Department of Agriculture’s Natural Resources Conservation Service, U.S. Department of Interior’s National Park Service, New York State Department of Environmental Conservation, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania’s Fish & Boat and Game Commissions, Maryland Department of Natural Resources, county soil and water and conservation districts, and others.

Government, however, is not alone in supporting and meeting the basin’s economic development and recreation needs. Many environmental, conservation, sporting and business interests are actively involved in their respective areas of conservation and tourism, including Trout Unlimited, The Nature Conservancy, the Audubon Society, regional and local conservancies, watershed associations, recreational outfitters and chambers of commerce.

3. Future Direction

The Susquehanna basin’s largely water-rich resources and forested and rural settings offer abundant opportunities for continued growth in tourism and recreation. The Commission and other governmental agencies and non-governmental agencies will need to be vigilant in balancing the needs of the environment while promoting sustainable economic development and growth. Future actions should include a prioritization toward minimizing the footprint of new development including natural gas while revitalizing depressed or abandoned areas and discouraging development in sensitive headwater areas. There should also be incentives for wastewater reuse, conjunctive water uses and reductions in the use of impervious covers.

With regard to power facilities:

- Hydroelectric facilities in their relicensing processes with the Federal Energy Regulatory Commission should be required to enhance recreation, including fish passage, boating opportunities, fishery access, and portage provisions and other navigational facilities.
- Thermoelectric facilities should be required to evaluate the costs, benefits, trade-offs and drawbacks of various cooling techniques, including the use of wet cooling towers, once-through cooling and dry cooling. They should fully evaluate options for providing consumptive use mitigation.
- The design and location of new power facilities should consider the role, value, benefits and relative worth of open space, historic sites, scenic vistas, wild and scenic stream reaches, and other natural amenities. Impacts on public rights in streams and streambeds should also be carefully reviewed and minimized.
- The unconventional natural gas industry should make every effort to minimize its reliance on fresh water and increase its reliance on impaired waters and wastewaters during hydraulic fracturing activities. Efforts should also be made by the industry to reduce the amount of sediment transport to nearby streams in the watersheds within which it operates.

F. Emerging Contaminants

1. Background

Emerging contaminants consist of a wide variety of materials that are largely unregulated and often have environmental effects that are poorly understood. Unlike traditional pollutants such as nutrients and metals, water quality standards for these contaminants generally do not exist. Emerging contaminants include human and veterinary drugs, antibiotics, hormones, steroids, plastics, some pathogens, antioxidants, fire retardants, disinfectants, fumigants, fragrances, cosmetics, pesticides, and other chemical compounds that are often present in water at very low concentrations – often at several parts per billion, parts per trillion, or less. The ability to detect emerging contaminants is increasing as laboratory analytical methods become more sensitive.



Some emerging contaminants, such as pharmaceutical products, are taken internally by humans and animals and subsequently excreted in feces and urine. They can eventually travel to surface water or groundwater through wastewater treatment plant discharges, combined wastewater overflows, septic system discharges, landfills, animal waste lagoons, and through animal manure and biosolids (wastewater treatment plant sludge) applied to the land. In addition to being present in water, some emerging contaminants are found in bottom sediments of rivers, lakes, and streams. Some bioaccumulate in the tissue of aquatic life over the long term and can be passed through aquatic food webs.

Some emerging contaminants were designed to affect the human hormone system, and are suspected of causing harm to reproduction in aquatic life. Increased public interest has been generated due to reports of intersex fish (males with female reproductive organs) in many areas, including the Susquehanna River Basin.

Other emerging contaminants were developed to treat disease organisms. The production and use of antimicrobial products has increased significantly during the past decade, and new risks are developing in creating strains of antibiotic-resistant bacteria in the environment.

The risks to aquatic life and humans are uncertain, and the list of emerging contaminants being produced and released into the environment is increasing. Most sewage treatment plant systems are not equipped to remove emerging contaminants, and removal methods are often expensive, poorly known, or otherwise infeasible.

2. Management Activities

The USEPA has devoted increased attention to monitoring for emergent contaminants and determining their fate and effects on aquatic life and human health. The USEPA's Office of Water has performed studies of emerging contaminants in fish tissue, wastewater treatment plant effluent and sludge, and biosolids applied to land. The USEPA's Office of Research and Development has prioritized research to develop new analytical methods, improved waste treatment, endocrine disruptor screening, and new approaches for monitoring.

The USGS also has been involved in emerging contaminant issues and has performed increased monitoring for such contaminants in recent years. During the Commission's 2000 Sediment Symposium, USGS staff reported the presence of antibiotic resistant bacteria from sediments obtained from behind Conowingo Dam on the lower Susquehanna River. Bacteria from all sampling sites were resistant to penicillin and ampicillin at the concentrations used for analysis.

3. Future Direction

Emerging contaminants were discussed in Priority Management Area B - Water Quality, which includes the goal of monitoring and assessing the biological, chemical, and physical quality of the waters of the basin to support restoration and protection efforts. One of the actions needed to accomplish this goal is to perform increased monitoring and assessments for bacteria and emerging contaminants of concern. Emerging contaminants were also discussed under Priority Management Area D – Ecosystems.

Additional research is also needed to determine both the ecological and human health effects associated with the many emerging contaminants presently known, and considerably more effort is needed to keep pace with the host of new compounds being invented and marketed to the public. For example, Johns Hopkins University has reported that at least 1,500 new antimicrobial products have been developed since the year 2000, with production increasing and no benefits from their use being provided to the average consumer (2005 Food and Drug Administration panel).

Additional information needs to be provided to the public regarding the extent and effects of emerging contaminants, as well as safe methods of treatment and disposal.

G. Energy Production and Development

1. Background

Energy development figures prominently in the Susquehanna River Basin. The basin's water resources have long been an integral part of any energy activity, whether it's the need for water for processing, cooling, or turning turbines, or the inextricable link between mineral extraction and impacts to proximal water resources. Given the large quantities of water needed for or influenced by the various activities, such projects have considerable potential to impact the basin's water resources.

Recent developments at the federal level are also having implications for the basin's water resources. New emissions rules have prompted the owners of many coal-burning plants to consider the installation of air scrubbers, which can consumptively use several million gallons per day of water in their operations. Also, the

January 2007, ruling by the U.S. Court of Appeals for the Second Circuit concerning the USEPA 316(b) regulations has many plant operators contemplating the need to implement cooling towers to reduce river withdrawals and impacts to fish.

a. Thermal Electric Power Production

Base load steam generating plants such as nuclear and coal-fired facilities, which are operated on a relatively constant basis, are the largest generators of power in the basin and consume the highest quantities of water, exceeding an average of 100 million gallons per day in a typical year. They require a means of dissipating massive amounts of rejected heat. Most utilities would prefer the use of “once-through” cooling systems for heat dissipation, but limitations in volume of available flow and heat absorption capacity of receiving waters often dictate the use of “closed-loop” cooling systems. Such systems are usually characterized by natural draft wet cooling towers, which require a source of water to replace evaporative losses (consumptive uses). Where once-through cooling is available, the thermal input has the net effect of raising the temperature of the receiving body of water while resulting in a relatively lower loss of water due to evaporation onsite.

A fourth nuclear power plant within the basin (Bell Bend Nuclear Power Plant, BBNPP) has been proposed by PPL Bell Bend LLC in Salem Township, Luzerne County. This proposed facility, if approved, will be located in close proximity to PPL’s existing Susquehanna Steam Electric Station nuclear facility. The proposed BBNPP application materials are currently undergoing review by many resource agencies, including the Commission. Please refer to Section G.2, Management Activities, for additional information on the BBNPP application.

b. Hydroelectric Power Production

The other major type of generating facility in the basin is hydroelectric power plants. While no water is withdrawn or consumed at these facilities, they are not without impacts to water resources, particularly ecological effects and issues related to the manipulation and modification to natural flow regimes. The Compact requires the Commission to fully review and regulate hydroelectric facilities in the basin for the purpose of assessing and mitigating impacts to habitat, fish migration, low flow alteration and water availability to other water users.

c. Unconventional Natural Gas Extraction

Strong interest exists in the extraction of natural gas using unconventional hydraulic fracturing or hydrofracturing techniques from geologic formations that underlie much of the basin. The hydrofracturing techniques involve the introduction of large volumes of water (4 to 5 million gallons per well) under very high pressures (8,000 to 10,000 psi) to stimulate the release of the natural gas contained within the shale bedrock. Fuel costs and developments in drilling techniques have made the extraction of natural gas from the Marcellus and other shales more economically accessible than in the past. The occurrence of natural gas shales including Marcellus Shale is widespread in the basin as shown in Figure 18. Because of the low permeability of the shale, horizontal drilling combined with a fracturing process using the injection of high-pressure water, called hydrofracturing, is necessary to access the gas. Unlike most traditional water withdrawal and use projects, the use does not occur at the site of the withdrawal, and multiple drilling sites can be served by many individual withdrawals. Rather than a continuous withdrawal, intermittent and short-term withdrawals are conducted to accumulate the water needed for a hydrofracturing job.

Since unconventional natural gas development in the Marcellus Shale began in the basin, the Commission has made significant changes to its regulations and expanded its professional, administrative, and IT staffing complements. As an example, unlike all other activities governed by the Commission, the

withdrawal of water by the natural gas industry requires approval in any amount, beginning with “gallon one.” In addition, the Commission has made significant efforts to reach out to water resource stakeholders and the general public to better inform them of the important regulatory and monitoring work being performed by the Commission.

The expanded staff, including critically needed IT support, made it possible for the Commission to meet the many new regulatory challenges posed by the unconventional natural gas industry and to continue successfully regulating the many previously existing water users within the basin. Online submittal of consumptive use and withdrawal applications, online monitoring and compliance data submissions, and electronic communications have contributed to increased efficiencies and the overall success of the Commission staff in meeting its responsibilities as water resource managers.

In developing review protocols, staff worked closely with allocation, water quality, stormwater, and mining personnel in the member jurisdictions to ensure a coordinated approach. The outcome is such that the role of the Commission is to direct companies to viable sources based on hydrologic analyses of streams and to impose restrictions as necessary. The Commission requires, in its withdrawal and consumptive use approvals, that gas companies acquire all necessary permits and comply with all requirements of member jurisdictions with respect to stormwater management, wastewater disposal, and site construction. The Commission has taken a proactive role in identifying potential sources for withdrawal, including streams, public water supplies, reservoirs and mine pools and quarries, and will continue to do so. In addition to the water withdrawals and consumptive water uses related to hydrofracturing and drilling activities, there is the need to review the hydrostatic testing of newly constructed pipelines for transport of the extracted gas. Related activities such as the construction of gas storage facilities, and mining activities to support construction needs of the gas industry are of great interest to the Commission, but remain the responsibility of its member jurisdictions.

The quarterly monitoring data and compliance data submitted online by the unconventional natural gas industry have enabled Commission staff to clearly define the water use profile for the industry. Table 7 presents a summary of the reported total industry-wide consumptive water uses and water withdrawals made on a quarterly basis beginning in Quarter 3 of 2008 and extending through Quarter 4 of 2012. These data support the conclusion that the unconventional natural gas industry ranks second (10.4 million gallons per day, MGD) as a consumptive water user within the basin behind electric generation (92.7 MGD), with water supply (8.9 MGD) and manufacturing (8.3 MGD) ranked third and fourth, respectively.

Although The Commission is not responsible for tracking or regulation of the transport, treatment, disposal or recycling of wastewaters generated by the unconventional gas industry, reports generated by the industry indicate increasing percentages of its wastewater are being recycled. Recycling occurs as a result of either mixing the untreated wastewaters with fresh waters and reusing the mixture for additional hydraulic fracturing events, treating wastewaters on-site then mixing with freshwaters and reusing, or transporting the wastewaters off-site to approved treatment facilities followed by transport of the treated fluids to pad-sites for mixing with fresh waters and reuse.

As of December 31, 2012, a total of 10,285 MGD of water (10.285 billion gallons) were consumptively used by the unconventional gas industry within the Susquehanna River Basin since the Marcellus Play began. This number represents the total consumptive water use for all of the individual gas companies involved in the play (an industry-wide total).

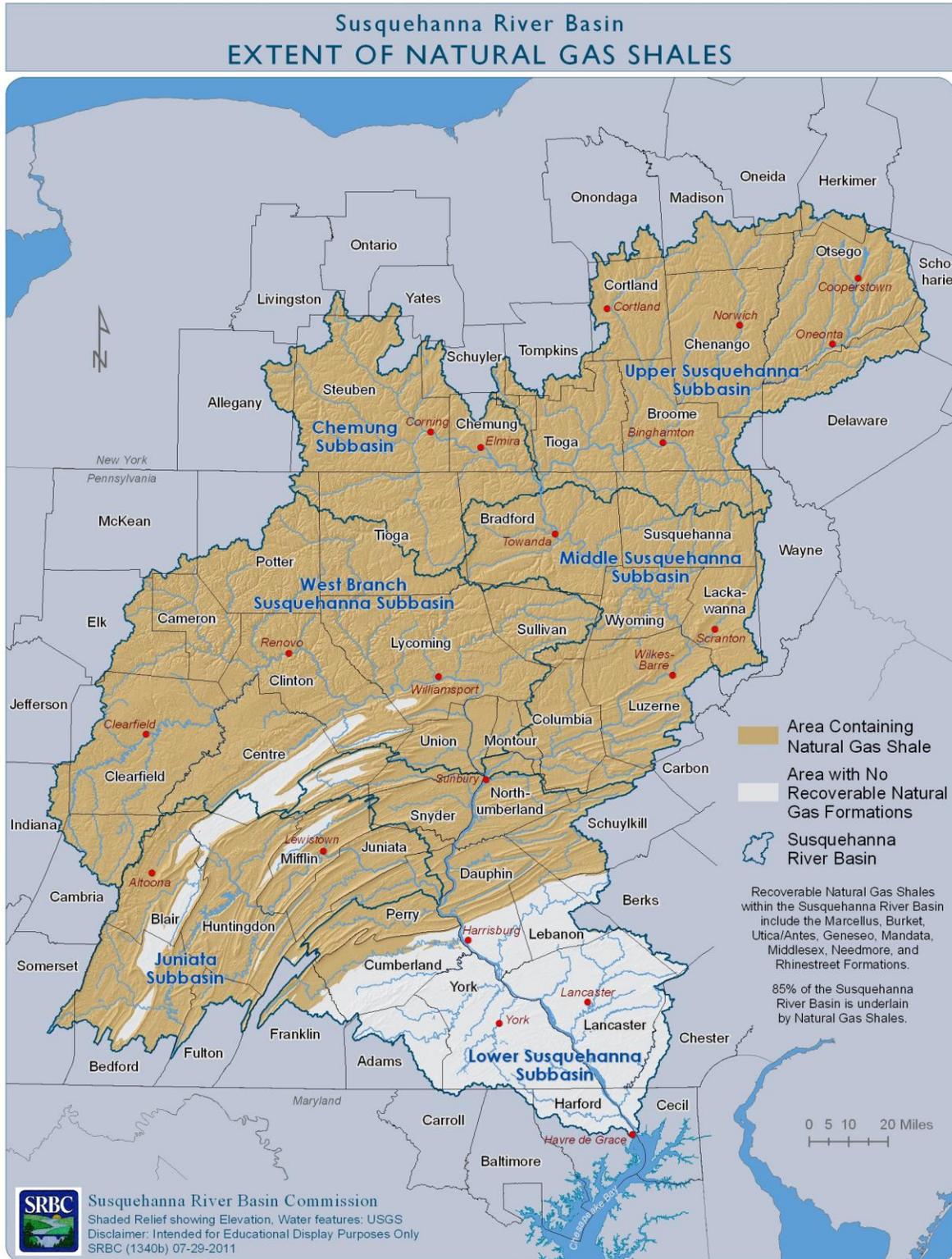


Figure 18. Occurrence of Natural Gas Shales in the Susquehanna River Basin

Table 7. Summary of Consumptive Use and Water Withdrawals for Unconventional Natural Gas Industry

Quarter/Year	Period Ending	Total Consumptive Water Use ¹ (CU) (Mgal) ^{2,4}	Ave. Daily CU Rate by Quarter (MGD) ²	Total Approved Water Withdrawals (Mgal) ^{2,4}	As a Percent of Total CU (%)	Ave. Daily With. Rate by Quarter (MGD) ²	Total for Other Approved Water Sources (Mgal) ^{3,4}	As a Percent of Total CU (%)	Ave. Daily Rate by Quarter (MGD) ²
Q3-2008	30-Sep-08	21	0.23	2	10	0.02	19	90	9.36
Q4-2008	31-Dec-08	35	0.38	14	41	0.16	20	59	1.42
Q1-2009	31-Mar-09	38	0.43	4	10	0.04	34	90	8.71
Q2-2009	30-Jun-09	76	0.83	36	48	0.40	39	52	1.09
Q3-2009	30-Sep-09	142	1.54	54	38	0.59	88	62	1.62
Q4-2009	31-Dec-09	222	2.41	191	86	2.08	31	14	0.16
Q1-2010	31-Mar-10	300	3.33	232	77	2.57	68	23	0.30
Q2-2010	30-Jun-10	543	5.97	460	85	5.06	83	15	0.18
Q3-2010	30-Sep-10	745	8.10	608	82	6.60	138	18	0.23
Q4-2010	31-Dec-10	716	7.78	752	105	8.17	158	22	0.21
Q1-2011	31-Mar-11	752	8.35	580	77	6.44	172	23	0.30
Q2-2011	30-Jun-11	906	9.95	660	73	7.25	246	27	0.37
Q3-2011	30-Sep-11	1,122	12.19	723	64	7.86	399	36	0.55
Q4-2011	31-Dec-11	1,035	11.25	962	93	10.46	73	7	0.08
Q1-2012	31-Mar-12	1,062	11.67	972	92	10.68	90	8	0.09
Q2-2012	30-Jun-12	1,101	12.10	822	75	9.03	279	25	0.34
Q3-2012	30-Sep-12	756	8.22	367	49	3.99	389	51	1.06
Q4-2012	31-Dec-12	715	7.77	560	78	6.09	155	22	0.28
Totals	----	10,285	----	7,999	----	----	2,481	----	----

Footnotes:

¹ Consumptive water use from all docketed withdrawal sources, plus other sources approved pursuant to 806.22(f).

² Abbreviations: MDW, SRBC Monitoring Data Website; Mgal, Million Gallons; MGD, Million Gallons per Day.

³ The vast majority of the non-docketed water sources are comprised of public water systems (PWS's); however, these sources also include impaired waters such as abandoned mine discharges (AMD), industrial and municipal wastewaters, pad stormwaters, tophole waters, etc.

⁴ In any given quarter, there will be differences between the Total Consumptive Water Use (Col. 4) and the combination of Total Docketed Water Withdrawals (Col. 6) plus Total Non-Docketed Water Sources (Col. 9) due to the dynamic changes in the amounts of water moving into or out of storage impoundments and storage tanks located on specific pads or in centralized locations.

While the above number of 10.285 billion gallons may seem to be very large in magnitude, it is in fact relatively small in relation to water available in the Susquehanna River basin. During an average flow day, the Susquehanna River delivers approximately 40,000 cubic feet per second (26 billion gallons per day) to the Chesapeake Bay. Consequently, on an average flow day, the River delivers to the Bay in approximately 10 hours the equivalent total amount of water used by the entire unconventional gas industry since the Marcellus Shale play entered the basin more than four years ago.

Although the preceding paragraph underscores the relative magnitude of the volume of water consumptively used by the unconventional gas industry, it is important to note that the locations and timing of the water withdrawals pursued by the gas industry are different than most other water users within the basin. For geologic reasons, the unconventional gas industry is primarily developing within relatively small watersheds located on the Appalachian Plateau of Pennsylvania. Water withdrawals from these smaller watersheds are in contrast to withdrawals from the larger watersheds located further south within the basin in which most other water users have historically been located. In addition, the natural gas industry would prefer to withdraw water at rates higher than the small streams within those small watersheds can tolerate, under low flow conditions, in an effort to minimize water trucking distances between withdrawal locations and well pads.

For the reasons mentioned above, the Commission adopted in December 2012 Policy No. 2012-01, the Low Flow Protection Policy (LFPP). The science underlying the LFPP was based in large part upon an ecosystem study completed for the Commission and the U.S. Army Corp of Engineers by The Nature Conservancy and in part upon a collaborative effort between the Commission's technical staff and the staffs of its member jurisdictions. Through this policy, the Commission imposes very strict site-specific requirements on all water withdrawals within the basin (including the gas industry and all other water users) to protect the aquatic ecosystems of the basin's waters. In essence, the LFPP requires most water withdrawals to temporarily cease when defined low flow conditions occur within the basin. Only relatively small water withdrawals considered by the Commission to be de minimus in magnitude are excluded from the LFPP requirements.

With respect to surface water withdrawals in calendar year 2012, the unconventional natural gas industry ranks fourth with an average of 8 MGD; behind electric generation (2,749 MGD), water supply (57 MGD), and manufacturing (25 MGD).

All of the water consumptively used by the unconventional gas industry originated from either direct approved surface water or groundwater withdrawals, or from approved sources (public water systems, impaired waters, wastewaters, etc.). The relative amounts of water taken from these two origins varied over time. During the early stages of the play (calendar year 2008), the majority of water (approx. 75 percent) was taken from public water sources, while approximately 25 percent of the water was taken from approved surface water withdrawals. No approved groundwater withdrawals occurred for the unconventional gas industry during 2008.

During calendar year 2009, on average, approximately 46 percent of the water was taken from approved surface water withdrawals and 54 percent was taken from approved public water sources. During calendar year 2010, the approved surface water withdrawals increased to 87 percent of the water taken, and public water sources dropped to approximately 13 percent of the water taken. No approved groundwater withdrawals occurred for the unconventional gas industry during calendar years 2009 or 2010. Calendar year 2011 found the industry taking approximately 77 percent of their water from approved surface water withdrawals and 23 percent from approved public water sources. Less than 1 MGD of groundwater was withdrawn by the gas industry during calendar year 2011.

By calendar year 2012, the industry was taking approximately 73 percent of its water from docketed surface water sources and 27 percent from public water systems. Reliance on groundwater withdrawals for calendar year 2012 remained below 1 MGD for the industry. The overall trends in water takings in amounts and source types during the five year period (2008 through 2012) were the result of the industry establishing more docketed surface water withdrawal approvals over time and relying less on the more expensive public water systems for their water needs.

By December 31, 2012, after the Marcellus play had been in progress for more than four years, a total of 1,977 unconventional natural gas wells had been hydraulically fractured within the basin. On average, each well's hydraulic fracturing effort consumed 4.4 million gallons of water. Eighty-six (86) percent of that average amount of water was comprised of freshwater (3.8 million gallons) and 14 percent (0.6 million gallons) was comprised of reused flowback waters from previous fracturing events. The amount of flowback waters that returned to each well-head within the first 30 days after fracturing pressures were released ranged from a low of 5 percent (average 220,000 gallons) to a high of 12 percent (average 528,000 gallons).

2. Management Activities

The power generation industry, as a whole, already accounts for the majority of the water withdrawal and consumption in the basin. Three nuclear power plants and PPL's coal-fired plant at Montour are among the largest Commission-approved consumptive water users in the basin; only the diversions by the City of Baltimore and Chester Water Authority for public water supply are larger. In 2005, for example, the four aforementioned base load plants were responsible for more than 50 percent of all the water consumed by regulated projects in the basin. The bulk of consumptive use at these power facilities is for cooling through cooling towers. There are also several coal-fired plants that employ once-through cooling. While this form of cooling consumes much less water, it requires very large surface water withdrawals and is associated with significant thermal discharges.

Because of the relative quantity of consumptive water use associated with power production and the concentrated local impacts, flow augmentation is generally needed to compensate for consumptive use by base load and peaking steam-generating power generation facilities during low flow periods.

Commission staff will continue to review application materials submitted by PPL Bell Bend LLC for consumptive water use, surface water withdrawal, and groundwater withdrawal for the proposed Bell Bend Nuclear Power Plant (BBNPP). These materials are being reviewed under Section 3.10 of the Susquehanna River Basin Compact and 18 CFR Part 806, the general standards set forth in the Commission's Consumptive Use Mitigation Plan (Publication No. 253, adopted by Commission Resolution No. 2008-01) and Commission Policy No. 2012-01, Low Flow Protection Policy related to Withdrawal Approvals, adopted on December 14, 2012. More specifically, the proposed withdrawal from the Susquehanna River and the consumptive use of that water, and the proposed groundwater withdrawal for construction dewatering, are being reviewed under 18 CFR §806.4, §806.22, and §806.23 to develop appropriate recommendations to limit, condition, or deny the withdrawal to avoid significant adverse impacts, including adverse cumulative impacts to the water resources of the basin.

The Federal Energy Regulatory Commission (FERC) licenses for York Haven Hydroelectric Project, Muddy Run Pumped Storage Facility and Conowingo Hydroelectric Generating Station, on the lower Susquehanna River, are set to expire in 2014. The Commission continues to coordinate with partner resource agencies and stakeholders of its member jurisdictions during the relicensing process. Efforts to date have included requesting specific studies, participating in agency/stakeholder meetings, and reviewing/commenting on study reports and findings. Critical water resources issues being evaluated as part of the relicensing process include flow management, fish passage, and sediment management. Based on its historic role in flow

management issues in the lower Susquehanna River, the Commission convened a flow management workgroup to develop alternatives to be modeled as part of the relicensing process for Muddy Run and Conowingo. The results of the model runs have been used by the workgroup to develop flow management proposals for use during settlement meetings with the ultimate goal of having a new flow management plan memorialized in the new license(s). Upon issuance of a Notice of Acceptance/Notice of Ready for Environmental Analysis (REA) by FERC for the license applications, the Commission will file (under the Integrated Licensing Process) a motion to intervene. Such motion will preserve the Commission's ability to formally comment on the applications as an intervenor. This is important because the Commission does not have the prescriptive authorities held by the state 401 certification agencies and the U.S. Fish and Wildlife Service.

A significant amount of Commission staff time has been and will continue to be invested in the regulation of water withdrawals associated with the natural gas industry. As previously noted herein, between June 2008 and December 31, 2012, approximately 1,977 unconventional gas wells were hydraulically fractured within the basin. During that same period, the industry was issued over 2,000 Approvals by Rule to consumptively use basin waters on well pads, was issued 216 approvals to withdraw surface water, and was issued 12 approvals to withdraw groundwater. Since the unconventional natural gas industry entered the basin in 2008, the Commission's Compliance Program has performed approximately 5,500 inspections and audits of natural gas well pads and water withdrawal locations. The results of the inspections support the conclusion that, in general, the vast majority of the natural gas companies are operating in compliance with the Commission's regulations. However, where violations of the Commission's regulations have been discovered, the Commission has taken timely and aggressive action against the offending parties to end the non-compliance activities and direct the operations to a state of compliance.

In April 2010, the Commission opened a regional office in Sayre, Pennsylvania. The primary purposes of the Sayre office were: 1) to provide for the first time in the history of the Commission a regional presence in the northern portion of the basin, 2) to enable a more efficient means of performing compliance inspections and audits of the upper basin water users, including the natural gas industry, and 3) to assist in the performance of field work conducted by other Commission programs within the upper portion of the basin.

Over the past six years, Commission staff members have organized and/or attended several hundred public meetings held throughout the active natural gas development area to answer questions regarding water regulations posed by the general public and the gas industry. Staff members have also provided written and oral testimony on many occasions to local, state and federal legislative bodies. Staff members have made dozens of presentations at professional organizations and conferences to explain the methodologies used to best regulate water acquisition and use by the gas industry and other water users within the basin and how to afford the most appropriate levels of protection to the aquatic ecosystems inhabiting the waters of the basin. The Commission also launched several web-based applications to provide information about the natural gas industry directly to the public, including its Water Resources Portal. All of these various efforts made by Commission staff are expected to continue well into the future.

3. Future Direction

The Commission must remain aware of trends in all sectors of energy development throughout the basin and their potential impacts on the basin's water resources. These potential impacts include the amounts of water withdrawn and consumptively used by nuclear facilities and the quantity and method of heat dissipation associated with those facilities. The water resource requirements associated with hydroelectric generation must be monitored, as well as the water-related ecological effects of those projects. The unique water use profile of the unconventional natural gas industry and the rate at which this industry has grown within the basin will demand considerable attention from Commission staff in the future. As described previously, all water withdrawals and consumptive uses associated with natural gas production will continue to be thoroughly evaluated. Commission staff will continue to explore various communication strategies to regularly inform the

public about the number of wells drilled and completed, quantities of water withdrawn and used, and how this activity impacts the basin.

The Commission recognizes the high potential in the basin for continued growth in energy development and electric power generation and is aware of the energy industry’s interest in realizing this potential. The future roles of ethanol-based energy, coal energy, and new nuclear generating facilities remain uncertain in light of the very rapid expansion of the natural gas industry within the basin. In addition to the significant natural gas activities, there exist opportunities in the future for the expansion at existing energy facilities such as power uprates at nuclear facilities and modifications to install cooling towers and flue-gas desulfurization at coal-fired plants. By 2025, total consumptive water use associated with energy initiatives within the basin could double to nearly 350 million gallons per day.

As discussed under Priority Management Area A. – Sustainable Water Development, the Commission is actively engaged in completing a cumulative water use and availability study of the entire basin. The study addresses the direct and cumulative effects of water withdrawals and consumptive uses, including those associated with the shale gas industry.

Significant capital investment and resources are employed in energy development and the planning, design, construction and operation of power generation facilities. Considering the heavy reliance on power and the large consumption of the basin’s water resources to develop that power, it is appropriate that the Commission also plan to allocate significant staffing resources to the review and oversight of energy development and power production projects in the future. In addition to reviewing proposed projects and facilities, staff will need to coordinate with other state and federal environmental and energy agencies and devote a considerable amount of time for compliance and monitoring activities.

H. Flood Forecast and Warning

1. Background

As discussed in Priority Management Area C - Flooding, the Susquehanna River Basin is one of the most flood prone watersheds in the nation and experiences on average \$150 million of damages every year. The basin’s topography and geography leave it vulnerable to tropical weather systems, intense thunderstorms, snowmelt and ice jams, and rapid surface water runoff. More than 80 percent of the basin’s 1,400 communities have residents in flood-prone areas.

In February 1985, a report entitled *Proposed Flood Forecasting System Improvement Program* recognized the limited ability of structural flood control measures to reduce flood damages in the basin and stated justification for improving flood forecasting and warning. In response to this report, the Commission coordinated formation of a new interagency committee and partnership that initiated an enhanced flood warning system that continues to operate today as the Susquehanna Flood Forecast and Warning System (SFFWS). The SFFWS is maintained and administered by the Interagency Committee on the SFFWS, also coordinated by the Commission. Other key members of the committee include the National Weather Service (NWS), USGS, USACE, and New York, Pennsylvania, and Maryland state emergency management and environmental agencies, as well as Pennsylvania’s community and economic development agency.



The mission of the SFFWS is to provide timely and accurate forecasts and warnings to help save lives and reduce property damages during basin floods. The SFFWS is a state-of-the-art, technological system comprised of radar and a network of stream and rain gages. The data provided by the system are used by NWS to forecast river levels and issue timely and accurate early warnings to businesses, communities and emergency managers. In turn, the emergency management officials use the warnings to make decisions regarding actions residents and businesses vulnerable to flooding should take to protect themselves and their properties. See Figure 19 for locations of current river forecast points and stream and rainfall gages in the basin.

The SFFWS is extremely cost-effective, with an estimated benefit-cost ratio of 20-to-1. For every federal dollar invested in the SFFWS, \$20 is saved through reduced damages and reduced federal flood recovery payouts. The system helps save lives and reduces average annual flood damages by \$32 million.

2. Management Activities

The Commission serves as a liaison between the members of the Interagency Committee and the residents and communities of the basin. In addition to coordinating the annual committee meeting and the annual budget, Commission staff strives to provide outreach and education to basin residents and to maintain lines of communication between the forecasters and the customers who rely on the forecasts. Based on available resources, the Commission continually raises awareness of the importance of the SFFWS within the basin and works to ensure necessary funding of the gage network that provides the foundation for the System.

A recurring theme since initial system implementation has been the struggle to ensure adequate annual funding for maintaining the existing system and for continuing system improvements. Federal Fiscal Year (FY) 2010 marked the last time direct federal funding was realized for the System. Since that time, the Interagency partnership has managed to maintain the stream and rain gage network through cooperative efforts with patchwork funding. Unfortunately, the patchwork approach is not sustainable and, as such, some rain gages in the Pennsylvania portion of the basin were shut down in FY 2013 and some rain gages are expected to be shut down in New York in FY 2014. Additionally, FY 2014 will be the first year that some stream gages are expected to be shut down in the New York portion of the basin.

June 2006 brought record flooding to several locations in the Upper Susquehanna Subbasin and Tropical Storm Lee in 2011 broke those records in some parts of the basin. Evaluation of the SFFWS following the June 2006 flood resulted in flood inundation mapping for parts of the basin being a recommendation to improve management of future floods. These maps proved their worth during the 2011 flood as emergency managers used them to facilitate and plan response actions to the flooding.

3. Future Direction

The SFFWS interagency committee identified the following goals to ensure that the program continues to meet the forecasting and warning needs of the Susquehanna River Basin. Regardless of current funding status, the Committee will continue to work toward these goals. However, the focus of the effort will be directed toward sustainable solutions to provide advanced warning of flood events.

- a. Develop and maintain a sustainable, state-of-the-art observation network.
- b. Provide as much lead-time and accuracy in forecasts and warnings as practicably possible (the current goal of the SFFWS is to provide at least six hours of advance warnings).
- c. Evaluate the spatial distribution of flood damages in the basin and prioritize problem areas.
- d. Expand the flood warning system to support other important water resource programs, including public water supply, drought management, and recreation enhancement within the basin.
- e. Take advantage of emerging technologies to improve flood warning dissemination.
- f. Increase public awareness, support, and use of services available from the National Weather Service.

- g. Establish procedures for obtaining dedicated funding for the SFFWS and for managing the funds.

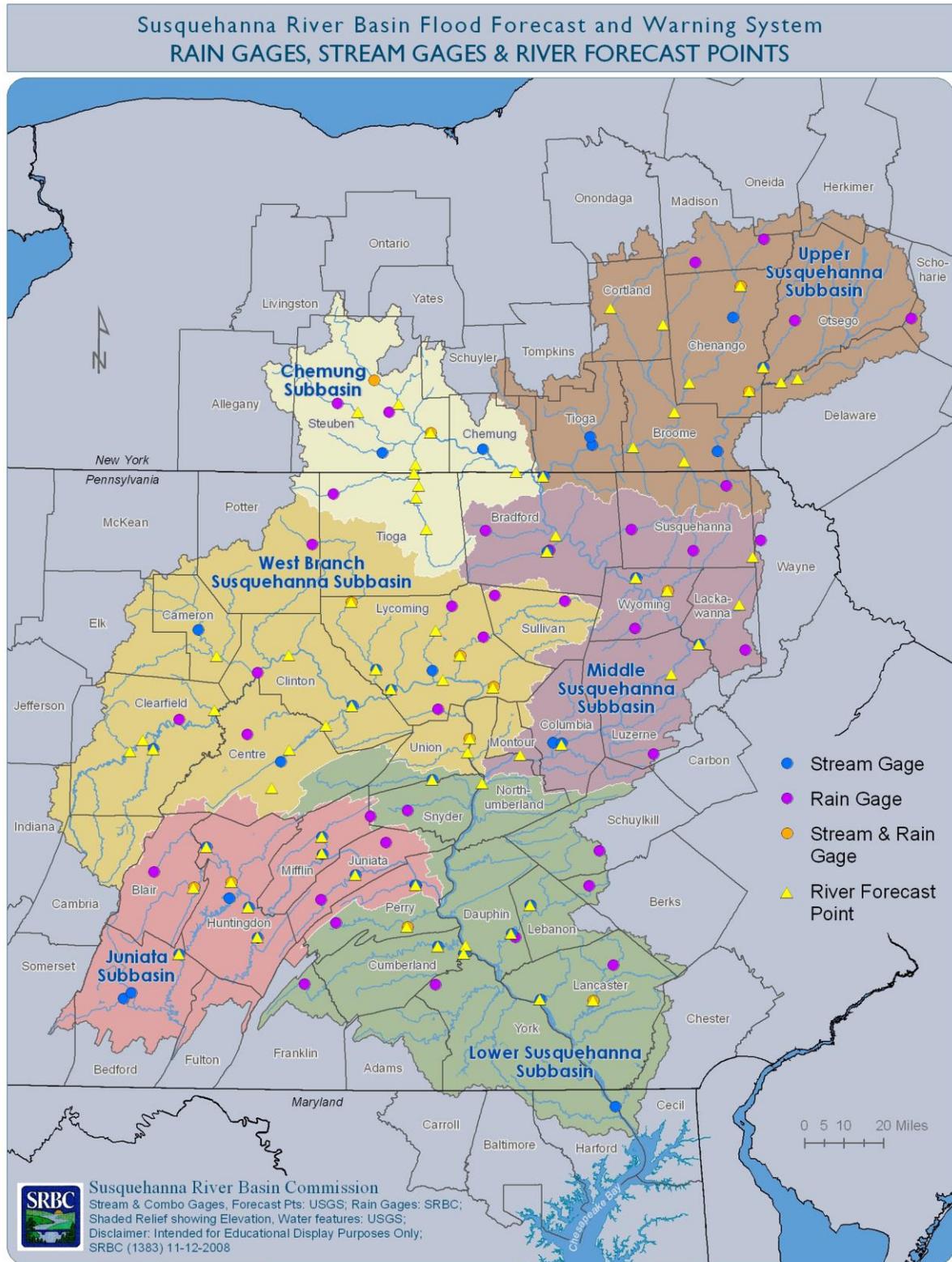


Figure 19. Gages and Forecast Points

I. Invasive Species

1. Background

As discussed in Priority Management Area B - Water Quality, invasive species can compete with native flora and fauna to upset natural species diversity and aquatic food webs. Invasive species are non-native species that are introduced by humans into waterbodies. They often have few natural predators, enabling them to spread rapidly and colonize areas in very large numbers. Some, such as zebra mussels, can also alter water quality, clog water supply intakes, and affect water contact sports. Effects of invasive species in the basin also have the potential to affect the ecological health of the Chesapeake Bay.



At the end of 2007, zebra mussels were firmly established in Canadarago Lake, Goodyear Lake, and Eaton Brook Reservoir in the New York portion of the basin, and have continued to spread to other areas. During the summer of 2007, adult zebra mussels were first reported in the West Branch Tioughnioga River in New York, Cowanesque Lake in northern Pennsylvania, Otsego Lake (the source of the Susquehanna River) in New York, and in the Susquehanna River downstream as far as Binghamton, New York. By 2008, zebra mussels had spread to the Lower Susquehanna River, with additional documented occurrences as recently as December 2012. Quagga mussels, a closely-related species, have been identified from a small quarry in central Pennsylvania near Raystown Lake.

Priority Management Area B - Water Quality includes the goal of monitoring and assessing the biological, chemical, and physical quality of the waters of the basin to support restoration and protection efforts. Monitoring for zebra mussels and other invasive species is included as an action needed to support that goal. This management area also includes the goal of protecting the quality of the basin's biological resources and sources of public drinking water supply. One of the actions needed to accomplish that goal is to provide enhanced tracking of aquatic invasive species in the basin.

Priority Management Area D - Ecosystems also relates to invasive species control and includes the goal of performing ecosystem monitoring and assessment to provide data needed for effective watershed management. Additionally, it includes the goal of protecting biological resources throughout the basin and in each of its major subbasins. One of the actions needed to accomplish this goal is to consider the potential spread of invasive species when evaluating project review applications for diversions and transfers of untreated water from one waterbody to another.

Some of the aquatic invasive species currently known to occur in the basin include zebra mussels, quagga mussels, Asian clam, purple loosestrife, water



chestnut, rusty crayfish, and flathead catfish. Species of concern that have not yet been reported in the basin include northern snakehead, bighead carp, and silver carp.

2. Management Activities

The federal government passed the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (amended in 1996), which calls for the development of state nonindigenous aquatic species management plans and provides funding for activities identified in these plans. The 1990 Act also established the Aquatic Nuisance Species Task Force and directed it to encourage the development of regional panels to protect marine and freshwater resources from aquatic nuisance species through coordinated planning and action.

In late 2004, the Commission accepted an invitation from the Aquatic Nuisance Species Task Force to serve on its Mid-Atlantic Regional Panel (later named the Mid-Atlantic Panel on Aquatic Invasive Species, or MAPAIS). The Panel was established in 2005, meets twice each year, and contains education and outreach, policy, and science workgroups to deal with invasive species issues in the Mid-Atlantic Region. Membership includes representatives from resource agencies in New York, Pennsylvania, Maryland, Virginia, West Virginia, New Jersey, Delaware, North Carolina, and the District of Columbia. Staff members from the U.S. Coast Guard, USACE, U.S. Fish and Wildlife Service, Chesapeake Bay Program, USGS, and National Park Service also belong to Mid-Atlantic Regional Panel, as well as representatives of several trade organizations.

In July 1991, the New York State Legislature passed Chapter 456 of the Laws of 1991 requiring the New York State Department of Environmental Conservation (NYSDEC) to develop a Nonindigenous Aquatic Species Comprehensive Management Plan, which was published in 1993.

In 2004, Pennsylvania Governor Rendell created the Pennsylvania Invasive Species Council to advise the governor and direct development and implementation of a comprehensive invasive species management plan for the Commonwealth. The Council completed the plan in October 2006.

The Commission performs basinwide monitoring for zebra mussels and works with the Mid-Atlantic Regional Panel and its members to help control the spread of invasive species in the basin. Monitoring is needed to identify areas where invasive species exist. Educational materials are provided to the public to help avoid the inadvertent spreading of invasive species from areas where they are present to areas where they are not.

The Pennsylvania Zebra Mussel Monitoring Network was established by the Pennsylvania Department of Environmental Protection shortly after zebra mussels colonized the Great Lakes in the late 1980s. In 2006, responsibility for operating the network was transferred to the Pennsylvania Sea Grant Program, which maintains records of zebra mussel sightings in Pennsylvania and provides educational materials to help prevent the spread of zebra mussels and other invasive species.

The Pennsylvania Sea Grant provided initial training for Commission staff to monitor for zebra mussel adults. Zebra mussel monitoring has been incorporated into the Commission's large river, interstate, and subbasin survey monitoring programs.

3. Future Direction

The Commission and others need to continue to monitor and provide public information regarding the spread of invasive species. GIS mapping of the range of invasives should be performed, and management plans should be updated as new species become established and their ecological effects on native species are better understood.

J. Fisheries Monitoring and Restoration

1. Background

Maintaining a healthy fish community is an important management component of water resource planning in the basin. The Commission is involved in primarily two activities: fish passage and diseased smallmouth bass issues.

Migratory fish include both anadromous and catadromous species. Anadromous fish, such as American and hickory shad, blueback herring, and alewife, spawn in fresh water, with the juveniles migrating to brackish or salt water to grow and mature into adults. American eel, the only catadromous species in the basin, spawns in deep waters of the Sargasso Sea near Bermuda. Young American eels ride the Gulf Stream north and enter rivers on the east coast of North America, where they grow and mature into adults.



In addition to the recreational, economic, and environmental benefits associated with migratory fish restoration, it is also one of the most readily recognized connections between the Susquehanna River and the Chesapeake Bay. Migratory fish restoration has a broad base of support, including angling and environmental organizations, power companies, resource agencies, and other partners in the Chesapeake Bay restoration effort.

Priority Management Area D - Ecosystems discusses the importance of restoring populations of migratory fish such as American shad, hickory shad, blueback herring, alewife, striped, bass, and American eel to the Susquehanna River system, and identifies several actions needed to support that goal.

Since 2005, the Pennsylvania Fish and Boat Commission (PFBC) has been tracking disease prevalence within the smallmouth bass fishery in the Susquehanna River Basin. The issue is potentially related to a host of possible stressors to the fish community that includes a rise in water temperatures, bacterial/viral infections, and pollutant loadings. To identify the cause for the disease outbreaks, the PFBC, PADEP, and the USGS, along with several other partners including the Commission, have been collecting data in the Susquehanna River and several tributaries to characterize water quality conditions and fish health during critical life stages for the smallmouth bass population. Data results to date have been inconclusive; however, the study partners continue to refine monitoring plans each year based on the most recent findings.

2. Management Activities

Modern efforts to restore migratory fish to the Susquehanna River system began in the 1950s, when the U.S. Congress appropriated funds to study the potential to restore shad fisheries in the basin. Pennsylvania anglers and the Pennsylvania Fish Commission (now the Pennsylvania Fish and Boat Commission or PFBC) played a major role in persuading Congress to make this appropriation. Utility companies with dams on the lower Susquehanna River provided additional funding for studies to determine the migratory response of shad placed above dams, the suitability of the Susquehanna River for shad reproduction and survival, and the engineering feasibility of providing passage for shad over high dams.

Migratory fish restoration activities in the basin were a cooperative venture from the start. In 1963, the Pennsylvania Fish Commission, Maryland Board of Natural Resources (now the Maryland Department of Natural Resources or MDNR), the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Fish and Wildlife Service (USFWS) organized the Administrative Committee for shad studies on the Susquehanna River. In 1969, the Administrative Committee reorganized as the Susquehanna Shad Advisory Committee to begin the process to rebuild stocks of American shad and provide fish passage at dams. The Advisory Committee included both policy and technical subcommittees. In 1970, the resource agencies and power companies reached a settlement agreement that called for the Philadelphia Electric Company (now Exelon) to build an experimental fish lift on the west side of Conowingo Dam.

In 1976, the Advisory Committee changed its name to the Susquehanna River Anadromous Fish Restoration Committee (SRAFRFC) to reflect its goal of restoring all anadromous fishes. SRAFRFC included power utilities, which funded development of the Van Dyke Hatchery for juvenile shad production near Thompsettown, Pa., along the Juniata River. PFBC staff has operated the hatchery since its establishment and rear juvenile shad for release in the river system in Pennsylvania and New York State. The fish are marked with tetracycline dye prior to stocking, and studies are performed to determine the percentages of hatchery versus stocked fish returning to the basin. Surveys also are performed to determine the relative abundance of juvenile shad passing downstream through the river system to tidewater in the fall of the year.

The west fish lift at Conowingo Dam was initially used to trap adult shad for transport above the four power dams on the lower Susquehanna River. However, trap and transfer operations ceased in the 1990s after the construction and operation of the larger capacity east lift at Conowingo Dam, lifts at Holtwood and Safe Harbor Dams, and a fish ladder at York Haven Dam. The west lift is still used for various research activities, as well as collection of adult American and hickory shad eggs to support hatchery operations.

In 1995, SRAFRFC changed its name to the Susquehanna River Anadromous Fish Restoration Cooperative (acronym remained unchanged). An organizational charter was developed and signed by PFBC, MDNR, NYSDEC, USFWS, as well as the National Marine Fisheries Service and the Susquehanna River Basin Commission. SRAFRFC continues to work in cooperation with the power companies, although they are no longer official SRAFRFC members.

Pennsylvania has provided strong support for migratory fish restoration activities, including continuing operation of the Van Dyke Hatchery and the removal of small dams to promote fish passage. NYSDEC has provided personnel to stock juvenile shad in New York waters and has actively promoted fish passage around existing dams. The migratory fish restoration effort on the Susquehanna River is a recognized component of the Chesapeake Bay Program, which has prioritized restoration of the Bay's living resources.

SRAFRFC considers American eel to be a species of special interest and is addressed in SRAFRFC's updated migratory fish management and restoration plan for the Susquehanna River Basin, as mentioned under Priority Management Area D – Ecosystems. The Commission's regulatory activities associated with water withdrawals, consumptive use, and resource protection also relate to migratory fish passage, and are discussed under Priority Management Area A - Water Supply.

3. Future Direction

In 2007, PPL Holtwood filed an application with the Federal Energy Regulatory Commission to amend its license to operate Holtwood Dam. The Commission needs to remain active in SRAFRFC and in relicensing activities for all of the four major power dams on the lower Susquehanna River, and to promote passage of shad at these and other dams in the Susquehanna River Basin. Increased effort is needed to provide both upstream and downstream passage for river herring and American eel throughout their historic range in the basin, and to promote the significant recreational and economic benefits associated with migratory fish resources.

K. Potentially Stressed Areas and Water Challenged Areas

1. Background

The Commission has identified eight Potentially Stressed Areas within the Susquehanna River Basin. In these areas, the demand for and use of water resources are potentially approaching or have exceeded the sustainable limit. Several areas with intrinsically low available water resources, termed Water Challenged Areas, have also been identified. The procedures for identifying Potentially Stressed Areas and Water Challenged Areas are tools developed by Commission staff for the review of projects as part of its regulatory program. (Also discussed in the Sustainable Water Development Priority Management Area and Part III.)



- a. Potentially Stressed Areas – The Commission has defined the sustainable limit as the average annual base flow (recharge) available in the “local” watershed during a 1-in-10-year average annual drought. That is, the amount of water withdrawn annually should only exceed the average amount of water recharge on an average of once every 10 years. Water users draw water from groundwater storage to meet their needs during the drought years, and the groundwater system is allowed to recover (storage refills) during the intervening years. The choice of the 1-in-10-year drought recharge standard is a compromise among considerations related to resource conservation, environmental needs, sustainable growth and development, and the need for adequate (and often expensive) constructed water storage facilities. Potentially Stressed Areas generally meet two or more of the following criteria:
 - Diminished yields
 - Declining water levels
 - Diminishing stream or spring flows
 - Expanded dry stream reaches
 - A water budget analysis indicating that withdrawals within a groundwater basin exceed the recharge during a 1-in-10-year average annual drought
 - Known withdrawals for rapidly developing areas exceeding 50 percent of the recharge during a 1-in-10-year average annual drought
- b. Water Challenged Areas – Water Challenged Areas have natural conditions that strongly limit the amount of water resources available and will support very little water resource development. As such, these areas should be identified for potential applicants and be actively managed.

2. Management Activities

- a. Potentially Stressed Areas – Using the criteria described above, the Commission identified eight Potentially Stressed Areas. As of 2013, they are:
 - Corning Area, Steuben County, N.Y.
 - Manheim/Lititz/Ephrata Valley, Lancaster County, Pa.
 - Pennsylvania Fruit Belt, Adams and York Counties, Pa.
 - Hanover Area, York County, Pa.
 - Hershey Area (Spring Creek Basin), Dauphin and Lebanon Counties, Pa.
 - Fredericksburg Area, Lebanon County, Pa.
 - Roaring Spring Area, Bedford and Blair Counties, Pa.

- State College Area, Centre County, Pa.

Many of the Potentially Stressed Areas share characteristics such as rapid growth in development, low yield aquifers, and concentrated water uses. Project applications submitted for review that are located in Potentially Stressed Areas receive a greater degree of scrutiny from the Commission. The requests for withdrawal may be denied, approved at a lesser quantity than requested, or an approval may include requirements such as water level monitoring, streamflow monitoring, water table mapping, development of a water resource management plan, and/or development of a mitigation strategy such as relocating a discharge location. The additional information is used to provide a clearer picture of the available water resources and allow additional steps to be taken to mitigate potential adverse or cumulatively adverse impacts from the withdrawal, as needed.

b. Water Challenged Areas – The Commission has identified two as of 2013, and they are the diabase areas and the Bonneauville Shale Belt. Upon further assessment, it is likely that additional areas, particularly those underlain by shale, will be classified as water challenged, although perhaps not as severely as the diabase areas and Bonneauville Belt.

- Diabase areas - Found in a narrow band stretching from Adams County through York, Dauphin, Lancaster and Lebanon Counties and into Berks County, these areas are marked by one of the lowest yielding aquifers in the Susquehanna basin. The diabase areas are poorly suited to agricultural, commercial, residential, and industrial uses, and as a result are largely undeveloped. However, as undeveloped land becomes scarce in high growth areas, the diabase areas are coming under substantial development pressure.
- Bonneauville Shale Belt - The material in this Adams and York County formation has very low permeability. Well yields are extremely low, even for residential use. Stream base flows are also very low.

3. Future Direction

Development pressures are not likely to decline in the Susquehanna River Basin, and thus the Commission should anticipate the emergence of additional Potentially Stressed Areas. As resources allow, the Commission should assess other regions of the basin with unfavorable water availability and make determinations about their characterization as Water Challenged Areas. The Commission's Cumulative Water Use and Availability Study, described in Priority Management Area A – Sustainable Water Development, will provide greater insight into the identification of Potentially Stressed and Water Challenged Areas through water use: water availability screenings for watersheds throughout the basin. Coupled with the uncertainty of future hydrologic conditions due to the effects of climate change, management of these areas has the potential to demand significant Commission resources.

In addition to monitoring and identifying potentially stressed and water challenged areas, the Commission will want to consider using another tool provided by the Compact – the designation of special protected areas. As conditions develop, some of the aforementioned areas may warrant such a designation, along with the protection standards that accompany it.

Commission policies and activities designed to avoid the creation of stressed areas and emphasize sustainable water use are detailed in Priority Management Area A – Sustainable Water Development.

L. Water and Wastewater Infrastructure

1. Background

Much of our nation's water and wastewater infrastructure was constructed during the 30 years following World War II. Wastewater treatment plants typically have a useful life of 20-50 years until they need renovation, while underground pipes can last from 15 to over 100 years, depending on the type of material from which they are constructed and the environment into which they are placed.

Aging water and wastewater infrastructure threatens the long-term quality of water in streams, rivers, lakes, and groundwater in the basin. The USEPA estimated that nationwide, the funding gap for infrastructure needs for the period 2000-2019 was \$122 billion for wastewater costs and \$102 billion for water supply. In 2002, the American Waterworks Association estimated that costs of replacing drinking water infrastructure may be as high as \$6,900 per household in some small towns.



Water is often underpriced by municipal systems in an effort to keep user rates low. Problems arise when the condition of existing infrastructure erodes, and when systems are unable to meet increased water supply or treatment demands.

Ensuring adequate funding for continued dam safety and required rehabilitation also are important. Unsafe dams are a public safety issue, and inspections must be performed on a regular basis. Several state-owned facilities in the basin have been lowered due to safety concerns and lack of rehabilitation funding, thereby reducing their recreational potential and water storage capability.

Adequate funding is also required for maintenance of an effective system to provide long-term, uninterrupted stream gage records. Stream gage records are needed for flood, drought, and consumptive water use management, as well as monitoring, assessment, restoration, and protection activities in both the basin and Chesapeake Bay. The existing gaging network should be expanded rather than reduced to support research and management activities associated with climate change.

Priority Management Area A – Sustainable Water Development includes the goal of ensuring sustainability of water sources by improving systems and managing water resources more efficiently. One of the Commission's ongoing activities is to support and coordinate efforts of member jurisdictions in oversight of public water suppliers to incorporate system improvements, including the use of multiple sources, metering and pricing, recycling, and other conservation practices.

Priority Management Area B - Water Quality includes the goal of developing, supporting, and implementing plans and projects for the remediation and enhancement of water quality in the basin. One of the action items listed under this goal is to encourage public and private support, maintenance and upgrades of the infrastructure needed for drinking water withdrawal, treatment and distribution; wastewater collection and treatment; on-lot septic treatment; stormwater management projects; combined wastewater overflows; sanitary septic overflows; and other projects needed for the maintenance and improvement of water quality. An ongoing activity under this goal in Priority Management Area B is to promote the use of green infrastructure and stormwater management approaches that mimic natural hydrologic regimes.

Priority Management Area B discusses the importance of an adequate stream gaging system. Priority Management Area F - Coordination, Cooperation, and Public Information contains action items related to stream gages under Goal d.

Priority Management Area C - Flooding also discusses infrastructure needed for adequate flood protection and stormwater management.

2. Management Activities

USEPA performs periodic reviews of infrastructure needs for the nation's water utilities. Reports on infrastructure needs are published and made available on the USEPA website. USEPA prepares its Drinking Water Infrastructure Needs Survey and Assessment to Congress on a periodic basis. USEPA's Office of Wastewater Management conducts its Clean Watersheds Needs Survey every four years in partnership with states, territories, and the District of Columbia.

In light of growing infrastructure concerns, USEPA developed a sustainable infrastructure initiative, which promotes sustainable practices to help reduce the gap between funding needs and spending at national and local levels. The initiative stresses four pillars of sustainable infrastructure; namely, (1) better management of utilities, (2) full cost pricing, (3) efficient water use, and (4) watershed approaches to resource management. USEPA also is promoting green infrastructure associated with transportation and in helping to manage wet-weather events, and is promoting water use efficiency to help alleviate additional infrastructure demands.

The federal Safe Drinking Water Act (amended in 1996) established the Drinking Water State Revolving Fund to help finance infrastructure improvements for drinking water. With passage of amendments to the Clean Water Act in 1987, the federal Construction Grants Program was replaced with the Clean Water State Revolving Fund. The Clean Water State Revolving Fund was intended to help finance nonpoint source, watershed protection, and restoration projects, as well as municipal wastewater treatment plants. Both funds provide money to states, which in turn, provide loans for infrastructure improvements.

3. Future Direction

Increased efforts are needed to support the maintenance and upgrade of water and wastewater infrastructure in the basin. Federal funding has not met this demand and has in fact decreased, putting additional burdens on state and local governments to meet the infrastructure gap. In the 2006-2008 time periods, federal financial support for water and wastewater infrastructure decreased by nearly half a billion dollars, and additional cuts were proposed for 2009. In response, Pennsylvania Governor Edward Rendell signed a 2008 executive order to focus on finding solutions to Pennsylvania's drinking water and wastewater system needs, including new funding options and non-structural alternatives to capital upgrades, such as nutrient credit trading, water re-use, and conservation.

In New York, statewide funding estimates to meet current wastewater infrastructure needs total approximately \$36 billion over the next 20 years. New York published a March 2008 report on wastewater infrastructure needs and has established a Clean and Safe Water Infrastructure Funding Initiative in an attempt to address the infrastructure crisis.

In 2004, Maryland took a major step forward to upgrade infrastructure and protect the Chesapeake Bay when it passed legislation known as the “flush tax,” which established a restoration fund to be supported by a monthly fee of \$2.50 included in sewer bills and a \$30 annual fee to be paid by septic system owners. The funds collected are distributed to utilities to upgrade wastewater treatment plants. In addition, Maryland published a July 1, 2008, Final Report of the Advisory Committee on the Management and Protection of the State’s Water Resources entitled “Water for Maryland’s Future: What We Must Do Today.”

In addition to the above, USEPA worked in collaboration with the Association of State and Interstate Water Pollution Control Administrators (now the Association of Clean Water Administrators), American Rivers, National Association of Clean Water Agencies, Natural Resources Defense Council, and The Low Impact Development Center to prepare its "Managing Wet Weather with Green Infrastructure Action Strategy 2008." Green infrastructure consists of systems and practices that mimic natural processes to infiltrate, evapotranspire, or reuse stormwater or runoff on the site where it is generated. Green infrastructure holds much promise for the future, providing both economic and environmental benefits including: (1) cleaner water, (2) enhanced water supplies, (3) cleaner air, (4) reduced urban temperatures, (5) moderation of impacts associated with climate change, (6) increased energy efficiency, (7) source water protection, (8) other community benefits, and (9) cost savings.

The Commission will continue to participate with its member states on an infrastructure workgroup chaired by USEPA, Region III, and will continue to work with its member jurisdictions to address infrastructure issues. The Commission and its member states also will continue to work with USEPA and the Association of Clean Water Administrators to coordinate infrastructure issues and promote appropriate infrastructure funding.

M. Relationship of Areas of Special Interest and Priority Management Areas

There is significant linkage between the specific water resource issues embodied in the areas of special interest and the broader priority management areas. For instance, water quality (priority management area) is directly impacted by abandoned mine drainage (area of special interest). Table 8 is a matrix displaying the major linkages. Note that any of the areas of special interest could be a focus for the priority management area of coordination, cooperation and public information.

Table 8. Relationship of Areas of Special Interest and Priority Management Areas

Areas of Special Interest	Priority Management Areas					
	Sustainable Water Development	Water Quality	Flooding	Ecosystems	Chesapeake Bay	Coord., Coop. & Publ. Info. ¹
Mine Drainage		X		X	X	X
Climate Change	X	X	X	X	X	X
Consumptive Use Mitigation	X	X		X	X	X
Drought Coordination	X					X
Econ. Devel., Recreation, and other Public Values	X	X	X	X	X	X
Emerging Contaminants		X		X		X
Energy Production and Development	X			X	X	X
Flood Forecast and Warning			X			X
Invasive Species		X		X	X	X
Fisheries Monitoring and Restoration				X	X	X
Potentially Stressed and Water Challenged Areas	X			X		X
Water and Wastewater Infrastructure	X	X	X			X

¹ Coordination, cooperation, and public information could deal with any of the ASI topics.

PART VI – DESIRED RESULTS, GOALS, AND ACTIONS INCLUDED IN THE COMPREHENSIVE PLAN

This part of the Comprehensive Plan presents a summary of the most important information in the Plan, i.e., desired results, goals, and actions. The summary is intended to provide essential information for a good understanding of the Plan's findings.

A. Desired Results and Goals

Part IV of the Comprehensive Plan discusses the desired results, goals and actions for each of the Commission's six priority management areas. The desired results represent a broad objective for successful water resource management in each priority area. A series of defined goals were established to provide measures needed to produce the desired results. Table 9 includes the desired results and goals in the same order as discussed in Part IV.

B. Development of the Actions

The actions necessary to meet goals were developed by the Commission and were designed to be fairly specific and reasonably achievable. They are primarily actions to be taken directly by the Commission with some actions taken by others with the assistance, support and/or encouragement of the Commission. Table 9 includes the actions that have been listed in the same order as discussed in Part IV.

The development of the actions was done in recognition of ongoing Commission activities that also support the goals established in the Comprehensive Plan. The ongoing activities are presented in Part IV and are also included in Table 9.

Table 9. Summary of Desired Results, Goals, and Actions

Priority Management Area A – Sustainable Water Development		
<p>Desired Result: To regulate and plan for water resources development in a manner that maintains economic viability, protects instream users, and ensures ecological diversity; and meets immediate and future needs of the people of the basin for domestic, municipal, commercial, agricultural and industrial water supply and recreational activities.</p>		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal a. Support and encourage the sustainable use of water for domestic, industrial, municipal, commercial, agricultural, and recreational activities in the basin</p>	<ol style="list-style-type: none"> 1. Support the sustainable use of water through the Commission’s regulatory project review and planning activities, through public education and outreach efforts, and through solicitation of the necessary guidance from the Water Resources Management Advisory Committee. 2. Assess the potential for climate change to impact the hydrology of the basin and the potential implications to the basin’s water availability and the occurrence and severity of floods and droughts. 	<ol style="list-style-type: none"> 1. Complete a Cumulative Water Use and Availability Study to comprehensively evaluate cumulative consumptive water use, determine water availability at varying spatial scales, consider establishment of locally sustainable limits for water use, and assess alternatives for avoiding, minimizing or mitigating potential impacts to the water resources of the basin. 2. Determine water availability through water budget assessments (analysis of demand increases and expected base flow levels) to establish local sustainable limits for water use development. 3. Protect healthy ecosystems and instream flow needs, including recreation. 4. Identify additional Potentially Stressed Areas, address unaccounted-for water in approved projects, and implement the recommendations contained in the 2005 Groundwater Management Plan. 5. Assess potential impacts of increased water use and the potential to temper increases through conservation and water reuse, particularly in Potentially Stressed Areas, and otherwise manage water resources for sustainability. 6. Support efforts by member jurisdictions to safeguard groundwater recharge by preserving recharge contributing areas.
<p>Goal b. Maintain an equitable system for allocating water for various uses, including the protection of instream flows and receiving waters of the Chesapeake Bay.</p>	<ol style="list-style-type: none"> 1. Perform periodic evaluation of the Commission’s regulatory program to determine the efficacy and consistency of the program. 2. Evaluate the need for new and amended regulatory requirements, policies and guidelines to enhance management of the basin’s resources and improve the efficiency of the regulatory program. 	<ol style="list-style-type: none"> 1. Evaluate Potentially Stressed Areas to determine if special protected status is warranted, for the purpose of preventing or addressing water shortages that would conflict with requirements of the Comprehensive Plan, and to allow sustainable development of water resources in the area.

Priority Management Area A – Sustainable Water Development (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
Goal b. (cont.)	<ol style="list-style-type: none"> 3. Enforce regulations and conditions of approvals to ensure fair and equitable management of water resources among all users. 4. Continue implementation of the Commission’s Low Flow Protection Policy and related instream flow protection measures. 	
Goal c. Ensure sustainability of water sources by improving systems and managing water resources more efficiently.	<ol style="list-style-type: none"> 1. Support and coordinate efforts of member jurisdictions in oversight of public water suppliers to incorporate system improvements, including the use of multiple sources, metering and pricing, recycling, and other conservation practices. 2. Encourage conjunctive use of water sources, where appropriate. 3. Continue making refinements to the Commission’s water use databases and associated analytical tools. 4. Improve coordination and exchange of water use data among member jurisdictions. 5. Proactively engage project sponsors to facilitate regulatory compliance and reduce burdensome demands on public and private resources. 	<ol style="list-style-type: none"> 1. Review and adjust Commission-approved withdrawal rates, as needed and in accordance with existing regulations, to ensure sustainability and protection of water quality and to reflect demonstrated needs. 2. Encourage and incentivize water conservation and recycling by water suppliers, industry and the public through education and application of regulatory requirements.
Goal d. Mitigate drought impacts through coordination and use of drought emergency powers.	<ol style="list-style-type: none"> 1. Support drought-related actions of the Commission’s member jurisdictions, as appropriate. 2. Implement the Commission’s drought emergency powers under Section 11.4 of the Compact, as appropriate. 	<ol style="list-style-type: none"> 1. Revise the Commission’s Drought Coordination Plan in consultation with the Drought Coordinating Committee.
Goal e. Manage diversions to avoid impacts to the basin’s water resources.	<ol style="list-style-type: none"> 1. Evaluate potential impacts of out-of-basin diversions and investigate conjunctive use alternatives in Commission actions; include and enforce protective conditions for approved diversions. 2. Assess potential adverse impacts and benefits of proposed diversions into the basin, including their potential to serve as mitigation water for other diversions or consumptive water use. 	<ol style="list-style-type: none"> 1. Periodically review the criteria for review of out-of-basin diversions to ensure that adequately protective standards are in place. 2. Monitor the ecosystem effects of diversions of water to and from the basin and transfers of water from one waterbody to another within the basin, including water quality requirements.

Priority Management Area A – Sustainable Water Development (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal f. Manage consumptive water use to mitigate impacts to the basin’s water resources.</p>	<ol style="list-style-type: none"> 1. Monitor consumptive water use in the basin and periodically revise projections for increased needed mitigation. 2. Periodically review consumptive water use fees paid to the Commission to ensure that this mitigation option is commensurate with the real costs of acquiring and managing sources of mitigation. 	<ol style="list-style-type: none"> 1. Implement recommendations of the Commission’s Consumptive Use Mitigation Plan (see Part V-C). Key recommendations include, among others: a) the evaluation of existing U.S. Army Corps of Engineers and other reservoirs for the potential to enhance current release operations; b) the evaluation of the ability of abandoned mines and quarries to supply water for releases during droughts; and c) the assessment of specific needs for instream flows to meet riparian, water supply, water quality, habitat and recreational uses. 2. In the absence of adequate water for local mitigation, restrict new water use to avoid impacts to vulnerable watersheds.
<p>Goal g. Maintain and enhance strong, visible and effective regulatory compliance measures.</p>	<ol style="list-style-type: none"> 1. Conduct visible compliance and enforcement measures that enhance the public reputation of the Commission. The Sayre, Pennsylvania office will continue to be adequately staffed as a key element in ensuring the measures are accomplished. 2. Encourage voluntary compliance by project sponsors. 3. Enforce Commission requirements through the judicious imposition of penalties and settlements. As prescribed in the Compact, penalties of up to \$1000 per day for each violation of a regulation can be imposed. The Commission may also suspend or revoke approval to withdraw or consume water, issue a Cease and Desist Order in the event of an ongoing violation, and seek further injunctive relief from the federal courts to halt violations. 	<ol style="list-style-type: none"> 1. Reduce the backlog of unsatisfied post-approval conditions through increased staff efficiency and improved strategies. 2. Increase the presence of compliance staff throughout the basin. 3. Establish better coordination with member jurisdictions.

Priority Management Area B – Water Quality		
<p>Desired Result: To support the designated uses of all water bodies by achieving water quality that meets or exceeds standards.</p>		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal a. Support and coordinate the efforts of the Commission's member jurisdictions in managing the basin's water quality.</p>	<ol style="list-style-type: none"> 1. Review and seek interstate compatibility of impaired waterbody listings, TMDL development activities, and point and nonpoint source pollution control activities. 2. Coordinate basinwide activities related to the protection of public water sources, in particular those systems that depend on the main stem of the Susquehanna River. 3. Coordinate basinwide water quality activities through the Commission's Water Quality Advisory Committee as well as state and interstate advisory committees and workgroups. 4. Consider physical, chemical, and biological water quality impacts during the regulatory review of applications for water withdrawals and consumptive water uses. 5. Coordinate with member jurisdictions incentivizing the use of lesser quality waters to improve downstream water quality conditions. 	<ol style="list-style-type: none"> 1. Complete comparative study of water quality data collection methods with member jurisdictions to enable direct comparison/use of datasets regardless of the jurisdiction within which the data were collected.
<p>Goal b. Monitor and assess the biological, chemical, and physical quality of the basin's waters to support restoration and protection efforts.</p>	<ol style="list-style-type: none"> 1. Maintain and improve core monitoring and assessment activities such as the Subbasin Survey, Interstate Streams, Low Flow, and Large River Assessment programs. 2. Perform monitoring and data analysis to support Chesapeake Bay restoration activities. 3. Continue to operate and maintain efforts associated with the collection and analysis of data through the continuous water quality monitoring station network, with emphasis on any issues related to specific conductance and turbidity/sediment in small watersheds undergoing development. 4. Maintain and improve stormwater monitoring efforts within select urban settings. 5. Maintain and improve the Susquehanna River Drinking Water Early Warning System. 	<ol style="list-style-type: none"> 1. Enhance monitoring design for the Subbasin Survey Program to improve methods of assessing basin health. 2. Monitor and assess waters for bacteria, pharmaceuticals and personal care products, and other emerging contaminants of concern. 3. Monitor for zebra mussels and other invasive species. 4. Expand the number of continuous water quality stations, as well as add additional parameters, for enhanced protection of aquatic life and public water supplies in the basin. 5. In partnership with the member jurisdictions, establish several monitoring stations in the basin to track changes in climatic conditions.

Priority Management Area B – Water Quality (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
Goal b. (cont.)	<ol style="list-style-type: none"> 6. Provide monitoring support to member jurisdictions’ efforts in developing TMDLs. 7. Perform assessments under Section 305(b) of the Clean Water Act, and provide the results to USEPA, the Commission's member states, and the public. 	
Goal c. Develop, support, and implement plans and projects to remediate and enhance the basin’s water quality.	<ol style="list-style-type: none"> 1. Support the Commission's member jurisdictions in controlling discharges from point and nonpoint sources, including upland activities, with particular emphasis on the states’ efforts to implement their Chesapeake Bay Watershed Implementation and Source Water Protection plans. 2. Encourage and support restoration planning as part of the Commission’s Year-2 Subbasin Survey Program and TMDL development activities for waterbodies impaired by mine drainage, urban, agricultural, and other nonpoint sources, with the goal of removing impaired waterbodies from state lists established under Section 303(d) of the Clean Water Act. 3. Encourage and support implementation of the recommendations outlined in the West Branch Susquehanna Subbasin and Anthracite Region mine drainage remediation strategies. 4. Promote the use of green infrastructure and stormwater management approaches that mimic natural hydrologic regimes. 	<ol style="list-style-type: none"> 1. Encourage public and private support, maintenance, and upgrades of the infrastructure needed for drinking water withdrawal, treatment, and distribution; wastewater collection and treatment; on-lot septic treatment; stormwater management projects; combined sewer overflows; sanitary septic overflows; and other projects needed for the maintenance and improvement of water quality. 2. Seek water quality improvements to complement water quantity mitigation provided for water withdrawal and consumptive water use projects. 3. Support county and municipality efforts to develop/implement regional stormwater management plans in the Lower Susquehanna Region.
Goal d. Protect the quality of the basin's biological resources and sources of public drinking water supply.	<ol style="list-style-type: none"> 1. Encourage the protection of threatened and endangered species and natural biological diversity in the basin. 2. Support further research on the effects of climate change on water quality in the basin, and support efforts to mitigate those effects. (See related climate change ongoing activity under Goal a. for Sustainable Water Development priority management area). 3. Identify waterbodies with exceptionally high quality water, habitat, and biological resources, based on monitoring results. 	<ol style="list-style-type: none"> 1. Provide educational materials regarding the spread of aquatic invasive species in the basin and downstream to the Chesapeake Bay. 2. Provide enhanced tracking of aquatic invasive species in the basin. 3. Expand monitoring for drinking water parameters of concern for the main stem of the Susquehanna River and major tributaries. 4. Establish a Susquehanna Source Water Partnership to work with public water suppliers and other stakeholders to protect drinking water supplies.

Priority Management Area B – Water Quality (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
Goal d. (cont.)	<ol style="list-style-type: none"> 5. Provide increased protection for headwater areas and watersheds with existing good water quality. 6. Develop regional source water protection plans for drinking water supply systems. 	
Goal e. Organize, maintain, and distribute water quality data to facilitate basinwide water quality improvement and protection activities.	<ol style="list-style-type: none"> 1. Maintain and enhance the Commission's water quality database and provide data for inclusion in appropriate USEPA databases. 2. Make data available to the public via the Commission's website and other electronic means. 3. Encourage exchange of data at the local, state, and federal level. 4. Develop consistent basinwide datasets and GIS layers, and enhance existing geospatial and tabular datasets. 5. Enhance and improve the sharing of information contained in water quality databases maintained by the Commission and its member jurisdictions. 	No new actions recommended under this goal.

Priority Management Area C – Flooding		
<p>Desired Result: To prevent loss of life and significantly reduce future damages from floods within the basin through an integrated system of structural and nonstructural flood damage reduction measures.</p>		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal a. Ensure continued operation, maintenance, and enhancement of the Susquehanna Flood Forecast and Warning System (SFFWS).</p>	<ol style="list-style-type: none"> 1. Coordinate SFFWS committee meetings and activities. 2. Answer media requests for information before, during and after flood events. 3. Compile information on major flood events and damage summaries. 4. Support annual SFFWS funding and a permanent funding source for the gage network. 5. Coordinate ice monitoring. 6. Maintain the SFFWS website and information portal. 7. Work with system partners to maintain a state-of-the-art observation network. 8. Endorse, promote and develop new technologies to increase lead-time and improve forecast accuracy. 9. Conduct education and outreach activities to promote awareness of forecast services and their proper use. 	<ol style="list-style-type: none"> 1. Evaluate new partnerships and technologies to support more sustainable long-term funding. 2. Develop, in cooperation with SFFWS partners, a high-resolution observational network. 3. Develop the infrastructure necessary to provide high-resolution flash flood forecasts. 4. Develop, in cooperation with SFFWS partners, new forecast points and flood forecast maps for priority damage locations. 5. Develop Commission capability to operate and maintain rain and stream gages to provide data of sufficient quality to support flood forecast and warning needs.
<p>Goal b. Promote protective floodplain management practices.</p>	<ol style="list-style-type: none"> 1. Improve public understanding of flood risk management. 2. Support FEMA flood disaster recovery efforts. 3. Maintain and distribute community flood insurance maps. 4. Participate in professional state and national floodplain management organizations. 5. Work cooperatively with municipalities, private interests, and the Commission’s member jurisdictions to encourage and identify potential stormwater management projects. 6. Support and publicize local community efforts to encourage development practices with low impacts to flood risk and water quality, and to discourage new development in floodplains. 7. Evaluate the effects of climate change on the nature of flooding in the basin. 	<ol style="list-style-type: none"> 1. Assist in the evaluation of need and implementation of flood damage reduction alternatives for high-risk communities. 2. Assist local and county flood managers in planning efforts and assessments of floodplain reclamation projects. 3. Continue to participate in assessment and mapping of flood risks. 4. Provide public education regarding flood risk management strategies, including the need for personal responsibility 5. Promote riparian and floodplain management practices that protect naturally beneficial floodplain functions 6. Provide technical assistance to local governments to implement proactive floodplain management programs that surpass minimum federal standards.

Priority Management Area C – Flooding (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal c. Improve community flood preparedness to ensure adequate and appropriate response by emergency managers before, during and after a flood event.</p>	<ol style="list-style-type: none"> 1. Provide technical assistance to communities for flood warning or mitigation programs. 2. Advocate participation in the Community Rating System of FEMA’s National Flood Insurance Program to incentivize communities to implement flood damage reduction measures and receive discounted flood insurance premiums. 3. Provide technical support to Pennsylvania’s Emergency Operations Center during flood events. 4. Coordinate, encourage and develop basinwide education and training programs regarding importance of flood warnings and offer information on flood insurance programs. 5. Support activities of Silver Jacket teams within the basin. 	<ol style="list-style-type: none"> 1. Conduct post-flood assessments to identify information needs, educational opportunities, lapses in forecast coverage, and other measures that can assist communities in reducing flood damages. 2. Develop a flood inundation mapping program, including a training component, for communities in the basin. These maps delineate areas of flooding corresponding to various river stages, designate evacuation routes, locate major buildings for potential mass evacuation shelters, and list general flood response procedures. 3. Advocate for and effectuate plans to maintain baseline gage network necessary to provide flood forecast and warning to at risk communities.
<p>Goal d. Assist the Commission's member jurisdictions, as appropriate, in reducing the introduction of man-made debris into the waters of the Susquehanna River Basin and, ultimately, Chesapeake Bay.</p>	<ol style="list-style-type: none"> 1. Encourage the enforcement of existing laws dealing with the deposit of debris into the basin’s streams and rivers. 2. Encourage public and private land owners to reduce the amount of debris and man-made materials stored adjacent to stream banks and in flood plains where they are vulnerable to removal by flood waters. 	<ol style="list-style-type: none"> 1. During dam relicensing, advocate for the continued removal of material from behind power dams on the lower Susquehanna River. 2. During the review and approval of water use projects, assess the potential for the project to result in the storage of man-made debris within the floodplain and take necessary action to offset resulting hazards.

Priority Management Area D – Ecosystems		
<p>Desired Result: To achieve healthy ecosystems that provide groundwater and surface water of sufficient quality and in adequate supply to support abundant and diverse populations of aquatic, riparian, and terrestrial organisms, as well as human use.</p>		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal a. Perform ecosystem monitoring and assessment to provide data needed for effective watershed management.</p>	<ol style="list-style-type: none"> 1. Perform water quantity and quality monitoring, and require appropriate monitoring for projects subject to the Commission's regulatory program. 2. Maintain programs to monitor and assess impacts occurring during low flow events. 3. Continue to monitor water quality and biological conditions near select withdrawal locations in order to track any potential adverse impacts. 4. Monitor and assess the health of fish, wildlife, and other biological resources. 	<ol style="list-style-type: none"> 1. Encourage the maintenance of critical stream gaging stations in the basin. 2. Perform additional instream flow studies to provide scientifically-based estimates of the amount of water needed for fish, wildlife, and recreational use. 3. Develop basinwide methods for assessing fish community health. 4. Assist member jurisdictions with monitoring efforts associated with assessing the health of smallmouth bass, as well as other high value species such as hellbenders.
<p>Goal b. Protect and restore biological resources throughout the basin and in each of the major subbasins.</p>	<ol style="list-style-type: none"> 1. Provide protection to wetlands, aquatic life, and downstream water users by requiring aquifer testing, passby flows, wetland monitoring, and conservation releases through the Commission's regulatory project review and approval process. 2. Participate in activities of the Mid-Atlantic Panel on Aquatic Invasive Species and disseminate pertinent information to the public regarding aquatic invasive species. 3. Identify streams/watersheds that support high quality, diverse biological communities, and encourage/promote protection efforts. 	<ol style="list-style-type: none"> 1. Consider the potential spread of invasive species when evaluating project review applications for diversions and transfers of untreated water from one waterbody to another. 2. Collect and disseminate information regarding the effects of emerging contaminants on the biological resources of the basin. 3. Provide information on the biological resources of the basin and promote fishing, boating, hunting, outdoor photography, eco-tourism, bird watching, and other water-based outdoor recreation through the Commission's website and appropriate links to other websites.
<p>Goal c. Restore populations of migratory fish throughout the Susquehanna River system.</p>	<ol style="list-style-type: none"> 1. Serve as a member of the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRFC) and work with dam owners and operators and others to restore populations of American shad, hickory shad, blueback herring, alewife, striped bass, and other anadromous fish to the Susquehanna River system. 2. Implement and periodically update SRAFRFC's Migratory Fish Management and Restoration Plan for the Susquehanna River Basin. 	<ol style="list-style-type: none"> 1. Work with SRAFRFC, dam owners and operators, sportsmen groups, conservation organizations, and others to implement the Migratory Fish Management and Restoration Plan for the Susquehanna River Basin which was approved by the SRAFRFC Policy Committee in November 2010 and adopted by the Commission in March 2011. 2. With assistance of SRAFRFC and others, support studies of eel migration and implement restoration plans to re-establish a fishable population of American eel in the Susquehanna River system and restore adult recruitment from the river to help rebuild spawning stocks for the east coast eel fishery.

Priority Management Area D – Ecosystems (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
Goal c. (cont.)		<ol style="list-style-type: none"> 3. Support preservation and restoration of tributary streams that provide habitat for migratory fish, including the removal of obstacles to upstream movement and remediation of streams that are impaired by mine drainage. 4. Require viable upstream and downstream migratory fish passage as part of relicensing activities for power dams on the lower Susquehanna River.

Priority Management Area E – Chesapeake Bay		
<p>Desired Result: To manage the water resources of the Susquehanna River Basin to assist in restoring and maintaining the Chesapeake Bay so it meets or exceeds applicable water quality standards and supports healthy populations of living resources, including oysters, crabs, fish, waterfowl, shore birds, and underwater grasses.</p>		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal a. Identify the minimum freshwater inflows needed from the Susquehanna River to assist in restoring and maintaining the ecological health of the Chesapeake Bay, while also identifying opportunities for enhancement.</p>	<p>1. Plan and implement low flow water management activities. (Also discussed under Sustainable Water Development Priority Management Area).</p>	<p>1. Work with USEPA's Chesapeake Bay Program, the USACE, the State of Maryland, and others to support the process to determine flow regimes under which the ecological health of the Bay can be restored and sustained. 2. Continue working with agency/stakeholder partners to develop ecosystem flow needs and goals for the lower Susquehanna River and upper Chesapeake Bay as part of the FERC relicensing of Conowingo Hydroelectric Station. 3. Plan any additional studies and modeling efforts that are needed and seek appropriate funding and implementation.</p>
<p>Goal b. Develop and implement plans to address the flow requirements in Goal a. above.</p>	<p>1. See Goal a. above.</p>	<p>1. Assess the feasibility of providing recommended flow regimes to the Bay. 2. Continue to update and review progress in providing the flows needed for the Bay. 3. Continue working with agency/stakeholder partners to develop, negotiate and ultimately memorialize and implement a revised flow management plan for Conowingo Hydroelectric Station as part of FERC relicensing.</p>
<p>Goal c. Support the Chesapeake Bay restoration effort, including sediment and nutrient reduction strategies developed by each of the Commission's member states.</p>	<p>1. Perform sediment and nutrient monitoring in the basin to help refine the Chesapeake Bay watershed model, support restoration activities, identify water quality trends, and document progress in meeting sediment and nutrient reduction goals established for the Susquehanna River. 2. Promote adequate funding and support tributary strategies and Phase II WIPs developed by each of the Commission's member states, and participate on committees and workgroups to advance restoration and protection efforts.</p>	<p>1. Perform trend analyses for additional sediment and nutrient monitoring sites as sufficient data are accumulated. 2. Coordinate, encourage and support efforts to manage sediment within the basin, including legacy sediments from mill dams and sediment that has accumulated behind dams on the lower Susquehanna River. 3. Promote water quality infrastructure improvement for point sources in the Susquehanna River Basin to benefit local water quality improvement and the Bay restoration effort.</p>

Priority Management Area E – Chesapeake Bay (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
Goal c. (cont.)	<ol style="list-style-type: none"> 3. Support studies to determine the remaining sediment trapping efficiency of dams on the lower Susquehanna River and determine if and how trapping capability may be retained. 4. Continue participation in the Lower Susquehanna River Watershed Assessment, led by USACE and MDE, to comprehensively forecast and evaluate sediment and associated nutrient loads to the system of hydroelectric dams located on the lower Susquehanna River and consider structural and non-structural strategies to manage these loads to protect water quality and aquatic life in the Chesapeake Bay. 5. Assist member jurisdiction efforts in preparing strategies for managing sediment stored behind the dams in the Lower Susquehanna. 6. Promote the installation of best management practices for point and nonpoint sources, including stormwater and agricultural runoff. 	

Priority Management Area F – Coordination, Cooperation and Public Information		
<p>Desired Result: To maximize available human resources and achieve common and complementary management objectives by the Commission, its member jurisdictions and others; to promote the planning and management of the basin’s water resources in the most efficient manner possible; to inform the public on the Commission’s water management responsibilities; and to enhance the public’s access to Commission information and in commenting on Commission activities.</p>		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal a. Continue use of interagency committees and ad hoc committee mechanisms to gather input from member jurisdictions and to encourage consistent interstate water management policies and actions.</p>	<p>1. Continue to participate in member jurisdiction water resource planning efforts and support the enhanced federal agency coordination activities of the USACE Baltimore District.</p>	<p>1. Consult the Commission’s established advisory committees such as the Water Resources Management Advisory Committee and Water Quality Advisory Committee and, as needed, activate ad hoc committees to address special issues or projects. 2. Facilitate interagency and interstate committees to deal with selected water management topics.</p>
<p>Goal b. Execute, review, and update memoranda of understanding (MOUs) with member jurisdictions to coordinate regulatory or other programs that overlap.</p>	<p>1. Review existing MOUs with federal agencies and evaluate the benefits of executing new MOUs with other federal agencies.</p>	<p>1. Keep the Commission-PADEP MOU current and consider amendments that address both substantive and procedural mechanisms to ensure effective implementation of Commission regulatory standards, including sustainable development of the resource while preventing significant adverse impacts to the environment. Explore possibilities of executing similar MOUs with Maryland and the federal government or establishing an alternate procedure for coordination and exchange of information on project approvals and other work programs. 2. Develop cooperative agreements and/or MOUs with New York and Maryland that will govern the review and application of water withdrawal regulations in those portions of the basin. 3. Enhance and improve the sharing of information related to regulated projects in databases maintained by the Commission and its member jurisdictions.</p>
<p>Goal c. Support uniform water management policies and standards in areas such as water quality, stream classification, flood plain management, instream flow protection, stream passby requirements and aquifer protection.</p>	<p>1. Continue to participate in national water organizations such as the Interstate Conference on Water Problems and the Association of State and Interstate Water Pollution Control Administrators, where common management problems and solutions can be more readily identified.</p>	<p>1. Determine the need for uniform standards in such areas as instream flows, aquifer testing, water conservation, and flood plain management, evaluate existing frames for uniform standards and implement appropriate standards through the drafting of guidance, adoption of policies, or development of regulations.</p>

Priority Management Area F – Coordination, Cooperation and Public Information (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
Goal c. (cont.)	2. Continue coordination with member states to implement low flow protection in a way that is consistent with the states' policies.	2. As appropriate, assemble special interagency and interstate task force committees to address special water management topics and the development of uniform water management policies or standards.
Goal d. Coordinate major interagency efforts such as flood forecasting and warning, drought emergency management, water conservation, and hydro power license renewal.	1. As discussed in Priority Management Areas A, C and F respectively, continue coordination and cooperative activities in the following areas: (1) the Interagency Drought Coordination Committee, (2) the basinwide flood forecast and warning system, and (3) Chesapeake Bay Program committees and related bay organizations.	1. Develop basinwide water conservation standards in cooperation with member states. 2. Facilitate interagency coordination of post-flood actions for the purpose of improving emergency response, technical information and flood damage reduction. 3. Expand leadership role and advocacy for the collection of water quality and quantity data for science, including the maintenance of an effective and sustainable stream and rain gage network. 4. Evaluate the establishment of a Susquehanna River Basin Monitoring Council.
Goal e. Inform legislators and executive branch policy makers on important issues related to the basin's water resources.	1. Enhance the manner in which the Commission informs state and federal legislators of its work in managing the basin's water resources and related legislative priorities. 2. Maintain contact with policy makers in the executive branches of the member jurisdictions to retain their support for the Commission's work.	No new actions recommended under this goal.
Goal f. Inform the public on matters affecting the basin's water resources and utilize current tools, methods and strategies to effectively reach the public.	1. Continue to rely on the Commission's web site as one of the primary public information tools, produce and disseminate publications, produce and disseminate television and radio public service announcements, and periodically conduct workshops on specific water resource topics. 2. Routinely disseminate information to the media using the full range of available communication options. 3. Incorporate GIS maps and other tools to the greatest extent possible to enhance public information products. 4. Organize and distribute to the public water resource data maintained by the Commission.	1. Periodically evaluate existing and emerging communication technologies and methods to determine their potential application and benefits to the Commission's public information program and strategies.

Priority Management Area F – Coordination, Cooperation and Public Information (cont.)		
Goals	Ongoing Commission Activities	Actions Needed
<p>Goal g. Enhance public access to Commission information and encourage public involvement in commenting on Commission activities.</p>	<ol style="list-style-type: none"> 1. Provide timely notice of Commission meetings and hearings via newspapers, legal notice publications and the Commission’s web site, and provide direct notice and other information electronically or by regular mail to individuals and organizations who have expressed an interest in a particular matter before the Commission. 2. Continue existing communications and contacts with non-governmental organizations on a range of water resource management issues. 	<ol style="list-style-type: none"> 1. Utilize currently available technologies to make information readily available through electronic means, including non-restricted files and records requested by interested parties to eliminate the need to physically visit the Commission’s headquarters building. 2. Identify, assess and consider a range of options for enhancing access to the Commission by the public and stakeholder groups to facilitate input to ongoing and emerging issues and programmatic matters; options for consideration could include holding periodic topical meetings or public forums, forming a general advisory committee, and using the Commission’s web site more effectively for direct public input. Implement options that enhance opportunities for public and stakeholder input. 3. Expand on existing relationships with non-governmental organizations to maximize the beneficial use of their resources and expertise in the management of the basin’s water resources, and consider their input on ongoing and emerging issues and programmatic matters 4. Identify opportunities to collaborate with academic institutions to maximize resources and scientific knowledge. 5. Provide opportunities for non-governmental organizations’ involvement in Commission activities and, through coordination efforts, encourage communication on activities/issues of mutual interest including ongoing emerging issues. 6. Coordinate with trade associations related to the various types of water use in the basin to promote sustainable water use in conjunction with economic development.

PART VII - IMPLEMENTING ACTIONS IN THE COMPREHENSIVE PLAN

This Comprehensive Plan has been developed to provide an overarching framework for the Commission in regard to management and development of the water resources of the Susquehanna River Basin and to serve as a guide for all Commission programs and activities. The Plan supports the broad goals set forth in the Compact and provides a basis for achieving desired results, meeting specific goals, and taking actions necessary to meet the goals.

It is important that the actions identified in Part IV, Priority Management Areas, be taken by the Commission in order to progress toward the goals set. This part of the Plan discusses the implementation process, roles and responsibilities, and progress assessment process established to help ensure the actions are taken.

A. Implementation Process

The process to implement the identified actions began with approval of the Comprehensive Plan by the commissioners. Most of the identified actions involve the continuation or initiation of them in various Commission work activities and programs. Those actions that are ongoing activities will require continuing emphasis to ensure they remain viable and productive. New actions will require integration into the Commission's work program with appropriate resources and priorities assigned. In view of the Commission's demanding workload, it will be important that Commission leadership stress the importance of timely and high quality actions and that staff effectively implement the actions.

The procedure for incorporating new projects, plans and other actions into the Comprehensive Plan is discussed in Part I, Section D-9. New projects approved by the Commission under its regulatory program will be incorporated by reference into the Comprehensive Plan unless otherwise determined by the Commission. Separate and specific action will be taken to incorporate those projects, considered under the regulatory program, that the Commission determines should not be incorporated by reference. Other water resource projects, plans, and other actions (e.g. policies, programs, and regulations), not approved under the Commission's regulatory program, will be considered for incorporation by the Commission on a case-by-case basis. These measures can be proposed for incorporation into the Plan by project proponents, member jurisdictions, or the Commission itself.

Article 14.2 of the Compact requires that the Commission adopt an annual water resources program, based upon the Comprehensive Plan, and consisting of the projects and facilities which the Commission proposes to be undertaken by the Commission and others during the ensuing six years or other reasonably foreseeable period. Accordingly, the Commission's annual Water Resources Program (WRP) is an implementation document for the actions identified in this Comprehensive Plan. The time period considered for actions in the WRP is two years in order to have a "reasonably foreseeable" forecast of needs, workload, priorities, project schedules and resource availability. The current WRP is included as Appendix 3 and it will be updated as annual revisions are made.

B. Roles and Responsibilities

The Commission's Executive Director has the responsibility to lead the ongoing operations of the Commission. He will ensure the actions from the Comprehensive Plan are assigned to the appropriate program office with adequate resources made available, provide guidance as needed, and monitor progress. He is also responsible to keep the federal and state commissioners informed on progress and seek their review and approval, as required, for significant issue resolution. The commissioners' views, decisions and directions will be used by the Executive Director and his staff for incorporation into the actions.

Management and implementation of actions lie with the Commission's Executive and Management Teams. Management and staff are responsible for taking identified actions, resolving issues and reporting on progress. Each

of the six Priority Management Areas discussed in Part IV is assigned to a lead Program Manager. There will be some overlap of actions among the Priority Management Areas and the managers involved will need to work together effectively to preclude redundancy and conflicts.

Some of the actions are to be taken by member jurisdictions and other groups and organizations with the Commission providing support, assistance or encouragement. In these cases, the other entities have the responsibility to lead and manage the work with the Commission working collaboratively with them in a spirit of full cooperation.

C. Progress Assessment Process

The true value of this Comprehensive Plan will be measured by the degree to which its goals are met through taking the identified actions and continuing the ongoing Commission activities. An annual assessment of progress on meeting goals will continue to be made by the Commission. Performance measures to include a listing of accomplishments in the preceding year are part of the assessment process. A review of the current Water Resources Program is used to identify actions planned or being taken toward meeting the goals. The results of the annual assessment are reported to the commissioners.