

*CHAPTER 8*  
***MANAGEMENT RECOMMENDATIONS***

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## 8.1 MANAGEMENT AND IMPLEMENTATION STRATEGIES

Based on information collected for the Pennypack Creek River Conservation Plan, the planning team has developed eight management goals. These goals are consistent with the goals of conservation plans and watershed management plans developed for the other watersheds in the City of Philadelphia. These goals are also consistent with goals found in other municipal and natural resource protection plans developed for the Pennypack Creek Watershed.

In this chapter, the goals are introduced along with the planning needs, data gaps, monitoring outcomes and education needs required to implement the goals. At the end of the chapter, a Management Options Matrix identifies the implementation actions or objectives that the steering committee has developed to implement the plan's goals. Many of these objectives can help forward a number of goals and can serve as a "to do" list for watershed stakeholders.

Members of the public were given an opportunity to identify their priority implementation actions through a series of public meetings held in September and October 2005. The results of this prioritization are included in Appendix G.

### Goal 1: Improve Stream Habitat and Restore Aquatic Communities

The Pennypack Creek Watershed contains 79 miles of surface water streams. Eighty-two percent of those stream miles do not support the aquatic communities that should be present in Pennypack Creek according to the state water plan and the Philadelphia Water Department's *Baseline Assessment of the Pennypack Creek Watershed*. Much of this degradation is due to the negative impacts of stormwater flows and the sediment and nutrient inputs from stormwater runoff.

Improving stream habitat will necessarily involve addressing the manner in which stormwater is managed in the watershed. Improved stormwater management practices will not only improve the overall health of the watershed's communities but will enhance overall stream habitat and create an environment for the recovery of natural biological communities in the Pennypack Creek.

#### PLANNING & DATA GAPS

In order to improve aquatic habitats, there is a need to first identify sections of stream channel in the watershed that are geomorphically unstable. The causes of this instability should be determined and addressed before habitat enhancement projects are planned or implemented. In stream reaches with stable urban hydrologic regimes, identification of projects that restore natural channel and floodplain geometry should be aggressively pursued. Currently the PWD is conducting a geomorphology study of the Pennypack Creek Watershed. This study will provide critical information needed to identify potential sites for stream channel and habitat restoration. PWD will use information collected during the geomorphology study and the River Conservation Plan for the basis of a Watershed Management Plan scheduled to begin in 2006/2007.

The Fairmount Park Commission's Natural Land and Environmental Education Program (NLREEP) developed a master plan for Pennypack Park. As part of the master plan, NLREEP performed habitat assessments for the Pennypack Creek within the park. NLREEP has used this assessment to prioritize and implement habitat restoration projects in the park. That plan

should be used as a model for assessing habitat quality in the Pennypack Creek Watershed for natural areas and lands outside of Pennypack Park. Prioritization should consider project costs as well as the benefits to the stream environment, water quality and aquatic habitat improvements for the stream. Part of this prioritization would include the identification of the owners of large, contiguous riparian land holdings in order to encourage those landowners to implement or permit restoration activities. Stretches of the Pennypack Creek that possess good quality stream habitat should also be identified and measures should be taken to prevent the degradation of these sites.

Habitat restoration plans should include riparian buffer restoration projects. These restoration projects will ultimately help to reduce economic losses and property damage resulting from stream bank and channel instability and will benefit the quality of life of everyone who lives, works or visits the creek as well as aquatic communities.

### IMPLEMENTATION

There are many positive actions that should be implemented to improve in-stream habitats and to restore aquatic communities. The removal of dams on the stream and restoring degraded stream channels to their natural condition are important objectives to restore longitudinal connectivity to the stream corridor. Implementing natural stream channel design projects, especially in areas experiencing geomorphic instability, will improve water quality and create habitat for native aquatic biological communities.

Riparian buffer restoration projects and removal of non-native plant species from the riparian corridor also play a role in restoring stream habitats. Fish and aquatic macroinvertebrates rely on riparian vegetation as sources of food and cover. Native forested riparian vegetation, which has been present in the watershed for millennia, is important because of its contribution to the stream energy cycle and food web.

### MONITORING OUTCOMES

The Philadelphia Water Department's five year biomonitoring program and the PA DEP's water quality assessment provide mechanisms for monitoring in-stream habitat conditions in the Pennypack Creek. Habitat and riparian land restoration projects should be monitored for successes improving water quality and enhancing biodiversity. These restoration projects should be monitored not only for desired outcomes but also revisited to determine the long term sustainability of these efforts.

A volunteer monitoring network should be established to assist with the evaluation of habitat restoration projects. Volunteers should be trained to evaluate improvements in habitat and stream system stability to provide long term data on the benefits and sustainability of restoration projects. Well trained and equipped volunteer monitors should collect additional water quality, stream morphology and habitat data. Volunteer monitoring programs should be established to ensure data quality control and to collect data that can be used to improve the body of knowledge about the Pennypack Creek. Existing groups, such as the Southeast Montgomery County Chapter of Trout Unlimited, have trained volunteer stream monitors. This group in particular can serve as a model for future volunteer monitoring efforts.

## EDUCATION

Habitat protection and enhancement projects serve as opportunities to engage the public and educate them about beneficial land-use practices and actions that they can take to improve the watershed environment. A targeted education and outreach effort for streamside property owners and institutional landowners that have large land holdings in the watershed should be developed to provide benefits to the Pennypack Creek and the watershed's habitats.

Education for municipal officials and developers regarding the interaction between land use and water resources should accompany efforts to restore stream habitats. The economic benefits of preserving natural stream corridors should be made clear to builders and municipal officials to encourage better community planning and site development.

## Goal 2: Improve In-stream Flow Conditions

The nature of development patterns and extent of impervious surfaces in the watershed have resulted in streams that have low baseflow, or baseflow that consists largely of wastewater treatment plant effluent during periods of dry weather. Two primary causes of reduced stream baseflow are the reliance on groundwater wells for commercial and residential uses in the upper watershed and the presence of large areas of impervious surfaces that prevent rainwater from infiltrating into the ground and recharging groundwater aquifers. After even small storm events, stream levels rise significantly and often result in flooding conditions. These large fluctuations in stream flow impact aquatic life, streambank and channel stability, and the water quality in the Pennypack Creek Watershed. Heavy reliance on groundwater sources reduces the amount of water available in streams during periods of low flow and impervious surfaces that increase stormwater run-off cause large increases in stream water levels and stream water energy.

Dams and other structures on the creek, such as bridges and culverts, also affect stream flows. Dams prevent the natural flow of the stream and create impoundments that result in upstream sedimentation and downstream erosion. These impoundments contribute to water quality degradation and hamper fish passage. Bridges and culverts, especially if not sized properly, also restrict the flow of a stream and can contribute to flooding problems when water can not pass through the structure's opening.

Improving in-stream flow conditions will require addressing both baseflow, to provide water for aquatic organisms during dry times, and addressing constrictions on the stream channel that exacerbate flooding and stream velocity conditions during times of elevated stream flow.

## PLANNING & DATA GAPS

The in-stream flow conditions of the Pennypack Creek are the result of a number of complex interactions between groundwater withdrawals, large areas of impervious surface in commercial and residential development in the watershed, wastewater discharges and many other factors. Understanding these interactions is necessary to address the large fluctuations of in-stream flows that are negatively affecting the aquatic communities in the watershed and have resulted in the stream's listing on the state's list of impaired waters.

Recommendations of the many on-going watershed planning efforts should be implemented to improve in-stream flow conditions in the Pennypack Creek Watershed. The Pennypack Creek

Watershed is in need of a comprehensive stormwater management plan, also known as an Act 167 Plan. Local land use and development controls need to be developed, in some cases, and implemented, in most cases, to ensure proper bridge and stream crossing design to prevent flow constrictions when stream crossings are built or repaired. Improved municipal cooperation that considers watershed wide impacts will not only improve the health of the Pennypack Creek Watershed but also reduce flooding and damage to the stream and property associated with elevated storm water flows. Detailed hydrologic studies, such as an Act 167 Stormwater Management Plan and the Temple University Floodplain Study of the Pennypack Creek, are critical to identifying the specific causes of flow fluctuations and properly addressing them.

Identification of locations of flow constrictions on the streams in the watershed is an important data need in this watershed. Temple University's Floodplain Study will identify structural constrictions of the Pennypack Creek and will provide a starting point to begin locating these flow constrictions. The Temple study should be utilized to encourage better planning to mitigate these conditions and ultimately reduce flooding associated with debris jams and flow constrictions.

### IMPLEMENTATION

There are many opportunities to implement projects to improve in-stream flow conditions within the Pennypack Creek Watershed through retrofitting existing conventional stormwater conveyance systems. The watershed is in need of demonstration stormwater BMPs such as infiltration trenches, porous pavement parking lots and other innovative stormwater BMPs. Identifying, prioritizing and retrofitting existing stormwater BMPs to do a better job at removing pollutants and reducing stormwater discharges would also greatly benefit the in-stream flow conditions in this watershed. Finally, addressing flow constrictions on the Creek by removing dams and ensuring proper bridge and culvert design during development and redevelopment is a critical step to restoring natural flow conditions to the Pennypack Creek.

### MONITORING OUTCOMES

Long term flow monitoring data is an important tool for analyzing a wide variety of water quality and physical stream characteristics. Existing USGS flow monitoring stations should be maintained to provide these data. Data from these stations may be used to track changes in in-stream flow conditions as measures are implemented to reduce flooding and increase stream baseflow.

The need for more flow monitoring stations should be investigated. Additional monitoring stations will capture flow fluctuations associated with new development and projects aimed at improving flow conditions in locations in the watershed that are undergoing rapid changes in land-use and hydrology. The Pennypack Headwaters sub-watershed would benefit from a flow monitoring station to measure the effects of land-use changes and watershed management efforts on the hydrology of this important sub-watershed.

### EDUCATION

There is a need in the watershed for education for the general public and municipal officials regarding the relationship between stormwater runoff, water conservation and environmental quality of the Pennypack Creek Watershed. Officials would benefit from education about how these factors relate to federal and state regulations to promote a better understanding of the need for these regulations. A better understanding of these issues for municipal supervisors

and staff would also encourage innovative municipal tools to improve the watershed environment beyond meeting minimum regulatory requirements.

### Goal 3: Improve Water Quality and Reduce Pollutant Loads

Improving water quality in the Pennypack Creek Watershed is largely tied to improving stormwater management in the watershed. Much of the watershed was developed before state and federal regulations requiring stormwater management were implemented. As a result, unmanaged stormwater flow causes erosion, transports pollutants to the stream and impacts water quality.

Other areas of the watershed have been developed before regulations requiring water quality improvements to stormwater were implemented (that is before NPDES Phase II regulations). These areas generally have stormwater regulations that control peak rates at which stormwater can be discharged without consideration to pollutant loads, water quality or total volume of stormwater discharged.

Improving water quality and reducing pollutant loads means reducing erosion and sediment resulting from stormwater runoff, as well as reducing the amount of nutrients, particularly phosphorous, in non-point source pollution. These reductions will most likely result from a combination of effective public education and improvement of stormwater BMPs, both in existing developments and new development.

#### PLANNING & DATA GAPS

An Act 167 Plan would encourage inter-municipal cooperation regarding stormwater management, require improved stormwater BMP function and develop minimum standards for stormwater management in new developments throughout the watershed. An Act 167 Plan would also develop the complex hydrologic and flow models that could be utilized in other watershed planning and monitoring efforts. Recent Temple University Studies will provide important hydraulic and hydrologic modeling data that will benefit the Act 167 Plan process.

Long term monitoring and maintenance plans for the watershed's new and existing stormwater BMPs should be required. An inventory of existing BMPs, which note the condition of the BMP and the party who is responsible for operation and maintenance, is a good first step to addressing the quality and function of these structures. Each new BMP installed in the watershed should have a routine maintenance schedule and have an identified, fiscally responsible party, such as a homeowners association, to ensure that long term operation and maintenance plans are carried out. The Temple University Floodplain study will identify potential stormwater BMP retrofit opportunities and will be a critical starting point to improving stormwater management in developed portions of the watershed.

#### IMPLEMENTATION

Improving water quality in the Pennypack Creek Watershed will require reducing point and non-point source pollutant loads. Point source pollutant loads can be reduced by the continued efforts of wastewater utilities to identify and repair leaking sewer infrastructure, track and eliminate illegal sewer cross connections between storm and sanitary sewers and ongoing efforts by the City of Philadelphia to implement their cross connection program, initiated in 1995,

and to reduce the occurrences of combined sewer overflows in the lower portion of the watershed.

Developing and implementing a TMDL to reduce sediment and nutrient loading to the Creek from both point and non-point source pollution is another critical step towards effectively improving water quality.

Reducing non-point source pollution inputs will require educating the community about their role in protecting water resources and implementing better land and stormwater management practices. Implementation of the recommendations of the Temple University Floodplain study to retrofit and repair stormwater BMPs in the watershed will help to improve water quality. In addition to stormwater retrofits, water quality in the Pennypack will benefit from implementation of long term operations and maintenance plans for new stormwater BMPs to ensure that these practices continue to function properly into the future. These plans should be developed to ensure continued compliance with NPDES regulations.

### MONITORING OUTCOMES

Targeted water quality monitoring programs that accompany BMP retrofits or other water quality improvement projects are necessary to gauge which tools and projects offer the greatest gains and improvements to the watershed water quality. Currently there are gaps and needs for data on the benefits of water quality improvement projects' effects on water quality. Monitoring programs should be established to document the effects of stormwater BMP retrofits and other water quality projects.

Additional chemical water quality data on the watershed is also needed. Philadelphia Water Department monitoring has provided a valuable water quality snap-shot for the watershed. Data such as continuous temperature and dissolved oxygen monitoring as well as wet weather sampling data should be collected to better characterize the sources of pollutant loading on the watershed and provide a more complete picture of the range of water quality fluctuations in the Pennypack Creek and its tributaries.

### EDUCATION

Since land-use in the watershed is largely residential, improvements in water quality should be made through encouraging and educating landowners, developers and municipal officials to become better watershed stewards. There are many existing resources to assist municipalities and organizations with providing this education. Meeting these educational requirements is a component of the NPDES Phase II stormwater regulations.

Education efforts should be implemented cooperatively between watershed municipalities to reduce costs, share information among the municipalities, and reinforce the concept of a watershed to residents. Benefits of an effective education program will not only meet regulation requirements but will ultimately help to reduce non-point source pollution and improve residential, municipal and construction land-use practices that contribute to water quality degradation.

### Goal 4: Improve and Protect Stream Corridors

Natural stream corridors are important to the health of the stream and the ecologic community of a watershed. Riparian and floodplain land-use management can directly impact water quality, in-stream flows, economics of flooding, recreation and a number of other aspects of the River Conservation Plan. Protecting existing natural stream corridors and improving riparian and floodplain land-use practices is a major goal of this plan.

#### PLANNING & DATA GAPS

A large portion of the Pennypack Creek is protected by a green corridor of privately and publicly protected lands. The Montgomery County Comprehensive Plan identifies further trail and greenway connections through the watershed and along the Pennypack Creek as county priorities. The goal of extending the existing green corridor and enhancing trail connections and recreational uses of the creek should be supported by municipal open space and recreational planning. Many of the open space plans for the municipalities in Montgomery County are being updated in response to the open space bond referendum passed in 2003. These plans should identify and target parcels that assist in the establishment of greenways along the Pennypack Creek.

Cooperation among municipalities to acquire lands to implement trails and greenways that cross municipal boundaries reduces cost share requirements of the Montgomery County Open Space program and improves the likelihood of success of obtaining state funding to implement watershed wide greenways.

A database of riparian landowners, land-uses and zoning would provide an excellent planning tool for targeting efforts to extend and protect the stream corridor along the Pennypack Creek and its tributaries. Riparian parcels can be prioritized by natural resource value, value as important linkage, and danger of conversion to intensive land-use or other priority. This information can be shared among municipalities and conservation organizations to assist in greenway planning and stream corridor protection.

Natural Lands Trust has developed a "Smart Conservation" program to evaluate the relative value of preserving parcels of land. This program may be a useful tool to evaluate riparian parcels in the Pennypack Creek Watershed in terms of their conservation value.

Protection of existing stream corridors on public lands is critical to promoting this goal. Natural areas and parks in the watershed would benefit from land management plans, especially for the riparian corridor, invasive species control and deer management.

#### IMPLEMENTATION

Implementation of watershed wide trails and greenways and preservation of green riparian corridors on private lands is dependant on successful outreach efforts to riparian land owners. Land owners should be encouraged to establish riparian buffers on their properties through education about the benefits of riparian buffers for water quality and the environment as well as for property values. Outreach efforts should also educate riparian land owners about the mechanisms and financial benefits of donating conservation easements. There are two active land trusts in the watershed, Natural Lands Trust and the Pennypack Ecological Restoration Trust that can play key roles in this task.

Implementation of trails and greenways will also require sources of funding and community based support. Some acquisition funds are available to Montgomery County municipalities through the Montgomery County Open Space bond issue. These funds should be matched by other sources to acquire land or easements on key corridor parcels. Negotiations with SEPTA and other large institutional land owners for trail easements will be more successful if presented by broad based community coalitions such as the Pennypack Partnership.

### MONITORING OUTCOMES

The success of efforts to preserve stream corridors and greenways in the watershed can be accomplished through collection of annual statistics of riparian parcels or acres preserved either through acquisition or easement by government agency or conservation organization. Stream corridor preservation efforts should be periodically evaluated to determine the most effective methods of preservation, the economic impacts of stream corridor preservation and the remaining unpreserved critical linkages for trails, greenways and wildlife corridors.

### EDUCATION

Educating riparian land-owners and the general public about the benefits of natural stream corridors improves stream corridor stewardship as well as political support for greenways and open space funding. Riparian landowners should be offered educational programming and materials regarding beneficial land use practices and management as well as education about the benefits to donating conservation easements along stream corridors.

Education concerning the benefits of trails and greenways should also be targeted at the watershed municipalities and developers. These educational efforts can encourage preservation of riparian corridors during the development process and stress the importance of regional open space linkages.

### Goal 5: Address Flooding

Flooding within the Pennypack Creek Watershed has cost watershed residents millions of dollars and even some lives in the past 10 years. As with many of the goals of this River Conservation Plan, reducing flooding is closely related to other goals such as improving in-stream flow conditions and protecting stream corridors. Reducing losses associated with flooding is directly related to stormwater management and to preventing development and encroachments of the creek's floodplain. A major recommendation of this plan, offered to reduce damage from flooding in the watershed, is to prevent any future development within the mapped floodplains and where possible, purchase flood prone properties to enhance the watershed wide greenway.

### PLANNING & DATA GAPS

Municipal land use and land development controls are the best tool for eliminating development in the floodplain and floodplain encroachment. Currently each of the municipalities in the watershed has ordinances that control development in the Federal Emergency Management Agency (FEMA) delineated 100-Year Floodplain. Careful review of planned development's cumulative effect on the downstream watershed needs to be considered when encroachments of the floodplain are proposed. Temple University's study of the floodplain of the Pennypack Creek Watershed will result in a remapping of the FEMA floodplain to reflect the impact of

suburban development on the hydrology of the watershed and identify structures that lie within the new floodplain boundary. Municipalities need to utilize this new tool to improve their floodplain management efforts.

With the completion of the Temple University Floodplain study, the Pennypack Creek Watershed will have the most current floodplain maps in the region as well as a wealth of knowledge regarding the hydrology of the watershed. Results and implications of this study and mapping need to be distributed to watershed stakeholders so that communities and watershed stakeholders can begin to implement flood mitigation projects that benefit the entire watershed.

Municipalities should work with FEMA and the PA Emergency Management Agency to develop flood emergency plans so that they are better equipped to respond to flooding, and to reduce loss of life and property. Municipalities that experience frequent flood damage should have established mechanisms to engage state and federal emergency management agencies to assist flood victims. These plans should also include the evaluation of flooding frequency so that educated decisions can be made regarding buy-outs of flood prone properties and mitigation of constrictions to the stream that exacerbate local flooding.

### IMPLEMENTATION

Reducing economic and environmental damage from flooding in this watershed will require mitigating structural constrictions on the creek, removing structures from the floodplain and preventing future encroachments on the floodplain of the Pennypack Creek.

The first task can be accomplished by identifying undersized bridges and culverts on the creek and its tributaries and redesigning or retrofitting the structures to accommodate flood flows. Mitigation efforts can be implemented when the structures are undergoing replacement or repair. Another step is to prevent future constrictions of the stream by ensuring that future bridge crossings and culverts are designed and constructed properly to allow for the passage of flood flows.

Identification of flood prone properties, removal of structures from the floodplain, and elimination of further development of floodplain areas is critical to reducing economic losses and mitigating flooding issues in the watershed.

### MONITORING OUTCOMES

Floodplain encroachments should be tracked and documented to evaluate progress in implementing floodplain management strategies and protecting the watershed's floodplain. Data should be collected regarding number of permitted encroachments as well as instances where variances are granted to allow development in the floodplain. These efforts will provide information on the number of new floodplain encroachments as well as how strictly municipal floodplain protection measures are enforced. This information can then be analyzed to create a municipal "report card" to help judge flood management efforts.

### EDUCATION

Municipal officials, planning staff and commission members would benefit from education on floodplain management and protection techniques. Education materials could include updated model floodplain protection ordinances, floodplain best management techniques and information from the Temple University Floodplain Study. This information should be shared among

municipalities and a clearinghouse should be created for the dissemination of new information. Education should stress the cumulative effects of allowing floodplain encroachments and granting zoning variances on downstream flooding.

### Goal 6: Enhance and Improve Recreational Opportunities

The parks and open spaces in the Pennypack Creek Watershed offer many active and passive recreational opportunities, from ball fields and bike riding to bird watching and fishing. The quality and enjoyment of those facilities is often related to the quality or perceived quality of the Pennypack Creek itself. When the Creek suffers from excessive flooding, trash and debris litter the banks and stream corridors. If the creek suffers from algal blooms, odors and appearance can prevent people from using streamside trails. The watershed's streams and recreational opportunities are closely related. Enhancing these recreational opportunities not only depends on protecting the stream and its corridor but also reinforcing the connection between these amenities and water resources through improved access to the stream.

#### PLANNING & DATA GAPS

Municipal park, recreation and open space planning efforts should consider the cultural and recreational value offered by the Pennypack Creek. The Pennypack Creek corridor and potential trail linkages should be incorporated into new development plans to further the goal of developing watershed wide trails and greenways. Stream access needs and stream corridor linkages need to be addressed in the watershed headwaters and at the mouth of the Pennypack Creek.

An inventory of available land for potential greenway, open space and recreational opportunities needs to be developed. Greenway linkages, access to the creek and large regional open spaces are particularly lacking in the upper watershed communities north of the Pennsylvania Turnpike. An inventory of existing opportunities to preserve open space and create recreational facilities would assist in implementation of the recreational and open space goals of this plan, the Montgomery County Comprehensive plan and municipal recreation and open space plans. This report provides a preliminary analysis of available land using available GIS data but a more in-depth evaluation of land ownership and usage needs to be performed.

#### IMPLEMENTATION

Acquisition of key open space parcels to provide linkages between the economic, cultural and environmental resources of the watershed should be a recreation priority for this plan. In addition to this implementation action, continued maintenance of existing facilities and development of programming for changing populations should be incorporated into open space and recreation plans for updated municipal open space and recreation plans.

#### MONITORING OUTCOMES

Municipal, county and regional planning commissions maintain standards for recreational lands and open space. As the watershed becomes more developed, open space will become more difficult to obtain and preserve. Gains in open space acquisition and protection should be tracked and monitored to gauge the benefits and needs of open space funding. A common protected land database should be developed for the watershed to facilitate open space and recreational planning and linking these resources together.

## EDUCATION

The Pennypack Creek possess many unique natural areas, open spaces and recreational opportunities. The watershed would benefit from efforts to educate the public about these amenities both to increase recreational opportunities for all watershed residents but also to encourage stewardship and political and financial support for efforts to improve the Pennypack Creek and its watershed. Outreach efforts should include educational materials, trail maps and information on preservation and protection measures that are on-going in the watershed.

### Goal 7: Enhance Quality of life for Watershed Residents

The Pennypack Creek, its tributaries, amenities and open spaces can enhance the quality of life for watershed residents and ultimately contains components of all of the other plan goals. Creek-side parks offer places to exercise, contemplate nature or simply relax. In areas where streams are neglected they can become unattractive, sources of odors and generally unwelcoming. In order for a stream to enhance residents' quality of life, the stream must be a clean, safe and accessible place to visit. In turn, as perceptions of the creek change and residents and visitors value the creek, efforts to protect the stream and its watershed gain momentum.

Enhancing the Pennypack Creek's role in watershed residents lives will require reconnecting those residents to the watershed and reinvigorating their sense of stewardship and common ownership of this resource. These efforts will necessarily include protecting the vestiges of green spaces in the watershed but also include enhancing existing amenities and making them more accessible to the general public.

## PLANNING & DATA GAPS

Planning efforts to enhance the role of the Pennypack Creek in watershed residents' lives should include development of green corridors and trails along the stream to provide access to the Creek and promote the public's enjoyment of the resource. Supporting effective natural resource protection and community development planning through municipal ordinances will also improve watershed quality of life while protecting the Pennypack Creek. Good planning increases property values, protects natural resources and improves the community in general.

The effects of new stormwater ordinances and watershed protection efforts should be evaluated to determine whether these new programs and regulations have provided the anticipated benefits for the watershed. There are a number of studies and planning efforts happening concurrently in the watershed, including Temple University studies and this River Conservation Plan. The effect of these programs on the watershed and the number of implemented plan recommendations should be evaluated to guide future studies and planning efforts.

## IMPLEMENTATION

Improving quality of life issues for residents of the Pennypack Creek Watershed will include maintaining the appearance and safety of parks, natural areas and the stream corridor. Regular stream clean-ups and trail maintenance activities can greatly enhance visitors' experiences with the Pennypack Creek.

Ensuring that the Willow Grove Naval Air Base is redeveloped in an environmentally sensitive manner, including contributions to community open space and protection of locations identified

in the Montgomery County Natural Area Inventory as well as important historic buildings will help to maintain community quality of life.

### MONITORING OUTCOMES

Continued public outreach and evaluation is a necessary part of determining whether efforts to improve the watershed are having an impact on residents' usage and enjoyment of the Pennypack Creek and its resources. Outreach will also help organizations active in watershed stewardship identify community needs and perceptions regarding the Pennypack Creek. These perceptions and continued public engagement are critical to maintaining long term momentum for watershed improvement.

### EDUCATION

Each plan implementation project should contain an education and outreach component to involve the community in on-going watershed stewardship opportunities. Outreach and education efforts not only engage the public in the watershed stewardship process but give the public opportunities to shape and improve their community as well as increase their knowledge about watershed issues.

Public awareness of watershed improvement projects positively improves perceptions and enjoyment of the watershed and its resources.

### Goal 8: Improve Stewardship, Communication and Coordination among Watershed Stakeholders and Residents

This goal is largely directed at encouraging coordination and cooperation among watershed stakeholders, sharing information to promote successful efforts to improve the watershed and maintaining the structure and momentum of the River Conservation Plan process. Implementing projects and ideas that impact the entire watershed requires sharing of ideas and resources, especially since the watershed encompasses all or parts of twelve municipalities in three counties. Inter-municipal and inter-agency cooperation is especially important to improving this complex watershed.

### PLANNING & DATA GAPS

The Pennypack Creek Watershed would benefit from the formalization of the Pennypack Partnership or other organization charged with promoting Pennypack Creek issues, acting as a clearing house for information regarding the challenges and opportunities in the watershed. This organization should serve as a steering committee to assist in coordinating on-going efforts to improve the watershed. There are many successful models for the creation of such an organization. The important issue is that an organization evolves to lead the implementation of the River Conservation Plan objectives and promotes on-going cooperation and dialogue among watershed stakeholders.

Pennypack Creek Watershed stakeholders need to be identified when forming a watershed management organization. Many of the stakeholders in the watershed should have been identified in the formation of the Pennypack Partnership and the formation of the steering committee for this River Conservation Plan. Immigrant and minority community leaders need to be identified to increase participation in watershed planning efforts from those communities.

## IMPLEMENTATION

This goal can be obtained through a myriad of education and outreach efforts. The principal vehicle for fostering cooperation and coordination of watershed protection efforts should be a watershed partnership. The partnership can take many forms but should serve as a clearinghouse of watershed information and provide support for watershed improvement efforts. A watershed partnership should foster cooperation among the many organizations and institutions working in the watershed and ultimately increase awareness of the Pennypack Creek.

## MONITORING

Implementation of this River Conservation Plan's objectives should be reevaluated in five years to monitor progress towards plan goals and to make adjustment to implementation actions to reflect changing watershed conditions.

## EDUCATION

Watershed awareness and education efforts are important and visible methods to maintain momentum and promote watershed improvement projects. There is a vast amount of valuable, existing information regarding watershed issues. The stakeholders of the Pennypack Creek need an accessible clearinghouse to obtain and share this information.

Municipal leaders, developers, grass roots organizations and community groups are among many of the important target audiences for educational efforts to improve the watershed and address outstanding watershed issues. These efforts need to be coordinated to reduce duplication of effort and to standardize the message being given to these groups.

## 8.2 MANAGEMENT OPTIONS MATRIX

Table 8.1 is a management options matrix that identifies the River Conservation Plan goal and the conservation actions or objectives identified by the steering committee as a means to attain the stated goal. The table also identifies the primary partners who would most likely lead implementation efforts of the action and the time frame in which the action may be accomplished.

Management Options continue to grow and evolve through the River Conservation Planning process. Although many of the Management Options can serve to forward a number of goals, each option is listed only once.

<b>Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix</b>				
<b>Issues and Concerns</b>	<b>Conservation Action</b>	<b>Specific Locations</b>	<b>Primary Partners</b>	<b>Project Implementation</b>
<b>Goal 1. Improve Stream Habitat and Protect Aquatic Resources</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Develop comprehensive stream bank and stream channel stability assessment</li> <li>Adopt consistent natural resource protection ordinances for all watershed municipalities</li> </ul>	<ul style="list-style-type: none"> <li>Work with Meadowbrook Country Club to improve natural riparian corridor</li> </ul>	PWD, SEMCTU, TU Municipalities, CPC, PEC	<ul style="list-style-type: none"> <li>2005-2006</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>Improve in-stream habitats through dam removal and habitat enhancement projects</li> <li>Daylight buried and piped stream channels where feasible</li> <li>Restore geomorphic stability through active channel restoration</li> <li>Implement stream and riparian restoration recommendations of FPC Pennypack Park Master Plan</li> </ul>	<ul style="list-style-type: none"> <li>Huntingdon Pike Dam</li> <li>Restore day-lighted section of the Sandy Run</li> <li>Lorimer Park Adopt-A- Stream project</li> </ul>	FOPP, FPC, PAFBC, PERT, PWD, SEMCTU	<ul style="list-style-type: none"> <li>On-going habitat restoration projects</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>Monitor successes of habitat and species restoration efforts through agencies, volunteers and non-profit organizations</li> </ul>	<ul style="list-style-type: none"> <li>Monitor success of PA Fish and Boat Commission Shad restoration and dam removal program</li> <li>Continue PWD Biomonitoring efforts</li> </ul>	DRKN, FOPP, FPC, PAFBC, PWD, SEMCTU	<ul style="list-style-type: none"> <li>On-going</li> </ul>
Education	<ul style="list-style-type: none"> <li>Work with PA DOT and municipalities to ensure proper bridge and culvert design for new and redevelopment</li> </ul>	<ul style="list-style-type: none"> <li>PA Turnpike repairs</li> </ul>	DVRPC, Municipalities, PA DOT, PEC, PWD	<ul style="list-style-type: none"> <li>2006-2007</li> </ul>
<b>Goal 2. Improve In-stream Flow Conditions</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Develop headwater protection ordinance to assist municipalities with protection of headwater streams</li> <li>Ensure enforcement of municipal natural resource protection ordinances</li> <li>Identify and prioritize stormwater BMPs for retrofits that promote infiltration and reduce stream flow variation during storm events</li> </ul>	<ul style="list-style-type: none"> <li>All municipalities</li> </ul>	PEMA, CCD, CPC, Municipalities	<ul style="list-style-type: none"> <li>2006-2008</li> </ul>

<b>Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix</b>				
<b>Issues and Concerns</b>	<b>Conservation Action</b>	<b>Specific Locations</b>	<b>Primary Partners</b>	<b>Project Implementation</b>
Implementation	<ul style="list-style-type: none"> <li>Encourage large institutional landowners to implement porous pavement, infiltration trench and other on-site infiltration demonstration projects</li> <li>Retrofit stormwater BMPs for biological water treatment and longer detention times</li> <li>Remove headwater ponds</li> </ul>	<ul style="list-style-type: none"> <li>Willow Grove Mall</li> </ul>	SEMCTU, PAFBC, Korman Corp.  Municipalities, PEC, PWD, TU	<ul style="list-style-type: none"> <li>2005-2006</li> <li>On-going</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>Establish additional flow monitoring stations on the creek</li> </ul>	<ul style="list-style-type: none"> <li>Establish flow monitoring stations in rapidly changing sub-watersheds such as the Pennypack Headwaters</li> </ul>	SEMCTU	<ul style="list-style-type: none"> <li>2006-2008</li> </ul>
Education	<ul style="list-style-type: none"> <li>Work with county conservation districts and municipal EACs to implement rain barrel, rain garden and green roof workshops</li> <li>Develop and present stormwater management workshops for homeowners, builders and municipal officials</li> </ul>		CCD, Municipalities, PWD	<ul style="list-style-type: none"> <li>On-going</li> </ul>
<b>Goal 3. Improve Water Quality and Reduce Pollutant Loads</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Develop Act 167 Plan</li> <li>Adopt and implement NPDES Phase II Regulations</li> <li>Collect fecal coliform monitoring data to characterize sources of coliform, including wet weather sampling</li> <li>Develop BMP database, including location, ownership and maintenance needs</li> <li>Develop long term monitoring and maintenance plans for new and existing stormwater BMPs in the watershed</li> </ul>		CCD, CPC, Municipalities, PWD, TU	<ul style="list-style-type: none"> <li>On-going</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>Institute stormwater BMP maintenance and monitoring program</li> <li>Continue to take actions to reduce the occurrence of combined sewer overflows</li> </ul>	<ul style="list-style-type: none"> <li>All municipalities and City of Philadelphia</li> </ul>	CPC, Municipalities, PWD, TU	<ul style="list-style-type: none"> <li>On-going</li> </ul>

**Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix**

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Monitoring	<ul style="list-style-type: none"> <li>Implement aggressive monitoring program to track sewer infrastructure leaks and illegal cross connections</li> <li>Conduct additional water quality monitoring on the watershed to characterize pollutant loading sources</li> <li>Monitor water quality changes in BMP retrofits</li> </ul>	<ul style="list-style-type: none"> <li>City of Philadelphia</li> <li>All municipalities</li> </ul>	CHD, DRKN Municipalities, PWD, Utilities	<ul style="list-style-type: none"> <li>2006-2008</li> </ul>
Education	<ul style="list-style-type: none"> <li>Develop homeowner’s manual for pond owners in headwaters to improve water quality</li> <li>Develop BMP demonstration site map and informational materials for municipalities and developers</li> </ul>		CPC, CCD, DRKN Municipalities, PWD, TU	<ul style="list-style-type: none"> <li>2006</li> </ul>
<b>Goal 4. Improve and Protect Stream Corridors</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Develop and implement deer management plans for natural areas</li> <li>Develop invasive species management plans for natural areas and parks</li> <li>Develop watershed wide open space/riparian corridor protection plan</li> <li>Create inventory database of riparian landowners to be used for outreach and education and research</li> <li>Adopt woodland protection ordinances, in watershed municipalities, that limit removal of existing vegetation and update standards for tree replacement with species that were removed from the development site</li> <li>Develop tree protection standards to be used by municipalities to protect existing trees and woodlands on development sites</li> </ul>	<ul style="list-style-type: none"> <li>Lorimer Park, municipal parks and open spaces</li> </ul>	FPC, CPC, CPD, PERT, NLT, PEC, Municipalities	<ul style="list-style-type: none"> <li>On-going</li> </ul>

<b>Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix</b>				
<b>Issues and Concerns</b>	<b>Conservation Action</b>	<b>Specific Locations</b>	<b>Primary Partners</b>	<b>Project Implementation</b>
Implementation	<ul style="list-style-type: none"> <li>Conduct landowner outreach and education programs to promote better riparian land management</li> <li>Improve upstream/downstream connectivity by protecting existing green corridors and promote new green corridors through easements, land acquisition and donations</li> <li>Actively remove non-native invasive plant species from riparian areas and restore riparian habitats by revegetating with native plant species</li> </ul>	<ul style="list-style-type: none"> <li>All along Pennypack Creek and tributaries</li> </ul>	CCD, FPC, PAFBC, PWD	<ul style="list-style-type: none"> <li>2007-2010</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>Track annual statistics of open space acquired, easements donated and acres of land preserved in a common database</li> </ul>		GSA, CPC	<ul style="list-style-type: none"> <li>On-going</li> </ul>
Education	<ul style="list-style-type: none"> <li>Hold workshop for golf courses, homeowners, corporations and apartment building managers and other large riparian landowners on stream and riparian management.</li> </ul>		CCD, CPC, Municipalities, PEC	<ul style="list-style-type: none"> <li>Immediately</li> </ul>
<b>Goal 5. Address Flooding</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Update flood emergency management plans</li> <li>Develop mechanism for the removal or reconfiguration of log and woody debris jams to reduce erosion and flooding</li> </ul>		FEMA, Municipalities, PEMA	<ul style="list-style-type: none"> <li>Immediately</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>Buy out flood prone properties to promote green river corridors</li> <li>Enforce floodplain protection ordinances</li> <li>Implement recommendations of Temple University Floodplain Study</li> </ul>		FEMA, Municipalities, PEMA, PADOT	<ul style="list-style-type: none"> <li>On-going</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>Track permitted floodplain encroachments and variances granted to allow development in the floodplain</li> </ul>		CPC, Municipalities	<ul style="list-style-type: none"> <li>2006</li> </ul>

# Pennypack Creek Watershed Partnership

<b>Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix</b>				
<b>Issues and Concerns</b>	<b>Conservation Action</b>	<b>Specific Locations</b>	<b>Primary Partners</b>	<b>Project Implementation</b>
Education	<ul style="list-style-type: none"> <li>Create clearinghouse of municipal information for repairing flood damage, protecting floodplains and floodplain best management techniques</li> </ul>		CPC, PEMA	<ul style="list-style-type: none"> <li>2006</li> </ul>
<b>Goal 6. Enhance and Improve Recreational Opportunities</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Develop maintenance and management plans for existing recreational facilities and open spaces</li> <li>Investigate opportunities for new active and passive recreational facilities in the watershed</li> <li>Update recreation plans to reflect demographic changes</li> </ul>	<ul style="list-style-type: none"> <li>Investigate further development of park at the mouth of the Pennypack Creek for interpretive center and environmental education</li> </ul>	CPC, CPRD, FPC, GSA, Municipalities, PDR	<ul style="list-style-type: none"> <li>2006-2009</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>Implement access and trail improvement recommendations of FPC Pennypack Master Plan</li> <li>Continue recreational facility upgrades and maintenance</li> <li>Acquire additional community open space</li> </ul>	<ul style="list-style-type: none"> <li>Implement Newtown Rail Trail and other identified trail linkages</li> <li>Significantly upgrade Pennypack Valley Park between Torresdale Ave. and State Road to reconnect park to Delaware River</li> </ul>	CPC, CPRD, FPC, GSA, Municipalities, SEPTA  CPC, CDC, CPRD, FPC, Municipalities, PDR	<ul style="list-style-type: none"> <li>2006-2010</li> <li>On-going</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>Conduct surveys to gauge public interest in proposed trail networks and connections</li> </ul>	<ul style="list-style-type: none"> <li>Bucks and Montgomery Counties</li> </ul>	GSA, CPC	<ul style="list-style-type: none"> <li>2006</li> </ul>
Education	<ul style="list-style-type: none"> <li>Market watershed's recreational amenities through development of brochures, maps and other educational materials</li> </ul>		CPC, CDC, CPRD, FPC, Municipalities, PDR	<ul style="list-style-type: none"> <li>On-going</li> </ul>
<b>Goal 7. Enhance Quality of Life for Watershed Residents</b>				
Planning & Data Gaps	<ul style="list-style-type: none"> <li>Identify opportunities to improve stream access, especially in upper watershed where connection to stream is lost</li> </ul>		GSA, CPC, Municipalities	<ul style="list-style-type: none"> <li>On-going</li> </ul>

**Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix**

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Implementation	<ul style="list-style-type: none"> <li>• Conduct regular stream clean-ups</li> <li>• Conduct regular trail maintenance activities</li> <li>• Ensure environmentally sensitive redevelopment of Willow Grove Naval Air Base, should it close                             <ul style="list-style-type: none"> <li>• Set aside land for recreation</li> <li>• Protect natural communities identified in the Natural Areas inventory</li> <li>• Use innovative BMPs for stormwater management</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate watershed wide clean-up day</li> <li>• Develop Adopt-A-Stream Program</li> </ul>	SEMCTU, PERT, FOPP, PWD  CPC, Municipalities, DCED	<ul style="list-style-type: none"> <li>• 2006</li> <li>• On-going</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>• Conduct series of surveys and public outreach events to evaluate success of River Conservation Plan implementation projects</li> </ul>		PP	<ul style="list-style-type: none"> <li>• 2009</li> </ul>
Education	<ul style="list-style-type: none"> <li>• Implement environmental education and program outreach to minority and immigrant groups</li> <li>• Implement program similar to National Institute of Health, educating people about health benefits of walking, running and bike riding in a natural setting</li> </ul>	<ul style="list-style-type: none"> <li>• Northeast Philadelphia and other areas with large immigrant populations</li> </ul>	CHD, CPRD, FPC, PERT	<ul style="list-style-type: none"> <li>• 2006-2009</li> </ul>
<b>Goal 8. Improve Stewardship, Communication and Coordination Among Watershed Stakeholders and Residents</b>				
Planning & data Gaps	<ul style="list-style-type: none"> <li>• Hold workshops to reduce municipal miscommunication and promote regional planning</li> <li>• Create an organization or other mechanism for plan implementation</li> <li>• Create a watershed information clearing house or web site that promotes and coordinates stewardship activities</li> </ul>		CPC, FPC, PEC, PWD, PP	<ul style="list-style-type: none"> <li>• 2006</li> </ul>

**Table 8.1 Pennypack Creek River Conservation Plan Management Option Matrix**

Issues and Concerns	Conservation Action	Specific Locations	Primary Partners	Project Implementation
Implementation	<ul style="list-style-type: none"> <li>• Promote education about buried segments of Sandy Run—similar to Wingohocking Mystery tour in Germantown</li> <li>• Develop a small scale map, brochure, or tour booklet to educate populace about watershed and reconnect headwater communities to the stream</li> <li>• Develop or implement accredited stewardship program or curriculum that meets state education standards</li> <li>• Target developers for education programs</li> <li>• Name unnamed tributaries in the watershed</li> <li>• Implement education program for residents about location, function and value of streams in their communities</li> <li>• Hold annual event to promote watershed issues</li> <li>• Present open space preservation education programs                             <ul style="list-style-type: none"> <li>• Tax benefits</li> <li>• Tools for municipalities</li> <li>• Benefits and methods</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Implement Adopt-A-Stream Program</li> </ul>	CPC, CCD, PP, PWD, PEC	<ul style="list-style-type: none"> <li>• On-going</li> </ul>
Monitoring	<ul style="list-style-type: none"> <li>• Create recognition program such as municipal ecology awards to promote environmental stewardship and good ordinance development</li> <li>• Review accomplishments of plan in 5 years for                             <ul style="list-style-type: none"> <li>• Watershed Impact</li> <li>• Implementation</li> </ul> </li> </ul>		CPC, CCD, GSA, PP, PWD, PEC  PP, PWD, PPSC	<ul style="list-style-type: none"> <li>• 2006</li> <li>• 2010</li> </ul>
Education	<ul style="list-style-type: none"> <li>• Develop and distribute education materials</li> <li>• Implement "Rediscover Your Watershed" Program (history, connections to natural environment)</li> </ul>		CPC, CCD, PP, PWD, PEC	<ul style="list-style-type: none"> <li>• On-going</li> </ul>

**Abbreviations:** CCD, County Conservation Districts; CDC, Community Development Corporations; CHD, County Health Departments; CPC, County Planning Commissions; CPRD, County Parks & Recreation Departments; DCED, Department of Community and Economic Development; DRKN, Delaware River Keeper Network, DVRPC, Delaware Valley Regional Planning Commission; FEMA, Federal Emergency Management Agency; FPC, Fairmount Park Commission; FOFP, Friends of Pennypack Park; GSA, Green Space Alliance; NLT, Natural Lands Trust; PA DOT, PA Department of Transportation; PAFBC, PA Fish & Boat Commission; PEC, Pennsylvania Environmental Council; PEMA, PA Emergency Management Agency; PERT, Pennypack Ecological Restoration Trust; PP, Pennypack Partnership; PPSC, Pennypack RCP Steering Committee; PRD, Philadelphia Department of Recreation; PWD, Philadelphia Water Department; SEMCTU, Southeast Montgomery County Trout Unlimited; SEPTA, Southeastern PA Transportation Authority; TU, Temple University