

DRAFT -- MARCH 12, 2008 -- DRAFT

**AN ASSESSMENT OF FLOODPLAIN AND STORMWATER MANAGEMENT
PROBLEMS**

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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, the Department of Environmental Protection 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 buyouts, 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, and 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 supportive and be 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 of 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.¹ It was the nation's most costly natural disaster until Hurricane Andrew ravaged the southeastern United States twenty years later². More recently, ten Pennsylvanians lost their lives during the June 2006 flooding that plagued the Delaware and Susquehanna River Basins³. These catastrophic events have not gone unnoticed. Nearly every local Hazard Mitigation Plan identifies flooding as the primary potential natural disaster facing their communities.

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, flooding from small rainfall events has also become routine 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 more frequent 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.

¹ Pennsylvania Enhanced All-Hazard Mitigation Plan, Appendix 6 of Annex W

² Susquehanna River Basin Commission, "History of Flooding", online posting.

³ USGS, "Flooding in Pennsylvania -- June 27-29, 2006," online posting.

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 not 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 government 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 Act⁴ require National Pollutant Discharge Elimination System (NPDES) permits for most construction activities affecting one or more acres, and for ten other categories of industrial activity. 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.

⁴ The Act of December 27, 1971, P.L. 95, No. 217, 91 Stat. 1566, *as amended*; 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 Law⁵ establishes the legal foundation for water quality protection and restoration, and water resources management in Pennsylvania. It also gives the Department 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 states 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 states 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 the “present and possible future uses of particular waters.” 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 Act⁶ 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 pressure. 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.

⁵ The Act of June 22, 1937, P.L. 1987, No. 394, *as amended*; 35 P.S. §691.1 *et seq* (2007)

⁶ The Act of October 4, 1978, P.L. 864, No. 167, *as amended*, 32 P.S. §680.1 *et seq* (1997)

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. 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 Quality⁷ and Exceptional Value⁸ 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 Code⁹ 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.

⁷ 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.)

⁸ 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.)

⁹ The Act of July 31, 1968, P.L. 805, No. 241, *as amended*; 53 P.S. 10101 *et seq* (1997)

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 Act¹⁰. 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. 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 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:
 - 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 National Flood Insurance Program (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

¹⁰ The Act of October, 4, 1978, P.L. 851, No. 166, §101; 32 P.S. 679.101 et seq (2007)

the NFIP the Center provides technical and financial assistance to PA's municipalities enrolled in the NFIP. The Center reviews municipal floodplain management ordinances to ensure municipal 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.

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, evacuation and recovery plans, relocation and redevelopment efforts to reduce or eliminate problems, and the promotion of 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 also 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 through requests 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 determine economic justification. Ultimately, a benefit/cost ratio must show benefits equaling or exceeding the cost of the project to justify proceeding.

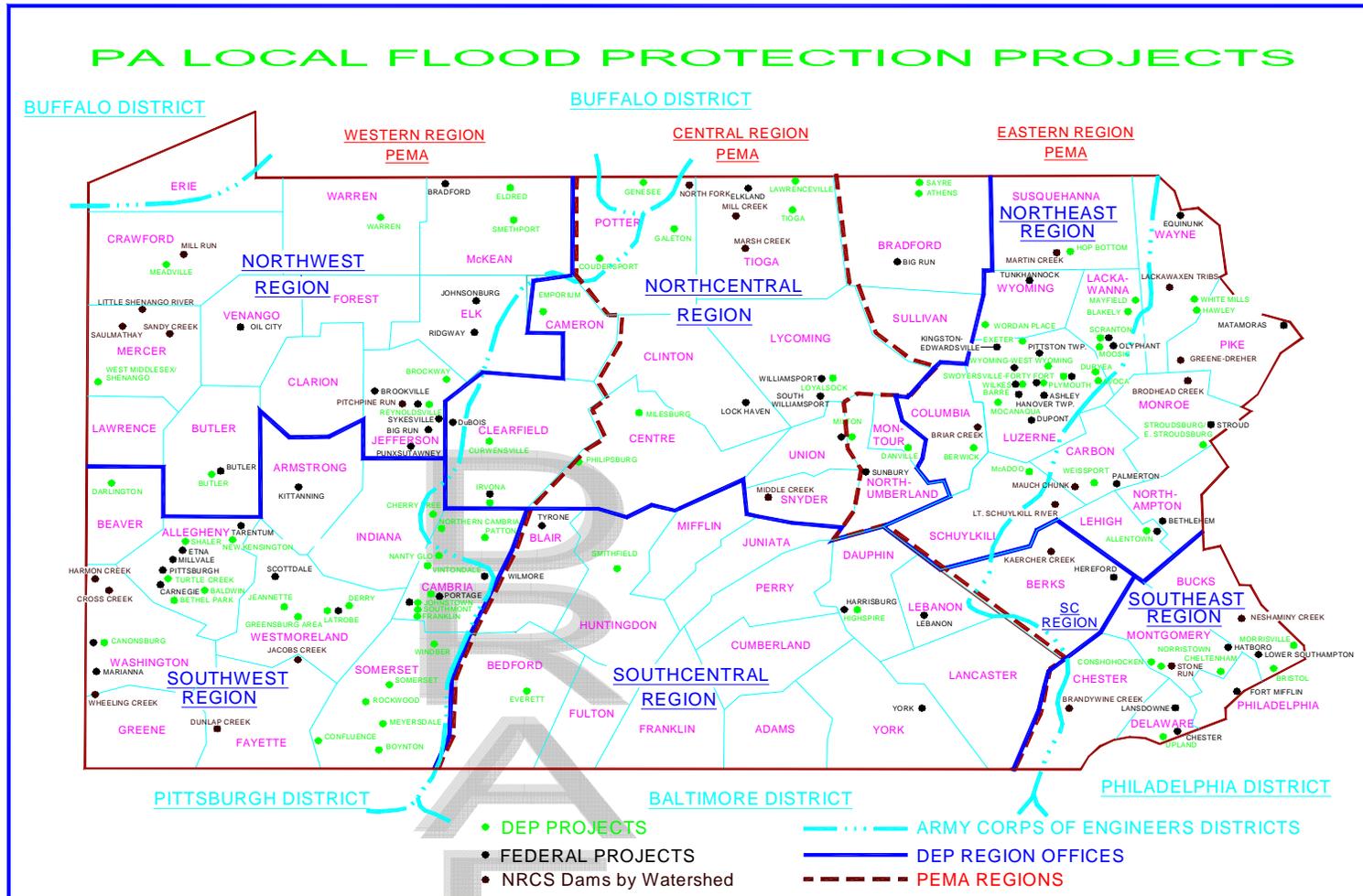
When a flood control project is justified, the local governing bodies are asked to sponsor it and commit to financial participation. Sponsorship involves acquiring rights-of-way and easements, holding the Commonwealth free of liability, maintaining and operating the completed project, providing borrow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

have been authorized by the General Assembly and released by 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 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.

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Map: PA Local Flood Protection Projects



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 of 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, 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 cost, 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. For example, urban stormwater management is 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 update 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 they are for other municipal services.

The 1936 Flood Control Act 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 new and 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, Flood Control Act, and Capital Facilities Debt Enabling Act is 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 requirements, development practices 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 for improving the Flood Control, Floodplain Management, and Stormwater Management Programs

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 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 government.
- 3) Support FEMA 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 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.
 - b) Amend the Flood Control Act to provide authority to consider and implement all potential flood control solutions, including non-structural alternatives and preventative approaches to reduce 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 as effectively and reasonably as possible to restore the floodplain and to prevent 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 of 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.