Commonwealth of Pennsylvania

STATEWIDE WATER
RESOURCES COMMITTEE

DEPARTMENT OF
ENVIRONMENTAL PROTECTION

Dear Reader:

As Chairperson of the Statewide Water Resources Committee and Acting Secretary of the Department of Environmental Protection (DEP), we are pleased to present you with the Pennsylvania State Water Plan (Plan). The Plan is the culmination of more than five years of data gathering, analysis and research, and we believe that the Plan will prove to be a meaningful and useful tool that will benefit each and every Pennsylvanian.

We would like to take this opportunity to express our gratitude to the 169 members of the Statewide and Regional Water Resources Committees who graciously volunteered their time to oversee and participate in this process. Their input and expertise were invaluable to the development of the Plan, and we look forward to continuing working with them into the future.

Following is the State Water Plan Principles which highlights the State Water Plan Priorities and Recommendations for Action, key components of the Plan that will carry us into the next five years and lay the groundwork for future versions of the Plan. The Plan in its entirety is also available on DEP's worldwide Web site to further engage the public and provide the resources needed for anyone to make informed decisions about water resources management. By providing improved information to make more informed decisions, we can continue to make the commonwealth a great place to live, work and recreate, and still be surrounded by beautiful natural resources.

Sincerely,

Donald C. Bluedorn II
Chair
Statewide Water Resources Committee

Sincerely,

John Hanger
Acting Secretary
Department of Environmental Protection

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# A VISION FOR PENNSYLVANIA'S FUTURE

Pennsylvania has abundant and magnificent water resources. These resources should provide the basis for an exceptional quality of life for Pennsylvania's residents, an opportunity for outdoor enthusiasts, an attraction for visitors, unparalleled natural beauty, thriving ecosystems, agriculture prominence and economic prosperity throughout the commonwealth. All those with an interest in Pennsylvania have a stake in the use, enhancement and stewardship of the state's water resources. Indeed, the Pennsylvania Constitution vests a right to pure water and the values of the natural environment in all Pennsylvanians, and imposes a duty to conserve and to maintain public natural resources for this generation and generations yet to come.

To achieve this vision, the *State Water Plan* will offer tools and guidance for all those who make decisions that affect the commonwealth's water resources or who make decisions based upon the availability of water of adequate quantity and quality. The plan should be useful to those who wish to locate and to design their projects so that the availability of water resources does not constrain them; those who wish to preserve high environmental quality where it exists and to achieve it where it does not; local governments with planning, conservation and economic development responsibilities; and commonwealth and interstate compact agencies. This plan should serve their needs by providing a qualitative and quantitative description of water resources in Pennsylvania based upon accurate, transparent and readily accessible data and guidance on the use of that description and those data in the decisions that face the plan's users. The plan is a starting point for considering the opportunities available to Pennsylvanians for managing the state's water resources to achieve our vision for the commonwealth.

# PREFACE

This *State Water Plan* replaces an outdated plan that was developed over an eight year period that ended in 1983. Although well-documented and presented, that effort eventually became irrelevant with the passage of time. The obsolescence of the current *State Water Plan* led the Department of Environmental Protection (DEP) to conduct a series of 16 water forums in the spring of 2001 that enabled people from all corners of the commonwealth to discuss water resource needs and priorities. The forums not only helped DEP set its strategic water resources management agenda, but they also generated grass roots support for legislation to require adoption of a new *State Water Plan*.

The Water Resources Planning Act signed into law on December 16, 2002, established a Statewide Water Resources Committee and six Regional Water Resources Committees that are collectively comprised of 169 members. The committees are charged with guiding DEP in the development of and approving and recommending approval to the secretary, a new *State Water Plan*. The Act stipulates that the plan be completed and adopted within five years of the effective date of the legislation and be updated every five years thereafter.

This plan seeks answers to the following questions: How much water do we have? How much water do we use? How much water do we need? As a functional planning tool, this updated water plan provides Pennsylvanians with a vision, goals and recommendations for meeting the challenges of sustainable water use over a 15 year planning horizon. The plan consists of inventories of water availability, an assessment of current and future water use demands and trends, assessments of resource management alternatives and proposed methods of implementing recommended actions. It also analyzes problems and needs associated with specific water resource usage such as navigation, stormwater management and flood control.

This is not a typical stagnant plan that will become outdated the day after it is finalized. It is a dynamic plan that will continue to evolve and remain relevant. Federal, interstate, state and local governments, as well as non-governmental organizations, water utilities and water end-users will all play major roles in implementing and constantly improving this plan. Actions taken to implement the recommendations of this plan, and steps taken to update the plan will be documented and be instantly accessible through DEP's worldwide web site. This process will directly engage the public by seeking opinions and priorities that will guide the committees and DEP in developing statewide priorities, and in exploring issues and trends as they emerge.

Pennsylvania has plentiful and accessible water resources that have shaped history and will define the future. Although water is a renewable resource, it is also a finite resource; and it is not always located where it is needed. If the right choices and investments are made, wise water resource management can safeguard public health, boost economic growth, encourage business vitality, sustain agricultural production and restore and protect Pennsylvania's watersheds and unique natural ecology.

# NATURAL RESOURCES PROTECTION

Protecting and enhancing Pennsylvania's water resources is the overarching theme that resonates throughout this plan. Pennsylvania has over 86,000 miles of streams and rivers, 161,455 acres of lakes, and is underlain by enough groundwater, if it were brought to the surface, to submerge the entire state beneath eight feet of water. Pennsylvania also holds 63 miles of Lake Erie shoreline, 17 square miles of Delaware Estuary, 512 acres of tidal wetlands and 403,924 acres of freshwater wetlands[1]. These waters and wetlands are home to over 1200 kinds of insects and other invertebrates, 30 species of amphibians, 19 species of reptiles and 221 known species of fishes. These formidable water resources support a vigorous economy, productive farms, numerous water-dependent recreational activities and the daily needs of nearly twelve and a half million Pennsylvanians. Such wide varieties of uses inevitably generate competition and sometimes create conflict among water users. The fundamental intent of this plan is to identify and recommend strategies to avoid and resolve such conflict, and to ensure that water demands are met in a sustainable manner while providing natural resource protection.

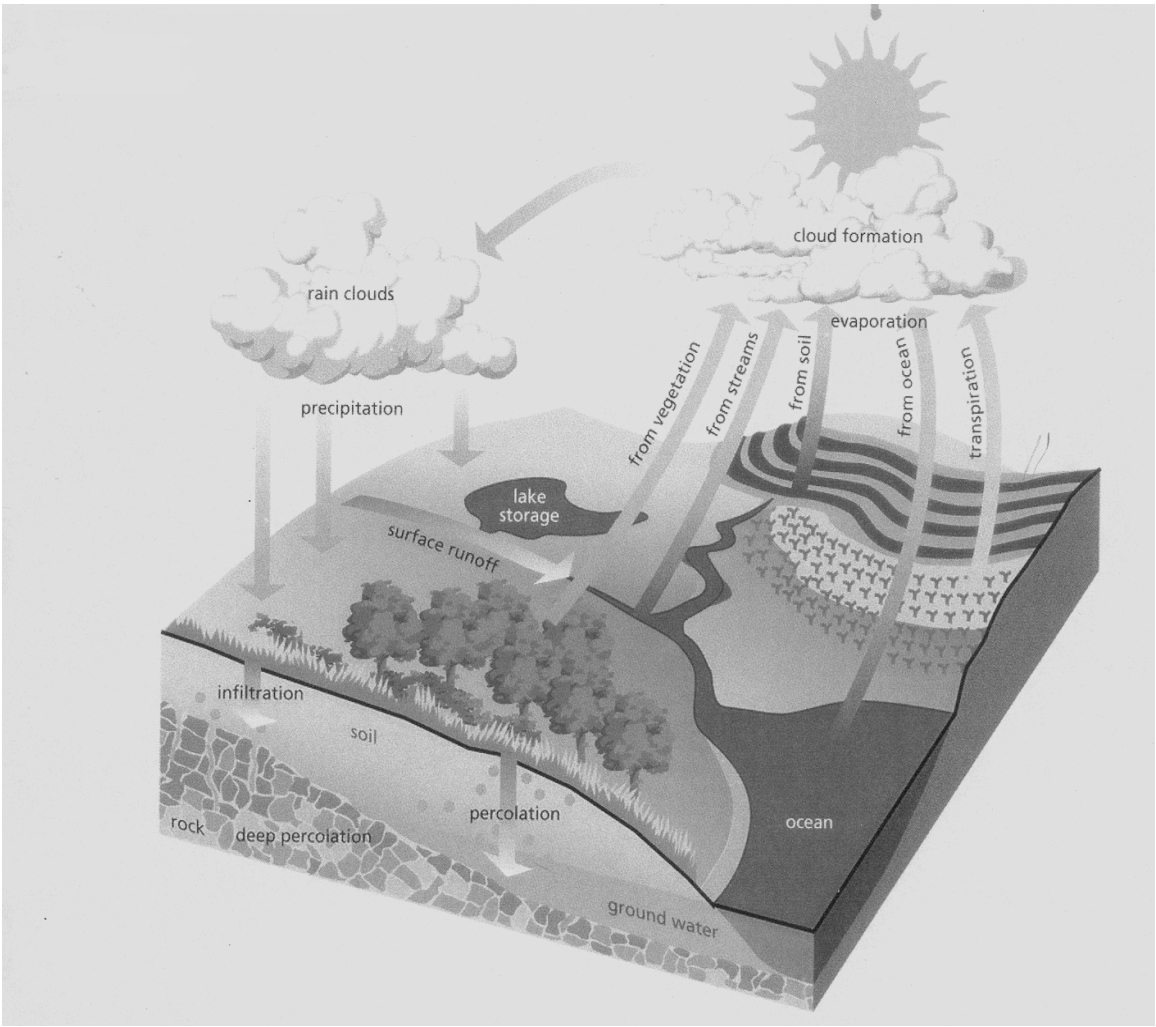
The opening statement of this *State Water Plan* entitled "A Vision for Pennsylvania's Future," emphasizes stewardship of the state's water resources and references the state constitution as vesting a right to pure water and the values of the natural environment in all Pennsylvanians. The Water Resources Planning Act[2] reinforces this principle by requiring the *State Water Plan* to consider "the water quantity and quality necessary to support reasonable and beneficial uses" including protection of fish and wildlife habitat and the aquatic environment. The Clean Streams Law[3], the federal Clean Water Act, [4]and compact basin commission regulations provide the prime legal support necessary to back the plan's prevailing dedication to resource protection.

The three principal statewide priorities guiding this plan are mainly directed toward natural resource protection. The priority that endorses integrated water resources management, in particular, solidifies this commitment. Integrated water resources management recognizes the critical links among water quality and quantity, surface and ground water and land use and water resource management. Each of the six Regional Water Resources Committees has also established priorities designed to protect Pennsylvania's abundant and diverse environmental resources. Specific regional priorities include protecting the quantity and quality of the water in Lake Erie, maintaining regional hydrologic integrity, reclaiming waters impaired by drainage from abandoned mines, connecting land use decisions and water resources management, protecting "at risk" waters, protecting important headwater habitats and initiating land use programs that protect water quality and quantity and preserve the ecological integrity of ground and surface water. In addition, one of the major outcomes of the state water planning process will be to identify Critical Water Planning Areas -- areas where existing or future demands exceed or threaten to exceed the safe yield of the available water resources. An essential step in this process is determining whether in-stream aquatic resource requirements can be sustained in the watershed.

This plan also includes numerous recommendations for action under the general topics of Integrated Water Resources Management, Navigation Needs and Improving Water Transportation, Stormwater Management and Flood Control, Water Quality, Water Withdrawal and Use and Water Conservation and Efficiency. A majority of those recommendations were made to assure that Pennsylvania's surface and ground water and

[1] *2008 Pennsylvania Integrated Water Quality Monitoring and Assessment Report*, April 2008
[2] 27 Pa.C.S. §3101 et seq.
[3] 35 PS §691.1 et seq.
[4] 33 U.S.C. §1251 et seq.

riparian resources continue to be protected, Emphasizing natural resources protection as one of the key themes for this plan provides clear and plain direction that forms a firm base for water resources planning. This principle also sets the stage for sound decision-making and sustainable actions in the future. As water restored and enhanced.
use demands evolve in response to ever changing conditions, the natural resources protection premise will remain a familiar benchmark that will help define appropriate courses of action set to avoid or resolve major problems and conflicts as they arise.



# WATER USE TRENDS – TOMORROW'S FORECAST

## Introduction

Water resources planning and management strategies draw heavily on the past to assess the present and predict the future. Historic information is routinely used to forecast floods, assess water availability, control stormwater runoff, manage droughts and protect the aquatic environment. The practice of looking in the rear view mirror to steer forward, however, may be coming to an end. Climate change and varying water use demands may soon cause current assumptions and models to become outdated and inaccurate. Consistent with one of the top priorities of this *State Water Plan*, data collection, interpretation and analysis will be essential to identifying and tracking water resource trends as they become evident. In response, a new generation of models, projections, planning guidelines, design parameters and management policies may need to be developed that are adaptable to dynamic conditions and capable of providing a clear picture of the future.

Pennsylvanians withdraw about 9.7 billion gallons of water every day from a variety of surface and ground water sources. The thermal electric power industry is responsible for approximately 70% of those withdrawals. Public water supplies make up about 15% of statewide water use while industries use roughly 12%. Mining and agriculture account for close to 2% and 1% of water use, respectively. These current water use patterns will continuously evolve. Population shifts, energy demands, farming practices, infrastructure management, consumer sophistication, national and international policies and climate change will all influence how water resources are managed over the next several decades. While acknowledging this considerable uncertainty, the future of water resources planning and management in Pennsylvania can be examined in general terms by considering a number of related assessments and relevant emerging trends. These topics are briefly addressed below with the intent of raising awareness and stimulating further discussion about their potential long term influence on water use, watershed protection, water resources planning and water management.

## Domestic Water Supply

Pennsylvania's population is nearing 12,500,000 and ranks sixth in the country, but it increased only about 1.2% over the period spanning 2000 to 2006. This slight population growth has not been uniform, but has been accompanied by a geographic population shift. Thirty-eight counties in the northern tier and western regions of Pennsylvania are losing population. Most urban centers, including Philadelphia and Pittsburgh, are also losing residents. Conversely, population in the south-central, eastern and northeastern counties is growing, due primarily to border state migration and suburban relocation. Pike and Monroe counties experienced population growths of over 25% and 19% respectively during the six year period. Chester County's population increased by over 48,000 and York County gained nearly 34,600 residents. Berks, Bucks, Montgomery and Monroe counties all had population increases of over 25,000 while Lancaster, Lehigh and Northampton counties each saw their populations expand by over 20,000 residents. These trends are expected to continue, but an even greater population shift is looming if drought conditions in the western United States persist as predicted. The National Oceanic and Atmospheric Administration has recently conducted simulations that show Colorado River flows, by mid-century, falling to about half the amount consumed today from the river[5]. If these predictions are realized, the water rich northeastern and Great Lakes states could experience a wave of immigration from some portion of the 30 million western sunbelt residents currently relying on the Colorado River for water.

[5] Kunzig, Robert. "Drying of the West." National Geographic, February 2008.

Disproportionate population growth translates into an uneven geographic demand for water that will test the adaptive capability of public water supplies. Although per capita water use is expected to remain stable or decline, the customer base for many established water systems will likely contract while overall demand for domestic water will increase in the growing areas of the commonwealth. To accommodate this redistribution of population, public water supply systems in and around densely populated urban centers will likely continue to consolidate. Institutional arrangements enabling common management of separate water systems to ensure optimum service and rates may also become more widespread. In addition, individual local water supplies will need to be developed or expanded to meet the extra service requirements created by people moving into suburban and rural settings. Protecting the quantity and quality of source waters tapped to address these added demands becomes a higher priority as relocation continues to dominate development patterns.

Increasingly sensitive instrumentation and analytical methods have recently revealed the presence of extremely low levels of unwanted substances in drinking water, including an array of pharmaceuticals and numerous toxic chemicals. The long term impact of those compounds on public health and the aquatic environment is generally unknown. Continued monitoring and research are necessary to understand the magnitude and extent of this issue and to guide how these implications may need to be addressed through water resource management.

## Energy Needs

Projections indicate that energy consumption in the United States will continue to grow in the coming decades. The expansion rate and types of new energy sources employed to meet these additional demands will be major factors in determining future water use in the commonwealth.

Pennsylvania's wealth of natural resources and infrastructure positions it to play a central role in meeting future national energy demands. The commonwealth is literally a "keystone" of electric generation and transmission and is directly affected by energy needs beyond its borders. It possesses an efficient power distribution network that is part of an energy grid spanning all or parts of 13 other states and the District of Columbia. In addition to serving all of its own energy needs, Pennsylvania exports approximately $5.0 billion in electricity each year[6].

In 2004, Pennsylvania enacted the Alternative Energy Portfolio Standards Act[7] that requires 18% of the commonwealth's retail electricity to be generated from alternative sources within 15 years. In addition, Gov. Rendell released an energy independence strategy in 2007 designed to produce enough homegrown fuel to replace the current level of foreign imports. In July 2008, legislation was passed that supports these goals by establishing a new $650 million fund to expedite research and development of alternative and renewable energy projects, and to subsidize energy conservation and efficiency projects initiated by individuals and small businesses. By reducing energy use and relying more on alternative energy sources such as wind, solar and hydroelectric power, a parallel reduction in water use may be realized over power generated in thermal electric plants.

As previously noted, the thermal electric generation sector currently dominates water use in the commonwealth. In the Susquehanna River Basin alone, there are eight fossil-fueled and three nuclear power plants that withdraw over 4.2 billion gallons of water per day and consume approximately 168 million gallons per day[8]. Based on anticipated growth in electric energy demand, projections show that as many as 15 new major power generation facilities will be needed in Pennsylvania by 2020. Increased energy production could stimulate greater water use and water consumption for raw mineral extraction, process water use and cooling water needs. Given the impingement and entrainment requirements of §316(b) of the

[6] Estimated from Energy Information Administration data by applying the average retail sales price (8.68cents/Kwh) to net 2006 exports.
[7] 73 P.S. §1648.1 et seq.
[8] Draft Comprehensive Plan for the Management & Development of the Water Resources of the Susquehanna River Basin, February 2008.

federal Clean Water Act[9], instead of the "once through" cooling systems once prevalent, new facilities may be expected to recycle cooling water, thereby lowering withdrawal quantities but increasing water consumption through evaporation. These new units will need to be carefully sited so that the low flow regimes of their water sources are not adversely influenced. Similar water recycling requirements are being implemented at existing power generation facilities that will further reduce withdrawal needs while appreciably increasing water consumption. The cumulative outcome of these modifications in water usage has not been critically evaluated but will undoubtedly be important to future water use trends and water resource protection policies.

Estimates have placed Pennsylvania's known coal reserves at 72 billion tons, which if liquefied would be equivalent to about 40 years of current national imports of petroleum products[10]. Protecting the quality and quantity of water in the areas overlying these reserves will play a major role in planning for their extraction and use.

Pennsylvania is also a significant producer of natural gas, and it is believed that even more extensive reserves are contained in the Marcellus Shale formation which underlies a substantial portion of western, north-central and northeastern Pennsylvania. Recent estimates have placed the Marcellus Shale natural gas reservoir at upwards of 500 trillion cubic feet, about 17 times the current annual production of the entire country. The hydrofracture stimulation technique used to develop the Marcellus Shale reserves generally requires 1-3 million gallons of water for each well, drawn over approximately 30 days. Of these amounts, 50% would be consumed (i.e., injected, but not returned) while the remaining wastewater would be treated and discharged at the site or taken to a remote facility. In some areas, off-site treatment options may be limited by a shortage of available capacity. As with all potentially significant water uses, water sources used in this process must be carefully selected and operated to avoid dewatering smaller streams and disrupting aquatic communities. In addition, the wastewaters associated with natural gas extraction and the alternatives for wastewater reuse, treatment and disposition, and the impact on the assimilative capacity of receiving streams should be closely evaluated.

The commonwealth's Energy Independence Strategy advocates developing alternative energy technology, including biofuels production facilities.[11] Legislation signed in July 2008 also will help spur the production of home grown fuels by establishing new requirements for the percentage of ethanol and biodiesel that must be in gasoline and diesel fuel. Pennsylvania's first ethanol production plants, located in Clearfield and Lancaster counties, are expected to be operational in 2010 or early 2011. These facilities will be fueled predominately by corn, and to a lesser extent, by cellulosic sources such as switch grass and wood pulp. Biodiesel production facilities mix animal fats or vegetable oils with petroleum-based diesel to produce blended diesel and home heating products. Biodiesel producers are currently located in Erie, Cumberland, Adams, York and Allegheny counties. One of the primary raw materials needed to produce biodiesel fuel is soybean oil that can be extracted from locally grown crops. Biofuel production facilities use a significant amount of water in the manufacturing process and create large incremental water demands where they are located. The agricultural production of feedstocks, such as corn and soybeans, to support biofuels may also lead to an incremental increase in agricultural water use if irrigation becomes more common to increase crop yields. Exact water use estimates for the biofuels production cycle are still in development, but clearly this element of the energy field promises to be a significant water use factor for consideration going forward.

## Agricultural Water Use

Pennsylvania's 58,000 farms are responsible for an estimated 1% of total water withdrawals, much of which is consumed. Lancaster County irrigates the most farmland, followed by Franklin and Adams counties while the largest

[9] 33 U.S.C. §1326.
[10] The Pennsylvania Energy Development Plan, April 2006 Draft.
[11] News release, Office of the Governor, February 1, 2007.

percentage of farmland is irrigated in Schuylkill and Erie counties at just over 2%[12].

Estimates indicate that Lancaster, Franklin and Lebanon counties use the most water to support livestock operations. Statewide, water use by livestock producers is projected to rise slightly over the next 20 years[13] due to an increased market and further concentration of livestock agriculture operations.

As global demands for food and fiber production increase and the value of various crops (such as corn) fluctuate with economic conditions, irrigation requirements and associated consumptive uses of water can be expected to rise. The escalating demand for corn and soybeans to be used as raw material for ethanol and biofuels facilities, along with a mounting worldwide market for grain, could also drive the value of cropland higher. If cropland value increases appreciably, pressure may build to place unused agricultural land into production. This could cause Pennsylvania to follow the developing national movement toward pulling farmland from conservation reserve programs and putting it into productive use. A substantial reduction in conservation reserve land area could lead to additional consumption of water for agricultural use, loss of established vegetative buffers along streams and reductions in wildlife habitat.

Climate change, growth and land development may directly influence agricultural water use as well. Climate variability and loss of productive land to development could intensify the demand for irrigated crop lands and eventually even change the present types of local crops grown to those requiring more routine irrigation. Rising temperatures could also result in additional water use by livestock operations. Continued land development will not only reduce land area available for food production but may also encourage a demand for landscape nurseries and their need for irrigation water. Monitoring agricultural water use and consumption over the coming years and decades will remain a priority. The outcome of this effort should be incorporated into the commonwealth's water resources planning, management and protection policies.

## Climate Change

This *State Water Plan* does not directly assess global climate change nor does it recommend specific actions to stabilize rising worldwide temperatures. However, climate change issues, and particularly the consequences of projected climate change on Pennsylvania's water resources, are factors that must be weighed in the overall water planning process.

In November 2007, the Intergovernmental Panel on Climate Change (IPCC) released its *Fourth Assessment Report*[14], stating that "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting in snow and ice and rising global average sea levels". A continuation of these trends would trigger increases in the frequency and severity of storms, floods, droughts and heat waves around the world.

Climate change is a global issue but most of its impacts will be experienced at the local to regional scale as world-wide changes in temperature and atmospheric dynamics interact with the characteristic features of each region. Although an extensive amount of research and global modeling has been conducted on climate change, only limited model simulations have been developed to assess potential climate impacts in specific regions, and in turn to evaluate the specific challenges climate change may pose to managing water resources, water supplies, water use, flooding and stormwater management and other water related concerns.

One such initial regional modeling effort is reflected in the *Northeast Climate Change Assessment Study* published in 2006, and ongoing research by authors of that study.[15]

[12] U.S. Department of Agriculture, 2004.
[13] Jarrett and Roudsari, 2007.

[14] Intergovernmental Panel on Climate change, *Climate Change 2007: Synthesis Report*, 12-17 Nov. 2007:30.
[15] Hayhoe, K., C. Wake, T. Huntington, L. Luo, M. D. Schwartz, J. Sheffield, E. F. Wood, B. Anderson, J. Bradbury, A. DeGaetano, T. J. Troy, and D. Wolfe, *Past and Future Changes in Climate and Hydrological Indicators in the U.S. Northeast,* CLIMATE DYNAMICS, 10.1007/s00382-006-0187-8 (2006).

Some of the conclusions of that initial modeling suggest that the future climate of the northeastern U.S. through the end of this century could include (1) winter temperature increases by an average of 1.6-4.8ºC; (2) summer temperature increases by an average of 2.4-4.8ºC; (3) a projected winter precipitation increase by an average of 11-14%, with small decreases in summer precipitation; (4) greater extremes in storm and drought events, with more concentrated, higher precipitation events, but also longer dry periods; and (5) fewer snow cover days and a smaller snowpack, with more precipitation falling in the form of rain, resulting in potentially less recharge to groundwater.

Sea level rise must also be considered. Due to anticipated global sea level rise and Mid-Atlantic subsidence, a 16-24 inch rise in the Delaware River Estuary by the end of the century has been projected. A sea level rise of this magnitude would physically damage existing water and wastewater infrastructure, and significantly alter water quality. Another major concern over rising sea levels is the potential for saline water reaching the Philadelphia drinking water intakes and the complexity and costs of potential mitigation options. If the *Northeast Climate Change Assessment Study* modeling results and rising sea level predictions are borne out, such changes would have important implications for future water planning and management across all of Pennsylvania. These repercussions affect the full range of water management considerations, from the design and operation of stormwater basins and mapping of floodplains, to the evaluation of the safe yield of stream sources and dependable recharge rates for aquifers. Water quality, as well as quantity, will be affected, as stream flow regimes affect pollutant assimilation and waterbody temperatures change and potentially affect such factors as dissolved oxygen concentrations. Most importantly, these models suggest that the traditional basis of almost all water planning (using historical data and patterns as a predictor of future conditions) must be reconsidered, and preparation for a more variable and unpredictable future hydrologic system should be made.

## Preparing for the Future

A plethora of water resource challenges, many of them unforeseen, will constantly test the abilities and patience of all Pennsylvanians. The three major priorities of this plan – data collection, water conservation and water resource innovation and integrated water resources management – form a stable foundation for water resources planning and management in the commonwealth. This *State Water Plan* is the initial step of a continuous process that will apply these priorities and strive to provide reliable and current guidance for recognizing and addressing water resource trends and needs as they materialize.

# STATE WATER PLAN PRIORITIES

## Principal Priorities

Pennsylvania must take an integrated approach to water resources management so that information can be collected that will aid the general public, and private and public sector interests, in making informed decisions about the quantity and quality of water available for domestic, industrial, agricultural, commercial and environmental uses. This requires recognition that land development, flooding, stormwater, wastewater, groundwater recharge, irrigation and water supply and withdrawals are elements of the same interconnected system. All water resources management decisions must respect these close relationships. Incentives and legislation may also be necessary to ensure that Pennsylvania has sufficient supplies of good quality water to meet the needs of its citizens and its businesses, and to promote a healthy environment. Three principle priorities emerge from this background to form a foundation for this *State Water Plan* that supports its vision for Pennsylvania's future.

First, the efforts initiated in the plan to collect, interpret and disseminate water resources information should continue into the future. Sound water resources management decisions cannot be made without ready access to reliable and current data. By maintaining up-to-date information about the quantity, quality and availability of water, as well as the demands for water, this plan will facilitate educated choices and will decrease the likelihood of conflicts arising among competing water users. Individuals, farmers, private enterprises, public regulators and economic development authorities need a continuous stream of fresh data available to them to meet their immediate needs and to guide formulation of their long-range objectives.

Second, an integrated approach to managing water resources should be encouraged and sustained. Pennsylvania has long regarded water resources as being separate and distinct from the surrounding environment. Regulatory, development, and market decisions about water withdrawals, wastewater discharges, stormwater management, flood control and mitigation, ground water recharge, irrigation and land use have routinely been made without regard for their effect on water resource ecology. Integrating these deeply interdependent water uses will significantly improve their sustainability. The commonwealth and local government must plan, regulate and oversee development so that these various water-related issues are considered in conjunction rather than in isolation. Similarly, it is imperative that the private sector use the information in this plan to examine all dimensions of an investment and give full consideration to projects with lower resource costs.

Third, the commonwealth should adopt policies that encourage technological advances designed to conserve and enhance water resources. Those new technologies could then be marketed to position Pennsylvania as a leader and exporter of water resources innovations. Pennsylvania is fortunate to have an abundance of water. Wise stewardship of those assets will guarantee ample water supplies for existing needs and contribute to an economically and environmentally robust future. Much of the United States and the world cannot make those claims. Businesses that can develop technology to conserve water, economically restore water quality, reduce water withdrawals, or minimize water quality degradation by any activity will improve health and enrich lives throughout the world while reaping significant financial rewards. Pennsylvania already has mature policies to promote alternative energy technologies and development. It should use those same concepts to advance innovative water resource conservation, protection and enhancement technologies for domestic use and for export to the international community.

## Regional Priorities

Each of Pennsylvania's major drainage basins has an array of individual characteristics that distinguish it from other regions of the state. These include diverse geographic and geologic

features as well as major differences in historical settlement, economic development and land use patterns. To reflect these variations, six Regional Water Resources Committees (Committees) were created by the Water Resources Planning Act to ensure that individual regional priorities were highlighted in the plan. The priorities and actions of the Committees influence not only local streams and rivers but also nationally prominent water bodies such as the Chesapeake Bay, the Delaware Bay, the Gulf of Mexico and the Great Lakes System.

The Committee members represent a wide range of interests in their region -- business and industry, agriculture, local government and the environment. While many water resources planning priorities are shared statewide, each Committee has identified additional concerns that are specific to its area. The top water resource management priorities as determined by the six Committees are presented below:

## Great Lakes

**Support legislation and other measures that will protect the quantity and quality of water in Lake Erie**

The Great Lakes form the largest surface freshwater system in the world. They hold the potential for massive water diversions to more arid parts of the United States or even to other water-poor countries across the globe, and they are equally attractive to industries that consume large volumes of water. Communities surrounding the Great Lakes' shores in both the United States and Canada are very much aware of these possible demands and seek to keep transfers, exports and consumption of Great Lakes water to a minimum.

Lake Erie is vitally important to the prosperity northwestern Pennsylvania. It serves regional domestic, commercial and industrial needs, supplies power generation, offers world-class recreational opportunities and provides transportation and trade access to the entire St. Lawrence Seaway. The Committee has determined that its leading priority is preserving the quantity and quality of water in this valued resource. Recognizing that protection of the entire Great Lakes system is crucial to protecting Lake Erie, close coordination with the surrounding states and Canadian provinces is key to meeting this goal. The Committee recommends support for the Great Lakes Annex Agreement and state and federal legislation to accompany and support the implementation of this agreement.[16]

**Maintain the hydrologic integrity of the region by evaluating and addressing land use changes and their effects on point and non-point source pollution, recharge, flow and the surface and groundwater regimes and establishing the capacity to do so**

The close relationship between land use and water resource management is well known and unchallenged. However, the ability to manage land use and development to minimize their influence on natural resources is currently limited by the planning policies in this region. Municipal land use ordinances should address conservation design and additional safeguards and include incentives for developers to take this approach. Reaching out to local regulators and providing them with the tools necessary to make these important land use planning decisions are imperative. For example, composting facilities capable of reducing nutrient loading to area waters have been built. These efforts should be expanded and new facilities should be considered to compost additional waste generated in the region.

## Ohio

**Reclaim water resources impaired by abandoned mines**

The Ohio watershed is rich in mineral resources. Bituminous coal has been mined in this region since 1760 when coal was first extracted from what is now Mt. Washington to be used at Fort Pitt across the Monongahela River. Mining is still an important industry in the region that helps fuel the state and national

[16] The Great Lanes-St. Lawrence River Basin Water Resources Compact has been adopted by all eight Great Lakes States. Pennsylvania adopted the Compact on July 4, 2008. The U.S. Congress consented to the Compact in October 2008 and it became effective on December 8, 2008.

economies. Abandoned mines and their untreated drainage are part of the historic mining heritage and have taken a heavy toll on the water resources of this basin. To ensure an adequate and reliable supply of quality water to meet human and ecological needs, remediation of these impaired resources is a major priority for this region. The committee recommends that a full assessment of all water resources impaired by drainage from abandoned mines be conducted, and that incentives and new technologies for the mining industry and others be developed to reclaim or reuse these waters.

**Identify water resources needed to promote and facilitate economic development and provide job opportunities, while maintaining watershed integrity and recreational benefits**

The abundant supply of clean and accessible water resources in this region can be used to promote economic development and job growth while preserving and enhancing watershed integrity. This requires careful planning that begins with identifying the best-suited water resources and understanding the water needs of potential businesses, and ends with a successful matching of businesses with compatible water resource access. The Committee has suggested working with water supply data, regional economic development groups and the Southwest Pennsylvania Commission to achieve this balanced approach to support economic growth and environmental goals. Encouraging water-based recreation and tourism is also an important component of this priority. In addition, the Committee recognizes that sewage problems in the region, particularly problems caused by malfunctioning on-lot sewer systems, have the potential to impair economic development, and considers proper sewage disposal to in for the Ohio River Basin.

## Delaware

**Link land use decisions and water resources management**

Linking land use decisions and water resources management is a top priority of the Committee to sustain and enhance the quality of life in the Delaware River Basin. The development and implementation of steps and approaches (including passage of legislation as appropriate) should require decision-makers at local, county, regional and commonwealth levels to recognize the link between land use and water resource management. These steps and approaches should further require consideration of water resources management, flood control, storm water management and sewage management in land use decisions, infrastructure funding, construction decisions and grant decisions, so as to preserve, protect, restore and enhance the quality, quantity and availability of clean, sustainable water supplies for the people, businesses and ecological needs of the commonwealth.

**Improve management of water resources (including stormwater and wastewater) and waterway corridors to reduce damages from extreme conditions (floods and droughts)**

The Delaware Basin includes areas that are heavily populated and highly urbanized as well as areas that, while currently undeveloped, are experiencing rapid growth. Actions will be needed at the state, regional, county and municipal levels to: manage stormwater to address the impacts of both floods and droughts and improve the quality of life in our communities; to identify riparian corridors and flood plains and optimize their multiple natural benefits, including maintaining the natural functions of floodplains, wildlife and aquatic habitats, water quality and recreation; and to maximize the use of water conservation techniques including enhancing water recycling measures and promoting water supply infrastructure reliability. The capture, storage and infiltration of stormwater flows can also be used to moderate the consequences of floods and droughts.

## Lower Susquehanna

**Evaluate supply and demand**

The Committee has identified finalizing accurate water supply and demand projections to improve the capability to plan for the social,

economic, environmental and recreational needs of the Lower Susquehanna region as a leading priority. This information serves as the basis for making decisions on land use planning, for identifying and analyzing Critical Water Planning Areas, and for making comprehensive preparations in advance of extreme floods and droughts, among other things. Collection and dissemination of sound water budget data are broad goals shared by other regions of the state, but they are especially important for this region because some well-known critical water needs and unique regional features (such as karst topography) influence how water resource plans in the region are designed and implemented.

**Protect "at-risk" water resources and reduce or prevent point and nonpoint source pollution with a focus on impaired streams**

This region has a significant number of impaired streams (approximately 3,400 miles, 20% of total stream miles) caused by various point and nonpoint sources of pollution. A major priority of this Committee is to reduce or prevent this pollution and to focus added attention on “at-risk” water resources. It will be necessary to identify, protect and restore key, at-risk, water resources, minimize the effect of various land-use activities on ground and surface water resources and implement comprehensive pollution prevention measures to decrease nutrient and sediment loading.

## Upper / Middle Susquehanna

**Protect important headwater habitats and recharge areas of the Upper/Middle Susquehanna River Basin**

To care for the water resources in the Upper/Middle Susquehanna River Basin and to ensure a sustainable supply of quality water, important headwater habitats and groundwater recharge areas must be protected. Because much of the basin is forested, the approach should focus on forested land use practices (public and private) and their effects on area water supplies. Given the extent of the Marcellus Shale Formation in the basin, the approach should also focus on all potential water resources impacts resulting from natural gas extraction. Working collaboratively with various interest groups (county and municipal government, conservation districts, watershed associations) is essential to advancing sound land use practices that are protective of these headwater areas. Coordination with local government to promote sound land use practices and appropriate zoning ordinances in public water supply recharge areas is particularly important in areas with limited availability of quality water. The Committee also recommends that water well construction standards be implemented, particularly related to residential water well drilling, that will protect and sustain groundwater quality and availability.

**Address the consequences of acidic drainages on receiving streams to improve and protect water quality and aquatic ecosystems, and to enhance the availability and utilization of water**

Acidic drainages have devastated miles of streams in this region. This legacy pollution and potential future disturbances of acid-producing rock must be addressed to improve and protect overall water quality and aquatic ecosystems, and to enhance the availability of water. To improve stream quality, efforts must focus on treating abandoned mine drainage sources, encouraging reuse of treated abandoned mine water, reclaiming abandoned mine lands and improving assimilation of nutrients and other pollutants in streams impaired by abandoned mine drainage. The benefits of this work would be far reaching: polluted water would be restored, treated water could be used as additional raw water sources where appropriate, abandoned mine lands could be returned to productive uses while minimizing erosion and sedimentation, and nutrient and sediment loads to the Chesapeake Bay would be reduced. Also, given the extent of the Marcellus Formation in the basin, it [the efforts of the regional committee] should also focus on all potential impacts on water resources from natural gas extraction.

## Potomac

### Address land use planning and growth

Managing growth is a critical priority in the Potomac River Basin as more and more residents and businesses migrate into southern Pennsylvania, particularly from neighboring Maryland. Considering this development pressure, the Potomac region needs a strategy to manage water supply and demand that relies on scientifically based data and principles for land use planning. The strategy must allow for growth and development while maintaining adequate water quantity and quality. Preserving the natural hydrologic cycle, controlling increased run-off and flooding, and preserving streams are among the major concerns in this region. The Committee recommends implementing sound land use practices, comprehensive regional planning, a regional regulatory program and providing local governments with tools to properly manage water resources when faced with prioritizing competing land use decisions.

### Develop land use programs that protect water quality and quantity and preserve the ecological integrity of groundwater and surface water, including springs, streams, lakes and wetlands

A major priority of this Committee is to develop land use programs that protect water quality and quantity, and preserve the ecological integrity of groundwater and surface water, including springs, streams, lakes and wetlands. To ensure adequate water resources for present and future generations in the Potomac Basin, the Committee recommends a water quality objective that encourages municipal programs to include domestic water well construction standards, riparian buffers and vegetated systems and the protection of the natural soil mantle.

# Recommended Legislative Priorities of the Statewide Water Resources Committee to Implement the State Water Plan

**December 18, 2008**

1) Enact legislation to require proficiency-based licensing and certification of water well drillers, and to establish statewide private water well construction standards.

2) Based on pilot plan assessments, enact new or amended legislation that would encourage the development and implementation of Integrated Water Resources Plans.

3) Enact new or amended legislation to link local land use decisions with water resources planning and management, and to provide adequate funding for developing information necessary for making sound decisions.

4) Amend the Pennsylvania Flood Control Act to provide DEP with general authority to indemnify federal agencies for water resources projects.

5) Amend the Pennsylvania Flood Control Act and the Stream Clearance and Rectification Act to provide authority to consider and implement all potential flood control or streambank stabilization solutions, including non-structural alternatives and preventive approaches to reduce the risk of flooding, and allow all types of flood control solutions to be funded through the capital budget process.

6) Evaluate Section 301(a) of the Flood Plain Management Act to consider expanding the list of floodplain obstructions that have been determined to present a special hazard to public health and safety, may cause significant pollution, or may endanger life and property.

7) Through appropriate legislation, regulation, and administrative changes, integrate and leverage existing state and federal stormwater management regulations, policies and requirements (e.g. Storm Water Management Act, Sewage Facilities Act, Municipalities Planning Code, Chapters 102 and 105, NPDES, MS4, TMDLs) to provide an effective, straightforward, seamless stormwater management program that is blind to regulatory origin.

8) Clearly authorize by legislation, regulation, or policy the creation and operation of local Authorities, Utilities or Management Districts, and/or other sustainable funding sources that would enable entities to collect fees and generate revenues dedicated to planning, constructing, monitoring, maintaining, improving, expanding, operating, inspecting and repairing public and private stormwater management infrastructure.

9) As further information concerning Pennsylvania's water use trends and challenges are developed over the next five years, concerted efforts should be undertaken to evaluate and evolve Pennsylvania's water rights and water withdrawal arrangements to a more consistent, secure and holistic approach that

   a) Offers water users well-defined, stable and predictable water rights;

   b) Promotes siting and development of uses requiring withdrawals in ways that assure adequate and sustainable supplies both in normal and drought periods, without causing unacceptable impacts on instream uses and environmental resources;

   c) Is administratively efficient and avoids unnecessary duplication between agencies and programs.

   Focus should be placed on considering and evaluating the options and issues described on [pages 48-49) of the Water Plan Principles, evaluating programs that are used in other states, utilizing a process which includes the Department, the Statewide Committee, and other major stakeholders. Based on that process, a report on the relative merits of the identified options should be developed, and appropriate recommendations should be made to the General Assembly as to whether and how Pennsylvania's water rights system might be improved and made more efficient, effective, predicable and secure.

# RECOMMENDATIONS FOR ACTION

The Statewide Water Resources Committee is comprised of 31 appointed and ex officio members representing a cross section of water users and public interests. The Committee is charged with coordinating the development of the *State Water Plan*, recommending policies and guidelines and overseeing development of the Plan in consultation and collaboration with the Regional Water Resources Committees and the DEP. The recommendations presented below were made by the Statewide Water Resources Committee to further improve water resources management in the commonwealth.

## Integrated Water Resources Management

1) DEP, with the advice and guidance of the Statewide Water Resources Committee, will develop and evaluate a framework and incentives for integrated water resources planning and management -- DEP, with assistance from other state agencies, compact basin commissions and local government representatives, should develop a framework that links water resources planning elements from the *State Water Plan* and programs such as Sewage Facilities Planning, Stormwater Management Planning, Source Water Protection Planning, Water Supply and Wastewater Planning, Flood Control Planning and the Watershed Restoration and Protection Program. Ultimately, this concept enhances water resources planning in Pennsylvania and directs planning efforts toward watersheds through county/multi-county/multi-municipal planning. In conjunction with this technical guidance, DEP should craft a financial incentive package that encourages integrated water resources planning and implementation. Initially, the incentive bank could be capitalized from various DEP financial assistance programs, the Department of Conservation and Natural Resources (DCNR) Rivers Conservation Fund, and the Department of Community and Economic Development (DCED) Land Use Technical Assistance Fund.

   This approach enables counties to develop integrated water resources plans and provide planning consultation services to the municipalities in their jurisdiction. Municipalities would adopt the county/multi-county plan and develop ordinances that are consistent with the Plan. Counties with a DEP-approved integrated water resources plan could be eligible for priority state funding to implement the recommendations of the plan. To be considered for funding, the relevant county plan would need to be generally consistent with the *State Water Plan*.

2) Implement trial integrated water resources plans using the Stormwater Management Planning program in cooperation with willing counties/multi-county areas -- DEP should work with willing local government officials and citizens to undertake integrated water resources planning in a variety of settings. The plans should encompass the elements in the framework, recommend implementation vehicles and identify specific decision-points and decision makers. The trial plans should be developed and implemented within the existing regulatory structure. The trial planning efforts should be continuously assessed to reveal gaps, barriers, inconsistencies, inefficiencies and decision-making voids created by the current regulatory and institutional structures. Based on the outcome of these evaluations, the above-referenced framework may be revised or further enhanced to promote a more efficient planning process. Proposals to amend pertinent regulations and to revise institutional organization or responsibilities governing all levels of water resources management could also be made.

3. Provide services to assist county and local officials to prepare and implement integrated water resources management plans. Ongoing training should be conducted to educate county and municipal

officials about the practical benefits and fiscal advantages of integrated water resources planning and management. DEP should provide flexible planning guidelines and model ordinances to assist county and local government officials to develop and implement integrated water resources plans that meet their specific needs. Model ordinances, guidance, standards and criteria should be developed and recommended for use by municipalities to aid in implementing their plans and ordinances. Training that is tailored to municipal solicitors and engineers should also be presented. Non-governmental organizations such as the Pennsylvania State Association of Township Supervisors and the Pennsylvania State Association of Boroughs, and professional associations including the Pennsylvania Planning Association and the Consulting Engineers Council should be prepared to offer counties and municipalities the assistance and guidance needed to adopt approaches that best suit their water resources objectives.

4. Provide sufficient resources to re-establish the multi-agency single point of contact (SPOC) for integrated water resource plans. The multi-agency SPOC for integrated water resources plans should be coordinated by the Governor's Center for Local Government Services and include participation by DEP, DCNR, the Pennsylvania Infrastructure Investment Authority (PENNVEST), Department of Transportation (PennDOT), Pennsylvania Energy Management Agency (PEMA) and the Public Utility Commission (PUC) to prioritize integrated water resource planning and implementation. The decisions of these agencies must be consistent with the *State Water Plan*.

5. Review current policies and identify potential roadblocks to integrated water resources management. During and after the development of the trial integrated water resources plans for selected counties, a third party should assist DEP and the Statewide Water Resources Committee to identify roadblocks to successful integrated water resources management plan implementation as well as legislative changes and possible amendments that would encourage more effective and efficient water resources integration. These analyses and the recommendations that flow from the trial projects will be highlighted and implemented as appropriate. The recommendations will be reviewed and updated as part of the 2013 *State Water Plan*.

## Navigation Needs and Improving Water Transportation

1) Hydrology and channel configuration create the fundamental conditions for navigation in Pennsylvania's waters. Where appropriate, the commonwealth should build on prior efforts related to infrastructure construction, shipping channel maintenance, security, adequate flow management and water quality protection to support commercial and recreational navigation. Also crucial are related mapping and dredging activities to allow safe passage. The commonwealth should work closely with the United States Army Corps of Engineers and other operators of dams and impoundments to maximize the benefits of multiple use management. The commonwealth should support bathymetric mapping of waterways used for navigation currently being conducted by the U.S. Geological Survey and DCNR.

2) Safe and effective management of dredged material is important to navigation on our rivers and lakes. The commonwealth, and other resource regulators and operators, should manage dredging and dredged material for multiple purposes such as enhanced navigation, beneficial uses, protection of watercourses and wetlands and beach formation.

3) The commonwealth should advance and encourage the efforts of PennPorts in the Department of Community and Economic Development, with the support of several federal agencies, to expand those efforts through regional port authorities to develop strategic plans for supporting and managing commercial navigation in Pennsylvania. The commonwealth should continue to promote the competitive position of the

Ports of Philadelphia, Pittsburgh, Erie and Bucks County.

4) The commonwealth should continue to address navigation-related water quality and quantity issues such as ballast water management, wastewater and trash disposal from commercial and recreational vessels, monitoring systems, emergency response and security management.

5) The commonwealth should continue to manage public natural resources in the beds of navigable waterways, subject to the permitting and submerged lands license or legislative lease process provided under the Dam Safety and Encroachments Act[17], as well as the requirements of the Fish and Boat Code[18].

6) The commonwealth should continuously evaluate infrastructure needs for locks and dams, reservoirs and intermodal transportation facilities. Where appropriate, the Pennsylvania Fish and Boat Commission (PFBC) should continue to fund or endorse dam removals where the dams no longer serve a useful purpose, thereby improving migratory fish passage and eliminating obstructions to recreational navigation. The commonwealth should periodically re-examine its institutional arrangements for evaluating infrastructure needs and their adequacy for achieving the commonwealth's goals.

7) The commonwealth should continue to participate in regional institutional efforts to manage water quantities, flows and flooding, which all affect navigation. Institutional arrangements and agencies that support Pennsylvania's navigation interests such as the Great Lakes Water Management Agreements, the interstate river basin compact commissions, and the International Joint Commission should be continued and encouraged.

8) Where appropriate, PFBC and other agencies should continue to fund or permit boat launches and other on-shore and in-water facilities that enhance recreational boating. Recreational boating should be facilitated in locations where it will not unduly interfere with water dependent biological communities, commercial navigation in areas with federal navigation channels or other more appropriate human uses. Diverse considerations may apply for different types of watercraft.

9) In implementing each of these recommendations, the commonwealth should continue to protect both the public rights in public trust resources and private rights in private property.

## Stormwater Management and Flood Control

Flood Control Recommendations

1) Review and update elements of the Pennsylvania Enhanced All-Hazard Mitigation Plan that address flooding. Revising the flood loss reduction and flood mitigation portions of the plan would provide updated guidance for federal, interstate, state and local agency activities in the commonwealth. To begin this effort, the Delaware River Basin Commission Interstate Flood Mitigation Task Force Report (July 2007) should be evaluated and relevant provisions should be considered for statewide application. In conjunction with this initiative, stormwater management plans developed under the Storm Water Management Act should be expanded to support local flood mitigation projects and should include specific recommendations for reducing flood events.

2) Invest in enhanced Flood Forecasting and Warning Systems for all major river basins, utilizing a partnership of federal, state and local government.

3) Support FEMA's efforts to update Flood Insurance Rate Maps.

4) Amend the Flood Control Act[19] to provide DEP with general authority to indemnify federal agencies for water resources projects.

[17] 32 P.S.693.1 et seq.
[18] 30 Pa.C.S. §101 et seq.
[19] 35 P.S. §653 et. seq.

5) Increase efforts to protect the floodplain and enhance community recovery assistance following a flooding event.

   a) Evaluate Section 301(a) of the Flood Plain Management Act[20] to consider expanding the list of floodplain obstructions that have been determined to present a special hazard to public health and safety, that may cause significant pollution, or that may endanger life and property.

   b) Amend the Flood Control Act to provide authority to consider and implement all potential flood control solutions, including non-structural alternatives and preventive approaches to reduce the risk of flooding; and allow all types of flood control solutions to be funded through the capital budget process.

   c) Review and evaluate the Federal Flood Insurance Program to identify policies, such as the buy-out option, which can be enhanced to decrease the amount of damage to communities.

   d) Prioritize flood recovery funds for activities that protect the flood carrying capacity of the floodplain. Invest funds effectively and reasonably to restore the floodplain and to reduce future losses.

   e) Revise existing post-flood recovery funding programs to require post-disaster assessments and mitigation investigations, and to emphasize increased efforts on floodplain restoration and restoration of flood carrying capacity.

   f) Ensure that state funding programs offer a preference for locating or relocating structures outside the floodplain. Where this approach is not feasible, approval to build or rebuild within the floodplain should include provisions for restoration and remediation of the floodplain to minimize future flood losses.

   g) Ensure that existing programs are coordinated and provide incentives for floodplain protection and restoration. Public funds used for flood recovery and rebuilding should target floodplain and carrying capacity restoration and obstruction removal. Retrofitting existing development with facilities designed to minimize flood losses should be considered where appropriate.

6) Appoint a commonwealth Flood Coordinator charged with coordinating flood prevention and recovery activities among state agencies. The commonwealth Flood Coordinator would also serve as the primary point of contact for federal, interstate and local officials on flood-related matters.

7) Working through the Department of Community and Economic Development, establish an information center/clearinghouse to provide education and training to local government officials, municipal solicitors, municipal engineers and the design community that emphasizes the importance of embedding integrated stormwater and floodplain management considerations into every municipal decision.

## Stormwater Management

Through appropriate legislation, regulation and administrative changes, integrate and leverage existing state and federal stormwater management regulations, policies and requirements (e.g., Storm Water Management Act, Sewage Facilities Act, Municipalities Planning Code, Chapters 102 and 105, NPDES, MS4, TMDLs) to provide an effective, straightforward, seamless stormwater management program that is blind to regulatory origin.

1) Establish an information center/clearinghouse (such as the Water Resources Technical Assistance Center authorized by Section 3120(A) of the Water Resources Planning Act[21]) to deliver education and training to local government

[20] 32 P.S. §679.301.

[21] 27 Pa.C.S. §3120(A).

officials, municipal solicitors, municipal engineers and engineering and design professionals involved in land development to advance the understanding and utilization of effective stormwater management practices and regulatory requirements and to emphasize the importance of integrating stormwater and floodplain management considerations into all municipal decisions.

2) Clearly authorize by legislation, regulation, or policy the creation and operation of local authorities, utilities or management districts and/or other sustainable funding sources that enable entities to collect fees and generate revenues dedicated to planning, constructing, monitoring, maintaining, improving, expanding, operating, inspecting and repairing public and private stormwater management infrastructure.

3) Through appropriate legislation, regulation and administrative changes, amend and update the stormwater management program to:

   a) Manage the level of effort allotted for preparing and updating stormwater management plans. Target critical watersheds with serious quality or quantity problems, based on a set of criteria (e.g., % impervious cover, population density, federal requirements, special protection watersheds, impaired waters, rate of development, chronic flooding history, Critical Water Planning Area designation), for detailed planning efforts. Remaining areas could be covered using a standard planning outline.

   b) Allow added flexibility to determine appropriate watershed-related planning units.

   c) Use stormwater management planning as a tool to achieve compliance with the TMDL implementation where a water body is impaired by stormwater, and a TMDL has been prepared or adopted.

   d) Improve enforcement provisions to provide meaningful economic incentives to adopt, amend and implement stormwater management plans and ordinances.

   e) Include provisions to address long-term operation and maintenance of stormwater management facilities.

4) Adequately fund regular updates to the Pennsylvania Stormwater Best Management Practices Manual to reflect innovation and change and continue to maintain and update the Stormwater Management Model Ordinance to reflect Manual revisions and statutory amendments.

5) To the maximum extent practicable and cost effective, vegetated buffers should be preserved and restored along all waterways.

6) Through legislative, regulatory and administrative provisions, seek to manage stormwater so as to reduce excess runoff and pollutants.

7) Fund, promote and encourage water resource restoration projects.

## Water Quality

1) To reduce sediment and nutrient loads for the improvement of Pennsylvania water quality, and to meet Chesapeake Bay Tributary Strategy goals, the commonwealth should provide funding for:

   a) Increasing loans, grants, or tax incentives for infrastructure improvements of sewage treatment facilities;

   b) Increasing loans, grants, or tax incentives for agricultural Best Management Practices; and

   c) Establishing loans, grants, or tax incentives for infrastructure improvements and retrofitting of stormwater management facilities.

2) The commonwealth should enact legislation requiring the certification of water well-drillers and establishing of private water well construction standards -- There are

currently national testing and certification programs available that measure the proficiency of applicants for initial licensing or renewal. The National Groundwater Association, among others, has functional model programs already developed. Pennsylvania should draw upon this expertise to establish a proficiency-based licensing and renewal system for water well-drillers. Legislation should be enacted to establish construction standards for private water wells. These standards should address:

a) Well Siting/Location – Wells must to be protected from potential contamination sources and appropriate distances from known points of contamination must be maintained.

b) Construction – Specifications should be established for grouting, casings and screening materials in order to preclude the entrance of contaminants.

c) Reporting –Post-drilling reports that document water quality and quantity should be required and be provided to the landowner and the appropriate regulatory agencies.

3) The commonwealth should continue funding for abandoned mine drainage restoration – Pennsylvania has made substantial progress in the treatment of abandoned mine drainage by partnering with local municipalities and watershed organizations. The continuation of that progress should be encouraged by establishing a dedicated funding source to implement and maintain abandoned mine drainage treatment facilities.

4) Local government land use planning decisions should consider the impacts on water as a resource--

a) Land use planning and zoning ordinances should consider the impacts of land use, development and redevelopment on water quantity and quality.

b) The protection of water resources must be considered early in the development planning process in order to address cumulative impacts to a watershed.

c) Alterations to the landscape must also consider stormwater management. It is important that stormwater be considered as a resource and be managed for re-use and recharge of the groundwater.

d) Protect, maintain and restore functions and values of sensitive areas during development and redevelopment. Sensitive areas within the watershed, such as wetlands, well heads, headwaters and riparian zones should be protected from the potential impacts of future development.

e) The last defense to protect water quality is the land immediately adjacent to rivers and streams. To the maximum extent practicable and cost effective, vegetated buffers should be preserved and restored along all waterways.

5) DEP along with other appropriate commonwealth agencies should develop guidelines and tools for groundwater assessment – Guidelines should be developed for assessing and minimizing cumulative hydrologic impacts in a watershed resulting from any activities on the land. A tool, similar to the Water Analysis Screening Tool, should be developed to assess the quality and quantity of groundwater and identify areas of impairment.

## Water Withdrawal and Use

1) Water use registration and reporting regulations should be adopted and implemented as expeditiously as practicable to facilitate the gathering of more accurate and timely water withdrawal and use information. DEP, in concert with stakeholder organizations, should engage in concerted outreach efforts to improve the understanding of and compliance with, the registration and reporting program.

2) The next phase of the *State Water Plan* should include, among other items, increased attention on the development of water use projections in each watershed for the next 20 years, and the evaluation of major water use trends.

3) As further information concerning Pennsylvania's water use trends and challenges are developed over the next five years leading up to the next update of the *State Water Plan*, concerted efforts should be undertaken to evolve Pennsylvania's water rights and water withdrawal arrangements to a more consistent, secure and holistic approach that (1) offers water users well-defined, stable and predictable water rights; (2) promotes siting and development of uses requiring withdrawals in ways that assure adequate and sustainable supplies both in normal and drought periods, without causing unacceptable impacts or instream uses and environmental resources; and (3) is administratively efficient and avoids unnecessary duplication between agencies and programs. Focus should be placed on considering and evaluating the options and issues, described on pages 48 and 49, evaluating programs that are used in other states, utilizing a process which includes DEP, the Statewide Committee and other major stakeholders. Based on that process, a report on the relative merits of the identified options should be developed, and appropriate recommendations should be made to the General Assembly as to whether and how Pennsylvania's water rights system might be improved and made more efficient, effective, predicable and secure.

## Water Conservation and Efficiency

1) A Water Resources Technical Assistance Center should be established. An academic institution or university should physically "house" and offer administrative support for the Center. Selection of this entity should be accomplished through a request for proposals (RFP) process. Oversight and functional responsibility should rest with a "board" whose membership would be comprised of representatives from the private sector, academia and government (including DEP and elected state officials).

2) Additional recommendations and goals for improving water conservation and efficiency in Pennsylvania include:

   a) Conducting research and promoting innovative practices through marketing incentives, outreach and educational efforts.

   b) Supporting innovation and implementation of technology and use policies that cut water resource uses and demands at peak times of drought or resource constraints.

   c) Implementing technologies and policies that result in a reduction in overall base demand.

   d) Providing support and resources to entities that have implemented or started to implement innovative water conservation or water efficient practices.

   e) Increasing use of local "microgrids of water" (catchment and use of precipitation to supplement withdrawals from ground water or streams and rivers).

   f) Offering funding rebates or swaps of industrial high water using equipment (open loop systems) with closed looped systems or low water use residential appliances.

   g) Installing "smart meters" that enable detailed measurement of water use in buildings to detect water leaks and other wasteful water use practices.

   h) Incorporating time-of-use rates that encourage using water at times of less demand.

# INTEGRATED WATER RESOURCES MANAGEMENT

## Introduction

For over a decade Pennsylvania has administered its water resources management programs on a watershed scale by encouraging local leadership and community action through financial and technical assistance. This approach has received national recognition and has produced lasting results, but an effective water resources management program must continue to build on its accomplishments to maintain energy and momentum. Successful water resources planning and management now demand a more organized and integrated course that combines the assets of all levels of government, private sector interests and citizen participation.

## Strategic Direction

Integrated water resources management entails making common sense decisions while considering water quantity and water quality needs. To chart a seamless and transparent path toward this goal, three strategic areas must be addressed:

- blending the components and processes of water resources management within DEP;
- improving coordination across state agencies and throughout the federal, interstate, state and local government hierarchy; and
- solidifying the connection between land use and water resources management.

The following discussion examines these three concepts in more detail.

DEP should administer its water resources management, watershed restoration and protection and water quality management programs in a more consolidated and coordinated fashion. The strong relationships among these programs should be used as the principal criterion guiding DEP's organizational alignment, strategic policy choices and daily decision-making.

DEP should continually strive to improve coordination among state agencies, as well as throughout the hierarchy of governance in Pennsylvania. State agencies have an obligation to work toward common objectives so that statutes, regulations and policies are mutually supportive, efficiencies are gained and conflict, duplication and waste are avoided. Similarly, federal, state, interstate and local governments need to align their efforts to ensure consistency among water resources management initiatives and take advantage of their combined wisdom and capital. The private sector, non-profit organizations and interested individuals should serve as partners in plotting and following a united course.

Land use has a profound influence on water resources planning and management. Federal, interstate and state governments have broad mandates to manage and regulate water resources. Pennsylvania municipalities have authority to adopt comprehensive plans, zoning regulations and subdivision and land development ordinances. Local land use decisions should integrate water resources management objectives in order to sustain economic growth while also achieving environmental protection goals.

## Recommendations

Integrated water resources planning and management offer a direct and efficient way to confront complex topics and concerns as they emerge from the state water planning process. This approach will not anticipate every pitfall, but it will serve as a practical means to identify and avoid major problems and as a viable instrument to resolve conflicts among water users and uses. To initiate integrated water resources planning and management in Pennsylvania, the commonwealth should:

1) Through DEP, with the advice and guidance of the Statewide Water Resources

Committee, develop and evaluate a framework and incentives for integrated water resources planning and management -- DEP, with assistance from other state agencies, compact basin commissions and local government representatives, should develop a framework that links water resources planning elements from the *State Water Plan* and programs such as Sewage Facilities Planning, Stormwater Management Planning, Source Water Protection Planning, Water Supply and Wastewater Planning and Flood Control Planning and the Watershed Restoration and Protection Program. Ultimately, this concept enhances water resources planning in Pennsylvania and directs planning efforts toward watersheds through county/multi-county/multi-municipal planning. In conjunction with this technical guidance, DEP should craft a financial incentive package that encourages integrated water resources planning and implementation. Initially, the incentive bank could be capitalized from various DEP financial assistance programs, Department of Conservation and Natural Resources' (DCNR's) Rivers Conservation Fund and Community and Economic Development's (DCED's) Land Use Technical Assistance Fund.

a) This approach enables counties to develop integrated water resources plans and provide planning consultation services to the municipalities in their jurisdiction. Municipalities would adopt the county/multi-county plan and develop ordinances that are consistent with the plan. Counties with a DEP-approved integrated water resources plan could be eligible for priority state funding to implement the recommendations of the plan. To be considered for funding the relevant county plan would need to be generally consistent with the *State Water Plan*.

2) Implement trial integrated water resources plans using the Stormwater Management Planning Program in cooperation with willing counties/multi-county areas -- DEP should work with willing local government officials and citizens to undertake integrated water resources planning in a variety of settings. The plans should encompass the elements in the framework, recommend implementation vehicles and identify specific decision-points and decision makers. The trial plans should be developed and implemented within the existing regulatory structure. The trial planning efforts should be continuously assessed to reveal gaps, barriers, inconsistencies, inefficiencies and decision-making voids created by the current regulatory and institutional structures. Based on the outcome of these evaluations, the above-referenced framework may be revised or further enhanced to promote a more efficient planning process. Proposals to amend pertinent regulations, and to revise institutional organization or responsibilities governing all levels of water resources management could also be made.

3) Provide services to assist county and local officials to prepare and implement integrated water resources management plans -- Ongoing training should be conducted to educate county and municipal officials about the practical benefits and fiscal advantages of integrated water resources planning and management. DEP should provide flexible planning guidelines and model ordinances to assist county and local government officials develop and implement integrated water resources plans that meet their specific needs. Model ordinances, guidance, standards and criteria should be developed and recommended for use by municipalities to aid in implementing their plans and ordinances. Training that is tailored to municipal solicitors and engineers should also be presented. Non-governmental organizations such as the Pennsylvania State Association of Township Supervisors and the Pennsylvania State Association of Boroughs and professional associations including the Pennsylvania Planning Association and the Consulting Engineers Council should be prepared to offer counties and municipalities the assistance and guidance needed to adopt approaches that best suit their water resources objectives.

4) Provide sufficient resources to re-establish the multi-agency single point of contact (SPOC) for integrated water resource plans -- The multi-agency SPOC for integrated water resources plans should be coordinated by the Governor's Center for Local Government Services and include participation by DEP, DCNR, the Pennsylvania Infrastructure Investment Authority (PENNVEST), the Department of Transportation, (PennDOT), the Pennsylvania Emergency Management Agency (PEMA) and the Public Utility Commission (PUC) to prioritize integrated water resource planning and implementation. The decisions of these agencies must be consistent with the *State Water Plan*.

5) Review current policies and identify potential roadblocks to integrated water resources management -- During and after the development of the trial integrated water resources plans for selected counties, a third party should assist DEP and the Statewide Water Resources Committee to identify roadblocks to successful integrated water resources management plan implementation as well as legislative changes and possible amendments that would encourage more effective and efficient water resources integration. These analyses and the recommendations that flow from the trial projects will be highlighted and implemented as appropriate. The recommendations will be reviewed and updated as part of the 2013 *State Water Plan*.

# WATER CONSERVATION AND EFFICIENCY IN PENNSYLVANIA

## Introduction

Since 2004, DEP, along with the Statewide Water Resources Committee and the six regional committees that have participated in the state water planning process and have evaluated various water resource issues to form principal priorities as the foundation of the *State Water Plan*. Promoting water conservation technologies emerged as one of the three principal priorities.

Businesses that can develop technology to conserve water and use water more efficiently, restore water quality and/or reduce water withdrawals and water quality impacts of any activity will improve health and enrich lives while reaping significant economic rewards. Pennsylvania should promote leadership and business development in innovative water resource conservation, water use efficiency, water quality protection and enhanced technologies.

## Water Conservation and Water Efficiency

Although the terms water conservation and water efficiency are commonly used interchangeably, there is a difference in their meaning. "Water conservation" refers broadly to a beneficial reduction in water use or water losses to wisely manage, preserve or save water. Water efficiency concepts are often part of water conservation initiatives. "Water efficiency" specifically refers to achieving the same result or accomplishing a function, task or process using less water or a minimal amount of water.

Water-efficient practices, products or systems use less water than traditional products or systems without sacrificing performance. Examples include use of low-flow plumbing fixtures such as toilets and shower heads, drip irrigation systems and reuse of gray water and capture/use of rainwater for non-potable uses.

Water conservation, as it pertains to reduction in demand for public water, is often implemented at a local level through programs that include but are not limited to public education, varied water rate structures, water restrictions or prohibitions on non-essential water uses during droughts and incentives for plumbing retrofits.

## Overview of Existing Programs

### Water Resources Planning Act —Proposed DEP Regulations, Chapter 110 and Water Conservation

Section 3118 of The Water Resources Planning Act[22] established an interim registration program and directed the Environmental Quality Board to "adopt regulations establishing requirements for the registration, periodic reporting and recordkeeping of withdrawals." The Environmental Quality Board has proposed regulations at 25 Pa. Code Chapter 110 that fulfill the requirements of 3112(a)(11) which requires the *State Water Plan* to include a process for identifying projects and practices that are being or have been implemented by water users that reduce the amount of water withdrawal or consumptive use, improve efficiency in water use, provide for reuse and recycling of water, increase the supply or storage of water and preserve or increase groundwater recharge. Sections 110.601-603 of the proposed DEP regulations establish a voluntary system for registration of water conservation projects or practices.

Section 110.603 of the proposed regulations requires periodic reporting by registrants to document the continuing effectiveness of the registered project or practice.

DEP will develop a process as described under Section 3112(a)(11) to provide the appropriate positive recognition of projects or practices documented through the above registration process subsequent to research in areas linking land management practices, water conservation and groundwater recharge.

[22] 27 Pa.C.S. §3118.

**The Water Rights Act**

In accordance with the Water Rights Act[23], DEP administers the Surface Water Allocation Program. Under this program, DEP approves the acquisition of surface water rights by public water supply agencies. These approvals, commonly referred to as water allocation permits, enable public water supply agencies to legally acquire rights in surface waters, "by purchase, lease… eminent domain or otherwise." Water allocation permits typically include a range of conditions with which the public water supply agency must comply, including conditions relating to water conservation. The water conservation conditions may, in addition to other requirements, require the public water supply agency to:

(1) Develop a drought contingency plan describing the measures that will be taken to conserve available supplies and reduce water use during an emergency, such as a drought or industrial waste spill, that may render sources inadequate or unavailable for a period of time

(2) Adopt and implement a water conservation program, including but not limited to:

   (a) Installation of customer meters
   (b An ongoing meter testing, repair and replacement program
   (c) An ongoing leakage/loss control program
   (d) A water conservation education program
   (e) A program to require installation of water-saving plumbing devices in all new accounts or promote the adoption of water conservation ordinances
   (f) A requirement to comply with the water conservation policies of the Compact Basin Commission, if applicable

(3) Submit an annual permit compliance report, which includes a description of the water conservation program and its implementation

(4) Reduce, if necessary and maintain its water loss accounting to a level of 20 percent or less

(5) Accurately measure, record and report to DEP its withdrawals from each source of supply

**Emergency Management Services Code—Drought Emergency Regulations**

*Drought Monitoring and Management*

Pennsylvania has one of the most sophisticated drought monitoring networks in the nation. It continuously tracks precipitation, stream flow, ground water levels, soil moisture and reservoir levels, providing real-time data and instantaneous analysis of these important drought indicators. DEP, PEMA and the basin commissions rely on these drought indicators to constantly measure overall water supply conditions. Indicator assessment results are used to determine whether a water supply drought is developing and to approximate its significance.

A "Drought Watch" is the least serious of the three phases of drought management. A drought watch can be issued by the DEP secretary upon consultation with the Drought Task Force and the governor's office. A drought watch is issued at the onset of drought conditions. It prompts a request for individuals to voluntarily reduce water use by about 5%, and initiates notification of public water suppliers to update and begin following their drought contingency plans. A "Drought Warning" is issued by the DEP secretary when conditions deteriorate to the point that an emergency is imminent. News releases are made in the affected areas, public water suppliers are notified of the change in drought status and individuals are asked to reduce water use by 10-15%.

Under the Emergency Management Services Code[24], the governor has sole authority to declare a natural resource shortage in Pennsylvania. Such a declaration is justified when a threat or actual occurrence of a local emergency is judged to be of sufficient severity

[23] 32 P.S. §631 et seq.

[24] 33 Pa.C.S. §7101 et seq.

and magnitude to warrant local action to prevent or alleviate damage, loss, hardship or suffering. It follows that a "Drought Emergency" may be declared only by proclamation of the governor. Upon the Drought Task Force recommending an emergency declaration, the Pennsylvania Emergency Management Council, chaired by the lieutenant governor, convenes to advise the governor whether a drought emergency should be declared in any part of the commonwealth. Issuance of a drought emergency proclamation by the governor activates PEMA's emergency management regulations at 4 Pa. Code Chapters 118, 119 and 120.

Chapter 118 requires each public water supplier in the affected area to ensure that DEP has a copy of its current drought contingency plan which must include, among other items, a plan of action which will be taken by the public water supply agency to respond to drought or water shortage conditions, and a water conservation program. Industrial and commercial water users may also be required to submit and follow drought contingency plans if conditions become extreme. Those plans must include descriptions of measures previously undertaken to conserve water at the facility, potential measures which could be implemented to reduce water use under emergency conditions and plans of actions to achieve a phased reduction of total withdrawal and use amounts of 5%, 15%, 25%, 35% and 50% should such reductions be ordered by the governor or the commonwealth drought coordinator.

Drought management requirements most visible to the public are the nonessential water use restrictions listed in Chapter 119. These restrictions are designed to achieve an overall water use reduction of up to 25%. Nonessential water use restrictions generally apply to outdoor usage such as irrigating lawns and shrubs, washing vehicles and paved surfaces, filling swimming pools and using water for ornamental purposes. The nonessential water use rules also describe a process for requesting exemptions and variances. Under provisions of Chapter 120, each public water supply agency and each municipality must monitor its water supply levels, estimate the availability of its sources and implement water conservation measures to extend supplies. If demands exceed or threaten to exceed supplies, a public water supplier or municipality may request the Commonwealth Drought Coordinator to approve water rationing within its service area. This step should be taken only when sources are so depleted that public health and safety are threatened. Under rationing, each customer is allotted a specific quantity of water that can be used. Exceeding the allotment results in steep excess-use charges and could lead to water service being physically restricted, interrupted or terminated. The Commonwealth Drought Coordinator ensures that rationing is justified before approving individual requests.

**River Basin Commissions**

*Delaware River Basin Commission*

The Delaware River Basin Commission (DRBC) is an interstate compact commission with regulatory authority over the entire Delaware River Basin, including those portions of the basin in Pennsylvania. The DRBC has promulgated regulations addressing water conservation through a series of resolutions over the past three decades.

Under the first resolution, adopted in 1976, DRBC undertook a "long-range continuing program to reduce water use" and established a policy to "require maximum feasible efficiency in the use of water" by industrial, municipal and agricultural users throughout the basin. Under that and successive resolutions amending the Basin Water Code, the DRBC:

(1) Required inclusion of a water conservation plan in applications by owners of water supply systems for new or expanded water withdrawals;
(2) Undertook research and planning programs to foster water conservation;
(3) Embraced the objective of reducing consumptive use of fresh water;
(4) Established water conservation performance standards for plumbing fixtures and fittings and mandated compliance with those standards in all signatory state and political subdivision water conservation performance standards;
(5) Required owners of public water supply systems supplying in excess of 100,000 gallons of water per day (gpd) to undertake

a systematic program to monitor and control leakage within their water supply systems;
(6) Promotes and supports retail water pricing by public water suppliers that encourages customer conservation, including a requirement for all suppliers withdrawing more than 1,000,000 gpd to include in applications for new or expanded withdrawals an evaluation of the feasibility of implementing a water conserving pricing structure and billing program;
(7) Required applicants for projects involving out-of-basin diversions to indicate the conservation measures that have been taken to forestall the need for a diversion of basin water;
(8) Required owners of public water supply systems that distribute in excess of 100,000 gpd to install customer water meters incident to the provision or maintenance of service at the retail level; and
(9) Required, with some exceptions, each project whose withdrawal exceeds 100,000 gpd to install source meters and to record and report their withdrawals to the DRBC or a designated state agency.

In 1983, the DRBC approved the "Good Faith Agreement," which established a drought management plan for the basin and incorporated it into the DRBC Water Code. That plan became the basis for Pennsylvania's Drought Management Plan and the regulations described above. The DRBC relies upon its state members to implement drought emergency provisions of the basin plan on its behalf, and Pennsylvania implements those provisions through 4 Pa. Code Chapters 118-120 under the Pennsylvania Emergency Management Services Code.

*Susquehanna River Basin Commission*

Like the DRBC, the Susquehanna River Basin Commission (SRBC) is an interstate compact commission, whose regulatory authority extends throughout the Susquehanna River Basin, including those portions of the basin located in Pennsylvania. The SRBC's water conservation requirements are addressed in 18 CFR Section 806.25 of its regulations.

The SRBC regulations require public water suppliers to:

(1) Reduce distribution system losses to 20 percent or less;
(2) Install meters for all users;
(3) Establish a program of water conservation, including requirements for installation of water conservation devices; distribution of water conservation literature to customers; implementation of conservation water pricing structures; and encouraging water reuse.

Industrial water users are required to:

(1) Designate a company representative to manage plant water use;
(2) Install meters or utilize acceptable flow measuring methods to accurately determine water use;
(3) Install appropriate flow control devices;
(4) Evaluate and utilize applicable recirculation and reuse practices.

Irrigation water users are required to utilize irrigation systems properly designed for the respective soil characteristics, topography and vegetation.

**Public Utility Commission**

Public utilities are regulated under Title 52 (Public Utilities) of the Pennsylvania Code.

52 Pa. Code Chapter 65. Water Service, includes provisions on metering. Customer water metering provides an incentive for water conservation by allowing customers to view their water use, detect leaks and develop their own conservation plan. Under Section 65.7, a public utility after August 15, 1981 which is issued a certificate of public convenience permitting it to begin to render water service and a currently existing public utility which begins to render water service to an additional, noncontiguous, service area shall be required to furnish metered service. Further, Section 65.8 provides specific requirements for allowable meter error, testing and installation/removal of meters.

Section 65.11 provides for the imposition of mandatory conservation measures to reduce or eliminate nonessential uses of water by public

utilities while Section 65.20 provides a statement of policy that during rate proceedings of water utilities, the PUC intends to examine specific factors regarding the action or failure to act to encourage cost-effective conservation by their customers. Utility efforts that are considered include education, water audits, efficient plumbing fixtures, water loss accounting, leak detection, metering and conservation plans.

**Reuse of Treated Wastewater**

In December 2005, DEP prepared a draft guidance manual for reuse of treated wastewater, describing activities that may only occur under the authority of a permit issued by DEP. The manual does not cover land application of wastewater for additional treatment purposes. It includes design, operation and maintenance requirements for wastewater systems discharging treated water for beneficial reuse. Promoting wastewater reuse and recycling conserves water usage and wastewater discharge.

Traditional wastewater treatment processes reduce the concentrations of wastewater pollutants to levels protective of receiving water since the potential for human contact, inhalation and/or ingestion is minimal. An additional level of public health protection is necessary to further reduce pathogenic organisms when considering water reuse. Advanced wastewater treatment processes are generally utilized for this purpose, particularly when high quality reclaimed water is necessary for public access areas.

One of the most critical objectives in a reuse program is assuring public health protection is not compromised. Other objectives, such as meeting user requirements, avoiding public nuisances and preventing environmental degradation, are also important considerations.

**Water Sense Partnership and Water Efficiency**

DEP is a governmental promotional partner for WaterSense®, a partnership program sponsored by the U.S. Environmental Protection Agency (EPA) whose mission is to protect the future of our nation's water supply by promoting and enhancing the market for water-efficient products, programs and practices. This "national brand" program, similar to the "Energy Star" program for energy efficiency, offers people a simple way to make product choices that use less water, with no sacrifice to quality or product performance.

As promotional partners, DEP has provided each of about 2,000 community water systems in Pennsylvania with information on the program to encourage their partnership with EPA and to disseminate information to their customers on the WaterSense® label and benefits. DEP also provides web links to the WaterSense website. Further information on WaterSense may be found at www.epa.gov/watersense.

**Sustainable Infrastructure**

There is a recognition that our nation's water and sewer infrastructure is in bad condition and getting worse. From this, the concept of "Sustainable Infrastructure" or "SI" has evolved to ensure long-term sustainability of water infrastructure and described by the EPA as four "pillars":

- Better Management
- Infrastructure Financing
- System Efficiency
- Watershed Approaches

Pennsylvania Gov. Edward G. Rendell signed Executive Order 2008-02 (as amended on April 28, 2008) that calls for the establishment of a "Sustainable Water Infrastructure Task Force" (Task Force) whose purpose is to provide, among other items, recommendations for legislative or regulatory changes to promote sustainable water and sewer services. A report coming from the Task Force scheduled for October 1, 2008, will include recommendations falling within the SI System Efficiency pillar:

"Efficient Operation" - incorporation of water and energy conservation and system optimization to deliver cost-effective treatments that meet or exceed existing and future public health and environmental standards.

"Maximization of Non-Structural Solutions" - integrating conservation, water reuse, trading strategies and comprehensive water resource planning into sewer and water infrastructure planning.

DEP will review the Task Force report and explore opportunities to interconnect programs to more effectively change the way it does business to promote SI concepts and water conservation.

**Water Resources Technical Assistance Center**

Water conservation will play an important role under System Efficiency through the establishment of a Water Resources Technical Assistance Center (Center), as required by Section 3120(A) of The Water Resources Planning Act[25]. The Center will be expected to promote voluntary water conservation and to provide technical assistance on water resource issues, including practices and measures that reduce demand for water, improve water use efficiency, reduce water leakage and enhance groundwater recharge.

**Recommendations:**

1) A Water Conservation Subcommittee of the Statewide Water Resources Committee that was formed in early 2007 to assist DEP in setting up the Center should satisfy the requirements set forth in Section 3120 of the Act.

   The Susquehanna River Basin Commission (SRBC) received a Growing Greener grant from DEP to develop a plan of action for implementing the Center. To support and enhance SRBC's efforts, four specific tasks that it could undertake were identified as:

   a) Produce a preliminary mission statement for the Center.

   b) Determine where the Center will be housed.

   c) Identify potential partners who would establish, maintain and operate the Center.

   d) Outline initial start-up funding requirements for the Center and investigate potential funding sources.

2) A hybrid model for managing water conservation programs is recommended to best meet Pennsylvania's needs. After reviewing other similar state programs, the model used by Arizona seems to be a good fit for Pennsylvania. An academic institution or university should physically house and offer administrative support for the Center. Selection for this entity should be done through a request for proposal (RFP) process. Oversight and functional responsibility should rest with a board with a membership comprised of representatives from the private sector, academia and government (including DEP and state elected officials).

3) Once SRBC completes and presents its plan of action for the Center, it is recommended that DEP issue the RFP for maintaining and operating the Center. Throughout this process, the Statewide Committee will work with DEP to initially establish the Center, including forming its governing "board."

4) A majority of the initial functions of the Center will be to achieve effective outreach and to build incentives. An eventual expansion into research and development is another goal for the Center.

   The Center will require a substantial, consistent and dependable funding source. The initial funding for the incubation period is estimated to be $250,000. A practical source of those funds is by appropriation through the Pennsylvania legislature. Future funding sources, in addition to Legislative appropriations, are grants (i.e., Growing Greener, academic and industry grants). These funding sources can be leveraged to provide research and development funding by a factor of 2 to 3 times.

Water conservation and efficiency measures such as these and others will be fully explored once the aforementioned Water Resources Technical Assistance Center is established and begins functioning.

[25] 27Pa.C.S. §3120.

# WATER WITHDRAWAL AND USE MANAGEMENT IN PENNSYLVANIA

## Introduction

Water resources law is fundamentally about the allocation of the use of water resources among competing users. In Pennsylvania, as in most of the eastern United States, the right to water is not a property right to which title can be acquired, but is rather a "right of use" of the water resources, called the "usufructuary right." The usufructuary right is one of those in the bundle of rights that goes with property ownership. The water right is not recorded on a deed and it cannot be severed or separately sold, like mineral or timber rights that may be held as separate estates in Pennsylvania.

## Common Law[26]

Pennsylvania's system of water allocation law is based on numerous court rulings dating back to the 1800s. This system of judicial rulemaking, called the common law, is decided on a case-by-case basis. The courts rely on previous court decisions or precedents to adjudicate the rights of competing users. Because common law rests on individual cases read together, rather than a cohesive code, many gaps remain in the court decisions governing water rights and the common law is always subject to refinement or modification as new cases are litigated. The common law is not scientifically based but evolved before knowledge of the hydrogeologic cycle was developed. Different rules govern the use of surface water and groundwater.

1. Surface Water Rules – Riparian Rights

In very general terms, riparian water rights are water rights derived from ownership of real property underlying or bordering streams and rivers. The riparian right is a right to make use of the water flowing in a stream upon or next to riparian land. Pennsylvania courts have adopted what is known as the "reasonable use" doctrine. The doctrine allows some reduction in a watercourse's natural flow, as long as other users are not unreasonably harmed. The holder of riparian rights has no property right to the water itself but only a non-exclusive right to use water. No right to divert or consume a specific quantity of water is obtained. All rights to water use depend upon the equal, correlative rights of other riparians to use the common resource. The right to divert and use surface water is generally confined to riparian land, the land along the stream bank. Diverting water away from riparian land is prohibited and considered unreasonable. Rights to use water off riparian lands may only be acquired by municipalities, utilities, and other users through prescription, eminent domain, or contract with all affected riparians. A riparian may divert, use and consume all water necessary for household and general domestic use. If there is a conflict with other uses, domestic uses have received priority. The riparian rules have favored the establishment of water-consuming industries on the lower reaches of Pennsylvania's major rivers.

2. Groundwater Rules

The riparian rules generally are followed for use of groundwater flowing in a rare "subterranean stream." But different rules govern the use of "percolating" groundwater, the vast majority of groundwater in Pennsylvania. Under the so-called "reasonable user" doctrine, also referred to as the "American Rule," a landowner may withdraw as much groundwater beneath his land as can be put to "natural and ordinary" use on the overlying land, regardless of the consequences to ground water supplies, wells and springs in the vicinity. As long as there is no malicious, negligent or foreseeable interference, waste or off-land use that results in harm or damage to adjacent owners, the use will not be enjoined. Most economic activities are considered natural and ordinary if the use of the water is confined to the overlying land. Groundwater rules are not designed to deal equitably with conflicts among users or to protect the resource. The biggest pump or the deepest well often wins. Furthermore, Pennsylvania courts have held that the

[26] *See* R.T. Weston and J.R. Burcat, *Legal Aspects of Pennsylvania Water Management,* WATER RESOURCES IN PENNSYLVANIA: AVAILABILITY, QUALITY AND MANAGEMENT (1990).

withdrawal of groundwater for use off the land of origin by public water suppliers is not a natural and ordinary use. Liability for damages may be imposed if the withdrawal interferes with other users, unless water is supplied to all interested injured parties.

## State Statutory Law

Superimposed on Pennsylvania's common law system are numerous statutory laws that regulate, piecemeal, particular uses or users. There is no statewide cohesive water resources management scheme that balances the needs of users while protecting the resource.

The *Water Rights Act*[27] authorizes the grant to public water supply agencies[28] of the right to acquire water rights to surface waters of the commonwealth, thus overcoming the common law prohibition against the use of water off the land of withdrawal. The statute replaced the old eminent domain system for individual municipal water allocations and vested allocation authority in one state agency, now DEP, the successor agency to the Water and Power Resources Board. The Act prohibits water suppliers from acquiring or taking surface waters without a permit. The permitting process requires proof of the need for the water, and that the taking will not interfere with navigation, jeopardize public safety or cause substantial injury to the commonwealth. DEP may condition the approval, including requiring minimum flow releases from dams and reservoirs and pass-by flows that establish minimum instream low flow that will not be allocated to any water supplier. Since public water supply agencies have been estimated to account for only about 10 percent of the surface water uses in Pennsylvania, the Water Rights Act allocation provisions cover only a small portion of Pennsylvania's water resources.

The *Dam Safety and Encroachments Act*[29], which replaced the 1913 Water Obstructions Act, grants DEP the authority to regulate the construction, operation and maintenance of dams and other water obstructions. Under this authority, DEP also establishes minimum stream flow requirements for dammed waterways. The Act also establishes the legal basis for Pennsylvania's regulation of activities encroaching upon or affecting wetlands. Permits are required for projects involving the modification to the course, current or cross section including the fill, draining, inundation or other encroachment on all wetlands in the commonwealth. Submerged lands licenses are required to occupy the beds of navigable rivers that are owned by the commonwealth.

The *Limited Power and Water Supply Act*[30] established two separate programs covering power projects and water supply facilities involving diversion of surface waters. The public water supply portion of the Act has been superseded by the 1939 Water Rights Act. The Act requires that any person who uses a dam or alters a stream or other body of water in order to develop hydroelectric power, or who diverts water for thermal-electric plant steam generation or cooling, must obtain a limited power permit from DEP. This statute is limited in its application to those non-FERC regulated facilities on non-navigable waters that do not affect interstate or foreign commerce.

The *Water Well Drillers License Act*[31] requires an annual license for all drillers and drilling rigs and the submission of groundwater information to the Department of Conservation and Natural Resources' Bureau of Topographic and Geologic Survey.

The commonwealth uses the general disaster and emergency management authority in the *Pennsylvania Emergency Management Services Code*[32]to respond to water resource shortages. Once the governor issues a Proclamation and declares a drought or a water shortage emergency, the PEMA drought regulations, at 4 PA. Code Chapters 118, 119 and 120, govern the management of water uses and water supplies, including the authority to curtail nonessential uses, to require preparation of drought contingency plans and to ration

[27] 32 P.S. §631 *et seq.*
[28] "Public water supply agency" is defined as "any corporation or any municipal or quasi-municipal corporation, district, or authority … vested with the power, authority, right, or franchise to supply water to the public in all or part of any municipal or political subdivision of the Commonwealth of Pennsylvania." 32 P.S. §631.
[29] 32 P.S. §693.1 *et seq*.
[30] 32 P.S. §591 *et seq*.
[31] 32 P.S. §645.1 *et seq*.
[32] 35 Pa.C.S. §7101 *et seq*.

water to conserve dwindling supplies. The Commonwealth Drought Coordinator, a DEP official, considers requests for variances and exemptions from the drought rules and must approve all local water rationing plans.

The *Water Resources Planning Act*[33] authorizes the preparation of a new *State Water Plan*, requires the registration with DEP of all withdrawals exceeding 10,000 gpd, and prohibits political subdivisions from allocating water resources.

## Three Key Decisions that Pose Important Legal Issues in Pennsylvania Water Management

A 1996 decision[34] by the Environmental Hearing Board (EHB) indicates that DEP is vested with indirect authority under the *Pennsylvania Safe Drinking Water Act*[35] to regulate groundwater withdrawals by public water systems to avoid violation of other state environmental laws, including the *Clean Streams Law*[36]. The EHB held that it was DEP's duty to protect waters of the commonwealth, such as wetlands, from pollution and degradation, and that diminishment of water quantity can constitute water pollution.

The Pennsylvania Commonwealth Court, in a 1994 decision[37], held that *the Municipalities Planning Code*[38] gave municipalities authority akin to a court of equity to approve, in the context of a zoning decision, the use of groundwater off the land of withdrawal by a public water supply agency. A 1995 decision[39] by the same court in the same matter, later affirmed by the Pennsylvania Supreme Court, held that local governments were preempted from imposing conflicting conditions on groundwater withdrawals approved by a river basin commission. Act 68 of 2000 added Section 603(b) of the code that recognized the preemptive effect of state or federal laws on zoning ordinances that regulate uses of land, watercourses and other bodies of water.

## Federal Compacts and Law

Pennsylvania is a member of two interstate compact commissions with regulatory authority over water withdrawals, the *Delaware River Basin Commission* (DRBC)[40] (1961) and the *Susquehanna River Basin Commission* (SRBC)[41] (1970). The effect of the compacts, consented to by Congress and each with full participation of the federal government, is that the member states and the federal government jointly exercise sovereignty over the water resources of the respective basin. Both commissions, by regulation, require prior approval of groundwater or surface water withdrawals exceeding 100,000 gallons per day. The SRBC also regulates consumptive uses that exceed 20,000 gallons per day. In 1981, because of threatened overuse of the resource, the DRBC established by regulation[42] the Southeastern Pennsylvania Groundwater Protected Area where a permit is required for all withdrawals of groundwater in excess of 10,000 gallons per day. Both compacts explicitly reserve to the states their traditional powers to manage waters within their boundaries and tend to defer to the state agency's permitting decision.

The *International Joint Commission* (IJC), a six-member board created by the United States and Canada under the *Boundary Waters Treaty of 1909*, governs the use, obstruction or diversion of boundary waters of the Great Lakes, including Lake Erie. The IJC receives "references" from the U.S. and Canadian governments to study and issue reports. The *Great Lakes Basin Compact*[43] (1956) created the *Great Lakes Commission*, which was limited by the U.S. Congress's consent to that compact in 1968 to be a consultative agency only and prohibited from offering full membership to the Canadian provinces.

[33] 27 Pa.C.S. §3101 *et seq*.
[34] *Oley Township et al. v. DEP and Wissahickon Spring Water, Inc.*, 1996 EHB 1098.
[35] 35 P.S. §721.1 *et seq*.
[36] 35 P.S. §691.1 *et seq*.
[37] *State College Borough Water Authority v. Board of Supervisors of Benner Township*, 645 A.2d 394 (Pa. Cmwlth. 1994).
[38] 53 P.S. §10101 *et seq*.
[39] *Levin v. Board of Supervisors of Benner Township*, 669 A.2d 1063 (Pa. Cmwlth. 1995), aff'd per curium, 689 A.2d 224 (Pa. 1997).
[40] 32 P.S. §815.101 *et seq*.
[41] 32 P.S. §820.1 *et seq*.
[42] 18 CFR Part 430.
[43] 32 P.S. §817.1 *et seq*.

Under the *Great Lakes Charter*, a good faith agreement entered into in 1985, diversions and consumptive uses of the waters of the Great Lakes Basin in excess of five million gallons a day require prior notice and consultation among the Great Lakes Governors and Premiers of Ontario and Quebec. In the *Water Resources Development Act*[44] *(WRDA)*, as amended in 2000, the U.S. Congress enacted a federal law that prohibits the diversion or export of water from the Great Lakes for use outside the basin without the approval of the Governors of all eight Great Lakes states. In 2001, the Great Lakes governors and premiers adopted an amendment to the Charter, called *Annex 2001*, in which they committed to develop a new conservation-based standard and new agreements among the eight Governors and two Premiers in three years to manage the Great Lakes. After submitting for public review and comment two different drafts of those proposed agreements in 2004 and 2005, the Great Lakes governors and premiers announced in December of 2005 the signing of the *Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement* and also released a *Great Lakes – St. Lawrence River Basin Water Resources Compact*[45]. The Agreement calls for adoption of legislation in each jurisdiction to prohibit diversions from the Great Lakes, with narrow exceptions, and to manage withdrawals in accordance with new common standards. During 2007 and 2008, legislation adopting the Compact has been signed into law in all eight states (Mich, Minn, Ill, Ind, NY, Ohio, Pa and Wis). On July 4, 2008, Gov. Rendell signed Act 43 of 2008, Pennsylvania's statute implementing the Great Lakes Compact. The U.S. Congress affirmed the Compact through a joint resolution that was signed by President Bush on October 3, 2008. The new Compact will become effective on December 8, 2008.

## Local Regulation of Water Withdrawals

The role of local regulation of water withdrawals and water rights, and its relationship to State and river basin commission regulation, remains unsettled.

Municipalities have various powers which directly or indirectly affect water use. The Borough Code specifically authorizes municipal regulation of water wells.[46] Other municipalities have the power to adopt ordinances deemed necessary for the peace, health, safety and welfare of the municipality. All municipalities are authorized by the Municipalities Planning Code to adopt zoning ordinances which permit and regulate "uses of land, watercourses and other bodies of water."[47] Among the allowable purposes of zoning ordinances are to promote or facilitate access to water and provision of adequate water.[48]

Acts 67 and 68 of 2000 amended the Municipalities Planning Code ("MPC"),[49] adding several provisions that address water resources. Act 68 amended Section 301(b) of the MPC to provide that a county, multimunicipal or municipal plan shall include a plan for the reliable supply of water. Local plans also shall be generally consistent with the *State Water Plan* and applicable river basin commission plans.

Act 68 amended MPC §603(b), which establishes the basic authority for municipalities to enact zoning ordinances. New language at the beginning of §603(b) indicates that except to the extent that zoning regulations of certain activities are preempted by certain enumerated statutes "or that regulation of other activities are preempted by other Federal or State laws," zoning ordinances may regulate uses of land, watercourses and other bodies of water. The MPC had previously allowed for zoning ordinances to regulate uses of land, watercourses and other bodies of water.

The amended MPC gives much greater emphasis to comprehensive planning and to the consistency of zoning and land use decisions to such comprehensive plans. MPC §603(j) calls for municipal zoning ordinances to be generally consistent with municipal or multimunicipal comprehensive plans, or where none exist, with the municipal statement of community development objectives and the county comprehensive plan.

[44] 42 U.S.C. §1962d-20.
[45] *See*, generally, the Council of Great Lakes' Governors website, www.cglg.org.
[46] 53 P.S. 46202(39).
[47] 53 P.S. §10603(1).
[48] *Id*. §10604(1).
[49] 53 P.S. §10101 *et seq.*

Act 67 amended Article XI of the MPC to provide new authority for intergovernmental cooperative planning and implementing agreements. Subsection 1105(c) provides that "Nothing in this article shall be construed to authorize a municipality to regulate the allocation or withdrawal of water resources by a municipal authority or water company that is otherwise regulated by the Pennsylvania Public Utility Commission or other Federal or State agencies or statutes."

Act 68 also adds a new Section 608.1, requiring that municipal authorities and water companies that plan to expand water, sanitary sewer or storm sewer service into a municipality which has not previously approved such extension shall provide notice to that municipality. At the same time, this section states that the authority of the PUC over public utility facilities and services shall not be limited, and that nothing in the new section authorizes a municipality to regulate the allocation or withdrawal of water by any person, municipality or water company.

Both Acts 67 and 68 contain provisions providing for state agency consideration of local plans. Section 1105 (added by Act 67) applies where municipalities have adopted a county plan or a multimunicipal plan, and the participating municipalities have conformed their local plans and ordinances to the county or multimunicipal plan by implementing cooperative agreements and adopting appropriate resolutions and ordinances. Under those conditions, state agencies "shall consider and may rely upon" comprehensive plans and zoning ordinances "when reviewing applications for the funding or permitting of infrastructure or facilities." Similarly, Section 619.2 (added by Act 68), applies where a county adopts a comprehensive plan in accordance with MPC §§301 and 302, and any municipalities in the county have adopted both comprehensive plans and zoning ordinances in accordance with MPC §§301, 303(d) and 603(i)[50] (which require consistency with such comprehensive plans). Where these conditions are satisfied, state agencies "shall consider and may rely upon" comprehensive plans and zoning ordinances "when reviewing applications for the funding or permitting of infrastructure or facilities."

The Water Resources Planning Act[51], however, provides evidence that municipalities are precluded from directly regulating water withdrawals and water allocation. Section 3136(b) of the Act declares, in pertinent part:

> (b) Limitations on Water Allocation Authority. -- The General Assembly reiterates the declarations of other statutes reflecting the need to manage water resources on a watershed basis without respect to political boundaries and the understanding that water management programs should be based upon an accurate and current state water plan. Accordingly, no political subdivision shall have any power to allocate water resources or to regulate the location, amount, timing, terms or conditions of any water withdrawal by any person.

This preclusion is tempered by language in §3136(c) which preserves the power of municipalities to adopt and enforce ordinances pursuant to the Emergency Management Services Code[52] and ordinances regulating the use of land pursuant to the Pennsylvania Municipalities Planning Code or other laws. Thus, the WRPA creates a distinction between municipal regulation of land use and municipal regulation of water withdrawal and water allocation. Further, each municipality is allowed to retain authority conferred by other statutes to adopt ordinances and regulations concerning: (1) mandatory connection to and use of available public water supplies; and (2) the prohibition or regulation of withdrawals from particular sources of water that may be contaminated in order to protect public health and safety from exposure to the contamination or to avoid the induced migration of contamination.

[50] The reference in §619.2(a) to §603(i) of the Act may be an erroneous cross-reference, and may instead be intended to refer to §603(j).

[51] 27Pa.C.S. §3101 et seq.

[52] 35 Pa.C.S. Pt. V.

## Water Withdrawal and Use Management and Recommendations

### Obtaining an accurate picture of current water use and projecting water use trends

In order to evaluate and formulate water policies, and to project, guide and manage water withdrawals to assure adequate and sustainable supplies, DEP needed to base the foundation of technical work on accurate information concerning current water uses and an ability to forecast trends in water withdrawal and use. For its first five years of the *State Water Plan* process, DEP focused its data collection efforts towards its priority of identifying critical water planning areas under existing demand conditions through a state-wide assessment of water availability. This existing condition analysis has been built upon data obtained largely from the initial registration process required under the WRPA with additional data coming from registrations received since the base registration year of 2003, from information obtained through verification work by technical partners and estimations to fill in for unregistered withdrawals.

Regulations establishing the ongoing reporting of water withdrawals will become effective in December 2008. These regulations requiring periodic reports collected from all significant water users regarding the amount of their withdrawals and consumptive uses are needed to improve the extent and quality of information currently collected under voluntary interim processes.

One of the tasks of the *State Water Plan* beyond the focus of existing demand conditions involves projection of current and future water use trends. While Statewide screening for the identification of critical water planning areas using the Water Analysis Screening Tool (WAST) has included preliminary demand projections, the projection of future demands and analyses of water use trends is planned to be fully developed for watersheds during future statewide water plan technical work and during development of critical area resource plans (CARPs).

*Recommendation 1*: The water use registration and reporting regulations should be adopted and implemented as expeditiously as practicable to facilitate the gathering of more accurate and timely water withdrawal and use information. DEP, in concert with stakeholder organizations, should engage in concerted outreach efforts to improve the understanding of, and compliance with, the registration and reporting program.

*Recommendation 2*: The next phase of the *State Water Plan* should include, among other items, increased attention upon the development of water use projections in each watershed for the next 20 years, and the evaluation of major water use trends.

## Evolving Pennsylvania's common law water rights doctrines and regulated riparian programs

Pennsylvania stands at an interesting point along the road of evolution of its water rights regime and programs for securing and managing water withdrawals. On the one hand, Pennsylvania's common law water rights doctrines lack clarity, predictability and administrative efficiency, and reflect a number of historical anachronisms and inconsistencies starting with divergent and conflicting approaches to managing surface and ground waters. Pennsylvania's state-level regulatory programs relating to water withdrawals are relatively weak, narrow and fragmented, with the only program specifically designed to address withdrawals (the Water Rights Act) focused solely on surface water withdrawals by public water supply systems – a use which reflects less than 10% of the total withdrawals across the commonwealth. On the other hand, in the Delaware and Susquehanna River basins, interstate basin commission water withdrawal permitting programs have been in place for nearly 50 and 40 years, respectively, and those programs appear to be functioning with generally broad acceptance and administrative efficiency.

To the extent that the commonwealth continues to rely exclusively or predominantly on common law doctrines to define water rights (which is

certainly the case outside of the Delaware and Susquehanna Basins), we need to consider how well the common law works and whether it effectively addresses current conditions and challenges. The current common law system in Pennsylvania has been criticized by knowledgeable commentators as having several significant problems:

- The common law doctrines largely ignore, and fail to accommodate, the hydrologic connection between ground and surface waters. As a result, the rules governing ground and surface water rights are inconsistent and incompatible.

- Common law water rights are not well defined; users obtain no defined amount of water upon which they can rely over a period of time. The lack of such definition and security can inhibit investments in enterprises that need long-term reliable supplies of water.

- The common law, which is built around deciding disputes between parties only as they arise, cannot address conditions on a watershed basis or "look ahead" to forecast and avoid conflicts among users or uses, including instream uses.

- The resolution of water rights disputes is almost always after the fact, and involves lengthy and expensive litigation proceedings before civil courts. Courts (judges and juries) are not trained in the technically complex hydrologic and geologic issues involved in water management issues, and such disputes frequently become a battle of experts.

- The common law has difficulty managing water as a replenishable resource as there is no practical avenue for recognizing and implementing a "water budget" concept or for protecting the water resource itself.

- The traditional concept of limiting water use to the lands immediately along a stream or on which a particular well is located is not practical in the modern world.

The question is, how do we evolve these arrangements to a more consistent, secure and holistic approach that (1) offers water users well-defined, stable and predictable water rights; (2) promotes siting and development of uses requiring withdrawals in ways that assure adequate and sustainable supplies both in normal and drought periods, without causing unacceptable impacts on instream uses and environmental resources; (3) is administratively efficient and avoids unnecessary duplication between agencies and programs?

There are a number of options that may merit review and evaluation, including:

(1) Codifying and clarifying common law rules, including harmonizing surface water and groundwater doctrines, through an approach similar to that followed in Ohio (which opted to adopt into state law the principles of the Restatement [Second] of Torts).
(2) Developing an alternative dispute resolution process for addressing water rights disputes, such as an expert mediation or arbitration service, with the capability of drawing upon the information and expertise of the *State Water Plan* process.
(3) Updating the Water Rights Act[53] and program for regulating public water supply agency withdrawals to encompass both groundwater and surface water, and to clarify the criteria to be considered in granting permits.
(4) Adopting a regulated-riparian approach on a watershed-by-watershed basis to manage withdrawals and establish water rights, utilizing existing programs (such as the SRBC and DRBC arrangements in the Delaware and Susquehanna River Basins and the new Great Lakes-St. Lawrence River Basin Water Resources Compact), and framing similar programs as appropriate in other basins (*e.g.*, the Ohio and Potomac River watersheds).
(5) Adopting a regulated-riparian approach in critical water planning areas if and when such critical areas are designated under the *State Water Plan*.
(6) Developing a statewide regulated-riparian program, similar to those in New Jersey, Maryland and Virginia, and recommended in the ASCE model water rights code.

[53] 32 P.S. §631 et seq.

Each of these options has some advantages and potential disadvantages or questions, and much will depend upon the acceptability of each option to the key stakeholders.

In the context of the review of these options, consideration should be given to policies and appropriate approaches for managing withdrawals to conserve flows needed for instream and downstream uses, including fisheries and aquatic systems. Those discussions should include a thorough review of the models, field experience and scientific data available concerning the relationship between flows, habitats and actual fish populations (considering the myriad of factors affecting such populations), and an examination of the impacts on sustainability and reliability of water supplies of various policy options relating to pass-by, conservation flows and the application of such policies to surface and groundwater withdrawals in various watersheds.

*Recommendation 3*: As further information concerning Pennsylvania's water use trends and challenges are developed over the next five years leading up to the next update of the *State Water Plan*, concerted focus should be placed on considering and evaluating the above options and issues, evaluating programs that are used in other states, utilizing a process which includes DEP, the Statewide Committee and other major stakeholders. Based on that process, a report on the relative merits of the identified options should be developed, and appropriate recommendations should be made to the General Assembly as to whether and how Pennsylvania's water rights system might be improved and made more efficient, effective, predicable and secure.

# WATER QUALITY

## Introduction

Water quality is influenced by both natural and anthropogenic conditions. Underlying geology, topography, soils and the presence of vegetation, combined with human activity on the landscape, interact to define water quality at any given location. The quality of surface water and ground water is vital to the health and quality of life for every Pennsylvanian and is crucial to sustaining indigenous water-dependent biological communities.

Several factors can lead to the impairment of water quality; the most common causes in Pennsylvania are sedimentation, metals and nutrients. There are numerous sources that contribute to these causes including agriculture, mining, wastewater treatment plants, development and urban runoff. A factor that is often overlooked is how a change in the quantity of ground or surface water can affect water quality. While DEP manages and regulates many aspects of water, it is common for DEP programs to only consider the management and regulation for the single purpose of their program, such as a potable water supply. Additionally, the regulation of water is segregated into different categories (water supply, wastewater treatment, stormwater management, wetlands protection, etc.) making it difficult to evaluate the pressures created by multiple changes to the watershed. An integrated approach to comprehensive water use planning will account for all the water users and dischargers in a watershed, will provide for the proper siting of those users, will protect sensitive areas, and will provide long term assurance that both water quantity and quality will be maintained for future generations.

## Challenges

### Causes and Sources of Impairment

Human activities that disturb the surface of the land have an impact on water quality; the goal is to conduct those activities in such a way that the impacts to the land surface and the potential impacts on water quality are minimized to the greatest extent possible. Pennsylvania has over 86,000 miles of streams. More than 16,200 miles of those streams are impaired due to sedimentation, metals and nutrients.

A certain amount of erosion and sedimentation occurs naturally, and the watercourse is able to assimilate these naturally occurring sediments without permanent adverse water quality impacts. Adverse effects most often result from accelerated erosion due to earth disturbance activities such as mining, agriculture, development and urban runoff. Approximately 8,700 miles of streams in Pennsylvania are impaired due to sedimentation. Excess sediment adversely affects water quality and water dependent biological communities; sediment can cover fish eggs and aquatic insect habitat resulting in declining fish populations. Sediment clouds the water and deprives plants of light needed for photosynthesis. Sediment has economic significance through increased treatment costs for public drinking water supplier and in the clean-up and restoration of impaired waterways. Additionally, sediment conveys other pollutants such as heavy metals and excess nutrients that spread by water action and cause problems not only at the source but also downstream.

Heavy metals, such as zinc, arsenic, selenium, lead and cadmium degrade water quality and may harm aquatic life. Heavy metals are introduced to surface and ground water through acid drainage from abandoned mines, and by urban runoff contaminated by petroleum products and industrial processes. Over 4,800 miles of streams in Pennsylvania are impaired due to heavy metals. Some heavy metals, such as copper, selenium and zinc, are essential in trace amounts to maintain the metabolism of the human body. At high concentrations, however, these metals are toxic. Many heavy metals bioaccumulate, or build up, in concentration in the body tissue of both animals and humans, causing long term health concerns.

Nitrogen and phosphorous are vital to all forms of life and are essential for crop production; however, when present in excess amounts these nutrients are detrimental to water quality and aquatic life. The main sources of nutrients are agriculture, wastewater treatment plants and urban runoff. Over 2,700 miles of stream in Pennsylvania are impaired by excess nutrients, and nutrient pollution has been identified as the primary problem in the Chesapeake Bay. Excess nutrients stimulate algae and other aquatic plant growth. This excessive aquatic plant growth can be deleterious to the physical, chemical and biological properties of the ecosystem. The resultant degradation has impacts on all water uses, from aesthetics and quality for recreation and fishing, to increased costs for treatment by drinking water suppliers.

## Changes in Flow

In-stream flow reduction can reduce available habitat for aquatic communities and diminish the ability of a waterway to process or assimilate pollutants. Changes in flow magnitude, duration, frequency, timing and rate-of-change all have consequences. A new withdrawal of significant volume could diminish available water and cause in-stream quality to deteriorate. Upstream withdrawals of either groundwater or surface water can reduce the base flow of a stream. Many areas are served by regional wastewater treatment plants that discharge at the base of the watershed. Water used by upstream residents and the surrounding community then travels through sewer pipes to the point of treatment, effectively removing it from the drainage system because the stream no longer receives it as base flow in the headwaters. This situation is exacerbated as development expands further upstream in the headwaters.

Another in-stream flow concern affecting both water quantity and quality is “flashy” flows. A stream is characterized as flashy if it exhibits low flows and quickly rises to bank-full or flood levels during storm events. While some streams are naturally flashy due to the geologic makeup of the watershed, many streams are made flashy by increased urban runoff from impervious surface areas and poor stormwater management practices. These wide fluctuations in flow produce increased bank erosion, resulting in a turbid, sediment laden stream. Stream flow spikes can change the geomorphology of the stream by altering its width and the riffle to pool ratio, as well as its biology, by physically removing organisms when the stream bottom is scoured. These physical changes frequently lead to broadly varying temperatures and dissolved oxygen levels in the water, both of which can be injurious to the water body.

## Protection of Sensitive Areas

The protection of sensitive areas such as well heads, headwaters, wetlands, river and stream corridors and flood plains contribute to the improvement of both water quantity and quality. Over three million Pennsylvanians rely on groundwater obtained from public or private wells. While public water supply wells are required to meet strict construction standards, private residential water well construction is largely unregulated and no minimum statewide construction standards are in place. Pennsylvania is one of only two states that do not have statewide standards regulating private water well construction. Properly sited and constructed water wells are reliable and safe sources of drinking water, and they prevent ground and surface water contamination.

Headwaters, where large rivers and streams begin, consist of a network of small upstream tributaries. The continued development of land in headwater regions alters the landscape, triggering changes to stream flow and water quality. Stream flow is affected by changes in natural stormwater runoff patterns and increased use of ground and surface water. These changes in stormwater patterns often include increases in volume and velocity that produce impairment as noted earlier. Water quality, as discussed previously, may be altered by quantity changes, and also by the introduction of pollutants in stormwater runoff and from other human activities that previously did not occur in the area.

The corridors directly along streams and rivers, known as riparian zones, are vital to maintaining water quality. When managed properly, riparian zones act as buffers to slow

runoff to streams, to filter pollutants and to provide vegetation to stabilize stream banks. These corridors also act as floodplains to provide storage for excess water during flood events. Riparian zones are critical to providing habitat for Pennsylvania's wildlife and aquatic communities.

## Water Dependent Biological Communities

There is an astounding diversity of aquatic life in Pennsylvania's streams and lakes that depend directly on an adequate amount of stream flow and appropriate habitat. The natural regime of high and low flow forms stream channels and supports the highest diversity of species. Consistent low flow conditions resulting from overtaxed aquifers, or frequent high flows where stormwater runoff is uncontrolled, reduce the number of species supported by an aquatic system.

Water dependent plant and animal life is found in perennial streams, intermittent and ephemeral streams, wetlands and the hyporeal zone, which is the interface between surface and groundwater. Pennsylvania's waters are crucial to some part of the lifecycle of at least 1200 kinds of insects and other invertebrates, such as crayfish, aquatic worms and mussels. The presence and diversity of these biological communities are the greatest indicators of the water quality in our streams. Balancing water as a resource to meet sustainable consumptive uses while supporting Pennsylvania's diverse biological communities needs to be a basic tenet in integrated water resources planning.

## Recommendations

1) To reduce sediment and nutrient loads to improve Pennsylvania water quality, and to meet Chesapeake Bay Tributary Strategy goals, the commonwealth should provide funding for –

    a. Increasing loans, grants and tax incentives for infrastructure improvements to sewage treatment facilities;

    b. Increasing loans, grants and tax incentives for agricultural Best Management Practices; and

    c. Establishing loans, grants, and tax incentives for infrastructure improvements and retrofitting of stormwater management facilities.

2) The commonwealth should enact legislation requiring certification of water well-drillers and establishing private water well construction standards -- There are currently national testing and certification programs available that measure the proficiency of applicants for initial licensing or renewal. The National Groundwater Association, among others, has functional model programs already developed. Pennsylvania should draw upon this expertise to establish a proficiency-based licensing and renewal system for water well-drillers. Legislation should be enacted to establish construction standards for private water wells. These standards should include:

    a. Well Siting/Location – Wells must be protected from potential contamination sources and appropriate distances from known points of contamination must be provided.

    b. Construction – Specifications should be established for grouting, casings and screening materials in order to preclude the entrance of contaminants.

    c. Reporting –Post-drilling reports that document water quality and quantity should be required and be provided to the landowner and the appropriate regulatory agencies.

3) The commonwealth should continue funding for abandoned mine discharge restoration – Pennsylvania has made substantial progress in the treatment of abandoned mine drainage by partnering with local municipalities and watershed organizations. The continuation of that progress should be encouraged by establishing a dedicated funding source to implement and maintain abandoned mine drainage treatment facilities.

Local government land use planning decisions should consider the impacts on water as a resource -

a. Land use planning and zoning ordinances should consider the impacts of land use, development and redevelopment on water quantity and quality.

b. The protection of water resources must be considered early in the development planning process in order to address cumulative impacts to a watershed.

c. Alterations to the landscape must also consider stormwater management. It is important that stormwater be considered as a resource and be managed for re-use and recharge of the groundwater.

d. Protect, maintain and restore functions and values of sensitive areas during development and redevelopment. Sensitive areas within the watershed, such as wetlands, well heads, headwaters and riparian zones should be protected from the potential impacts of future development.

e. The last defense to protect water quality is the land immediately adjacent to rivers and streams. To the maximum extent practicable and cost effective, vegetated buffers should be preserved and restored along all waterways.

5) DEP along with other appropriate Commonwealth agencies should develop guidelines and tools for groundwater assessment – Guidelines should be developed for assessing and minimizing cumulative hydrologic impacts in a watershed resulting from any activities on the land. A tool, similar to the Water Analysis Screening Tool, should be developed to assess the quality and quantity of groundwater and identify areas of impairment.

# ASSESSMENT OF NAVIGATION NEEDS AND THE MEANS FOR RESTORATION, DEVELOPMENT AND IMPROVEMENT OF TRANSPORTATION BY WATER

## Introduction

Pennsylvania's commercial and recreational navigation assets provide significant economic benefit to the commonwealth. Navigational commerce offers direct employment and supports thriving businesses that depend on the availability of commercial ports and accessible waterways. Commercial port activities on the Delaware Estuary, Lake Erie, and on the Allegheny, Monongahela and Ohio Rivers are vital to the economy of surrounding regions. Many Pennsylvanians and visitors to the commonwealth also enjoy sailing, pleasure boating, fishing and other water sports that further contribute to the economic strength and the quality of life in Pennsylvania.

The commonwealth has a legal obligation to preserve public rights in submerged lands of the commonwealth and navigation. Pennsylvania's water resource management decisions should support both commercial and recreational navigation opportunities but must also carefully consider public trust responsibilities as well as economic benefits, the needs of water dependent uses, wetland and aquatic resources preservation and private property rights.

Institutionally, there are numerous public and private organizations and programs that collectively manage and support both commercial and recreational navigation. Examples include:

- Port authorities
- Private sector interests in shipping and support services
- U.S. Army Corps of Engineers' divisions and districts -- dredging, infrastructure construction related to reservoir management, locks and dams and port facilities
- U.S. Department of Homeland Security -- Coast Guard districts and stations
- Water quality monitoring, ballast water management and emergency response systems
- Interstate compact commissions and international treaty organizations
- State agencies, including the Departments of Environmental Protection, Conservation and Natural Resources, Community and Economic Development (PennPorts) and the Fish and Boat Commission
- U.S. and Pennsylvania Geological Surveys, U.S. Environmental Protection Agency and the National Park Service
- Marina and other access operators
- U.S. Department of Commerce, National Oceanic and Atmospheric Administration – charting, weather services and planning support, coastal resources management and Sea Grant programs through state partnerships

## Challenges

The potential environmental consequences of commercial and recreational navigation differ by region in the commonwealth. Infrastructure needs also vary widely, extending from locks and dams, flood protection and flow management, reservoir operations and control structures, to Great Lakes water management measures affecting lake levels and ice conditions. Dredging equipment and dredged material disposal facilities, applied technological solutions for preventing the introduction and spread of invasive species (including ballast water discharge controls), short sea shipping, ferry boat support facilities and special structures related to tidal estuary and marine shipping requirements present additional challenges. Vessel types capable of operating globally and using regional infrastructure vary broadly, as do sanitation needs for marine or fresh water environments. In addition, flow management, flooding and water quantity protection and monitoring strategies are not regionally or internationally consistent.

Commercial shipping, international trade and maintenance of federal navigation channels and recreational boating harbors raise multifaceted management issues related to aquatic habitats and dredged material disposal. Alterations of navigable waterways and non-navigation related uses of submerged lands provoke questions about public benefits and equitable compensation.

Because of the importance of commercial and recreational navigation to the commonwealth, specific steps are needed to address these challenges.

## Recommendations

1) Hydrology and channel configuration create the fundamental conditions for navigation in Pennsylvania's waters. Where appropriate, the commonwealth should build on prior efforts related to infrastructure construction, shipping channel maintenance, security, adequate flow management and water quality protection to support commercial and recreational navigation. Also crucial are related mapping and dredging activities to allow safe passage. The commonwealth should work closely with the United States Army Corps of Engineers and other operators of dams and impoundments to maximize the benefits of multiple use management. The commonwealth should support bathymetric mapping of waterways used for navigation currently being conducted by the U.S. Geological Survey and the Department of Conservation and Natural Resources.

2) Safe and effective management of dredged material is important to navigation on rivers and lakes. The commonwealth, and other resource regulators and operators, should manage dredging and dredged material for multiple purposes such as enhanced navigation, beneficial uses, protection of watercourses and wetlands and beach formation.

3) The commonwealth should advance and encourage the efforts of PennPorts in the Department of Community and Economic Development, with the support of several federal agencies, to expand those efforts through regional port authorities to develop strategic plans for supporting and managing commercial navigation in Pennsylvania. The commonwealth should continue to promote the competitive position of the Ports of Philadelphia, Pittsburgh, Erie and Bucks County.

4) The commonwealth should continue to address navigation-related water quality and quantity issues such as ballast water management, wastewater and trash disposal from commercial and recreational vessels, monitoring systems, emergency response and security management.

5) The commonwealth should continue to manage public natural resources in the beds of navigable waterways, subject to the permitting and submerged lands license or legislative lease process provided under the Dam Safety and Encroachments Act[54], as well as the requirements of the Fish and Boat Code[55].

6) The commonwealth should continuously evaluate infrastructure needs for locks and dams, reservoirs and intermodal transportation facilities. Where appropriate, the Pennsylvania Fish and Boat Commission should continue to fund or endorse dam removals where the dams no longer serve a useful purpose, thereby improving migratory fish passage and eliminating obstructions to recreational navigation. The commonwealth should periodically re-examine its institutional arrangements for evaluating infrastructure needs and their adequacy for achieving the commonwealth's goals.

7) The commonwealth should continue to participate in regional institutional efforts to manage water quantities, flows and flooding, which all affect navigation. Institutional arrangements and agencies that support Pennsylvania's navigation interests such as the Great Lakes Water Management Agreements, the interstate river basin compact commissions and the International Joint Commission should be continued and encouraged.

[54] 32 P.S. §693.1 et seq.
[55] 30 Pa.C.S. §101 et seq.

8) Where appropriate, the Pennsylvania Fish and Boat Commission and other agencies should continue to fund or permit boat launches and other on-shore and in-water facilities that enhance recreational boating. Recreational boating should be facilitated in locations where it will not unduly interfere with water dependent biological communities, commercial navigation in areas with federal navigation channels or other more appropriate human uses. Diverse considerations may apply for different types of watercraft.

9) In implementing each of these recommendations, the commonwealth should continue to protect both the public rights in public trust resources and private rights in private property.

# AN ASSESSMENT OF FLOODPLAIN AND STORMWATER MANAGEMENT PROBLEMS

## Introduction

Significant flooding occurs periodically throughout Pennsylvania. Modification of the landscape, if not properly conducted, can potentially increase the frequency and amplify the magnitude of these events. Human activity on the land can radically alter drainage patterns, and intensify and redirect runoff. The consequences of this artificial intervention can be dire -- pollution, property damage and, in extreme cases, loss of life.

Topography and precipitation patterns combine to make Pennsylvania vulnerable to intermittent flooding. In response to this threat, Pennsylvania has developed one of the most extensive flood protection programs in the nation. Traditionally, DEP and its predecessors have worked with local government sponsors to address specific problems identified in flood prone communities. This collaboration has often led to the construction of earth levees, concrete lined channels, upstream detention reservoirs, channel improvements, diversions or any combination of these systems. Measures such as property buy-outs, improved stormwater management and flood proofing are also becoming more common components of flood protection programs, and of overall watershed protection and restoration efforts.

Preventing loss of life and reducing property damage due to flooding are among the commonwealth's chief priorities. These priorities have stimulated a renewed emphasis on ensuring the safety of high hazard dams, and expanding floodplain management and flood control efforts. Existing flood mitigation efforts can be enhanced by establishing floodplain management programs on a watershed basis that integrate stormwater management planning and water quality protection. Integrated stormwater and floodplain management techniques that draw on a broad spectrum of management practices, legal requirements and structural options will accelerate the restoration of natural floodplains and their flood carrying capabilities. Even the best flood control arsenal, however, will sometimes be overwhelmed. When it is, emergency response and recovery programs must stand ready to provide both immediate services and enduring remedies to affected communities.

A vigorous stormwater management program strengthens flood control efforts and supports flood protection priorities. Enhanced stormwater management planning demands expanded data collection and upgraded computer models to simulate stormwater runoff. Employing natural land features to restore and sustain the hydrologic balance of surface and ground water to prevent potential water quality and quantity degradation is essential. Once in place, assurance of continued operation and maintenance of stormwater control facilities and best management practices (BMPs) becomes critical to continued success.

Local government plays a dominant role in both floodplain and stormwater management. All municipalities that have been identified by the Federal Emergency Management Agency (FEMA) as being subject to flooding must adopt such floodplain management ordinances as are necessary to comply with the National Flood Insurance Program. Local floodplain management plans, in conjunction with stormwater management plans that provide for sound land use and development practices, could prevent or reduce future damage and substantially alleviate existing problems in flood prone areas. Local governing bodies also sponsor and financially participate in flood control projects. Priority must be placed on engaging all levels of government as partners in resolving stormwater and flooding problems. This can be accomplished through comprehensive technical assistance programs directed toward elected officials and their professional consultants. Adequate technical and financial assistance for local government officials will address the need to initiate integrated water resources planning and management on a municipal, county, or even regional watershed scale. Once developed,

vigilant and consistent implementation of those plans will become a priority for all levels of government. commonwealth agencies can also facilitate this process by incorporating integrated comprehensive water resources planning elements into their regulatory, financial and technical assistance programs.

In addition, significant progress can be made through innovation. Fostering, testing and employing innovative technology can advance stormwater management and flood control techniques beyond current capacities. Incentives for pursuing sustainable development practices are equally important, particularly in areas of rapid growth and in densely populated neighborhoods experiencing frequent flooding and degraded water quality.

Many historic problems can be remedied and future problems can be minimized, through a combination of sound planning, properly constructed and maintained infrastructure and appropriate management practices. By recognizing stormwater runoff as a valuable and reusable resource rather than as a waste that must be quickly moved away, a host of opportunities are opened to promote environmental protection and enhancement while saving money and complementing new growth and development.

Ideally, approaches to stormwater runoff management and flood protection projects should be integrated, mutually supported and guided by two fundamental principles:

- Avoiding, minimizing and addressing problems through integrated approaches to comprehensive planning and progressive development practices, and

- Mitigating any remaining problems through the use of various structural and non-structural management techniques.

These principles are straightforward, and setting goals and priorities that are consistent with them is a routine task. Translating the goals into action, however, can present major challenges. This chapter briefly describes the consequences of uncontrolled runoff and Pennsylvania's current efforts to manage stormwater and floodplains and to control flooding. Gaps, challenges and opportunities for improvement are then identified, setting the stage for specific legislative, regulatory and policy recommendations that could offer a safer and cleaner future for all of Pennsylvania.

## Framing the Issues

Pennsylvania is one of the most flood prone states in the nation. It has experienced several serious and sometimes devastating floods throughout the past century as a result of strong tropical storms, heavy rains on melting snow, ice jams and dam failures. Pennsylvania is positioned to be the focal point of unpredictable and extreme weather conditions. For example, the largest precipitation event in the recorded history of the United States occurred in August 1942 near Smethport, McKean County, when 30 inches of rain fell over a five-hour period.

Flooding disrupts and takes lives. The statewide flooding in 1972 caused by Tropical Storm Agnes alone resulted in property damage approximating $3.0 billion.[56] It was the nation's most costly natural disaster until Hurricane Andrew ravaged the southeastern United States twenty years later[57]. More recently, ten Pennsylvanians lost their lives during the June 2006 flooding that plagued the Delaware and Susquehanna River Basins[58]. These catastrophic events have not gone unnoticed. Nearly all local Hazard Mitigation Plans identify flooding as the primary potential natural disaster facing their community.

Powerful tropical storms and other severe weather events are to be expected and will periodically recur to cause significant flooding. No form of stormwater management can eliminate flooding caused by prolonged or intense precipitation. However, in many watersheds, including Walnut Creek in Erie County, Neshaminy Creek in Bucks County and Valley Creek in Chester County among others,

[56] Pennsylvania Enhanced All-Hazard Mitigation Plan, Appendix 6 of Annex W
[57] Susquehanna River Basin Commission, "History of Flooding," online posting.
[58] USGS, "Flooding in Pennsylvania -- June 27-29, 2006," online posting.

flooding from small rainfall events has also become regular due to conversion of land use and ineffective stormwater management. This increased flooding frequency is the product of new and extensive impervious surfaces generating larger volumes of stormwater runoff and discharging it more rapidly throughout the watershed.

Stream meander, and bed and bank erosion are normal processes that cause all channels to undergo continuous alteration, but greater stormwater runoff volumes can transform small meandering streambeds into highly eroded and deeply incised channels. As the volume of runoff from each storm increases, stream channels experience repeated bank-full conditions that force accelerated changes to their natural shape and form. Pools and riffles that support aquatic life are devastated, and eroded bank and substrate material blanket downstream beds with sedimentation. Defying logic, the majority of this stream channel destruction occurs during the frequent small-to-moderate precipitation events, not during major floods.

Stormwater problems are not limited to flooding. Stormwater runoff carries significant quantities of pollutants washed from impervious and altered land surfaces. The mix of potential pollutants ranges from temperature and sediment to varying quantities of nutrients, organic chemicals, petroleum hydrocarbons and other constituents that cause water quality degradation.

A delicate balance of replenishing groundwater, sustaining stream flow and evaporating surface water to the atmosphere is maintained under natural conditions. The hydrology of a watershed becomes unbalanced when stormwater runoff is removed from an area and is no longer available to recharge local groundwater reserves. An obvious consequence of a receding groundwater table is the loss of local wells. Stream base flow may diminish or even cease when deprived of its constant groundwater nourishment, turning previously productive waterways into dry and lifeless ditches. Reduced base flow may also significantly influence surface water supply sources, as well as the water quality and habitat features of a stream.

Improperly managed stormwater causes recurrent flooding, water quality degradation, stream channel erosion, reduced groundwater recharge and loss of aquatic species. The host of problems generated by impervious and altered surfaces can be avoided or minimized, but only through stormwater management techniques that include runoff volume reduction, pollutant reduction, groundwater recharge and runoff rate control for all storms.

Integrated stormwater and floodplain management programs are essential to reversing the alarming trend of intensified stream degradation and more frequent flooding caused by increased runoff volumes. This comprehensive and coordinated approach to runoff management must grow from a thorough understanding of the natural systems involved, complementary regulatory requirements and dedicated individual efforts.

## Pennsylvania's Current Stormwater Management, Flood Protection and Floodplain Management Programs

### Stormwater Management

Federal, state and local governments all have defined responsibilities and play important roles in managing stormwater runoff in the commonwealth.

Regulations promulgated by the Environmental Protection Agency (EPA) under the federal Clean Water Act[59] require National Pollutant Discharge Elimination System (NPDES) permits for most construction activities affecting one or more acres and for ten other categories of industrial activities. All NPDES permit applicants for construction activities must submit a post-construction stormwater management plan describing BMPs that will be maintained after building has been completed. This requirement establishes the critical link between temporary soil erosion and sediment control measures and long-term stormwater management practices.

[59] 33 U.S.C. §1251 *et seq.*

The original federal stormwater rules required medium and large municipalities (those with populations greater than 100,000) with separate storm sewer systems to obtain an NPDES permit for their stormwater discharges. Philadelphia and Allentown were the only two Pennsylvania cities that met these criteria. The 1999 regulatory amendments expanded the NPDES permit requirements to encompass 942 small municipal separate storm sewer systems (MS4s) in Pennsylvania. Each permittee must, within the permit term, develop and enforce a stormwater management program designed to reduce the discharge of pollutants to the maximum extent practicable, with the goal of protecting water quality and satisfying water quality requirements of state and federal law. The program must contain a schedule of activities, and identify BMPs and measurable goals for six Minimum Control Measures, one of which is addressing post-construction stormwater management in new development and re-development settings.

The Pennsylvania Clean Streams Law[60] establishes the legal foundation for water quality protection and restoration and water resources management in Pennsylvania. It also gives DEP authority to implement related federal regulatory programs. In its Declaration of Policy, the Clean Streams Law states, "clean, unpolluted water is absolutely essential if Pennsylvania is to attract new manufacturing industries and to develop Pennsylvania's full share of the tourist industry". It also affirms that the law's objective is "not only to prevent further pollution of the waters of the commonwealth, but also to reclaim and restore to a clean, unpolluted condition every stream in Pennsylvania," and that prevention and elimination of water pollution is directly related to the economic future of the commonwealth. In addition, this section of the law maintains that "a comprehensive program of watershed management and control" is required to meet these objectives. In response to these declarations, the legislature conferred certain powers and duties on DEP to consider "water quality management and pollution control in the watershed as a whole," and to take the "present and possible future uses of particular waters" into account. Further, DEP was given the power to "coordinate and be responsible for the development and implementation of comprehensive public water supply, waste management and other water quality plans". This statute has a broad range and establishes the critical bonds among clean water requirements, watershed planning and stormwater management.

The Pennsylvania Storm Water Management Act[61] forms the specific legislative basis, and serves as the centerpiece, for statewide stormwater management. It enables county and municipal governments to develop comprehensive watershed stormwater plans that address their entire spectrum of needs and demands created by uncontrolled runoff and development pressures. Specifically, this legislation establishes a systematic program for counties to prepare watershed-based stormwater management plans that provide control measures to preserve and restore stormwater runoff quantity and quality; groundwater supplies; and groundwater recharge areas from future development, existing development and other activities that may affect stormwater runoff. A water quality protection component must be included in every stormwater management watershed plan. The recommended control measures in the completed plan are implemented through the adoption of ordinances and regulations by local municipalities. DEP provides 75% reimbursement of eligible costs incurred in developing and implementing these plans. All of these factors combine to make this process an attractive and effective tool that outlines an integrated approach to watershed-based stormwater management.

On September 28, 2002 DEP published its Comprehensive Stormwater Management Policy. The policy promotes a comprehensive watershed approach to stormwater management in the commonwealth. The goals of the policy are to improve and sustain ground and surface water quality and quantity through the use of sound planning practices and BMPs that reduce the generation of stormwater runoff, provide groundwater recharge and minimize the harmful influence that stormwater discharges have on ground and surface water resources.

[60] 35 P.S. §691.1 *et seq* .

[61] 32 P.S. §680.1 et seq.

The policy also supports state regulatory obligations to protect and maintain existing stream uses and the level of water quality necessary to protect those uses in all surface waters, and to protect and maintain water quality in High Quality[62] and Exceptional Value[63] waters.

Specific regulation of land development and activities that affect stormwater runoff in Pennsylvania must be achieved through adoption of ordinances and zoning by local government. This places extraordinary responsibility directly in the hands of 2,565 separate jurisdictions that exhibit diverse natural, social and cultural features, and possess an equally diverse set of needs and priorities. Because the Pennsylvania Municipalities Planning Code[64] enables, but does not require, local government officials to adopt comprehensive planning, zoning and subdivision/land development regulations, a wide assortment of requirements has evolved. Nevertheless, the authority under the Municipalities Planning Code remains the key to improving stormwater management practices statewide.

Pennsylvania's stormwater management program operates under a complex structure of shared authority and power by all levels of government. This presents both challenges and opportunities. Challenges include coordinating among layers of government, ensuring baseline consistency and the near absence of mandatory local regulation. Conversely, this shared government responsibility often promotes tailored and more flexible local requirements, stronger commitments and superior results.

## Floodplain Management

Floodplains are a vital part of the native ecosystem. In addition to providing natural storage of floodwater, they supply valuable and unique habitat for wildlife and plants, serve as excellent recreational resources, and can be extremely fertile cropland.

Floodplain management is a local government responsibility authorized under the Pennsylvania Flood Plain Management Act[65]. Under the Act, each municipality that FEMA has identified as having an area or areas subject to flooding must adopt such floodplain management ordinances as are necessary to comply with the National Flood Insurance Program (NFIP). This includes at least portions of approximately 98% of Pennsylvania's municipalities. Local floodplain management regulations must be consistent with regulatory criteria established by the Department of Community and Economic Development (DCED). These criteria, standards and requirements are summarized below:

- Consideration must be given to the comprehensive planning and land use activities being undertaken by other municipalities within the watershed.
- Floodplain management plans, programs and activities must be coordinated and be compatible with the needs and circumstances of the watershed generally, and with any floodplain management or storm water management plan that has been adopted by any group of municipalities, county or river basin commission.
- The technical aspects and requirements of the floodplain management regulations enacted by individual municipalities within a particular watershed must be coordinated and compatible with those of other municipalities within the watershed.
- Floodplain delineations must be continuous from one adjacent municipality to another and be coordinated throughout the watershed.
- At a minimum, local floodplain management regulations must apply to the following kinds of construction and development activities within areas subject to the 100-year flood:

[62] High Quality Waters – Surface waters having quality that exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying 25 Pa. Code Section 93.4.b. (a). (Section 93.4.b. (a) lists qualifying criteria.)

[63] Exceptional Value Waters – Surface waters of high quality that satisfy 25 Pa. Code section 93.4.b. (b). (Section 93.4.b. (b) lists qualifying criteria.)

[64] 53 P.S. 10101 *et seq*.

[65] 32 P.S. 679.101 et seq.

- Completely new buildings or structures;
- Substantial improvements to existing buildings or structures; and
- Any man-made change to improved or unimproved real estate, including but not limited to such things as filling, grading, paving, excavating, mining, dredging, or drilling operations.

The Governors Center for Local Government Services (Center) within DCED is the lead agency for the NFIP in Pennsylvania. NFIP is a federally subsidized insurance program, administered by FEMA, that applies to existing (constructed prior to Flood Insurance Rate Maps) buildings. In exchange for the availability of subsidized insurance for existing buildings, communities are required to protect new construction and substantially improved structures through adoption and enforcement of community floodplain ordinances. As the state coordinating agency for the NFIP, the Center provides technical and financial assistance to municipalities enrolled in the NFIP. The Center reviews municipal floodplain management ordinances to ensure compliance with FEMA regulations and processes requests for floodplain delineation data. The Center also administers a program to reimburse up to 50% of the costs associated with preparing, administering and enforcing floodplain zoning ordinances and floodplain management ordinances necessary to comply with the NFIP and Pennsylvania's floodplain management requirements.

Floodplain management should consist of more than the adoption of codes and ordinances that regulate development in flood prone areas. Comprehensive floodplain management should also include establishing flood warning systems, developing evacuation and recovery plans, endorsing relocation and redevelopment efforts to reduce or eliminate problems, and promoting flood insurance. Despite its obvious importance as an individual issue, floodplain management is only one of numerous other community planning and development considerations. All floodplain management activities undertaken by a municipality must be coordinated and integrated with other planning and related efforts that have been initiated.

Municipalities are encouraged to adopt regulations that more adequately control the use and development of areas that are subject to flooding. For example, municipalities could more closely regulate the kinds of uses and activities located within its flood prone areas. Short of an outright prohibition, municipalities could require all permanent land improvements, new buildings and other structures to be raised or flood-proofed to an elevation above the existing 100-year flood elevation. Numerous other possibilities could be explored, adapted to local conditions and implemented.

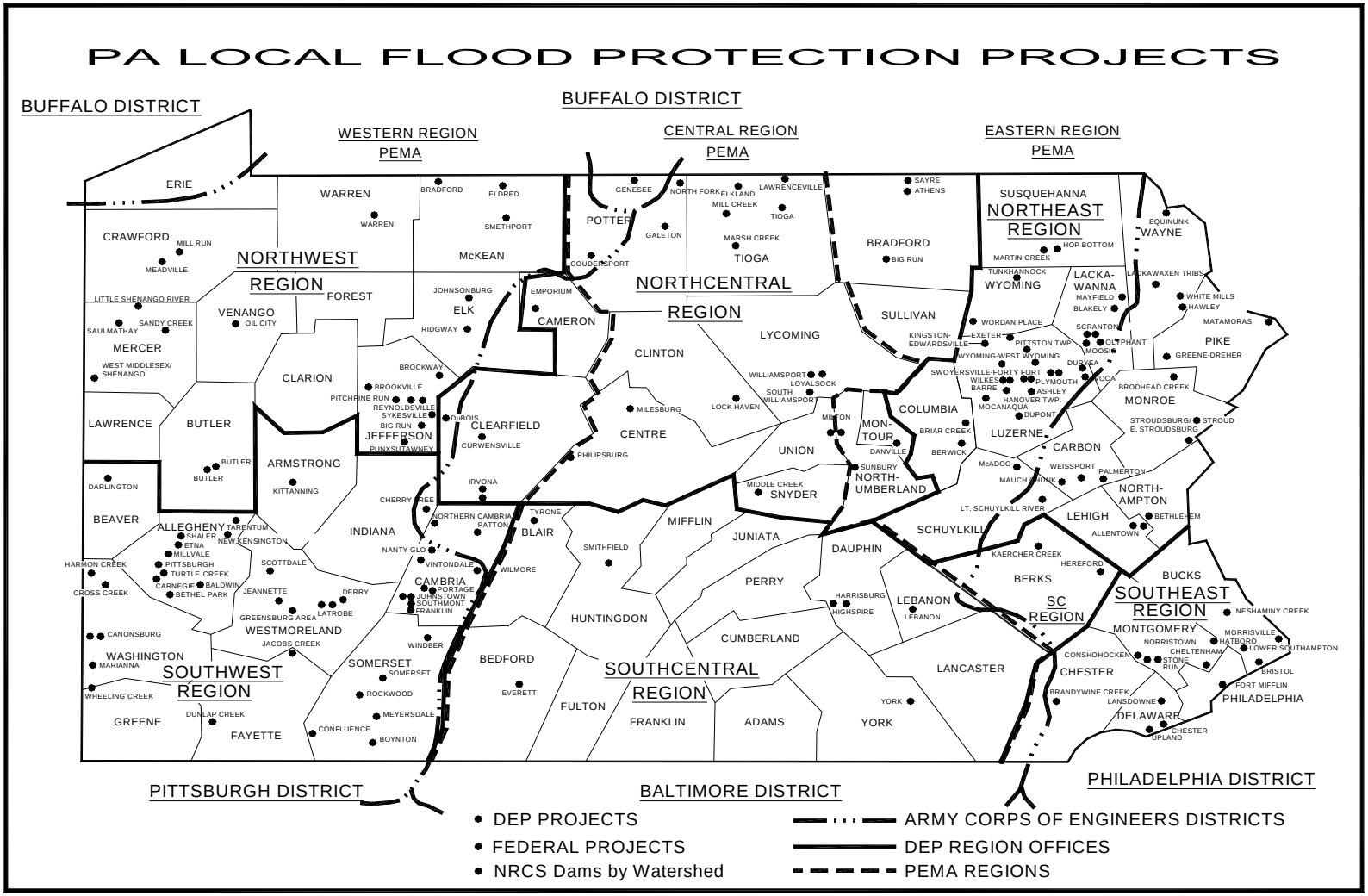
## Flood Protection

Pennsylvania has one of the most extensive flood protection programs in the country, and like the stormwater management program, it is based on the premise of shared government responsibility. Independently, or in partnership with federal agencies, this program has constructed over 300 individual flood protection structures along rivers and streams in nearly 200 Pennsylvania communities. The projects are developed to control major flooding (generally the 100-year recurrence) where the rates and volumes of runoff far exceed those for which stormwater storage and infiltration can contain. State authorities normally become aware of significant flooding problems from flood prone communities seeking assistance, or by direct observation during major flooding. If extensive protective works are required, and a local jurisdiction agrees to act as a sponsor, DEP will conduct a feasibility study to assess economic benefit. Ultimately, a benefit/cost ratio must show benefits equaling or exceeding the cost of the project to justify proceeding.

Once a flood control project has been justified, the local governing bodies are asked to sponsor it and commit to financial participation. Sponsorship involves acquiring rights-of-way and easements, holding the commonwealth free of liability, maintaining and operating the completed project, providing borrow and spoil areas, relocating or removing buildings and utilities that would interfere with the project and altering or rebuilding inadequate bridges. After local sponsorship has been secured, funding is requested in the commonwealth's capital budget. Project design and construction can

begin following funding by the General Assembly that had been released the governor's budget office. Upon completion of construction, project sponsors become accountable for long-term operation and maintenance of the structures. In partnership with local officials, DEP conducts annual inspections to ensure that the project continues to provide the designed level of protection.

Flood forecasting is an effective non-structural method of protecting citizens from harm and reducing flood damage by providing advanced warning to areas of predicted flooding. The Susquehanna River Basin Commission coordinates the Susquehanna Flood Forecasting and Warning System that is designed to provide prior notice of impending floods by offering accurate predictions of flood magnitude and timing. The forecasting system assures that local authorities and the affected population are advised of the expected levels and extent of flood inundation. SRBC estimates that every dollar invested in the flood forecasting and warning system translates to a $20.00 savings in property damage from flooding.


PA LOCAL FLOOD PROTECTION PROJECTS
BUFFALO DISTRICT
BUFFALO DISTRICT
WESTERN REGION PEMA
CENTRAL REGION PEMA
EASTERN REGION PEMA
NORTHWEST REGION
NORTHCENTRAL REGION
NORTHEAST REGION
SOUTHWEST REGION
SOUTHCENTRAL REGION
SOUTHEAST REGION
SC REGION
ERIE
WARREN
BRADFORD
ELDRED
SMETHPORT
POTTER
GENESEE
NORTH FORK
ELKLAND
LAWRENCEVILLE
MILL CREEK
TIOGA
GALETON
MARSH CREEK
SAYRE
ATHENS
BRADFORD
BIG RUN
SUSQUEHANNA
WAYNE
EQUINUNK
HOP BOTTOM
MARTIN CREEK
TUNKHANNOCK
WYOMING
LACKA-WANNA
LACKAWAXEN TRIBS
MAYFIELD
BLAKELY
WHITE MILLS
HAWLEY
MATAMORAS
PIKE
GREENE-DREHER
CRAWFORD
MILL RUN
MEADVILLE
McKEAN
COUDERSPORT
LITTLE SHENANGO RIVER
SAULMATHAY
SANDY CREEK
MERCER
WEST MIDDLESEX/ SHENANGO
VENANGO
OIL CITY
FOREST
JOHNSONBURG
ELK
RIDGWAY
EMPORIUM
CAMERON
SULLIVAN
LYCOMING
CLINTON
WORDAN PLACE
KINGSTON-EDWARDSVILLE
EXETER
SCRANTON
OLYPHANT
PITTSTON TWP.
MOOSIC
WYOMING-WEST WYOMING
DURYEA
SWOYERSVILLE-FORTY FORT
WILKES-BARRE
PLYMOUTH
ASHLEY
HANOVER TWP.
MOCANAQUA
DUPONT
OLYPHANT
BROADHEAD CREEK
MONROE
STROUDSBURG/ E. STROUDSBURG
STROUD
LAWRENCE
BUTLER
BUTLER
BUTLER
CLARION
BROCKWAY
BROOKVILLE
PITCHPINE RUN
REYNOLDSVILLE
SYKESVILLE
BIG RUN
JEFFERSON
PUNXSUTAWNEY
DuBOIS
CLEARFIELD
CURWENSVILLE
ARMSTRONG
KITTANNING
MILESBURG
CENTRE
PHILIPSBURG
WILLIAMSPORT
LOYALSOCK
SOUTH WILLIAMSPORT
LOCK HAVEN
MILTON
MON-TOUR
COLUMBIA
BRIAR CREEK
BERWICK
DANVILLE
LUZERNE
CARBON
UNION
SUNBURY
NORTH-UMBERLAND
MIDDLE CREEK
SNYDER
McADOO
WEISSPORT
PALMERTON
MAUCH CHUNK
NORTH-AMPTON
LT. SCHUYLKILL RIVER
BETHLEHEM
ALLENTOWN
LEHIGH
SCHUYLKILL
DARLINGTON
BEAVER
ALLEGHENY
TARENTUM
SHALER
NEW KENSINGTON
ETNA
MILLVALE
PITTSBURGH
TURTLE CREEK
CARNEGIE
BALDWIN
BETHEL PARK
HARMON CREEK
CROSS CREEK
SCOTTDALE
JEANNETTE
DERRY
LATROBE
GREENSBURG AREA
WESTMORELAND
CANONSBURG
JACOBS CREEK
WASHINGTON
MARIANNA
WHEELING CREEK
DUNLAP CREEK
GREENE
FAYETTE
INDIANA
CHERRY TREE
NANTY GLO
VINTONDALE
CAMBRIA
PORTAGE
JOHNSTOWN
SOUTHMONT
FRANKLIN
NORTHERN CAMBRIA
PATTON
IRVONA
WILMORE
WINDBER
SOMERSET
SOMERSET
ROCKWOOD
MEYERSDALE
CONFLUENCE
BOYNTON
TYRONE
BLAIR
SMITHFIELD
HUNTINGDON
BEDFORD
EVERETT
FULTON
MIFFLIN
JUNIATA
PERRY
CUMBERLAND
FRANKLIN
ADAMS
DAUPHIN
HARRISBURG
HIGHSPIRE
LEBANON
LEBANON
YORK
YORK
LANCASTER
KAERCHER CREEK
HEREFORD
BERKS
BUCKS
NESHAMINY CREEK
MONTGOMERY
NORRISTOWN
MORRISVILLE
HATBORO
CHELTENHAM
LOWER SOUTHAMPTON
CONSHOHOCKEN
STONE RUN
BRISTOL
CHESTER
FORT MIFFLIN
BRANDYWINE CREEK
LANSDOWNE
PHILADELPHIA
DELAWARE
CHESTER
UPLAND
PITTSBURGH DISTRICT
BALTIMORE DISTRICT
PHILADELPHIA DISTRICT
DEP PROJECTS
FEDERAL PROJECTS
NRCS Dams by Watershed
ARMY CORPS OF ENGINEERS DISTRICTS
DEP REGION OFFICES
PEMA REGIONS

## Connecting Stormwater Management to Floodplain Management and Flood Protection

Past stormwater management efforts have been primarily directed toward new development; however, there are opportunities to incorporate similar practices into flood protection programs for existing communities. Rather than relying totally on hard-engineered solutions for flood protection, broader approaches to mitigate local flooding in conjunction with improved stormwater management are now being used in some areas. For example, reestablishing natural stream corridors and floodplains through local stormwater management requirements could offer more environmentally friendly flood control options than concrete structures. As older flood control structures reach the end of their service life, alternate flood protection techniques should be fully explored before rehabilitating or simply upgrading the existing structures. As exemplified by the ongoing effort to remove orphan dams, this approach can result in significant cost savings while offering superior protection to Pennsylvania citizens and the environment.

As a result of past development and land management practices, many areas still may need traditional flood protection responses to complement their updated stormwater management controls. However, before going directly to the design table, innovative stormwater management should be considered and incorporated as an important component of the overall flood mitigation plan. As the reuse of urban land and brownfields increases, opportunities to disconnect stormwater from conventional conveyance systems in favor of on-site management will emerge. The reconstruction of urban stormwater management infrastructure in Philadelphia and on the campus of Villanova University are prime examples of managing stormwater from established neighborhoods to decrease flood flow contributions and improve runoff quality from the annual, and other more frequent, storm events. In the Valley Creek watershed, an urban Exceptional Value stream that runs through historic Valley Forge National Park, the Pennsylvania Fish and Boat Commission and the National Park Service have developed a watershed management plan that incorporates infiltration as a critical restoration element. These and similar projects can cumulatively reduce runoff and help attenuate the severity of the frequent local flooding in heavily developed urban and suburban environments.

## Progress is Being Made

Stormwater management and flood protection priorities are rapidly changing. Improved planning, low impact development and more effective BMPs that meet a multitude of environmental objectives are being emphasized. Researchers, progressive developers, environmental organizations, government policy makers and concerned citizens are working together to constantly advance stormwater management and flood control approaches.

The Butterfly Acres floodplain restoration project in Lancaster County exemplifies a design that demonstrates multiple environmental benefits. In addition to enhanced flood protection, the project will reduce nutrient and sediment loads to Lititz Run and the Chesapeake Bay, provide a vegetative buffer to protect water quality, maximize groundwater recharge and improve terrestrial and aquatic habitat. Improved groundwater recharge, nutrient and sediment reductions and wetland replacement may all prove to have economic value to local businesses and industries and attract private funding. Mutually supportive floodplain and stormwater management planning is also taking place. In Lycoming County, the Lycoming Creek stormwater management plan and planning for a watershed flood control project are being closely coordinated.

Low Impact Development (LID) is an ecologically friendly approach to site development and stormwater management that minimizes disturbance to the land, air and water. LID emphasizes integrating site design and planning techniques to maintain natural systems and hydrologic functions on a site. LID is not a singular, prescriptive design standard

but a combination of practices that can result in a variety of environmental and financial benefits. It encourages the treatment, infiltration, evaporation and transpiration of precipitation close to where it falls. LID relies on a system of source controls and small-scale, decentralized treatment practices to help maintain a functional landscape. Examples include grassy roadside swales, rain gardens, pervious pavement materials, narrow streets, vegetated areas and wetland filters. LID preserves open space, protects the natural environment and incorporates existing site features such as wetlands and stream corridors to manage stormwater at its source. From a developer's perspective, LID techniques can reduce land clearing and grading costs, decrease infrastructure costs, lower stormwater management costs and increase community marketability and property values. These practices are slowly being incorporated into municipal development codes and stormwater management ordinances across Pennsylvania.

Shifting from traditional stormwater management methods to designs and practices that also address channel alterations and degradation, runoff quality, dry-weather flow protection and aquifer recharge requires an underlying change in how water resource professionals do business. Seeking to create a long-term research effort to support this shift in design philosophy, and to bring together governmental, professional, industrial and academic interests, DEP and Villanova University co-founded the Villanova Urban Stormwater Partnership (VUSP). The mission of VUSP is to advance the evolving comprehensive stormwater management field and to foster public and private partnerships through research on innovative BMPs, directed studies, technology transfer and education. Several other institutions are sponsoring stormwater management research as well. The Stroud Water Research Center in Avondale, The Pennsylvania State University and Temple University are all conducting some level of stormwater management research in Pennsylvania. Other states currently endorsing stormwater management research include Florida, Maine, Vermont, New Hampshire, Maryland and Washington. Additionally, the Water Environment Research Foundation in Alexandria, Virginia; the Center for Watershed Protection in Ellicott City, MD; the Stormwater Research Group in Austin, Texas; and EPA in Washington, D.C. are undertaking or supporting national research efforts. Stormwater research interest is not limited to the United States. Urban stormwater management is also an ongoing topic of study at Griffith University, located across the globe in Nathan, Australia.

In December 2006, DEP published a new Stormwater Management BMP Manual that is customized specifically to meet Pennsylvania's needs and physical diversity. The manual provides standards and planning concepts to guide DEP, conservation districts, engineers, local authorities, planners, land developers, contractors and others involved with planning, designing, reviewing, approving and constructing land development projects. The manual emphasizes technical solutions that will lead to better water quality and quantity management for new land development and redevelopment. The manual focuses on an integrated management approach that addresses stormwater events ranging from showers to floods and includes rate control, volume control and water quality enhancement. In addition to reactive solutions, the manual describes a wide variety of non-structural practices based on an expanded understanding that land and water resource management techniques are inseparable.

## Gaps, Roadblocks and Opportunities

Most of Pennsylvania's current law, regulations and local ordinances governing stormwater management and flood protection were written for a narrow purpose or to fulfill a specific need. Engineering, science and government policies have become much more sophisticated since the passage of the enabling legislation while the statutes have remained relatively static and inflexible. For the most part, current laws do not recognize that integrated floodplain and stormwater management plans are essential to supporting the economy, protecting life and property and sustaining the environment. They do not consider a comprehensive approach to watershed restoration and protection. They were conceived prior to federal rules limiting total maximum daily loads (TMDLs) to streams; they preceded water quality credit trading

programs; they marginalized the importance of proper site planning and the use of natural systems; and they viewed stormwater runoff as a nuisance instead of a resource. Through the years, municipal ordinances have predictably followed this pattern.

When enacted in 1978, the Storm Water Management Act was considered landmark legislation because it authorized comprehensive planning and management of stormwater on a watershed scale while being consistent with sound water and land use practices. Although the purpose and scope of the act have withstood the test of time, the methods employed to implement the act have become outdated. The traditional view of this statute has resulted in protracted development of stormwater management plans overburdened by unnecessary detail and spurned by county and local governments. Through appropriate legislation, regulation and administrative changes, the stormwater management program should be updated so that it supports an integrated system and takes advantage of the capabilities of all levels of government to effectively regulate stormwater. Long-term operation, maintenance and replacement of stormwater management BMPs are currently not adequately addressed. With the proliferation of stormwater BMPs and the shift to on-site management, operation and maintenance take on greater significance. When a stormwater BMP fails or reaches the end of its useful life, the need for stormwater management does not disappear. The individual and cumulative effects of stormwater BMP failures will result in personal and public costs that go well beyond the expense to operate and maintain them. Long-term ownership, operation and maintenance of stormwater management infrastructure are as important as sustaining other municipal services.

The Flood Control Act[66] was enacted solely to provide structural protection to flood prone communities in Pennsylvania. The Act does not allow a full array of potential flood damage reduction solutions to be considered. It has been observed that the current process perpetuates minimal community involvement and restricts consideration of flood control strategies. It affords little flexibility for innovative technologies and successes, limits examination of multiple benefits and hampers consideration of other program objectives from within DEP or other agencies. By focusing on structural protection measures, potentially less expensive and more effective non-structural solutions are excluded from the analysis of alternative solutions.

Municipal zoning requirements, and subdivision and land development ordinances, are often at odds with effective stormwater management policies and practices. Problems range from rigid requirements addressing parking lot size, street width and infiltration to no stormwater or floodplain management requirements at all. Without active and enlightened municipal governance, progressive stormwater and floodplain management concepts will not be translated into practice.

Adequate state planning and project funding through the Storm Water Management Act[67], Flood Control Act[68] and Capital Facilities Debt Enabling Act[69] are essential to picking up the pace of comprehensive stormwater and floodplain management. Increasing dedicated funding under the Storm Water Management Act would accelerate the development and implementation of updated stormwater management plans, with the resultant investment translating into reduced flood damages and improved water resources statewide. In addition, a dedicated funding source for alternative flood control and stormwater management techniques would enable non-structural flood control and stormwater management measures to be considered and would encourage communities to examine a wide variety of options to address area flooding.

## Moving Forward

Stormwater management, floodplain management and flood protection efforts are undergoing revolutionary changes in Pennsylvania. For decades regulatory

[66] 35 P.S. §653 et seq.

[67] 32 P.S. §680.1 et seq.
[68] 35 P.S. §653 et. seq.
[69] 72 P.S. §3919.101 et seq.

requirements, development practice and engineering standards have concentrated on preventing surface flooding by controlling peak flow during extreme storms, channelizing streams to accelerate runoff and building concrete and steel structures to minimize flooding. This narrow approach to mitigating the effects of excess runoff has generally reduced flood peaks, but it has not addressed a wide range of other problems including runoff quality, stream bank erosion, groundwater recharge and dry-weather stream flow protection.

Comprehensive stormwater and floodplain management must be addressed simultaneously. Emphasis must shift from mitigation to prevention practices that manage stormwater close to the source and minimize flooding potential by relying on simple, non-structural control methods and management practices. Stormwater must be recognized and managed as a critical resource, not as an annoyance or threat to be quickly passed downstream; and flood protection efforts must be planned consistent with this goal.

Stormwater management planning is the original watershed-based planning process and could serve as the backbone for numerous watershed restoration and protection efforts across the commonwealth. The tiered role of governance coupled with meaningful public participation establishes a robust model that can be generalized to all watershed resource management programs. This approach can be summarized as state government providing strategic direction, county government developing tactical frameworks or plans and local government establishing functional implementation methods. The portion of the *State Water Plan* entitled “Integrated Water Resources Management” further explores and makes recommendations on these topics.

Strong stormwater management, floodplain management and flood protection programs that are rooted in sound science and reasonable regulation should be among the commonwealth’s highest priorities. It is essential that the public and private sectors, in conjunction with strong academic support, continue to learn, advocate and implement integrated stormwater management and flood control practices. The well being of millions of Pennsylvanians and their valuable water resource assets are at stake.

## Recommendations

### Flood Control Recommendations:

1) Review and update elements of the Pennsylvania Enhanced All-Hazard Mitigation Plan that address flooding. Revising the flood loss reduction and flood mitigation portions of the plan would provide updated guidance for federal, interstate, state and local agency activities in the commonwealth. To begin this effort, the Delaware River Basin Commission Interstate Flood Mitigation Task Force Report (July 2007) should be evaluated, and relevant provisions should be considered for statewide application. In conjunction with this initiative, stormwater management plans developed under the Storm Water Management Act should be expanded to support local flood mitigation projects and should include specific recommendations for reducing flood events.

2) Invest in an enhanced Flood Forecasting and Warning Systems for all major river basins, utilizing a partnership of federal, state and local governments.

3) Support FEMA's efforts to update Flood Insurance Rate Maps.

4) Amend the Flood Control Act to provide DEP with general authority to indemnify federal agencies for water resources projects.

5) Increase efforts to protect the floodplain and enhance community recovery assistance following a flooding event.

    a) Evaluate Section 301(a) of the Flood Plain Management Act[70] to consider expanding the list of floodplain obstructions that have been determined to present a special hazard to public health and safety, that may cause

[70] 32 P.S. 670.301

significant pollution or that may endanger life and property.

b) Amend the Flood Control Act to provide authority to consider and implement all potential flood control solutions, including non-structural alternatives and preventive approaches to reduce the risk of flooding; and allow all types of flood control solutions to be funded through the capital budget process.

c) Review and evaluate the Federal Flood Insurance Program to identify policies, such as the buy-out option, which can be enhanced to decrease the amount of damage to communities.

d) Prioritize flood recovery funds for activities that protect the flood carrying capacity of the floodplain. Invest funds effectively and reasonably to restore the floodplain and to reduce future losses.

e) Revise existing post-flood recovery funding programs to require post-disaster assessments and mitigation investigations, and emphasize increased efforts on floodplain restoration and restoration of flood carrying capacity.

f) Ensure that state funding programs offer a preference for locating or relocating structures outside the floodplain. Where this approach is not feasible, approval to build or rebuild within the floodplain should include provisions for restoration and remediation of the floodplain to minimize future flood losses.

g) Ensure that existing programs are coordinated and provide incentives for floodplain protection and restoration. Public funds used for flood recovery and rebuilding should target floodplain and carrying capacity restoration and obstruction removal. Retrofitting existing development with facilities designed to minimize flood losses should be considered where appropriate.

6) Appoint a Commonwealth Flood Coordinator charged with coordinating flood prevention and recovery activities among state agencies. The Commonwealth Flood Coordinator would also serve as the primary point of contact for federal, interstate and local officials on flood-related matters.

7) Working through the Department of Community and Economic Development, establish an information center/clearinghouse to provide education and training to local government officials, municipal solicitors, municipal engineers and the design community that emphasizes the importance of embedding integrated stormwater and floodplain management considerations into every municipal decision.

**Stormwater Management Recommendations:**

1) Through appropriate legislation, regulation and administrative changes, integrate and leverage existing state and federal stormwater management regulations, policies and requirements (e.g., Storm Water Management Act, Sewage Facilities Act, Municipalities Planning Code, Chapters 102 and 105, NPDES, MS4, TMDLs) to provide an effective, straightforward, seamless stormwater management program that is blind to regulatory origin.

2) Establish an information center/clearinghouse (such as the Water Resources Technical Assistance Center authorized by Section 3120(A) of the Water Resources Planning Act) to deliver education and training to local government officials, municipal solicitors, municipal engineers and engineering and design professionals involved in land development to advance the understanding and utilization of effective stormwater management practices and regulatory requirements and to emphasize the importance of integrating stormwater and floodplain management considerations into all municipal decisions.

3) Clearly authorize by legislation, regulation, or policy the creation and operation of local

Authorities, Utilities, or Management Districts and/or other sustainable funding sources that enable entities to collect fees and generate revenues dedicated to planning, constructing, monitoring, maintaining, improving, expanding, operating, inspecting and repairing public and private stormwater management infrastructure.

4) Through appropriate legislation, regulation and administrative changes, amend and update the stormwater management program to:

   a) Manage the level of effort allotted for preparing and updating stormwater management plans. Target critical watersheds with serious quality or quantity problems, based on a set of criteria (e.g., % impervious cover, population density, federal requirements, special protection watersheds, impaired waters, rate of development, chronic flooding history, Critical Water Planning Area designation), for detailed planning efforts. Remaining areas could be covered using a standard planning outline.

   b) Allow added flexibility to determine appropriate watershed-related planning units.

   c) Use stormwater management planning as a tool to achieve compliance with the TMDL implementation where a water body is impaired by stormwater, and a TMDL has been prepared or adopted.

   d) Improve enforcement provisions to provide meaningful economic incentives to adopt, amend and implement stormwater management plans and ordinances.

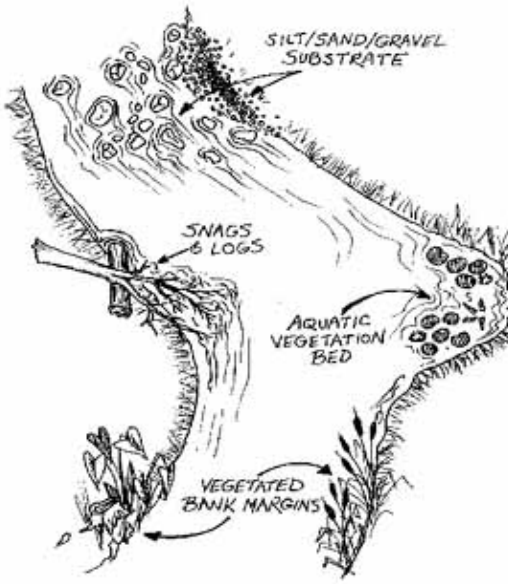
   e) Include provisions to address long term operation and maintenance of stormwater management facilities.

5) Adequately fund regular updates to the Pennsylvania Stormwater Best Management Practices Manual to reflect innovation and change, and continue to maintain and update the Stormwater Management Model Ordinance to reflect Manual revisions and statutory amendments.

6) To the maximum extent practicable and cost effective, vegetated buffers should be preserved and restored along all waterways.

7) Through legislative, regulatory and administrative provisions, seek to manage stormwater so as to reduce excess runoff and pollutants.

8) Fund, promote and encourage water resource restoration projects.



# WATER SUPPLY ALTERNATIVES AND ASSESSMENTS

## Introduction

The Water Resources Planning Act[71] requires that this *State Water Plan* include **"**an identification and assessment of practical alternatives for an adequate supply of water to satisfy existing and future reasonable and beneficial uses, including improved storage, groundwater recharge and surface/groundwater conjunctive management programs." Identifying alternatives involves an investigation of methods and practices that either increase water supply or decrease water demand. In turn, their practical application depends on their resource protection capacity, natural conditions, existing infrastructure and financial feasibility. Some alternatives, consumer conservation for example, can be easily undertaken while providing side benefits such as environmental enhancement and lower treatment, delivery, chemical and energy costs. Other means of assuring sufficient water to satisfy all reasonable and beneficial uses can be complex, expensive, or politically challenging.

The Act further requires "an assessment of both structural and nonstructural alternatives to address identified water availability problems, adverse impacts on water uses or conflicts between water users, including potential action to develop additional sources or alternative supplies, conservation measures and management techniques." In this edition of the *State Water Plan*, an assessment of broadly functional options and their applicability to a specific set of parameters was generically conducted through the use of a decision matrix presented in Appendix S. The identified and assessed alternatives ranged from straightforward and inexpensive management techniques to costly and highly invasive construction projects. When choosing any remedy to a defined problem, water resource protection should play a central role in the selection process, and options having a reduced potential for altering the environment should be given primary consideration. These alternatives are normally less invasive and typically less costly. If the assessment points toward new construction, or to a project that would directly influence stream flow or water quality, careful planning and design must be employed to ensure the continued viability and protection of the affected water resources.

The identified and assessed alternatives are not exhaustive nor are they exclusive. The decision matrix was created to provide a convenient method of evaluating the array of options and to generate a range of possible solutions. The list of described alternatives and their assessments are intended to provide only a general direction and do not represent *State Water Plan* recommendations.

## Definitions

It is important to define several key terms that are used to frame this discussion. An "adequate supply of water" refers to the quantity of water necessary to sustain reasonable and beneficial uses over the planning horizon. A planning horizon of 15 years has been selected because the *State Water Plan* will be updated at five-year intervals, and the inaccuracy of water resource need projections beyond 15 years leads to considerable uncertainty. "Reasonable and beneficial uses" is a multifaceted term that refers to using water for a useful and productive purpose, while considering the rights of other users and remaining consistent with the public interest. It also includes using water in an efficient manner. The assessment considered both withdrawal and non-withdrawal water uses. "Withdrawal uses" references any use of water that is taken from a surface or underground source and includes traditional uses such as domestic, municipal, public, commercial, industrial, energy development and production and agricultural water supply. "Non-withdrawal uses" are activities that utilize water while it is in place. Examples of non-withdrawal uses are navigation, in-stream hydropower production, recreation, fish and wildlife habitat protection and sustaining the aquatic environment.

[71] 27 Pa. C.S. §3101 et seq.

Finally, "consumptive use" means the loss of water from a groundwater or surface water source through an artificial conveyance system (including water that is delivered through a public water supply system), due to transpiration by vegetation, from incorporation into manufactured products, evaporation, diversion out of the basin, or by any other process that withdraws water from a basin without returning it.

## Practical Alternatives for an Adequate Supply of Water

### Employ Consumer Conservation Measures

Water conservation relieves stress on water supply sources; saves industrial, agricultural and residential customers money; and produces a number of related benefits. Consumer conservation reduces energy cost and chemical use, can eliminate the need for inter-basin water transfers and can delay or avert expansion of existing drinking water and wastewater infrastructure. Providing water conservation educational programs, installing water saving plumbing fixtures and using water meters all effectively reduce residential and institutional water consumption. Minimizing leakage and loss, recycling wastewater, or making fundamental process changes can also significantly reduce industrial water use and consumption. Industrial and commercial water conservation measures are often implemented in conjunction with more general pollution prevention efforts. Farmers can employ conservation techniques to effectively manage water use at their livestock operations, and they can minimize crop irrigation water use by relying on irrigation systems designed specifically for existing soil, topography and vegetation.

Although water use reduction and water conservation are largely presented in the Water Resources Planning Act as voluntary actions, water conservation is also prominently addressed in several regulatory contexts. Projects that implement water conservation practices are to be given special funding consideration by the Pennsylvania Infrastructure Investment Authority (PENNVEST) under the Act. The Act also directs the Environmental Quality Board to adopt regulations that, in part, describe "a process under which users may document and register practices or projects that they have implemented to reduce water withdrawals or consumptive use, promote groundwater recharge or otherwise conserve or enhance water supplies for consideration and use in providing appropriate recognition and credit during the implementation of existing or future water supply programs."

Other legislation identifies water conservation as a mandatory activity. Permits issued under the Water Rights Act[72] are typically conditioned to require adoption and implementation of a water conservation program. In addition, drought emergency regulations require public water supply agencies, and major industrial and commercial water users, to develop drought contingency plans that match water use reduction scenarios to various levels of drought conditions. Water users in the Susquehanna and Delaware River Basins must also comply with Susquehanna River Basin Commission (SRBC) and Delaware River Basin Commission (DRBC) water conservation regulatory requirements.

### Utilize Public Water System Metering

Nearly 98% of public water suppliers in Pennsylvania meter their customers' use of water. Metering water use has several advantages. It can provide an accurate picture of water use differences among customers, identify seasonal use variation, monitor conservation efforts and help identify structural problems. Metering customer water use also establishes an incentive to reduce consumption and forms the basis for a volumetric rate structure. DEP and DRBC have adopted policies and regulations that enable them to require public water suppliers to meter all new customers on un-metered systems. In addition, Public Utility Commission regulations require customer metering by all water utilities under its jurisdiction. DEP also requires public water suppliers to meter individual surface water sources as a condition of issuing a surface water allocation permit. SRBC and DRBC have source metering requirements as well that apply

[72] 32 P.S. §631 et seq.

to ground and surface water withdrawals of 100,000 gallons per day or more. The trigger point for source metering drops to 10,000 gallons per day in the Southeast Pennsylvania Groundwater Protected Area, and to 20,000 gallons per day of consumed water in the Susquehanna River Basin.

## Apply Appropriate Pricing Strategies

Clean water has a cost. How that cost is determined and how it is recovered can be important components to promoting water conservation. Consumer water rates should be set to recover the full cost of managing a water system by accounting for debt service, administration, operation, maintenance, capital improvements and environmental protection. Full cost pricing promotes system sustainability, financial stability and economic efficiency. Because water rates can prompt customers to use water more efficiently, billing should be clear and logical so that consumers can easily link their water use to cost and make appropriate adjustments.

There are several types of rate structures in use. A flat rate system assesses the customer an equivalent amount each billing cycle regardless of the quantity of water used. A tiered rate structure is based on paying a specific amount for each predetermined block or unit of water used. Decreasing block rates result in lower unit cost as water use escalates, while increasing block rates require the customer to pay higher rates for each volumetric tier encountered. In setting increasing block rates, it may be appropriate to establish different usage block ranges based on customer class so that large volume, conservation-conscious, users are not unduly charged merely because of their size. Volumetric pricing simply charges the customer based on the volume of water used – the more water used, the more the customer is charged. Seasonal rates and surcharges are variations of block and volumetric pricing. Seasonal rates increase during the warmer months when water use is at its peak, and they should be based on the full cost of capacity needed to meet summer demand. A surcharge rate component assesses premium rates to customers for excessive water use beyond a predetermined threshold. Volumetric and tiered rate structures require that individual water use be metered.

An efficient pricing strategy can be a strong incentive to reduce water use and can lead to multiple environmental benefits, deferred capital costs and decreased use of power and chemicals. To effectively encourage informed water resource use, pricing and rate structures must be directly linked to the amount of water used and capacity needed, and produce sufficient revenue to cover the full long-term cost of supplying water.

DRBC encourages appropriate pricing stratgies by requiring water purveyors in the Delaware River Basin seeking new or expanded water withdrawals of more than one million gallons per day to evaluate the feasibility of implementing a water conservation pricing structure and billing program.

## Implement Water Loss Control

Water loss control can be viewed as water conservation by water suppliers. Water systems can waste or lose significant amounts of water through distribution system leaks and storage overflows. Water that is treated and lost translates to reduced revenue and overuse of the water source. Responding only to erupted water mains and customer complaints increases the frequency of public health threats and will not solve or contain system leakage problems. Effectively controlling leakage requires a management program that includes periodic water audits, prompt response to identified losses and planned rehabilitation or replacement of system piping prior to the end of its useful life. Many effective strategies currently enable water utilities to identify, measure, reduce, or eliminate leaks in a manner that is consistent with their cost of doing business. The Water Resources Planning Act recognizes the value of leakage and loss reduction by directing PENNVEST to give special funding consideration to projects that “address unaccounted for water loss.”

## Revise Operational Protocols

Revising operational protocols entails changing operation and management procedures on

water supply systems and water resource management projects to maximize yield, system flexibility and beneficial uses. It is fundamentally a risk-based decision making approach used to efficiently balance supply with multiple demands. If a system has more than one reservoir, coordinated water routing and use among reservoirs based on specific needs and timing could increase overall water delivery and enhance multiple water uses. Operational changes to the timing or volume of reservoir storage and releases can also be made to match various priorities, to increase system efficiency, or to focus on a specific use. Unless new construction or facility demolition is necessary, revising operational protocols can be a relatively inexpensive means of maximizing beneficial use potential and minimizing water use conflicts.

## Employ Conjunctive Management Techniques

Conjunctive management programs maximize water availability and minimize resource damage by optimizing the combined use of water supply sources, including ground and surface sources, and interconnections. Conjunctive water management is applied to increase water supply reliability through the planned, coordinated management and use of multiple sources. Successful conjunctive water resource management results in cumulative benefits beyond those achieved through separate management of the sources. Conjunctive water resource management does not create new sources of water but uses available water in the most efficient manner possible. It extends the use of existing sources based upon their individual seasonal and long-term yields or availability, their storage characteristics, operational costs and contractual arrangements with other suppliers. For example, run-of-stream sources with little or no storage would generally be used first to preserve stored ground or surface water for periods when stream flows are insufficient or at critical stages. Contracts with other water suppliers for supplemental supplies through interconnections may be used either early or late after cost, seasonal capability and contractual arrangements with the interconnecting system are considered. While operating costs are a consideration, a conjunctive management operating plan that attains full overall system yield will not, in many cases, align with the most cost-efficient operating plan. Conjunctive water management must be tailored to local conditions, and be administered with an understanding of the unique environmental, economic and operational characteristics of the system involved. In areas of Pennsylvania where demand is approaching the safe yield of available water resources, conjunctive management could extend water availability, improve reliability and prolong beneficial uses by coordinating all available surface and groundwater assets.

## Restore Watershed Integrity

Watershed restoration is an efficient way to expand the scope of beneficial water use. Restoring and protecting Pennsylvania's water resources begins with home management of local watersheds. Effective watershed protection and restoration tools include stabilizing stream banks, establishing forested riparian buffers, reclaiming abandoned mine discharges and mine sites, recharging groundwater through effective stormwater management, re-using treated wastewater, applying best management practices to farmland and minimizing the footprint of development. Removing legacy sediment is also emerging as a means of reclaiming streams' carrying capacities to minimize flooding. Additionally, protecting public water supply sources provides significant benefits to overall watershed quality.

Local watersheds serve as sources of clean drinking water, filter and purify groundwater, provide industrial process water, supply water for irrigation and offer natural flood control and protection. Small watersheds and their riparian areas are also the single most important habitat for terrestrial and aquatic wildlife. Local watersheds present outstanding recreational opportunities and confer a sense of place and history to the surrounding area. Local watersheds also make up larger watersheds and major river basins that progressively influence the condition of downstream creeks, rivers, lakes and estuaries. In fact,

Pennsylvania is accountable to downstream states for the health of the Chesapeake Bay, the Delaware Bay, the Gulf of Mexico and the Great Lakes system; and to 38% of the nation's population who drink water originating from or passing through Pennsylvania watersheds.

## Replace Potable Water Use

Treated drinking water is routinely used for a variety of purposes that do not require water of potable quality. Using non-potable water to irrigate crops and gardens, water golf courses, make snow and flush toilets can effectively conserve potable water while saving money and chemical use. Stormwater capture or infiltration systems such as rain gardens, rain barrels, cisterns, infiltration beds and pervious pavement are all capable of supplementing and moderating reliance on potable water sources. Recycling and reusing wastewater also reduces overall fresh water use and extends potable water sources at individual locations. DEP's Southeast Regional Office in Norristown, where a 5000-gallon cistern captures precipitation for use by restroom facilities, provides an example of local precipitation harvesting. While these individual practices do not generate substantial new sources of water, they combine to reduce demands on, and prolong, traditional potable water supplies.

## Mitigate Consumptive Water Use

Consumptive water use removes ground or surface water from a watershed or river basin and does not return it. Water can be consumed by evaporation through cooling towers, evapotranspiration through irrigated crops, incorporation into manufactured products, or diversion to another river basin. A huge amount of water is lost from Pennsylvania's major river systems every day. This continuous water consumption under drought conditions can become critical as streams approach dangerously low flows. SRBC and DRBC have both established regulations to mitigate the potential consequences of extreme drought by banking water that can be released to augment basin flows as needed.

SRBC regulates consumptive ground and surface water use exceeding 20,000 gallons of water per day to compensate for the lost water during periods of low flow in the Susquehanna River Basin. Acceptable compensation measures include, among others, replacing consumed water at or above the intake point and making monetary payments to SRBC. The rate through 2008 for water consumption in the Susquehanna River Basin is fourteen cents per thousand gallons. This rate will increase to twenty-one cents per thousand gallons consumed during 2009 and will further increase in 2010 to twenty-eight cents per thousand gallons consumed. SRBC uses the funds collected to purchase stored water from the U.S. Army Corps of Engineers (USACE) at Cowanesque Lake in Tioga County and Curwensville Lake in Clearfield County. Currently, about 30,000 acre-feet of such storage have been procured. The stored water is released during drought conditions to maintain aquatic habitat and in other ways minimize the effects of excessive low flow on downstream water users. Construction to provide additional storage is currently ongoing at the Whitney Point Lake Reservoir in Broome County, New York as well. The Whitney Point project is scheduled for completion in late spring of 2009.

SRBC is also actively engaged in replacing the estimated 15.7 million gallons per day of water needed to compensate for agricultural consumptive use during low flow conditions. By partnering with the commonwealth in a project to restore ten million gallons of treated abandoned mine water to the Susquehanna Basin, agricultural consumptive use will be partially compensated during the growing season. Additional methods such as using abandoned quarry water and developing underground mine storage are being considered to acquire the remaining 5.7 million gallons per day needed for full compensation.

DRBC Basin Regulations adopted in 1974 codified "Water Supply Charges" that apply to all water users in the Delaware River Basin. The regulations require payment for surface water use in the basin, with appropriate exceptions, consistent with a schedule of water charges. In March of 2006 the payment schedule was revised to six cents per thousand gallons for consumptive use of water and six-tenth of a mil per thousand gallons for non-

consumptive use. DRBC uses the revenue generated to purchase storage from USACE in the Blue Marsh Reservoir on the Schuylkill River and the Beltzville Reservoir on the Lehigh River. Releases can be made from these facilities to supplement low river flows. The Merrill Creek Reservoir is also used to augment flow in the Delaware River. It is a 650 acre pump and storage reservoir in New Jersey built and operated by regulated power generators. Water is pumped to the reservoir from the Delaware River during high flows and released during low river flows to make up for the evaporative water consumption at contributing electric generating units. This source of water ensures that the generating units can continue to produce power under drought conditions.

### Expand Treated Water Storage

There are nearly 3,800 tanks and other containment vessels that store treated water on public water distribution systems throughout Pennsylvania. Expanding treated water storage capacity is a straightforward approach to improving short-term water supply availability and reliability. It is particularly effective as a way to mitigate water shortages caused by natural disasters, temporary power disruptions, or pollution incidents. The previous *State Water Plan* recommended that all public water supplies have the capability to keep at least one day's worth of treated water in reserve. Although some small water systems may still lack that capability, most public water suppliers have fulfilled the recommendation.

### Regionalize Water Systems

In densely populated urbanized centers and in high growth areas expanding from an urban core, regionalizing water systems may be appropriate. Regionalizing separate water supply systems can lead to cost savings, better service, improved reliability and enhanced flexibility. Regionalization is not based solely on economy of scale, but also on superior technical and financial resources. Instituting arrangements to operate multiple systems more efficiently through common management and procurement, and sharing other resources, without physically connecting the systems, may also appreciably improve their reliability and service. Although many benefits of regionalization can be realized whether or not systems are physically integrated, increasing yields would usually require interconnecting regional systems.

There are some areas where regionalization through physical connection of scattered small water systems is not appropriate and could be counterproductive. This condition is typical where there is no single growth center and where growth patterns are spread among suburban and exurban areas near small communities. Pursuing large scale regionalization in these locations, if not closely linked to local land use planning efforts, could undermine sustainable development efforts and contribute to expansion of growth patterns in areas where dense development is not favored. Large regional systems in these settings may also deter the use of local water resources where they are available, and could promote inter-basin transfers of wastewater out of the watersheds where the source water supplies were originally drawn.

### Recharge Groundwater

The importance of groundwater cannot be overstated. Groundwater supplies approximately 4.5 million Pennsylvanians with drinking water, contributes a stable base flow to streams and rivers, and provides nearly all stream flow under drought conditions. In many rural areas, groundwater may be the single practical source of water available, partially accounting for Pennsylvania having the second highest number of domestic water wells in the nation. To manage groundwater on a sustainable basis, withdrawals and recharge must be balanced and linked closely with land use planning efforts.

Of the 42 inches of precipitation that Pennsylvania averages annually, about thirteen inches contribute to replenishing groundwater reserves under natural conditions. Groundwater levels throughout the state vary seasonally and are generally at their peak during the early spring and at their lowest levels during mid-autumn. These normal seasonal fluctuations can range up to 50 feet. Precipitation, groundwater levels, soil types,

geologic formations and recharge rates differ significantly throughout Pennsylvania. This variability influences local groundwater movement, storage capacity and accessibility. Groundwater can be recharged both naturally and artificially. Natural recharge takes place most efficiently in undisturbed areas as precipitation percolates to the groundwater table. Natural groundwater recharge can be maintained in developing areas by managing runoff through preservation of native hydrologic watershed features. Artificial groundwater recharge can be achieved by using reclaimed wastewater to supplement natural aquifer regeneration. Using reclaimed wastewater for irrigation and other practices may also incidentally contribute to groundwater recharge. The Water Resources Planning Act directly encourages groundwater recharge through provisions that enable water users to document and register projects or practices with DEP that "promote groundwater recharge."

### Expand Treatment Capacity

Expanding treatment capacity is a straightforward approach for meeting a treated water demand deficit or satisfying new needs. Treatment capacity expansion would require a new water allocation permit or approvals from the DRBC or SRBC if withdrawals were to be increased beyond current allocations or authorizations. Adding treatment capacity could involve upgrading existing facilities or constructing an entirely new treatment plant.

### Increase Withdrawals from Existing Sources

Increasing water availability could be as simple as withdrawing more water from an existing source or obtaining an increased allocation amount. Optimizing the volume of withdrawals on a watershed among water users could also be an economical and environmentally neutral means of ensuring adequate water availability. Any anticipated withdrawal increase must be measured against its projected influence on other existing and competing uses. The potential harm to riparian surface water and groundwater users must be assessed along with the potential impairment to the aquatic community. Boosting surface or groundwater withdrawals or increasing their allocations may require SRBC or DRBC approval. Public water suppliers seeking to add to their surface water allocation would need to obtain a new Water Allocation Permit from DEP.

### Increase Raw Water Storage

Increasing raw water storage is among alternatives that may be considered for ensuring a reliable and adequate supply of water. This option could involve improving capacity at existing facilities or building new structures. Reservoirs collect and detain water for later release or use. With nearly eight million Pennsylvanians obtaining water for daily use from surface water sources, improved water storage is usually associated with enhancing public and industrial water supplies. Reservoir storage can also be critical to sustaining adequate stream flow for a number of other beneficial water uses such as recreation and aquatic and riparian habitat protection. New reservoirs may have a substantial environmental cost as well. Their invasiveness can potentially modify the native stream and wetland ecology, influence local groundwater levels and alter water temperatures.

Most reservoirs were created for a specific purpose; for example, flood control, recreation, or as water supply sources. Many existing reservoirs have untapped multiple use capability that could be integral to drought management, navigation, resource protection, flood control and hydropower production. Additionally, local storage can improve water quality, upgrade water system reliability and flexibility and provide drought resistance. Release of stored water plays a critical role in maintaining acceptable flow in the Ohio, Susquehanna and Delaware River systems to support navigation, maintain fisheries, ensure adequate drinking water supplies and provide cooling water for power generation and industrial facilities.

There are 3,368 permitted dams and approximately 7,500 additional smaller dams in Pennsylvania creating pools, impoundments and lakes on waterways and watersheds of all sizes. The large majority of dams are privately

owned, with only 906 of the 3,368 dams being held in public ownership. At maximum pool levels, the permitted dams are capable of holding back over ten million acre-feet, or in excess of three trillion gallons, of water. Numerous existing dams in Pennsylvania were built decades ago and were not designed to meet modern safety standards. Many are now showing signs of structural aging and numerous outdated dams have been demolished over the past several years. Since 1997, DEP has issued only 43 permits authorizing the construction of new dams in Pennsylvania.

New, strategically located, water storage facilities could provide real-time flow management capabilities, facilitate multiple source blending to improve water quality, augment conjunctive management capability and provide added protection from catastrophic events. The cost of new surface storage capacity varies greatly, but most projects face the financial challenge of raising a large amount of capital over a short period of time. Many beneficiaries normally share the cost of multipurpose storage projects. Storage capacity can usually be expanded more economically at existing facilities by raising reservoir levels, dredging accumulated silt, modifying reservoir outlets, or changing operating procedures.

Off-stream surface storage also provides valuable benefits. With few exceptions, these storage facilities are not designed to provide additional benefits such as flood control, power generation, or primary recreation. Their principal functions are to improve water system reliability and flexibility, to satisfy water supply needs at small industrial sites and to supply recreational sites such as ski areas and golf courses.

In some areas it may be possible to inject or infiltrate and store, water in a local aquifer for future use. Underground storage can be a reliable means of providing clean water during a drought or pollution incident emergency. It also eliminates evaporative loss, reduces vulnerability to contamination and tampering, and may improve water quality and supplement stream base flow during dry periods. Aquifer storage is less expensive than constructing new surface reservoirs, and usually is less disruptive to the native environment. Excess treated water may also be stockpiled underground in a suitable aquifer to be recovered and used during periods of peak water use or low stream flow.

Developing additional storage capacity by constructing new dams and creating new reservoirs may generate significant environmental costs or require local economic and social adjustments. The potential harm to the water body and surrounding wetland ecology, including loss of habitat and changes to water temperature, must be closely studied and avoided or mitigated. Potential hydrogeological changes must also be assessed. New reservoirs may reduce tax revenue to local government and could change the social fabric of an area. All of these matters must be explored and compared to the intended benefits when planning new projects.

## Develop Additional Water Sources

Developing additional sources of raw water is an obvious means of addressing a need deficiency. Decisions related to new source development depend on the specific conditions encountered, the quantity required, and the relative availability, quality and abundance of suitable water. New sources can be attained from direct stream withdrawals or groundwater development of wells and springs. In some regions of Pennsylvania, large volumes of water are being held in limestone quarries and in abandoned surface and deep coal mines, creating a mostly untapped, potential supply of confined water.

Interconnecting water systems can also provide an inexpensive temporary or permanent solution to potable water deficits. This alternative involves two or more separate water supply systems being physically connected and the purchase of treated water by the utility experiencing the need. Interconnections are most applicable where a water surplus is located near a water deficient area. Interconnections are encouraged by the Water Resources Planning Act which requires PENNVEST to give such projects special consideration for funding.

In rare instances, transfers or diversions can economically redistribute water to satisfy water supply needs in a neighboring basin or watershed. All proposed water transfers and diversions must be closely evaluated because they could alter the character of both the source and destination watersheds. Care must be taken to ensure that the hydrologic and biologic integrity of the donor and recipient watersheds are not harmed by the diversion and that unsustainable development is not artificially encouraged in the receiving basin. SRBC and DRBC both have formal regulatory standards that address proposals to divert water from the Susquehanna and Delaware River Basins. In addition, DEP implements a statewide policy discouraging interbasin water transfers unless the importing basin has made reasonable efforts to develop its own sources, the transfer will not prevent the exporting basin from meeting its own needs, and compensation through augmentation is provided to the exporting basin during low periods.

Locating and developing additional water sources for domestic, commercial, or industrial use is a complicated process. Relative cost, permit requirements, social concerns and environmental consequences must all be part of the appraisal leading to a final choice.

# CRITICAL WATER PLANNING AREAS

## The Critical Water Planning Area Designation Process

The Water Resources Planning Act[73] established a process to designate "Critical Water Planning Areas" (CWPAs). CWPAs are areas of the commonwealth where existing or future demands exceed or threaten to exceed the safe yield of available water resources. The Act also outlined a process for identifying CWPAs and provided the authority to prepare "Critical Area Resource Plans" (CARPs) for any watershed or watersheds within a CWPA. Required components of a CARP include assessments of water availability and quality, water uses, conflicts among users and consideration of stormwater and floodplain issues. A CARP must also identify practical alternatives for assuring an adequate supply of water to satisfy existing and future reasonable and beneficial uses.

During the early stages of updating the current *State Water Plan*, the Statewide Water Resources Committee formed a Critical Water Planning Area Subcommittee and initially tasked it with assisting DEP in the development of a formal guidance that would define the CWPA designation process. This effort resulted in DEP issuing the "Guidelines for Identification of Critical Water Planning Areas (Guidelines)" on September 30, 2006. The Guidelines, presented in Appendix E, supply necessary detail on the statutory basis, the criteria and process for identifying CWPAs; and describe a five-stage process for nominating, reviewing, recommending and designating CWPAs.

| | |
|---|---|
| Stage 1 | Nomination |
| Stage 2 | Initial screening and prioritization |
| Stage 3 | Data verification, development and review |
| Stage 4 | Review and recommendations by Regional Committees |
| Stage 5 | Review and designation by Statewide Committee and DEP secretary |

## Baseline Information and Assessment Tools

The following describes how water use data were collected and managed, how the Water Analysis Screening Tool (WAST) was developed, and how the screening tool is being employed to identify potential CWPAs.

## Water Use Data System

The "backbone" of the *State Water Plan* is the water use data that are supplied to the USGS-developed WAST to assist in the preliminary identification of potential CWPAs. DEP has maintained a database of water resources information since the 1970's. This Water Use Data System (WUDS) includes information on water withdrawals, uses and discharges. Documentation of water resource use had previously been collected on a periodic basis from public water suppliers as part of their annual water withdrawal reporting, as part of water allocation permitting and reporting, and from annual metering reports required by the Delaware River Basin Commission (DRBC). The WUDS records, however, did not encompass all water use sectors to the extent necessary to adequately run the WAST model.

DEP used the existing WUDS as a basis for a more comprehensive system to gather, process and distribute information on the availability, extent, quality and use of water resources. The updated system includes a water use registration program, required by the Act, which provides the level of water use data demanded to perform the watershed assessments and related work necessary to identify potential CWPAs.

## Registration Program

The Act requires registration of all water withdrawals and uses greater than 10,000

[73] 27 Pa. C.S. §3101 et seq.

gallons per day averaged over any 30-day period and of all public water supply and hydropower facilities. This level of informational detail, when accumulated, adequately represents water withdrawals and their influence within a given watershed.

In 2003, DEP established paper and web-based options for registering water use. Several outreach efforts were then conducted that targeted water use sectors expected to fall within the registration requirements. Using a Department of Labor and Industry mailing list, DEP contacted major water users across the state of their likely obligation to register their water use. With the assistance of the Department of Agriculture, an agriculture work group was created in 2003 to inform the farming community of the registration requirements and to encourage their water use registration. Also in 2003, direct mailings were made to farmers and agricultural businesses by several of the participating agriculture advocacy agencies. In addition, a teleconference was held by the College of Agriculture at the Pennsylvania State University to disseminate information on the Act and its water use registration provisions to conservation districts and Agricultural Extension Services. During this same period, DEP contacted all public water suppliers through mailings to remind them of their obligation under the Act to register their water uses. These efforts resulted in 2003 being selected as the base year for water withdrawal and use information.

## Water Analysis Screening Tool (WAST)

Also in 2003, DEP entered into an agreement with the U.S. Geological Survey, Pennsylvania Water Science Center in New Cumberland, Pa. to develop a way to manage and analyze the extensive water resource information that is required to assess current and future statewide water use and availability. The result was a Geographic Information System (GIS) based model, the WAST.

The WAST is a sophisticated planning tool that compares net water withdrawals (withdrawals minus discharges/returns) against designated criteria (percent of the low flow [7Q10]) to measure the influence of the net withdrawals on aquatic resources. The graphical output features of the model are used in conjunction with local information and with knowledge provided by DEP's technical partners (DRBC, SRBC, ICPRB and USGS) and the regional water planning committees, to screen for potential CWPA watersheds. The watersheds identified will then undergo more rigorous analyses to determine whether existing or future water use demand is expected to exceed or threaten to exceed the availability of water resources.

For more information on stream flow statistics, methodologies, assumptions, limitations and use of the tool as described by USGS, please refer to the Appendix D.

## Demand Forecasting and Gap Filling

Accurate estimates of existing and future water demands are essential in the screening process to evaluate the current and future adequacy of water supplies. DEP, USGS and DRBC, with assistance from the firm Camp Dresser & McKee (CDM), developed the methodologies that would be used to supplement withdrawal data that could not be captured through registration (Appendix I). The methodology for forecasting future water use demand was also developed by this group.

Estimates of agricultural water withdrawals and use not reported through the registration process and forecasts of future agricultural water use, were important to the success of the screening process. An additional study by Dr. Albert R. Jarrett, Ph.D., P.E., P.L.S., professor of agricultural engineering at the Pennsylvania State University, provided valuable information on animal and irrigation water uses in Pennsylvania that was used to fill in the missing information (Appendix M).

## Population Projections

Using the previous state water plan population forecasts as a baseline, DEP had continued to maintain statewide population projections that are integral to making water allocation permit decisions. For this update, a new set of projections was constructed that reflected 2000 census data. A full explanation of the

methodologies and steps taken to develop the updated population projections is provided in Appendix R.

### Discharges and Returns

In addition to an accurate and relatively complete set of water withdrawal data, information describing discharges and returns was critical to the screening process. The return flow data were primarily obtained from discharge monitoring reports (DMRs) that facility owners submit to DEP under the National Pollutant Discharge Elimination System (NPDES) permit system. The Susquehanna River Basin Commission (SRBC) and DRBC helped DEP collect and consolidate DMR records from DEP's six regional offices. After verification, the records were entered into an electronic database where they became accessible to the WAST. A more complete description of DMR data collection and verification procedures may be obtained from the documents listed in Appendix Q.

### CWPA Designation Stage 1: Nominations

Under the Guidelines, CWPAs may be identified through the planning process as a regional plan component or in advance of formal adoption of a regional plan based on information revealed during the planning process. Potential CWPAs may be nominated by a regional committee, a committee member, or any other person or entity, or initiated by DEP. As of December 2008, two nominations have been presented to DEP: 1) York and Adams counties submitted a nomination for a portion of both the Conewago Creek and South Branch Codorus Creek watersheds, and 2) The Chestnut Ridge Chapter of Trout Unlimited submitted a nomination for the Laurel Hill Creek watershed in Somerset County. Both nominations met the completeness requirements of the Guidelines and were distributed to their respective regional committees.

Thirty other watersheds identified by an initial statewide screening effort are going through a data verification process to confirm potential regional committee-generated nominations. Data for the two submitted nominations are also being checked. Upon completion of this verification work, DEP will review the results with the regional committees to recommend which of the thirty-two watersheds should be supported nominations and moved to the Statewide Water Resources Committee as CWPA candidates for designation by DEP.

### CWPA Designation Stage 2: Screening for the Identification of CWPAs

### Pilot Projects

During the late summer of 2006, the WAST was tested on two pilot watersheds by comparing it against the initial screening criteria specified within the Guidelines. The results of the pilot projects, including data checks and corrections performed as part of the analyses, were used to launch a statewide CWPA screening effort required by the Water Resources Planning Act. Information from the statewide screening would be provided to the Regional and Statewide Water Resources Committees to support CWPA nominations generated by the committees and used to assist in reviewing nominations made by other parties.

The Wissahickon Creek watershed and the Codorus Creek watershed were chosen as the two pilot watersheds because they collectively exhibited a number of attributes that would ensure thorough testing of the WAST and enable a critical review of its results. The list of preferred characteristics included:

- Watershed size – each less than 300 square miles
- Presence of stream gauges
- Presence of unregistered, estimated withdrawals within the DEP data sets
- Presence of registered withdrawals from varying sectors
- Presence of DMRs from NPDES permit holders
- Existence of water resources studies

DEP managed the work on the Wissahickon Creek watershed and USGS oversaw the Codorus Creek watershed initiative. The two agencies coordinated their efforts and regularly discussed progress and problems encountered during the pilot work.

## Initiation of Initial Data Checking and Correction Projects

While working on the pilot projects, it became apparent that having accurate and complete water withdrawal, discharge and locational data was crucial. Two levels of critical data checks and corrections were identified as being necessary prior to conducting a statewide screening with WAST. At this broad level, errors that could be more easily identified within large tables of data would need to be corrected. On an individual watershed scale, more complete and locally unique data would need to be identified and verified or corrected.

With this understanding, DEP developed a data check and correction plan for the remainder of the state. DEP carried out the work through agreements with DRBC for the Delaware Basin, the Interstate Commission for the Potomac River Basin (ICPRB) for the Potomac Basin and USGS, on behalf of SRBC, for the Susquehanna Basin. USGS was also responsible for the statewide data checking and correction work. In addition, USGS became the repository for the original and modified data sets while providing quality assurance and quality control for the information. DEP coordinated the overall effort and provided assistance when needed.

The original work plan included provisions to account for flow mitigation by reservoirs within the watersheds, conservation releases and other regulated conditions such as pass-by requirements before the Regional and Statewide Water Resources Committees prioritized the CWPA evaluations. It soon became evident that completing such a large scope of work for all potential CWPA watersheds would be time and cost prohibitive. As an alternative, the data check and correction process was applied statewide, but the more detailed data evaluations were performed only on selected watersheds where there was a reasonable expectation that work would be completed by the fall of 2007. DEP, in consultation with its technical partners, developed a process for determining where to direct the detailed data analysis efforts.

## Selection of Watersheds for Initial Data Checking

Candidate watersheds for the detailed data analysis were drawn from several informational sources:

- The 2004 inventory of potentially stressed watersheds or areas compiled from regional committees and river basin commission responses
- Preliminary runs of the WAST that were used to elevate watersheds showing net withdrawals exceeding the screening criteria
- Recommendations from DRBC and SRBC that introduced commission perspective and knowledge into the selection process
- Advice from DEP regional office personnel and DEP representatives sitting on the regional committees
- Discussions with USGS that narrowed and finalized the list of watersheds that would undergo verification

The following 22 watersheds were selected for full evaluation:

**Delaware Basin**
Jordan Creek
Unami Creek
Maiden/Sacony Creeks
Brodhead Creek

**Upper/Middle Susquehanna Basin**
Moshannon Creek
Marsh Creek
Spring Creek
Toby Creek

**Lower Susquehanna Basin**
Plumb/Halter Creeks
Conewago Creek
Swatara Creek (Upper parts in Lebanon and Berks Counties)
Octararo Creek

**Potomac Basin**
Antietam Creek
Marsh Creek
Toms/Middle Creeks
Rock/Alloway/Piney Creeks

**Great Lakes Basin**
Elk Creek
Walnut Creek

**Ohio Basin**
Buffalo Creek
Raccoon Creek
Loyalhanna Creek
Blacklick Creek

An assessment of the 22 selected watersheds focused efforts on defining procedures and determining levels of effort necessary for checking and correcting data, and on preliminary WAST results. Mitigation due to reservoir storage, pass-by flows and conservation releases were not considered. The analysis of mitigation was to be accomplished on select watersheds later in the screening process.

## Results of Data Checking and Correction

For each of the watershed data verification and correction projects, withdrawal and discharge data were examined to reveal discrepancies. Errors commonly found included incorrect coordinates, incorrectly coded use type or units, missing withdrawals or discharges and inaccurately reported withdrawals or discharges. In the twenty-four watersheds examined, approximately 700 changes were made to records within the data sets -- about 400 changes related to quantity values and 300 related to spatial or locational changes. Many other data corrections were also made for withdrawals and discharges located outside of the twenty-four watersheds that were specifically studied. The changes improved the level of confidence in the accuracy of the screening process enough to run the WAST statewide.

## Statewide Screening

During the fall of 2007, DEP used the information generated by its technical partners to run the WAST statewide. This process screened out 90% of the state and focused attention on the remaining 10% for further data verification and evaluation of mitigation effects.

The initial statewide screening results were given to the technical subcommittees of each of the six regional water resource committees in November 2007. The individual subcommittees then assisted in making recommendations to each full regional committee in January 2008.

## CWPA Designation Stage 3: Data Verification, Development and Review

Criteria established by the regional committees were applied in reviewing the results of the statewide screening to establish a shortlist of thirty-two watersheds for which DEP and its technical partners would conduct a yet higher level of data verification and analyze potential mitigating factors such as reservoirs, pass-by flows and conservation releases. Among the thirty-two watersheds selected for verification were the two watersheds that were submitted to DEP in 2007 in accordance with the Guidelines as nominations for CWPA outside the statewide screening and verification process. The selected watersheds are presented on the following page.

| Selected Watershed | Planning Region | Watershed Area (sq. mi.) |
|---|---|---|
| Brodhead Creek | Delaware | 144 |
| Little Lehigh Creek | | 190 |
| Neshaminy Creek | | 233 |
| Macoby Creek | | 17 |
| West Branch Brandywine Creek | | 135 |
| Hay Creek | | 22 |
| Toby Creek | Upper Susquehanna | 35 |
| Spring/Nittany Creeks | | 76 |
| Anderson Creek | | 59 |
| Sugar Creek | | 189 |
| Little Catawissa Creek | | 17 |
| Conestoga River | Lower Susquehanna | 475 |
| Chiques Creek | | 126 |
| Swatara Creek | | 572 |
| Beaverdam Branch | | 87 |
| Conewago Creek / Codorus Creek | | 581 |
| Deer Creek | | 13 |
| East Branch Antietam Creek | Potomac | 52 |
| Alloway Creek | | 16 |
| Toms Creek | | 37 |
| Rock Run / Marsh Creek | | 143 |
| Conococheague Creek | | 494 |
| Crooked Creek | Ohio | 291 |
| Indian Creek | | 125 |
| North Branch Blacklick Creek | | 69 |
| Connoquenessing Creek | | 333 |
| Beaver Run | | 55 |
| Laurel Hill Creek | | 125 |
| Temple Creek | Great Lakes | 15 |
| Sixmile Creek | | 19 |
| Elk Creek | | 98 |
| Fourmile Creek | | 12 |

As of December 2008, work is underway to complete these watershed verifications.

### CWPA Designation Stage 4: Review and Recommendations by Regional Committees:

After the verifications have been competed, regional committees will employ a review and decision making process, including public hearings, to recommend CWPA designations to the Statewide Committee. The findings will be summarized, and recommendations will be made as to which watersheds, if any, meet the criteria for CWPA designation.

### CWPA Designation Stage 5: Review and Designation by Statewide Committee and DEP

The final stage of the CWPA designation process involves the Statewide Water Resources Committee receiving individual regional committee recommendations, holding a Statewide Water Resources Committee Meeting to discuss the recommendations and approving and forwarding recommendations to the DEP secretary for concurrence and final designation decisions. The DEP secretary will approve or reject recommendations, provide notifications of decisions, publish notice of the decisions in the *Pennsylvania Bulletin* and post results to the DEP website.

### Development of Critical Area Resource Plans

Following designation of a CWPA, the Act states that a Critical Area Resource Plan (CARP) may be prepared for any watershed or watersheds within the designated CWPA. CARPs should address the key problem or problems identified during the CWPA designation process. CARPs will consist of a detailed investigation of water availability and current and future demands for water in the designated CWPA. They will also include assessments of water quality, stormwater and floodplain management problems and current or potential water use conflicts among water users. Finally, they will identify practical solutions to the problems encountered by assessing supply-side and demand-side alternatives intended to ensure an adequate supply of water to satisfy existing and future water uses. The relevant regional committee will establish a Critical Area Advisory Committee to guide DEP in developing each CARP. Each Critical Area Advisory Committee will be comprised of a cross section of local interests and will advise the regional committee and DEP throughout the process. Once adopted, CARPs become a component of the *State Water Plan* and may be implemented voluntarily.

# DRINKING WATER AND WASTEWATER SUSTAINABLE INFRASTRUCTURE

**Discussion**

On February 27, 2008 Gov. Edward G. Rendell issued an Executive Order creating the Sustainable Water Infrastructure Task Force. The task force was charged with issuing a report by October 1, 2008 that provides an analysis of the issues related to cost-effective and sustained investment in Pennsylvania's water and sewer infrastructure, including investigation of potential funding sources and financing options with the goal of including the recommendations in the governor's fiscal year 2009-10 budget proposal. The order directed the report to address the following issues:

1. Current and projected costs for the construction, upgrade, repair and operation and maintenance of Pennsylvania's drinking water and sewage infrastructure.

2. Projected cost savings realized by the consideration and implementation of all available non-structural alternatives.

3. Current and projected financial resources to address water and sewer services and infrastructure needs.

4. Current and projected gap between water and sewer service, and infrastructure financing needs and available resources.

5. Potential sustainable funding from federal, state and local sources and public/private partnerships.

6. Actual costs of water and sewer service, including recommendations for allocating the costs of capital investment, asset management, operation and maintenance, among customers and state or federal assistance programs.

7. Targeting of funds to address the most serious and urgent needs of the commonwealth, with particular focus on protecting public health and safety, maintaining recreational opportunities and encouraging economic development.

8. Recommendations for legislative or regulatory changes to promote sustainable water and sewer services, including the following components of sustainability:

   - **Effective System Management** – Creation and implementation of business plans, workforce and management training and development, the promotion of measures to insure customer satisfaction and the protection of public health and the environment.

   - **Asset Management** -- Incorporation of accounting and business practices to assess and anticipate operational, replacement and long-term capital improvement costs; and assure they are covered by available resources.

   - **Efficient Operation** – Incorporation of water and energy conservation and system optimization to deliver cost-effective treatment that meets or exceeds existing and future public health and environmental standards.

   - **Regionalization** – Integrated water resource planning and incentives for consolidation or decentralization of water systems to achieve the best scale to facilitate professional management.

   - **Maximization of Non-Structural Solutions** – Integrating conservation, water reuse, trading strategies and comprehensive water resource planning into sewer and water infrastructure planning.

In addition, the Executive Order calls for the Pennsylvania Infrastructure Investment Authority, the Department of Environmental

Protection and the Department of Community and Economic Development to review all existing policies, procedures, rules, regulations and program guidance governing the planning, permitting, operation and maintenance, as well as provide any financial and compliance assistance related to Pennsylvania's water infrastructure to ensure consistency with the five components of sustainable infrastructure defined above. This analysis will be done within the framework of the four pillars established by the US Environmental Protection Agency in 2003:

- **Better Management** (Effective System Management and Asset Management) – This includes better management practices like asset management, environmental management systems, consolidation and public-private partnerships.

- **Full-Cost Pricing** (Infrastructure Financing) – A key consideration in constructing, operating and maintaining infrastructure is ensuring that there are sufficient revenues in place to support the costs of doing business.

- **Efficiency of Water Use** (Efficient Operation) – One way to reduce the need for costly infrastructure is to effectively manage the many different uses of water. There are many options for enhancing water efficiency including metering, water reuse, water-saving appliances, landscaping and public education**.**

- **Watershed Approaches to Protection** – In addressing infrastructure needs for the purposes of water supply and water quantity, it is important to look more broadly at water resources in a coordinated way. This includes the use of non-structural alternatives, concepts for regionalization, integrated water resource planning, the development and implementation of the *State Water Plan* and source water assessment and protection.

With due process, and at an appropriate time after issuance of the report and completion of the objectives outlined in the Executive Order, the Statewide Water Resources Committee may make specific recommendations related to ensuring the long term sustainability of the commonwealth's water infrastructure.

# Appendix A

## Glossary

*7-day-10year low flow* – The lowest consecutive 7-day mean flow expected to occur once every ten years.

*Adequate supply* – The quantity of water necessary to sustain reasonable and beneficial uses over the planning horizon.

*Class A trout stream* – Stream reaches designated by the Pennsylvania Fish and Boat Commission as streams that support a population of naturally produced trout of sufficient size and abundance to support a long term and renewable sport fishery. These stream sections are managed solely for the perpetuation of the wild trout fishery with no stocking.

*Conjunctive Management Programs* – Programs that maximize water availability and minimize resource damage by balancing and optimizing the combined use of water supply sources, including ground and surface sources and interconnections.

*Consumptive Use* – The loss of water from a source through a manmade conveyance system, transpiration by vegetation, incorporation into products during their manufacture, evaporation, diversion out of a basin, or any other process to the extent that the water withdrawal is not returned to the waters of a basin.

*Critical Area Resource Plan* – A water resources management plan established for a Critical Water Planning Area that identifies practicable supply-side and demand-side alternatives for assuring an adequate supply of water to satisfy existing and future reasonable and beneficial uses.

*Critical Water Planning Area* – Any significant hydrologic unit where existing or future demands exceed or threaten to exceed the safe yield of available water resources.

*DEP* – Department of Environmental Protection of the commonwealth.

*Discharge Monitoring Report (DMR)* – A report submitted periodically to DEP by an NPDES permit holder that documents the quantity and quality of their authorized discharge.

*Future* – A planning horizon that serves as the basis for evaluating water supply adequacy. Considering that the *State Water Plan* will be updated every five years, and considering the accuracy of projections beyond fifteen years, a planning horizon beyond fifteen years is likely to introduce substantial uncertainty into the evaluation and is therefore considered appropriate.

*Groundwater* – Water beneath the surface of the ground within a zone of saturation, whether or not flowing through known and definite channels or percolating through underground geologic formations, and regardless of whether the result of natural or artificial recharge, the term includes water contained in aquifers, artesian and non-artesian basins, underground watercourses and other bodies of water below the surface of the earth.

High hazard dam -- Any dam so located as to endanger populated areas downstream by its failure.

*HUC-10* – HUCs (Hydrologic Unit Code) are drainage basins that are referenced by the number of digits in the code. More digits indicate a finer level of scale. HUC-10s generally encompass watersheds with drainage areas ranging from 62 to 390 square miles.

*National Pollutant Discharge Elimination System (NPDES)* – The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under the federal Clean Water Act. Facilities subjected to NPDES permitting regulations include operations such as municipal wastewater treatment plants and

industrial waste treatment facilities. NPDES permits in Pennsylvania are issued by the Department of Environmental Protection under a delegation agreement with the Environmental Protection Agency.

*Net withdrawals* –The total volumetric withdrawals from a watershed minus the total discharges.

*Nonwithdrawal uses* – The functions of, or activities in, water that is not withdrawn from a water resource, including, but not limited to, navigation, instream hydropower production, recreation, fish and wildlife habitat and the aquatic environment.

*Reasonable and beneficial uses* – The use of water for a useful and productive purpose, which is reasonable considering the rights of other users and consistent with the public interest, in a quantity and manner as necessary for efficient utilization. The term includes withdrawal and nonwithdrawal uses.

*Recharge* – Addition of water to an aquifer by infiltration of precipitation through the soil, by seepage from streams other bodies of surface water, by flow of groundwater from another aquifer, or by pumping water into an aquifer through recharge wells; also, the water added by these processes.

*Safe Yield* – The amount of water that can be withdrawn from a water resource over a period of time without impairing the long-term utility of a water resource such as dewatering of an aquifer; impairing the long-term water quality of a water resource; inducing a health threat; or causing irreparable or unmitigated impact upon reasonable and beneficial uses of the water resource. Safe yield of a particular water source is primarily to be determined based upon the predictable rate of natural and artificial replenishment of the water source over a reasonable period of time.

*Surface Water* – Water on the surface of the earth, including water in a perennial or intermittent watercourse, lake, reservoir, pond, spring, wetland, estuary, swamp or marsh, or diffused surface water, whether such body of water is natural or artificial. The term does not include recirculated process water or wastewater stored in an off-stream impoundment, pond, tank or other device unless such water or wastewater is withdrawn and used by a person other than the person who initially withdrew the water from a water resource or obtained such water from a public water supply agency.

*Total Maximum Daily Loads (TMDLs)* – The maximum amount of a pollutant allowed to enter a waterbody by law so that the waterbody will meet and continue to meet the water quality standards for that particular pollutant. TMDLs are used as planning tools to develop specific methods or controls used to meet water quality standards in the impaired waterbody.

*Water conservation* – A beneficial reduction in water use or water waste/losses to wisely manage, preserve, or save water.

*Water use efficiency* – Achieving the same result or accomplishing a function, task, or process using less water or a minimal amount of water.

*Withdrawal uses* – Any use of water that is withdrawn, including but not limited to, domestic, municipal, public, commercial, industrial, energy development and production, and agricultural water supply. The term includes the use of water transferred through interconnections but does not include transfer of water within a system operated by the same public water supply agency.

## Appendices B-S are available at www.depweb.state.pa.us

**Appendix B**
Statewide Water Resources Committee Members

**Appendix C**
Regional Water Resources Committee Members

**Appendix D**
Development of the Water Analysis Screening Tool Used in the Initial Screening for the Pennsylvania *State Water Plan* Update 2008

**Appendix E**
Guidelines for Identifying Critical Water Planning Areas

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Regulations Establishing Requirements for the Registration, Periodic Reporting and Recordkeeping of Withdrawals (Chapter 110 – Water Resources Planning)

**Appendix H**
Pennsylvania Aquatic Species List

**Appendix I**
Methodology for Statewide Water Demand Forecast with Pilot Study, CDM, Nov. 2005

**Appendix J**
Water Use Factor Analysis, DEP

**Appendix K**
Residential Consumptive Use Analysis, DRBC

**Appendix L**
Outline of Water Use Analysis Process, Demand Side Analysis, DEP

**Appendix M**
Animal and Irrigation Water Use in Pennsylvania in 2002, 2010, and 2030, Albert R. Jarrett, Ph.D., P.E., P.L.S

**Appendix N**
Methodology for Establishing Golf Course Inventory for Pennsylvania and Water Use Estimates, DRBC

**Appendix O**
Integrated Water Quality Monitoring and Report

## Appendix P

Low Flow, Base Flow and Mean Flow Regression Equations for Pennsylvania Streams, USGS 2006

## Appendix Q

Act 220 Discharge Flow Compilation (Discharge Monitoring Report [DMR]) Procedures and Database Users Manual, SRBC

## Appendix R

Population Projection Methodology for the Act 220 Water Plan

## Appendix S

Assessment Matrix for Water Supply Alternatives

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