River Basin Approaches to Water Management in the Mid-Atlantic States

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The Mid-Atlantic Water Program is a coordinated effort among: Delaware State University; University of Delaware; University of the District of Columbia; University of Maryland; University of Maryland, Eastern Shore; Penn State; Virginia State University; Virginia Tech; and West Virginia University.

CONTENTS

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Introduction

Most Mid-Atlantic states are interconnected through their waterways. Some are also interconnected through river basin commissions and other water management institutions.[1] Pennsylvania, for example, has land area, population centers, agricultural producers, commercial production, and a range of other human activities in the Susquehanna, Delaware, Ohio, and Potomac river basins as well as the Great Lakes basin. Although river management issues are most effectively discussed and disputes between stakeholders resolved at the river basin level, these basins rarely coincide with a single jurisdictional boundary, such as a county, state, or country.

The Interstate Commission on the Potomac River Basin was the Mid-Atlantic region's first (1940) basinwide commission. This was followed by the Ohio River Valley Water Sanitation Commission (ORSANCO) in 1948, the Delaware River Basin Commission (DRBC) in 1961, the Susquehanna River Basin Commission (SRBC) in 1970, and the Chesapeake Bay Commission (CBC) in 1980. DRBC and SRBC have the broadest authority. The newest commission is the Council of Great Lakes Governors (CGLG), enacted in 2008.

Each commission differs in its geographic focus, mission, and powers. Some stakeholder groups are not aware of, or are confused about, the differing jurisdictional authorities of these commissions. The commissions' decisions affect interests within and outside of the river basins. Some stakeholder groups affected by commission decisions participate in opportunities to shape the commissions' policies, but others do not. There are regular opportunities for public input into the commissions' decisions. See the section, "How Can Citizens, Scientists, and Industries Work with River Basin Commissions and Other Interstate Water Management Institutions?" (page 10).

Interstate conflict over water resources is growing in the Mid-Atlantic region and elsewhere. As our region's population continues to increase and industries and energy sources shift, water is in greater demand. Several issues, such as out-of-basin diversion of water and water use for shale gas well development, have lately highlighted the interstate connections among the Mid-Atlantic region's water resources. Other concerns, such as aquatic invasive species and alterations in water availability due to climate change, are likely to become more pressing in the future.

Water management institutions have authority relevant to these issues and are trying to keep abreast of the rapid changes and respond appropriately to them. As with most any change, these emerging issues, proposed solutions, and decisions can create conflict. Some people will be pleased with the changes or outcomes associated with various solutions, and some will not. We can't foresee what the future will bring, but we can be certain that, as in the past, there will continue to be conflict over how water quantity and quality are managed. In a democratic society, the purpose of many government institutions—legislative, administrative, and judicial—is to mediate conflicts among parties with different interests and views with respect to resources, including water.

Rationale and Potential Uses for This Publication

In this publication we introduce the concept of interstate or regional water management institutions, highlighting the workings of river basin commissions, but also discussing several other forms of water management institutions. Opportunities exist to educate and involve all affected stakeholders in Mid-Atlantic region water policy planning. Three examples of those opportunities are:

1. Virginia Department of Environmental Quality is developing a state water resources plan, and there will be opportunities for stakeholder input. The target date for completion is the end of 2012. (www.deq.state.va.us/watersupplyplanning/statwat.html)

2. The Pennsylvania Department of Environmental Protection completed an updated state water plan in 2009. The process of identifying Critical Water Planning Areas for the state—areas where existing or future water demands may outstrip sustainable supply levels—continues. There have been opportunities for public comment in the process, and there may be more.

3. The Army Corps of Engineers in Pittsburgh is participating in the Ohio River Basin Comprehensive Reconnaissance Study, one goal of which is to establish an official water quantity–focused commission for the basin. See www.orboutreach.com/ for possible future opportunities for public involvement and/or comment. (See sidebar, page 10, for more information.)

[1] We use the term "water management institutions" throughout to refer to river basin commissions and the other governmental water management bodies discussed here.

This publication was written to:

- increase readers' understanding of broader basinwide management issues; regional water management institutions, their powers, and stakeholders; and how stakeholders can more effectively participate in these bodies' decisions.
- encourage individuals, businesses, and groups, such as watershed organizations, to network and collaborate on water quality and quantity connections, issues, and management solutions, and to use existing multistate institutions that aid in basinwide approaches to water management.
- increase readers' understanding of the water quality and quantity dimensions of emerging issues, including (a) out-of-basin diversions of water and population growth, (b) drilling for shale gas in the Mid-Atlantic region, (c) global climate change, (d) aquatic invasive species, and (e) efforts to improve water quality in Chesapeake Bay.

The Concept of Interstate River Basin Commissions

With the 1961 creation of the Delaware River Basin Commission came a shift in managing water resources—the creation of a collaborative agency in which each partner shares equal responsibility for managing the river and its watershed without regard for political boundaries. Water, after all, does not stop flowing at the boundaries between municipalities, states, and nations. A commission guides the conservation, development, and administration of the basin's water resources.

A river basin commission may be formed by an interstate compact adopted into law by each of the participating states and consented to by the U.S. Congress. In addition to other issues, a river's status as a navigable waterway gives the federal government an interest in its management, along with the basin states.

We focus here primarily on the Delaware River Basin Commission and the Susquehanna River Basin Commission because they have the broadest authority. We also discuss other water management institutions in the Mid-Atlantic that are organized differently and hold considerable responsibility for managing water quantity and/or quality.

Emerging Issues Facing River Basin Commissions

In this publication we introduce five emerging interstate water management issues that river basin commissions are facing or will face. These issues illustrate how quickly a new water use or concern can alter the interests of a resource's stakeholders. The discussion also demonstrates how important it is to keep up with water issues and how vulnerable water can be.

The emerging issues are:

- out-of-basin diversions and population growth;
- shale gas extraction;
- climate change;
- aquatic invasive species;
- improving water quality in Chesapeake Bay.

The issue briefs begin on page 13.

The Interstate River Basin Commissions of the Mid-Atlantic Region

The Delaware River Basin Commission (DRBC)

In 1961 the basin states of Delaware, New Jersey, Pennsylvania, and New York, along with the federal government, created the Delaware River Basin Commission through the Delaware River Basin Compact to manage water interests in the densely populated Delaware River watershed. Before the commission was created, 43 state, 14 interstate, and 19 federal agencies exercised various powers within the watershed. Creation of the commission marked the first U.S. partnership of the federal government and a group of states for river basin planning, development, and regulation.

The Delaware River Basin Commission arose from a long-standing interstate legal debate over rights to water within the Delaware River watershed and an out-of-basin diversion (in 1931, an average of up to 440 million gallons per day, which increased to up to 800 million gallons per day in 1954) from three Delaware basin reservoirs (transfer of Delaware River water

"An ounce of prevention is worth a pound of cure."
—Ben Franklin

to New York City, which is not in the watershed). Supreme Court decrees in 1931 and 1954 resolved the city's diversion rights and became the foundation for a more comprehensive water management agreement among the litigants when they formed the commission by interstate compact in 1961. The compact's initial term is 100 years. (For more information, see Issue 1, "Out-of-Basin Diversions and Population Growth," page 14.)

The commissioners include the governors of the four basin states (Delaware, New Jersey, Pennsylvania, and New York) or their designees and a federal representative appointed by the U.S. president. Each has one vote of equal power, and a majority vote is needed on most issues. The commission oversees "water quality protection, water supply allocation, regulatory review (permitting), water conservation initiatives, watershed planning, drought management, flood loss reduction, and recreation" in the basin.

DRBC activities are funded by the federal government and member states, project review fees, water use charges, fines, and grants. The commission holds meetings and hearings on policy matters and water resource projects under regulatory review. The public is invited to attend these events, as well as the advisory committee meetings.

According to DRBC's Rules of Practice and Procedure, all water-related projects in the basin meeting certain thresholds must be approved, or "docketed," by the commission. The threshold for ground and surface water withdrawals is 100,000 gallons per day as an average over any 30-consecutive-day period, except within the Southeastern Pennsylvania Ground Water Protected Area, where a groundwater withdrawal of 10,000 gallons per day as an average over any 30 consecutive days triggers commission review.

DRBC currently requires only groundwater withdrawals that average or exceed 10,000 gallons per day (gpd) to register their wells with the appropriate state agency. New users may be required to limit withdrawals if their use interferes with that of established users or to provide replacement water supplies when interference is unavoidable. No withdrawal of ground or surface water, well drilling, or impoundment construction may begin without a docket.

DRBC has also been involved in settling disputes about water use within Pennsylvania, something it was not designed to do but had the authority to facilitate. DRBC became involved because Pennsylvania has no easy mechanism for resolving water disputes. Some people question whether the commission has the resources and local knowledge to deal with these in-state disputes.

DRBC and the compact signatories engaged in a multiyear negotiation to balance the competing uses of New York City's water supply reservoirs in light of the various rights granted in the 1954 court decree. The parties involved unanimously agreed to the results of this negotiation, called the Flexible Flow Management Program (www.state.nj.us/drbc/FFMP/index.htm).

The Susquehanna River Basin Commission (SRBC)

The Susquehanna River watershed lies in three states (New York, Pennsylvania, and Maryland), and its status as a navigable waterway gives the federal government an interest in its management as well. The Susquehanna River Basin Compact was signed in 1970 to coordinate actions of the three basin states and the federal government associated with the river, and to allow management of the Susquehanna's water and related natural resources with a broad, basinwide view. The initial compact term is 100 years.

SRBC works much like DRBC in commission membership, voting representation, responsibilities, and open public meetings. SRBC regulates large withdrawals from ground- or surface water (100,000 gpd for any consecutive 30-day period) and large consumptive water uses (20,000 gpd or more for any consecutive 30-day period). In December 2006, SRBC significantly expanded its purview over water withdrawals of all volumes related to a regulated consumptive water use. In addition to any other requirements of its regulations, the commission requires registration of the amount of withdrawals or

diversions in excess of an average of 10,000 gpd for any consecutive 30-day period and re-registration every 5 years unless the withdrawal is discontinued sooner.

Proposed consumptive water use projects sourced from ground- or surface water require prior review and approval by SRBC even if the withdrawal averages less than 100,000 gpd. Consumptive-use projects are required to mitigate, or compensate, for their use. SRBC provides a list of mitigation options that include measures such as payments, water reductions, or release of stored waters.

In addition to water withdrawal projects involving 100,000 gpd or more from a surface- or groundwater source, proposed water withdrawal projects using a combination of sources totaling 100,000 gpd or more for any consecutive 30-day period will also require prior approval by SRBC. Additional requirements can be imposed to limit, condition, or mitigate withdrawals, or require the project sponsor to undertake other measures to meet its present or foreseeable future water needs from ground- or surface water sources.

Projects that propose to divert water into the Susquehanna River basin or divert an average of 20,000 gpd or more of water out of the basin in any consecutive 30-day period require SRBC review and approval. All diversions, whether they are water into or water out of the basin, must meet SRBC requirements.

Under the revised regulations, there are withdrawal projects that typically would not require prior review or approval but may be subjected to the review process if so determined by SRBC's executive director. These projects include those affecting interstate water quality; those within a member state that have the potential to affect waters within another member state; those having a significant effect on SRBC's comprehensive plan; or those that could have adverse or interstate effects on water resources of the basin.

Withdrawal projects that are subject to SRBC review and approval, and that have been in place since 1979, are also subject to water conservation requirements for public water supply, industrial, or irrigation use.

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"A river is more than an amenity, it is a treasure."
—U.S. Supreme Court Justice Oliver Wendell Holmes

What Makes Interstate River Basin Commissions Work?

Experts on DRBC and SRBC policies agree that it is critical for the members of an interstate compact to recognize common problems and commit to working through them outside of the court system. Successful dispute resolution usually comes during face-to-face negotiations with the help of the basin commission's technical staff, who remain neutral on the issues. A key to the broad powers of DRBC and SRBC is that their compacts enable them to both make and implement decisions.

Regularly scheduled commission meetings offer interested parties an opportunity for interaction and for learning about the issues and others' perspectives and proposed solutions or decisions. Given these opportunities, stakeholders who thought they were entirely at odds may identify significant common interests on which to build a compromise or develop mutually satisfying new solutions. Many interstate water management institutions hold annual conferences, which offer additional relationship-building opportunities. Seeing "the other side" as people with understandable needs is helpful in any conflict.

River basin commissions often conduct scientific research and monitoring. For example, DRBC has identified some emerging contaminants—chemicals from products such as some flame retardants, pharmaceuticals, and personal care products—for further study. Work continues to understand and prioritize these potential issues. DRBC is also studying the impact of flow volumes on water quality. DRBC monitors the amount of snow pack in the basin and is expanding the basin's flood warning system.

SRBC coordinates the Susquehanna Flood Forecasting and Warning System among various federal and state agencies and has developed flood inundation maps for riverside communities, assuming various levels of flooding. In 2010, the SRBC began implementing a real-time monitoring network in areas where drilling in the Marcellus shale is most active, and in other locations in northern Pennsylvania and the southern tier of New York where no drilling activities are planned. The Remote Water Quality Monitoring Network continuously measures and reports water quality conditions of smaller rivers and streams, and uses instrumentation that is sensitive enough to detect subtle changes in water quality (temperature, pH, conductance, dissolved oxygen, and turbidity). The water quality data can be accessed from SRBC's web site.

Other Interstate Water Management Institutions in the Mid-Atlantic Region

Other interstate water management institutions (Tables 1, 2) with various water management concerns and responsibilities (Table 3) exist in the Mid-Atlantic region. These are discussed briefly below.

Chesapeake Bay Commission (CBC)

After the U.S. Environmental Protection Agency (U.S. EPA) showed water quality in the Chesapeake Bay to be declining, the Chesapeake Bay Commission was created in 1980 "to coordinate Bay-related policy across state lines and to develop shared solutions." The CBC is a leader of efforts to restore Chesapeake Bay and includes mainly legislators from Maryland, Virginia, and Pennsylvania. The commission aims to sustainably manage the bay's natural resources, conserve land, and protect water quality. Its unique structure includes five legislators from each member state, a representative of each state's natural resource management agency, and three private citizens. The commission's duties include research and analysis, policy development, and consensus building on matters concerning the bay. The CBC has no regulatory or enforcement authority.

Chesapeake Bay Program (CBP)

Beginning in the 1970s, water quality concerns in the Mid-Atlantic region increased as more data became available on the quality of surface waters and the Chesapeake Bay's deterioration. In 1983, the states of Maryland, Pennsylvania, and Virginia; the District of Columbia; the CBC, and the U.S. EPA signed an agreement establishing the Chesapeake Bay Program to protect and restore the bay's ecosystems.

State and federal officials in December 2010 were finalizing details for the bay's total maximum

Table 1. States with land area within the watersheds overseen by the various interstate water management institutions in the Mid-Atlantic region.

Delaware River Basin Commission (DRBC)	Susquehanna River Basin Commission (SRBC)	Ohio River Valley Water Sanitation Commission (ORSANCO)	Great Lakes—St. Lawrence River Basin Water Resources Council (GL-SLRBWRC)	Chesapeake Bay Commission (CBC)	Chesapeake Bay Program (CBP)	Interstate Commission on the Potomac River Basin (ICPRB)
DE	NY	IL	IL	MD	Wash., DC	Wash., DC
NJ	PA	IN	IN	PA	MD	MD
NY	MD	KY	MI	VA	PA	PA
PA		MD*	MN		VA	VA
		NC*	NY			WV
		NY	OH			
		OH	PA			
		PA	WI			
		TN*				
		VA				
		WV				

*Within watershed but not signatory to compact.

daily loads (TMDL) plan for various pollutants. This is the amount of a pollutant that the bay can receive daily and still meet the water quality standard. The total load is then divided among the various sources of the pollutant. For more information, see "Issue 5: Improving Water Quality in Chesapeake Bay" (page 25).

Among other activities, the CBP supports the maintenance of reductions already achieved in nitrogen, phosphorus, and sediment loadings; evaluates and encourages practices that will restore water quality in the bay; offers grant programs to help fund bay restoration projects; cultivates and supports leaders for bay initiatives; and promotes community engagement and education about bay issues. The CBP has no regulatory or enforcement authority.

Interstate Commission on the Potomac River Basin (ICPRB)

Congress established the Interstate Commission on the Potomac River Basin in 1940 to "enhance, protect, and conserve the water and associated land resources of the Potomac River and its tributaries through regional and interstate cooperation." Members include the states of Maryland, Pennsylvania, Virginia, and West Virginia, and the District of Columbia. The U.S. government is a formal participant but not a signatory to the compact.

The commission assumes the following roles and functions: interstate and basinwide coordination, stimulation of federal and state action, basinwide water quality monitoring evaluation and conduct of water-related studies, liaison with citizen and government groups, dissemination of information about the Potomac, and provision of services and technical support to Compact members.

The ICPRB exercises limited regulatory authority through its Section for Cooperative Water Supply Operation on the Potomac River, which, through a series of agreements, regulates the release of stored water during drought conditions. Supplies are then shared by several large water utilities serving the Washington, D.C., metropolitan area.

Ohio River Valley Water Sanitation Commission (ORSANCO)

Ohio River Valley Water Sanitation Commission member states—Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia—have cooperated since its formation in 1948 to control future pollution and reduce existing pollution in the waters of the Ohio River basin. The commission exercises regulatory jurisdiction over water quality, not quantity. ORSANCO operates monitoring programs to check for pollutants and toxins that may interfere with specific uses of the river, and conducts special studies to address emerging water quality issues. ORSANCO staff are developing a TMDL for bacteria because almost half of the river exceeds the bacteria water quality standard to allow water-contact recreation use.

Table 2. General information about interstate water management institutions in the Mid-Atlantic region.

Commission	Year created or year compact enacted	Drainage area (square miles)	Estimated population served (millions)
DRBC	1961	13,539	15
SRBC	1970	27,510	4.2
ORSANCO	1948	164,000	20+
GL–SLRBWRC	2008	375,400	43
CBC	1980	64,000	13
CBP	1983	64,000	13
ICPRB	1940	14,760	6.1

Great Lakes–St. Lawrence River Basin Water Resources Council (GL–SLRBWRC)

Managing the use of Great Lakes waters falls under the jurisdiction of the Great Lakes–St. Lawrence River Basin Water Resources Compact, enacted into law in 2008. The Council of Great Lakes Governors serves as secretariat to the Great Lakes–St. Lawrence River Basin Water Resources Council created by this compact. Parties to the agreement include eight of the Great Lakes states.

Among other things, the compact seeks to (1) foster economic development through sustainable and responsible use of Great Lakes basin waters, (2) enforce a general ban on new out-of-basin diversions of water, with limited exceptions allowed for communities near the basin, (3) make consistent the standard for review of proposed uses of basin waters, and (4) provide a forum for ongoing collaboration.

The separate Great Lakes Commission, also formed via an interstate compact, does not exercise regulatory authority.

Why River Basin Commissions? A Watershed Approach to Solutions

Interstate management of rivers has several advantages. First, watersheds cross jurisdictional boundaries. River basin commissions take a regional view and can work across state boundaries to settle disputes before they reach a crisis. The interstate compact process gives states the ability to address mutual problems through negotiation and consensus building rather than litigation. An important strength of the river basin approach stems from their flexibility to deal with changing situations, such as that presented by shale gas extraction.

Basinwide management of a river often involves:

- integrating water projects throughout the basin to fulfill as many different needs as possible, thereby maximizing economic and social returns for resource users,
- constructing efficient multipurpose water storage structures to provide irrigation, navigation, flood control, recreation opportunities, and power generation as well as consistent water supply, and
- using water resources management to direct regional development.

Without a basinwide management approach, many fruitful uses of water may prove impossible because of uneven flow or poor or inconsistent water quality.

Table 3. Key activities of interstate water management institutions in the Mid-Atlantic region.

Commission	Interstate coordination	Conflict resolution between states	Water quality monitoring	Discharge requirement and water quality standards	Enforce-ment powers	Applied water quality research	Flood mitigation	Source water protection	Regulation of major water users	Public education/ outreach
DRBC	X	X	X	X	X	X	X	X	X	X
SRBC	X	X	X	—	X	—	X	X	X	X
ORSANCO	X	X	X	X	X	X	—	X	—	X
GL–SLRBWRC	X	X	—	—	X	—	—	—	X	X
CBC	X	X	—	—	X	—	—	X	—	X
CBP	—	—	—	—	—	—	—	—	—	
ICPRB	X	X	—	—	—	X	—	X	X	X

Because of the individual perspectives of smaller governmental units and their desires for sovereignty and control, enormous barriers to basinwide river management approaches exist without the cooperation enforced by a formal river basin commission.

How Can Citizens, Scientists, and Industries Work with River Basin Commissions and Other Interstate Water Management Institutions?

We all have a stake in sound public policies for water management. Most water management institutions have regular meetings that are open to the public. Before most legislative and regulatory changes are made, the public can submit comments or contact their river basin commission representatives. You can help shape future water policies. Learn when and where key decisions about water are being made. Make effective and informed input using objective information when opportunities to shape policy arise. See the "Resources" section on page 12 for some sources of information to begin with.

Most, if not all, water management institutions have some kind of advisory board composed of concerned citizens and/or scientific specialists. Participation on these boards may provide a strategic interaction point for people wishing to influence the policies of these bodies.

Many organizations need volunteers to help with projects like water quality monitoring. Citizens can volunteer by themselves or as part of an organized body, such as Trout Unlimited, or a local watershed group.

Most organizations have public education opportunities. For instance, the ICPRB organizes an annual "Potomac River Ramble," a multiday river float trip whose aim is "to elevate awareness of the Potomac River's importance to the region and to encourage local residents to play an active role in its restoration."

Representatives of industry can play an important role in river basin commissions' activities by serving on advisory committees and supporting other activities. In 2009 East Resources, Inc. (now part of Royal Dutch Shell), a natural gas company in Warrendale, Pa.,

A Water Quantity–Focused Basin Commission for the Ohio River?

Some citizens and organizations in western Pennsylvania and other parts of the Ohio River basin have asked what it would take to establish a water quantity–focused river basin commission for the Ohio River with powers similar to SRBC's and DRBC's. The Army Corps of Engineers in Pittsburgh is participating in the Ohio River Basin Comprehensive Reconnaissance Study to determine, among other things, the most efficient ways of reinvesting in existing reservoirs and flood protection projects in the basin. An official water quantity–focused commission for the basin is one ultimate goal of the study. Some other participants in the comprehensive study include three other Corps districts and the 15 basin states.

A river basin commission is formed by an interstate compact adopted into law by each of the participating states, and consented to by the U.S. Congress. It is a form of collaborative government. The new Great Lakes–St. Lawrence River Basin Water Resources Council is the most recently created interstate compact body (in 2008). SRBC was created in 1970. DRBC was established in 1961, and the Interstate Commission on the Potomac River Basin in 1940. It seems now as though the Delaware and Susquehanna river basin commissions were ahead of their time in acknowledging the importance of managing a river system without regard to political boundaries. Many parties and interests would need to come together to start a similar commission to address water quantity in the Ohio River basin. Other portions of the Mid-Atlantic region might also benefit from coverage by a river basin commission. ■

"I started out thinking of America as highways and state lines. As I got to know it better, I began to think of it as rivers. Most of what I love about the country is a gift of the rivers . . . . America is a great story, and there is a river on every page of it."
—Charles Kuralt

with substantial interests in Marcellus shale in the Mid-Atlantic region, donated the initial funding of $750,000 to SRBC to install thirty electronic water quality monitors on smaller streams as part of its Remote Water Quality Monitoring Network.

Conclusions

Through federal–interstate river basin commissions such as DRBC and SRBC, distinct governmental bodies can collaborate to manage a common resource—a river and its watershed. These successful arrangements to share decision making serve as models for other river managers around the country and the world.

It seems now as though the Delaware and Susquehanna river basin compacts were ahead of their time in acknowledging the importance of managing a river system without regard to political boundaries. However, river basins exist within a political context, and those with regulatory authority operate within a legal framework. The commissions depend on the participating states and jurisdictions for funding and other input. Despite these constraints, the river basin management approach and the commissions' efforts have generally aided basinwide watershed information gathering, management activities, and policy.

In some cases, however, the commissions have made decisions that represented tradeoffs between the competing users of water. As a result, some water resource users and their representatives have been unhappy about certain of the commissions' decisions and about the commissions themselves. River basin commissions were designed as regulatory, managing, and operating institutions. They don't perform these functions perfectly. But they should be able to use their broad knowledge of water supply and demand and their authority to carry out basinwide planning programs and projects for the immediate and long-range use and development of the basin's water resources.

A river basin commission has advantages and disadvantages. The advantages include the ability to apply a basinwide approach to solutions and to offer help in resolving conflicts. Some of the disadvantages include ongoing funding requirements and difficulties, vulnerability to the hot-button issues of the day, an additional layer of bureaucracy, the difficulty of establishing a commission, lack of commission coverage for some areas resulting in uneven policies and rules within states, and the difficulty of managing the water quality–quantity connection.

Separating out the management of water quantity and water quality into different agencies may hinder the creation of scientifically sound policy. DRBC and SRBC each have some responsibility for water quality as well as quantity. However, the other water management institutions discussed here have only one or the other responsibility, and most of these have no regulatory or enforcement authority. To improve management of water resources, policy makers should look for ways to better integrate water quality and quantity management goals.

River basin commissions and other water management institutions in the Mid-Atlantic region face several emerging issues. Their established interstate collaborations make possible "big-picture" planning, analysis, and tackling of these multifaceted problems. We explore these issues further in the five issue briefs in this publication.

Out-of-basin diversions (page 14) remain a challenge, especially when they are unpredictable or occur during low-flow periods. Population growth can change water use patterns, both within the basin and for out-of-basin diversions, and can create friction among users. Jockeying for control among various stakeholders can divert commission staff members' attention from broader picture issues.

Water use in shale gas well development (page 16) has been difficult to plan for because of the industry's rapid growth and uncertainty about how large the industry will become. Regulatory and technology developments surrounding the treatment and disposal of wastewaters from gas well development also present unknowns to the future of the industry. The rapid growth of the shale gas drilling industry illustrates how quickly the water regulatory landscape can change.

The impacts of future climate change (page 20) are uncertain, which makes managing for them difficult.

We present as an example the threat of possible future disturbance of one of Philadelphia's public water supply intakes owing to encroaching salinity with climate change–induced drought.

Several dramatic examples of aquatic invasive species (page 22) have been in the news recently in the Mid-Atlantic region. These issues present complex tradeoffs between economic gain and environmental consequences, requiring a broad, systemwide view to develop a tenable solution.

Monitoring data continue to show that even after decades of cleanup efforts the Chesapeake Bay has poor water quality, degraded habitats, and low populations of many species of fish and shellfish (page 25). Federally driven efforts to reduce pollution in the bay have recently received more attention and priority.

All in all, given the continuation of trends in the Mid-Atlantic region, it appears that the water quantity and quality management challenges facing the existing river basin commissions and other decision makers concerned with water are likely to increase in number and complexity in the future. As decision makers take on these challenges, it is important that they understand the river basin management commission concept and experiences to date.

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Introduction to the Emerging Interstate Water Management Issues

As the Mid-Atlantic region's population continues to increase and industries and energy sources shift, water is in greater demand. Several issues, such as out-of-basin diversions, population growth, and water quantity and quality challenges associated with recent development of the Marcellus shale gas field, highlight the interstate connections among the Mid-Atlantic region's hydrologic resources. Other issues, such as alterations in water quality or availability due to climate change, may become more pressing in the future. Water management institutions, where they exist in the region, have authority to influence these issues and are trying to keep abreast of the rapid changes and respond appropriately to them. As with most any change, these emerging issues, proposed solutions, and decisions can create conflict. Some people will be pleased with the outcomes and some displeased. We can't foresee what the future will bring, but we can be certain that, as in the past, there will be "winners" and "losers" in water quantity and quality conflicts.

The issue briefs that follow are meant to be a starting point for discussion. After an introduction to each issue, we provide a short list of resources for those who would like to delve more deeply. The issues chosen were current as of 2010; however, pressing issues are constantly changing and evolving.

Issue 1: Out-of-Basin Diversions and Population Growth

Introduction

Long-standing and potential new or expanded out-of-basin diversions complicate water management. Some river basins see appreciable use by users outside of the basin. These "out-of-basin diversions" typically existed before the relevant river basin commission was formed. These diversions can be a management challenge because their use is uncertain and variable.

In the early 1900s out-of-basin diversion of water for New York City from the Delaware River was a prime driver behind formation of the Delaware River Basin Commission. The City of Baltimore has a grandfathered right to withdraw water out of basin from the Susquehanna River. As the population of both the cities and the river basins themselves grows and shifts, competition for water increases and these diversions could become greater concerns for the river basin commissions.

New York City Diversion from Delaware River

In the 1920s New York City announced plans to divert water from the Delaware to meet the needs of its growing population. In 1931 the U.S. Supreme Court decreed that New York City could divert an average of up to 440 million gallons per day (mgd) from the basin for the city's water supply. This decree was amended in 1954 to increase the city's allocation to up to 800 mgd from three Delaware basin reservoirs. In exchange the city agreed to release from its reservoirs a certain minimum flow as measured at Montague, New Jersey. The amended decision allowed the parties to return to the court system if circumstances changed.

Instead, the parties created the Delaware River Basin Commission in 1961 to manage the whole of the river basin as a system, rather than along political boundaries. The compact forming the commission gives it great flexibility to meet changing needs, including the authority to change the terms of the 1954 decree by unanimous agreement of the parties.

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Diversion from Susquehanna River by City of Baltimore

In the mid-1960s, the City of Baltimore constructed a 35-mile-long pipeline capable of transmitting 250 mgd from the lower Susquehanna, although there is sufficient pump and motor capacity to convey only up to 137 mgd. The water comes from a pipe in the Conowingo Pond, a 90-foot-deep reservoir behind Conowingo Dam, on the Pennsylvania–Maryland border. The pond also supplies a nuclear power plant, three other electricity-generating facilities, and another large diversion for public water supply, and serves about 65,000 recreational users annually.

This diversion has been used only during prolonged periods of drought and was in place before the compact founding SRBC was signed in 1970. Given the multiplicity of users of the Conowingo Pond, SRBC and the City of Baltimore reached a settlement agreement in 2001 for coordinated management to meet the increasing water supply needs of Baltimore, provided that operating plans or other mitigating measures will prevent significant adverse impacts to other water users or the water resources in or downstream of Conowingo Pond.

Population Growth

The Chester County, Pennsylvania, water authority also has a grandfathered right to divert 60 mgd from the Susquehanna, also from the Conowingo Pond on the Pennsylvania–Maryland border. Both Chester County and Baltimore may increase their diversions in the future to satisfy population growth, taking them closer to the upper limits of what's allowed. Chester County's population grew 13.4 percent between 2000 and 2008, making it the fastest-growing county in the state for that period.

Proposed Susquehanna to Potomac Watershed Diversion

This proposed diversion is different from other diversions noted because it involves the transfer of finished drinking water from York, Pa. (Susquehanna River watershed) to Gettysburg, Pa. (Rock Creek–Marsh Creek, Potomac River watershed). The proposed interbasin transfer is due to a growing population and limited water resources. Potential issues facing the Potomac basin come entirely from sewage treatment plants that will discharge to the Rock–Marsh creeks basin after the transferred water is used. Sewage plant loadings could dominate flows in the creeks, particularly during drought. The transfer could affect both the water flows and water quality of Rock-Marsh creeks. The treated wastewater flows also will become part of drinking water supplies downstream.

Resources

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Delaware River Basin Commission,
www.state.nj.us/drbc/

Susquehanna River Basin Commission,
www.srbc.net/

Issue 2: Shale Gas Extraction

Introduction

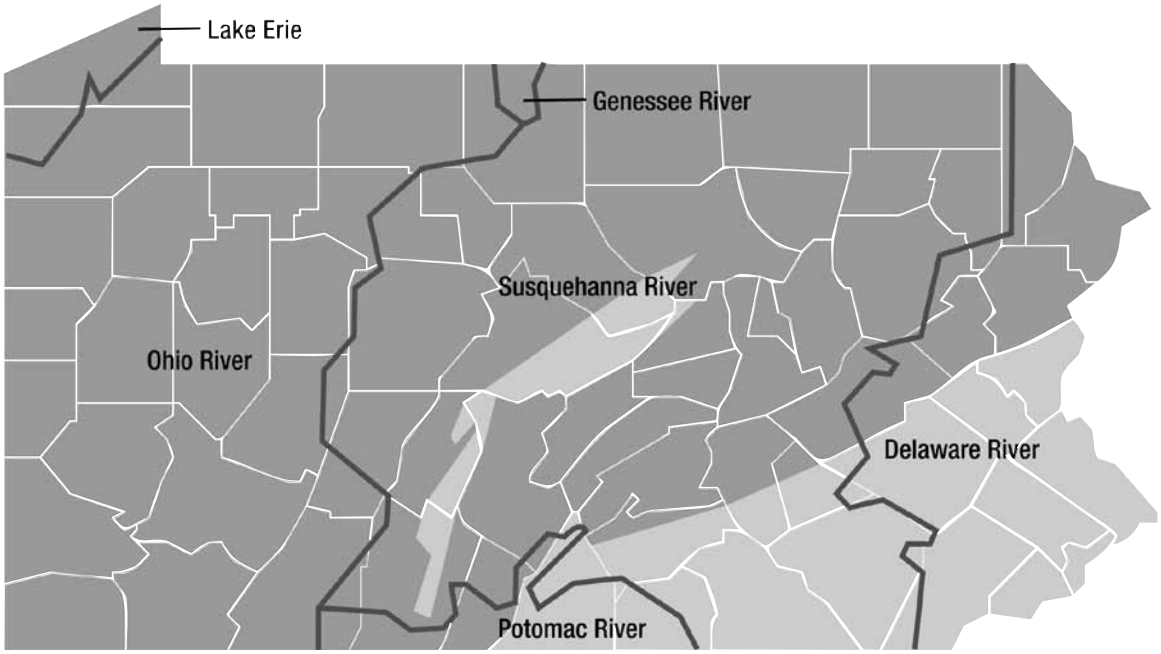
Natural gas–rich Marcellus shale occurs below parts of Pennsylvania (Figure 2.1), West Virginia, Maryland, New York, Ohio, and Virginia. Its development as a potentially significant future source of energy illustrates how energy policies and trends can drive land and water use changes and public policy changes, resulting in complex regional water quantity and water quality concerns.

Expanding demand for energy in the developing world and for domestically produced energy in the United States, along with new drilling technologies such as horizontal drilling and hydraulic fracturing ("fracking"), have whetted mineral exploration companies' interest in drilling into these deep gas reserves. Still, uncertainty exists as to how big the Marcellus shale gas "play" will become. A sharp drop in energy prices and the worldwide economic slump slowed leasing activity in late 2008. Nevertheless, leasing activity increased again in 2009, as did drilling and hydrofracturing of gas wells. Although the full impacts of Marcellus shale drilling remain to be seen, it appears that development of this shale is transitioning quickly to a production phase in Pennsylvania and perhaps soon in nearby states.

Water Essential for Gas Extraction

Water is critical for extracting gas from the Marcellus shale. The shale around most new gas wells must be fractured to release the trapped gas so it can be brought to the surface. Hydrofracturing uses high-pressure water, sand, and chemicals (see also page 18, "Gas Drilling and Water Quality") to break up the gas-producing rock and improve the flow of gas to the bore hole. Hydrofracturing of a deep vertical well may use 500,000 to more than 1 million gallons of water. Hydrofracturing a horizontal Marcellus well may use 3–4 million gallons of water, typically within about one week. If the Marcellus is like other shale gas plays (e.g., the Barnett in Texas), some wells may need to be hydro-

Figure 2.1. Distribution of Marcellus shale in Pennsylvania, with major river basins overlaid. Darker shading represents Marcellus areas.



fractured several times over their productive life (typically 5–20 years). These large water withdrawals may have significant ecological effects. Thus far, most withdrawals in the Northeast and Mid-Atlantic states have been from surface water sources. Large withdrawals could also affect nearby drinking water sources and other uses. Putting water to one use may mean that it is not available for another use, thereby increasing the potential for conflicts between water users.

In Pennsylvania, the state's Department of Environmental Protection (PA DEP) oversees oil and gas drilling. DEP staff issued about 2,000 new permits for Marcellus shale drilling in 2009. They are expected to issue about 5,200 in 2010. SRBC estimates that at full development the total annual water withdrawal by drillers into the Marcellus shale in the basin (about 10 billion gallons per year) will equal about the same amount of water as thermoelectric power plants in the Susquehanna River basin use in 3 days. In this light, the expected amounts seem manageable. But state environmental agencies and the river basin commissions are concerned because these gas wells often occur in remote areas, where the closest water source may be an ecologically sensitive, small forested stream. Therefore, the region's overall environmental and economic health demands that these withdrawals be scrutinized. Drilling and fracking water and wastewater is increasingly being transferred between river basins, and this may further complicate permitting and big-picture water management.

For specific details on SRBC's and DRBC's regulatory responses to exploration and drilling in the Marcellus shale, see the Penn State Cooperative Extension publication, *Water Withdrawals for Development of Marcellus Shale Gas in Pennsylvania,* by C. Abdalla and J. Drohan (2010) (pubs.cas.psu.edu/FreePubs/pdfs/ua460.pdf). Also check the SRBC and DRBC Web sites (see page 12) because this issue is rapidly changing. In December 2010 DRBC proposed draft regulations governing drilling in the Marcellus shale. Until they are finalized in 2011, a drilling moratorium remains in place in that watershed.

Uneven Coverage of River Basin Commissions for Areas with Shale Gas Resources

Many areas of the Mid-Atlantic, both within and outside the Marcellus shale play, have no river basin commission focused on water quantity. This has raised a number of issues about equity and uniform permit requirements. In Pennsylvania, for example, the state

DEP is applying SRBC's passby guidelines in the area of the state outside SRBC's and DRBC's oversight to ensure a consistent regulatory approach statewide. These guidelines allow for water withdrawal from a stream during times of high or normal flow but require that the withdrawal stop or decrease during times of low stream flow, usually during the late summer or early fall. Some stakeholders have suggested that the Ohio River basin, of which western Pennsylvania is part, would benefit from creation of a water quantity–focused river basin commission with powers similar to those of the SRBC and DRBC.

Gas Drilling and Water Quality

Water quantity and water quality are closely linked. If the amount of water in a stream is reduced, any pollutants in the remaining water become more concentrated.

Sand, gas, and chemicals are added to water used for hydrofracturing to extract gas. Wastewaters may also contain brine and other contaminants such as radioactive radon released from the underground rock formation. The chemicals used in hydrofracturing may include oils, gels, acids, alcohols, and various manufactured organic chemicals. Therefore, the storage, treatment, and return of these waste fluids to the environment are water quality concerns.

The 2005 federal Energy Policy Act excluded fracking from the definition of "underground injection," as covered by the Safe Drinking Water Act. This portion of the act protects belowground drinking water from contamination by underground injection. Thus, regulation of fracking and fracking fluids falls to the states, which in many cases have fewer resources than the U.S. Environmental Protection Agency. There is ongoing discussion among some federal policy makers and stakeholders about the appropriate roles of the federal and state governments in regulating the environmental impacts of fracking and related issues. Several changes to federal laws were proposed in spring 2009.

Fracking fluids must be treated appropriately before disposal. SRBC and DRBC require disclosure to them of the chemicals used in well development, although the exact ratios are proprietary.

Some Marcellus wastewater has been disposed of via deep underground injection wells. Pennsylvania has only eight brine disposal wells, and they have little remaining capacity to accept additional wastewater. West Virginia has 74 brine disposal wells and New York State has 6, but transporting water out of a river basin for disposal vastly complicates the permitting process. For Pennsylvania, the U.S. Environmental Protection Agency oversees underground injection wells, whereas PA DEP oversees all other aspects of wastewater treatment and disposal in the state. This split jurisdiction makes for confusion and complexity when problems arise, such as happened with the Dunkard Creek fish kill in 2009. See "Issue 4: Aquatic Invasive Species" (page 22) for more information.

State and regional agencies were forced in 2008 and 2009 to play catch-up with the fast-moving industry after a number of water-related Marcellus shale drilling incidents.

- Several streams in Pennsylvania were dewatered for drilling and/or fracking.
- DEP fined Cabot Oil and Gas Corp. $56,650 for three spills totaling 8,000 gallons of a chemical used in the fracking process within one week in Susquehanna County.
- Methane gas migration from Marcellus drilling in Dimock, Pa., caused several private drinking water wells to explode and fouled nine other wells. DEP says that for at least three Dimock wells, Cabot Oil and Gas Corp. appears to have improperly sealed off the aquifer during the early stages of drilling. In December 2010 strengthened regulations governing the casing (lining to protect groundwater and allow the safe operation of the well) of Marcellus shale wells to protect groundwater were in the final stages of approval. This is not a new issue for well drilling in Pennsylvania, but it is new for Dimock and some other regions seeing Marcellus development.
- Total dissolved solids (TDS) concentrations nearly double the state and federal recommended level were measured in the Monongahela River in southwest Pennsylvania in 2008. A number of municipal sewage treatment plants on the river had been accepting drilling wastewater for treatment. Pennsylvania DEP ordered them to reduce their acceptance of this wastewater to only 1 percent of their daily flow until levels of total dissolved solids fell below the recommended level. A study by a consultant for the mining industry later determined that lower-than-average flows were to blame for the high TDS. In 2010, DEP finalized rules to establish new water quality effluent standards that will affect treatment and disposal of Marcellus shale extraction and other industrial wastewater discharges with high TDS. These regulations took effect in January 2011.

Existing permit requirements may be further modified to keep pace with changing conditions and challenges.

The appropriate treatment and disposal of fracking fluids is a major challenge to development of gas from the Marcellus shale, although drillers are now reusing more of the water for multiple frack jobs. This is an area of intense research. See the "Resources" section at the end of this brief for ways to stay informed.

Summary: Implications of Shale Gas Drilling for River Basin Commissions

The Marcellus shale overlaps a number of watersheds in the Mid-Atlantic and Northeast regions, raising the challenge that cooperation among various levels of governments is needed on the scale of a geological resource instead of a water resource. The issue reminds us that water management issues can develop rapidly and change rapidly and require quick responses of river basin commissions and government agencies. River basin commissions have been on the front lines of this issue, creating and revising policy critical to existing water users and ecosystem integrity.

As long as the Marcellus shale play remains a possibility, energy development will be a driver for change in water resources management. The technologies used to extract this resource and to treat the resulting wastewater are changing rapidly and require diligent oversight.

Similar issues could arise elsewhere in the region. DRBC has had at least one inquiry about natural gas drilling in the Lockatong Formation in Bucks County, Pa., and replied that the rules currently applied to the Marcellus formation apply there as well. As of April 2010, four wells were being permitted in Maryland and many more in West Virginia.

Resources

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Issue 3: Climate Change Impacts

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Introduction

According to the Science and Technical Advisory Committee of the Chesapeake Bay Program (Pyke et al., 2008), the effects of global climate change in the Mid-Atlantic region are expected to include higher temperatures (by 2–5 degrees Fahrenheit by 2100); more precipitation, especially in winter, but more as rain than snow; more drought, with longer stretches between precipitation events; and more extreme weather events. Some water-related changes as follows are expected:

- sea-level rise leading to increased flooding and reduced natural water filtration capacity as tidal marshes recede;
- lower dissolved oxygen levels in the bay and larger "dead zones" (i.e., areas with very low dissolved oxygen);
- reductions in the prevalence of eelgrass, which is the principal underwater vegetation in the bay and is critical for food and shelter for many bay creatures;
- increased growth of harmful algae;
- possible changes to habitat conditions that favor warm-water fish and shellfish.

One possible problem caused by climate change is discussed in more detail below. Similar issues could develop at other locations in the region.

Salinity Intrusion in the Delaware Estuary

About one million people in Philadelphia get their drinking water from the Delaware River. If climate change raises sea levels, the 250 milligrams per liter salt line—a mixing zone between low salinity water moving south from the upper reaches of the Delaware River and higher salinity bay water—could move northward, potentially overtaking a major water intake for the city of Philadelphia. Because Philadelphia's drinking water treatment plant on the Delaware is a conventional facility, it is not capable of removing salt from the source water. Any salt present in the source water passes through the plant and distribution system to customers, which may pose unacceptable

health risks for sensitive dialysis patients and those on sodium-restricted diets. The water intakes also supply fresh water for innumerable industrial processes.

To address this problem, DRBC established a minimum flow target for the leading edge of tidal waters to prevent chloride concentrations from detrimentally affecting water supply to Philadelphia and nearby communities. But if this solution does not suffice, very expensive new water management adaptations, such as finding a new source or building the capacity to remove the salt, may be needed.

Resources

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Issue 4: Aquatic Invasive Species

Introduction: Aquatic Invasive Species in the News in the Mid-Atlantic States

Some aquatic invasive species have been around for a while. For instance, zebra mussels arrived in the Great Lakes area via ballast water dumped from freighters in the 1980s. They have been found in the main stem Susquehanna River. This species and other aquatic invasives continue to pose problems in interstate and international waterways.

More recently, two other aquatic invasives—golden algae and Asian carp—have been making news in the Mid-Atlantic region. Both case studies illustrate some common issues with management of aquatic invasive species that will continue to face interstate river basin commissions and similar entities. The most prominent issues are overlapping jurisdictions and how information is shared among agencies. Invasive species management involves choosing between complex potential economic and environmental costs and benefits.

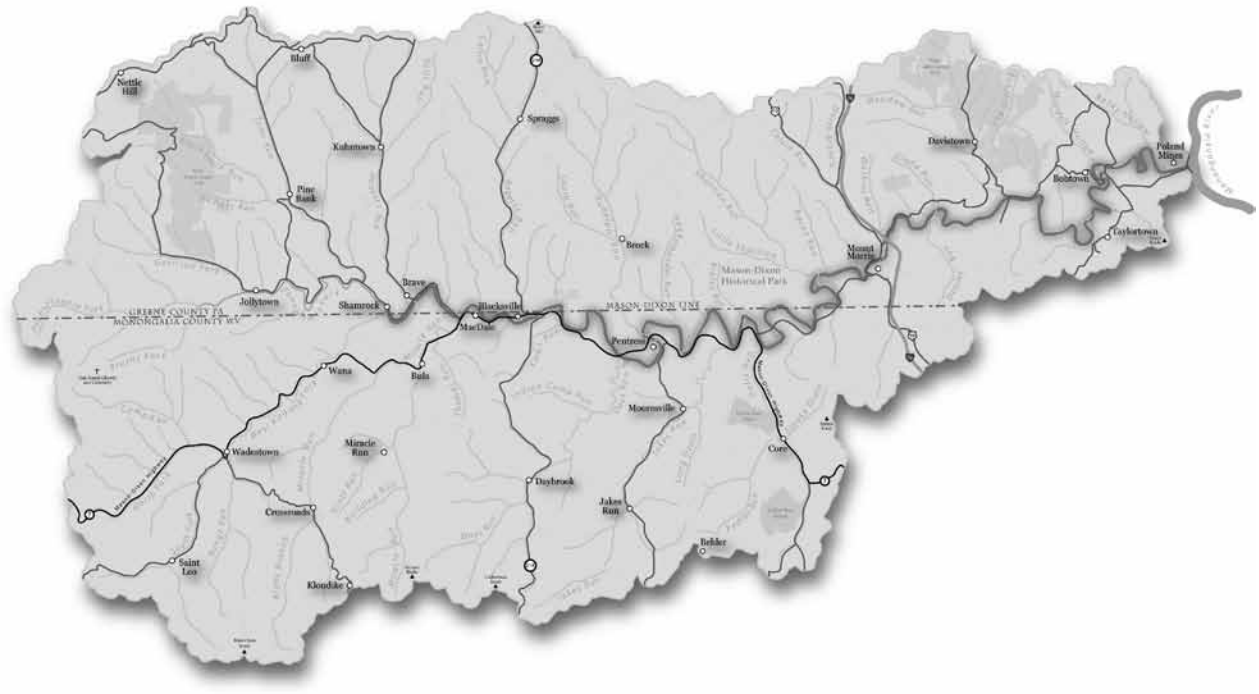
This case study presents two dramatic examples, but there are constant threats of species introduction. Most create small changes in an ecosystem that go unnoticed until critical mass is reached.

Golden Algae in Dunkard Creek—West Virginia and Pennsylvania

In September 2009 an estimated 161 aquatic species were lost in a 43-mile stretch of Dunkard Creek (Figure 4.1), located on the West Virginia–Pennsylvania border. Fish, salamanders, and mussels were affected. The U.S. Environmental Protection Agency (EPA) described the kill as "massive and, in terms of mussels, complete."

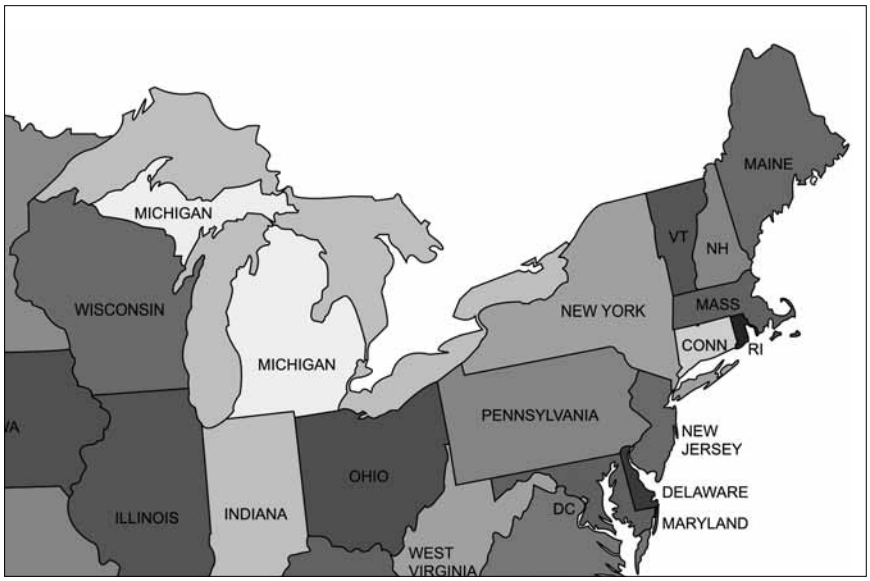
The causes of this water quality problem are multiple and complex. Experts believe that golden algae, *Prymnesium parvum*, normally found in southern coastal areas such as Texas, were able to thrive and produce toxins because the stream's water became extremely high in total dissolved solids (TDS) (including sulfate and chloride) due to industrial

Figure 4.1. Dunkard Creek, on the West Virginia–Pennsylvania border, was the site of a massive fishkill in 2009.



Dunkard Creek Watershed Association, dunkardcreek.org/dunk_new.html

Figure 4.2. Great Lakes region.
Pennsylvania is part of both the Great Lakes and the Mid-Atlantic region.



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(coal, oil, and gas) or other wastewater discharges. Low flows, possibly exacerbated by water withdrawals by gas drilling companies, concentrated the TDS. The Pennsylvania Fish and Boat Commission in October 2009 asked the state attorney general to conduct a criminal investigation of the fish kill.

Conclusive evidence indicates that *Prymnesium parvum* was the mechanism that killed the fish and aquatic life, but it is not known how the invasive salt-loving algae came to the creek. One hypothesis is that the algae "hitchhiked" on gas well drilling equipment.

Several challenges exist for managing the situation:

- Dunkard Creek crosses the West Virginia–Pennsylvania border 23 times (see Figure 4.1).
- Multiple federal, state, and local agencies have some jurisdiction in the area, so duplication of effort, information sharing, and overall leadership may be issues.
- During difficult economic times, there is pressure not to harm existing job-producing industries, such as coal, or hinder development of a relatively new industry, Marcellus shale gas extraction, that could help drive economic recovery from the recent recession.

The problems presented by golden algae are probably here to stay. Since the Dunkard Creek kill, golden algae have been detected in at least five other streams in West Virginia. Once established, it is difficult to eradicate. Controlling TDS levels on the affected streams is the best solution for controlling theseblooms.

Asian Carp in the Great Lakes

Bighead and silver Asian carp came to the Great Lakes area (Figure 4.2) in the 1970s via catfish farmers who imported them to help keep their ponds clean. Some of the carp were released into waterways of the Mississippi River basin during large floods in the early 1990s. Since then they have steadily worked their way north on the Mississippi toward the Great Lakes. They are now found in the Illinois River, which connects the Mississippi to Lake Michigan.

The carps' large size (up to 4 feet long and 100 pounds) and prolific reproduction make them a threat to the Great Lakes ecosystem. They could alter the lakes' food chain by consuming up to 40 percent of their body weight per day in plankton, which is an important food source for other native organisms.

To prevent their spread into the Great Lakes, several federal and international agencies—the U.S. Army Corps of Engineers, U.S. EPA, the State of Illinois, the International Joint Commission, the Great Lakes Fishery Commission, and the U.S. Fish and Wildlife Service—cooperate to maintain existing electric barriers to Lake Michigan and propose to install more.

In December 2009 Michigan filed suit in U.S. Supreme Court against Illinois, the U.S. Army Corps

of Engineers, and the Metropolitan Water Reclamation District of Greater Chicago to force temporary and permanent closure of shipping locks that could allow invasion of Asian carp into the Great Lakes. Michigan argues that the $7 billion Great Lakes fishery is at stake. Critics of the suit say that closing the locks connecting the Mississippi River and the Great Lakes would devastate the region's shipping economy and possibly flood thousands of homes. Wisconsin, Minnesota, New York, Ohio, and the Canadian province of Ontario have filed briefs in support of Michigan's case.

In January 2010 the U.S. Supreme Court denied Michigan's request to close the locks. In March 2010 the court again rejected Michigan's request for an injunction to temporarily close the locks. The U.S. Army Corps of Engineers is studying the issue to determine if the locks should be closed, and on what timetable.

In February 2010 federal officials proposed a $78.5 million plan to keep carp out of the Great Lakes. The plan would include ramped-up searches for carp in Lake Michigan, new barriers to prevent the fishes' spread via flooding, and a third electric barrier.

By January 2010 genetic material from Asian carp had twice been found beyond an electric barrier into Lake Michigan. So it may already be too late to prevent damage from occurring in the Great Lakes ecosystem.

In December 2010 a federal judge again denied a preliminary injunction that would have temporarily closed a key lock and dam protecting Lake Michigan.

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Issue 5: Improving Water Quality in Chesapeake Bay

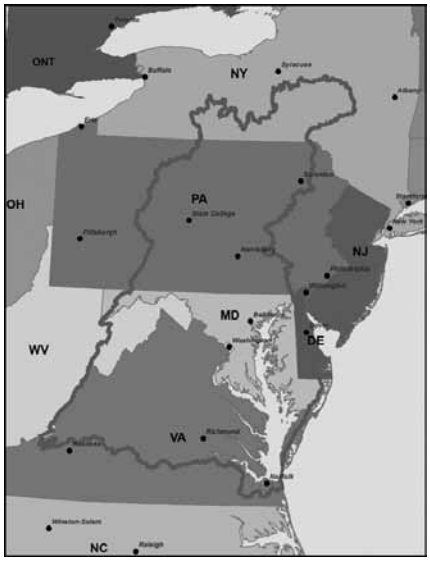
Introduction

Chesapeake Bay is the nation's largest estuary—a place where freshwater and saltwater mix—and the third largest in the world. The vast watershed (Figure 5.1) covers 64,000 square miles of the East Coast, stretching from central New York to southern Virginia, from the West Virginia panhandle to the Delmarva Peninsula.

Many factors heighten the political importance of the bay on a national scale. Nearly 17 million people live in the bay watershed. The bay supports a strong history and cultural identity of fishing and crabbing. Chesapeake Bay serves as the outdoor recreation and tourism hub of the national capital region. The Chesapeake Bay Watershed Blue Ribbon Finance Panel in 2004 estimated the bay's total economic value at about $1 trillion per year.

In January 2009, the Washington Post ran an editorial calling bay cleanup efforts a failure. To some, this editorial helped to reframe the discussion about efforts to improve the bay by suggesting that a new and perhaps dramatic shift in direction was needed in the government's approach to the cleanup. Monitoring data show that even after decades of cleanup efforts Chesapeake Bay has poor water quality, degraded habitats, and low populations of many species of fish and shellfish. The bay and its rivers are overenriched with nitrogen, phosphorus, and sediment from agricultural operations, urban and suburban runoff, wastewater, airborne contaminants, and other sources. Acknowledgment of these facts in the media led to a call for greater accountability and monitoring and increased ongoing evaluation.

Figure 5.1. Chesapeake Bay watershed.



wikipedia.org

A Federally Mandated TMDL to Clean Up Chesapeake Bay

Federally driven efforts to reduce pollution to the bay have recently received more attention and priority. On May 12, 2009, President Obama issued Executive Order 13508 on Chesapeake Bay Protection and Restoration. The purpose of the Executive Order is "to protect and restore health, heritage, natural resources, and social and economic value of the nation's largest estuarine ecosystem and the natural sustainability of its watershed." It establishes the Federal Leadership Committee for the Chesapeake Bay, chaired by the Administrator of the U.S. Environmental Protection Agency (EPA), and including the departments of Agriculture, Commerce, Defense, Homeland Security, Interior, and Transportation. All of these federal agencies are charged with coordinating efforts, along with appropriate state agencies, to clean up the bay.

At the same time, the EPA is under "court ordered" consent decrees with Virginia and the District of Columbia to finalize a Bay TMDL (total maximum daily load) by May 1, 2011. EPA and the states agreed in 2008 to work toward an accelerated completion date to develop the TMDL by December 2010. EPA released a draft TMDL for the bay watershed in late September 2010. EPA worked with its state partners to set restrictions on nutrient (nitrogen and phosphorus) and sediment pollution through the TMDL, a regulatory tool of the federal Clean Water Act that will be backed by a series of accountability measures to ensure that cleanup commitments are met. This process has been referred to as a "pollution diet."

All of the state Watershed Implementation Plans (WIPs), indicating how they will accomplish their share of the pollution reductions needed for the bay to be healthy, were finalized in December 2010. State WIPs specify intended reductions from "point sources," such as sewage treatment plants, urban storm water systems, and large animal feeding operations, and

"nonpoint sources," such as polluted rainfall runoff from agricultural lands and hard surfaces. The WIPs will be supported by a series of two-year milestones for achieving specific near-term pollution reduction actions and targets needed to keep pace with the commitments.

The state watershed implementation plans were combined to establish the final EPA Chesapeake Bay TMDL in December 2010. States will potentially face unspecified federal consequences if they do not achieve certain TMDL requirements. Examples of possible consequences that EPA could impose include more stringent pollution reductions on regulated point sources such as wastewater, storm water, or concentrated animal feeding operations; objecting to state-issued NPDES (National Pollutant Discharge Elimination System) permits; limitations or prohibitions on new or expanded discharges; and withholding or reallocating federal grants.

Some believe that the TMDL will generate uneven costs and benefits for the upper versus lower bay states and for the agricultural versus industrial/municipal sectors, which presents challenges in solving the problem. Much of the new strategy will have to focus on cleaning up urban and suburban stormwater nonpoint sources—the only sector of pollution to the bay that is actually increasing. These sources tend to be more difficult and costly to quantify and remediate than point source discharges into a waterway from a pipe. Agriculture will continue to be a focus of remediation efforts because it is the largest source sector of nutrient pollution to the bay and the most cost-effective to address. Some people in the upper parts of the basin may feel that their areas are being targeted for action and enforcement, but they worry that most of the benefits of cleaner water will be felt further downstream.

Because the Chesapeake Bay Program is now in the forefront of a large watershed–scale approach to TMDL development and implementation, water quality decision makers in other watersheds and regions with major unresolved water quality problems may closely watch the program's progress.

Adapted from an article by Jim Clark, Extension Educator, McKean County, Pennsylvania. Penn State Extension. *Water Currents.* Winter 2010.
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