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Dulcie Flaharty, Montgomery County Lands Trust

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(MAPS APPEAR IN ORDER OF DISCUSSION IN TEXT)

REFERENCE MAPS TO THE SCHUYLKILL WATERSHED CONSERVATION PLAN	**CHAPTER(S)**
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Schuylkill Watershed Conservation Plan

www.schuylkillplan.org

May 31, 2001

prepared for

Pennsylvania Department of
Conservation and Natural Resources

and

The William Penn Foundation

by

THE ACADEMY OF NATURAL SCIENCES
Patrick Center

NATURAL LANDS TRUST

The Conservation Fund

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

This River Conservation Plan for the Schuylkill River watershed has been produced through a partnership between The Conservation Fund (TCF), Natural Lands Trust (NLT) and the Patrick Center for Environmental Research at the Academy of Natural Sciences (PCER - ANS).

The Plan is designed to be a guidebook for municipalities, conservation groups, and citizens interested in taking steps to enhance the long-term health of the Schuylkill River watershed. However, due to the regional nature of the assessments in this project, it is likely that municipalities and nonprofits will be the primary users. Municipalities and nonprofits may, in turn, use the Plan to engage landowners and citizens in implementing the recommendations developed in this Plan.

The Plan focuses on three major areas of interest:

- An analysis of watershed lands required for ecosystem sustainability;
- A broad-scale analysis of water quality; and
- An assessment of watershed institutions (public agencies and nonprofit organizations).

While agricultural, scenic, cultural, historic and recreational resources are acknowledged as critical aspects of the watershed community and part of the comprehensive planning process, they have not been specifically addressed in this Plan due to the agreed-upon scope of work, the scale of the watershed assessment (almost 2,000 square miles) and the limited resources available. A tight focus on the three primary areas of interest was required to meet the goals of the project.

1.1.1 Project Goals

Goals for the Plan were established in the contract with the Pennsylvania Department of Conservation and Natural Resources (DCNR), as follows:

- Identify conservation issues important to local communities and governing agencies;
- Conduct a broad scale inventory and assessment of land and water resources to establish priorities;
- Make recommendations for a watershed-wide conservation agenda to guide future studies and actions at the site-specific, local community level; and
- Make recommendations for a management structure to implement the recommendations of the report.

1.1.2 Public Participation

The Plan includes a summary of findings on existing physical and institutional conditions, input from government agencies, municipal and county officials, and private citizens, solicited through public meetings, surveys, and interviews.

- A public opinion poll was conducted to assess the general public's environmental awareness and gather input on perceived watershed issues and problems. The poll was based on a random sample of 800 adults throughout the seven counties in the Schuylkill River watershed.

- A series of four public meetings were held during the summer of 1999 to solicit input on watershed issues. A second series of meetings were held in September 2000 to receive public comment on the key findings and recommendations from the draft watershed plan. Comments were solicited using breakout groups. Meetings were held in Berks, Schuylkill and Philadelphia counties. Public comments are listed at length in the Technical Supporting Documents. A third and final set of public meetings were held in March 2001 to review final plan recommendations and solicit potential Implementation Project lists from municipalities, government agencies and non-profits throughout the watershed

- Numerous reports and other documentation were reviewed. These included reports from federal and state agencies and nonprofit organizations. A list and summary of references is given in the Technical Support Document.

- The Schuylkill Watershed Conservation Plan Technical Advisory Committee (TAC) met four times prior to the issuance of this draft plan: September 14, 1998; May 25, 1999; and December 1, 1999. At these meetings, the TAC did not necessarily identify new issues but rather assisted in how they were categorized and presented. This draft plan was presented to the TAC on October 16, 2000 and is pending review by the TAC and PA DCNR. The TAC includes watershed representatives from federal, state and local government, nonprofit groups, academic institutions and industry.

1.1.3 Project Documentation

The documents produced through this planning effort for the Schuylkill River watershed, and information on where they can be found, is presented below.

- The Executive Summary to the Schuylkill Watershed Conservation Plan

  An Executive Summary to the Conservation Plan is available as a separate document, and also included as Chapter 1 of the Plan. The intent of this summary is to present key issues and conditions in the watershed, and to describe the three focal analyses performed and their related recommendations. A printed copy of the Executive Summary is available to the public via the Plan's website, http://www.schuylkillplan.org/.

- The Schuylkill Watershed Conservation Plan

  The complete River Conservation Plan for the Schuylkill River watershed is provided, by section, in PDF format online at http://www.schuylkillplan.org. This document can be downloaded and read using the free Adobe Acrobat™ software available on the Internet. The Plan contains 7 sections:

Chapter 1.0	Executive Summary
Chapter 2.0	Foreword
Chapter 3.0	Watershed Characterization
Chapter 4.0	Identification of Major Watershed Issues
Chapter 5.0	Water Quality
Chapter 6.0	Promoting a Sustainable Landscape
Chapter 7.0	Institutional Assessment

Maps referenced in these chapters of the Schuylkill Watershed Conservation Plan also are provided separately as PDF files on the website. A limited number of printed copies of the full Plan are available for review at the following locations.

- Planning Commissions: Berks, Montgomery and Schuylkill Counties
- National Resource Conservation Service: Berks, Montgomery, and Schuylkill
- Philadelphia Free Library
- Schuylkill Resource Conservation District
- Other locations as noted on the project website at: http://www.schuylkillplan.org.

- Maps

  Color and grayscale maps referenced in the Schuylkill Watershed Conservation Plan can be viewed on the website (http://www.schuylkillplan.org). Maps are referenced by name in the text of the Plan. Printed copies of the maps also are available with the full Schuylkill Watershed Conservation Plan at the selected locations listed above.

- Online Reference Documents

  Supplementary reference documents, such as large tables and general maps related to the water quality, landscape and institutional analyses, are compiled in the online Reference Documents. These documents are referenced in the chapters of the Schuylkill Watershed Conservation Plan. The Reference Documents are available online in PDF format at http://www.schuylkillplan.org. Paper copies of these Reference Documents have been distributed only to the project funders, to the Technical Advisory Committee, and along with the printed copies of the full Plan distributed at selected locations throughout the watershed as noted above.

1.1.4 Project Funding

The Schuylkill Watershed Conservation Plan was produced with financial assistance from the Pennsylvania DCNR's "Rivers Conservation Program," which awarded a planning grant to the project in 1997. A matching grant also was provided for the project from The William Penn Foundation.

When the Pennsylvania DCNR approves the final version, this Schuylkill Watershed Conservation Plan will be submitted for inclusion on the Pennsylvania Rivers Registry, providing the basis for DCNR matching grants to municipalities and nonprofits that are interested in implementing the recommendations provided in this report. Some of the watershed municipalities and nonprofits have provided a preliminary list of their proposed implementation projects in the online Reference Document **Potential Implementation Projects** to this Plan.

1.1.5 Project Partners

The project team drafted different sections of the Schuylkill Watershed Conservation Plan. Your comments on any sections are welcome. However, please recognize that these comments may not be addressed directly until the next updating of the Plan (assumed to be sometime between 2004-2006). Comments should be made via the project website, where full instructions will be given regarding comment procedures. Comments should be addressed to the project team as follows (complete contact information is provided below).

- Executive Summary, Foreword, Watershed Characterization, Identification of Major Watershed Issues and Promoting a Sustainable Landscape (Chapters 1- 4, and 6): Clare Billett, Natural Lands Trust
- Water Quality (Chapter 5): Tom Johnson, Patrick Center for Environmental Research, ANS
- Institutional Assessment (Chapter 7): Anne Desmarais, National Office, The Conservation Fund

Contact information for each project team member is given below, and via the project web page at http://www.schuylkillplan.org. In order to ensure appropriate documentation of your issues and concerns please submit written comments via the web site only.

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1.2 Watershed Characterization

1.2.1 Watershed Location

A *watershed* is defined as the land area that "sheds" or contributes water to a river or stream. The watershed of the Schuylkill River is located in southeastern Pennsylvania, and includes large parts of Schuylkill, Berks, Montgomery, Chester, and Philadelphia Counties (see the map: **Watershed Orientation**). Smaller areas of Carbon, Lehigh, Lebanon, Lancaster, Bucks and Delaware Counties also lie within the watershed. The Schuylkill River watershed is about 80 miles long and 25 miles wide, and encompasses an area of approximately 1,916 square miles (4,962 sq. km). The principal towns and cities

along the mainstem of the river are Pottsville, Reading, Pottstown, Phoenixville, Norristown, Conshohocken, and Philadelphia. See the map: **Cities, Townships & Boroughs**.

The Schuylkill River travels approximately 130 miles from its headwaters at Tuscarora Springs in Schuylkill County, to its mouth at the Delaware River in Philadelphia. The major tributaries of the Schuylkill, in downstream order, are Mill Creek, the West Branch of the Schuylkill, Little Schuylkill, Maiden Creek, Tulpehocken Creek, Manatawny Creek, French Creek, Perkiomen Creek, and Wissahickon Creek (see the map: **Major Streams & Tributaries**).

For the purposes of this Conservation Plan, the Schuylkill River watershed was subdivided into 37 subwatersheds as shown in the map: **Subwatersheds & Municipalities**. The Schuylkill subwatersheds were designated to facilitate the water quality, landscape sustainability and institutional analyses, and for ease of reference. Subwatersheds were defined at a scale small enough to allow meaningful comparisons, while not exceeding the resolution of the data. The approximate size of each subwatershed is 125 square kilometers or 12,500 hectares (about 31,000 acres). Attempts also were made to delineate subwatersheds so that areas with existing (or in-progress) river conservation plans remained intact. This was done to facilitate the incorporation of issues and recommendations from other plans into the broader Schuylkill Watershed Conservation Plan.

1.2.2 Watershed Population

The first settlers of the Schuylkill River valley were approximately 2,000 Lenape Indians, mostly of the Unami tribe, who settled in the lower reaches. The Dutch and Swedes arrived in the Philadelphia region in the early 1600s, and the river's name comes from the Dutch *Skokikl*, meaning hidden creek. The European population remained low until 1680, when William Penn obtained his land charter from King Charles II. From the 1680s through the 18th Century, Pennsylvania's population grew faster than the rest of the nation, with major growth in the southeast. Population projections through 2010 suggest that Berks County and other central parts of the Schuylkill River watershed will see the greatest population growth (between 30-50% increases) under the influence of continued decentralization to the suburbs, and economically induced out-migration from Schuylkill County.

1.2.3 Historic Land Uses

Primary land uses of the Schuylkill have changed over the years. Early settlers relied on agriculture and used the Schuylkill River network to transport crops to larger markets downstream. However, the vast natural resources in the watershed, including iron ore, hardwood, and river power, soon created a thriving iron industry. Later, with the discovery of vast coal sources in the northern headwaters, the Schuylkill River became a primary mode of transportation due to the Schuylkill Navigation System: a system of 32 dams and 103 locks. By the turn of the century, railroads replaced river navigation; however, numerous dams and canal features remained. The industrial growth and dams caused water pollution and habitat degradation, and created obstacles to migratory fish.

The coal industry peaked in the 1910s, and many coal lands were transferred to county governments by the 1930s. Abandoned mines leaking acid mine drainage (AMD) and sedimentation continued to affect water quality in the Schuylkill River watershed. Steps towards river renewal included dredging by the U.S. Army Corps of Engineers (US ACE) and recent environmental legislation, has resulted in laws governing the discharge of industrial and municipal sewage from point sources and is now focusing on reducing pollution from nonpoint sources (e.g. agriculture, urban runoff). The outcome of these efforts, along with the river's natural abilities to cleanse itself over time, is a river network on the rebound.

1.2.4 Physical Characteristics

The Schuylkill River flows through four major geological landscape provinces from its headwaters to its mouth: Ridge and Valley, New England, Piedmont, and the Atlantic Coastal Plain. The upper or headwaters portions of the watershed rise between steep hills in the Appalachian Mountain section of the Ridge and Valley province. Moving downstream, the mainstem Schuylkill River joins the West Branch at Cressona, the Little Schuylkill at Port Clinton, and flows into the Great Valley province. Past this area of open rolling farmlands, about 25 miles from its source, the Schuylkill River flows between the Reading Prong section and South Mountain into the Gettysburg-Newark Lowlands. At the mouth of the Perkiomen Creek, the Schuylkill River enters the Piedmont Uplands, an area of moderate relief. In Philadelphia, the river drops over the fall line into the Atlantic Coastal Plain, a region of low relief and tidal marshland. The Schuylkill River is a tidal river from the Fairmount Dam south of Manayunk to its mouth at the Delaware River.

Temperature and precipitation in the watershed vary with topography and elevation. The climate is generally humid, with a mean annual temperature of 52°F and summer and winter averages of 72°F and 31°F respectively. The rugged topography and higher elevations of the Appalachian Mountains causes greater temperature variations than in the Coastal Plain and Piedmont. Topography and elevation also affect precipitation elsewhere in the watershed. Average annual precipitation is highest in the mountainous headwaters region (45-50 in/yr) and decreases eastward to the Coastal Plains (43 in/yr).

Local precipitation is the source for water to rivers, streams, ponds and other aquatic environments within the Schuylkill River watershed. On average in Pennsylvania, about 50% of annual precipitation is evaporated or transpired by plants back to the atmosphere, about 20% runs off into rivers and streams as "stormflow" during rainfall and snowmelt events, and about 30% infiltrates the ground to recharge groundwater acquifers (Fleeger 1999; Biesecker et al. 1968). Rates of streamflow are highest in late winter and early spring due to snowmelt and low evaporation/transpiration rates, and lowest in late summer and early fall due to high rates of evaporation/transpiration from vegetation.

Except for unconsolidated deposits on the Coastal Plain, most aquifers within the Schuylkill River watershed are composed of consolidated rocks (Biesecker et al. 1968). The median water bearing capacities for aquifers in most of the Schuylkill River watershed range from about 20 to 200 gallons per minute. Median water bearing capacities of greater than 200 gallons per minute occur in the carbonate rocks of the Great Valley, and in the unconsolidated deposits of the Atlantic Coastal Plain. Median water bearing capacities of less than 20 gallons per minute occur in parts of the Piedmont in northern Chester and Montgomery Counties, where groundwater depletion may be an issue (Biesecker et al. 1968).

1.2.5 Vegetation and Wildlife

Forest is the dominant form of vegetation in Pennsylvania. A detailed list of *Terrestrial and Palustrine Plant Communities of Pennsylvania* produced by Fike (1999), documents 11 types of forest and woodland types in Pennsylvania. In general, the following forest associations characterize the watershed, as defined in the *Wissahickon Creek River Conservation Plan* (Delta Group et al. 1999).

- On dry upper elevations: chestnut oak, sweet birch, scarlet oak, red oak American beech, pignut hickory, black oak, white pine and black gum dominate the forest canopy.
- On cool north-facing slopes: hemlock, white pine, sweet birch, black cherry and red oak.
- In ravines with steep slopes: tuliptree, white oak, black cherry, American beech, red maple, shagbark hickory, ironwood, redbud, and dogwood.

- Along streams and floodplains: American sycamore, red maple, American basswood, river birch, white ash, ironwood, witch hazel, spicebush, elderberry and red-stem dogwood.
- On abandoned, cleared land: succesional native plants such as red cedar, box elder, sumac, black locust, black walnut, blackhaw viburnum, red stem dogwood, goldenrod, asters and many other herbaceous perennials.

It is estimated that before colonial settlement around 97-98% of Pennsylvania was forested land cover (Schein and Miller 1995). Forest cover in the Schuylkill subwatersheds in the early 1990s ranged from over 70% forest cover in Schuylkill County and a few other isolated areas, to less than 33% in agricultural and developed sections. A wave of non-native (exotic) invasive plant species and pathogens also continues to alter the composition and distribution of Pennsylvania's natural plant communities.

There also are imbalances in the watershed's fauna, including localized increases in deer density that affect habitat quality for other animals and plants, and the invasion of exotic species such as the gypsy moth and the Asiatic earthworm. Much more is known about the Commonwealth's terrestrial resources than its aquatic resources, but there are indications that the aquatic resources are more threatened (PA Fish and Boat Commission 1995).

1.3 Key Findings

The following three sections on Water Quality, Landscape Sustainability and Institutional Assessment present an overview of the goals, analysis and recommendations for the three focal areas of interest identified by PA DCNR for the Schuylkill River watershed. The summary table of recommendations in each section lists the name, a brief description, priority areas or institutions for implementation, and the code number and page number where a detailed description of that recommendation can be found, in the corresponding chapter of the Schuylkill Watershed Conservation Plan. The code number is a unique identifier for that recommendation; anywhere the recommendation appears in the document it is referenced by this number.

1.4 Water Quality

1.4.1 Water Resource Issues

Good water quality is essential to the health and productivity of aquatic ecosystems, and to support a variety of human needs including industrial and domestic water supplies, drinking water, and recreation. Input from watershed stakeholders received from the public meetings, the results of the public opinion poll, and review of relevant literature highlighted the following water resource issues of major concern in the Schuylkill River watershed.

- Need for water quality monitoring data
- Urban/suburban development and stormwater runoff
- Non-point source pollution
- Habitat quality
- Acid mine drainage (in the Schuylkill headwaters region)

- Wastewater and other waste discharges
- Water supply

1.4.2 Water Quality Analysis

A summary of water quality in the Schuylkill River watershed has been compiled based on the Pennsylvania Department of Environmental Protection (PA DEP) water quality assessment, available monitoring data, and landscape/water quality modeling. The water quality analysis identifies data gaps and issues needing further study, and recommends ways to protect and improve water quality throughout the watershed. Data were analyzed in a Geographic Information System (GIS) and using hydrologic modeling. Data used in the water quality assessment and modeling were as follows.

- **Water Quality Monitoring and Assessment**
  Pennsylvania DEP 303(d) impaired waters list
  Existing monitoring data

- **Watershed Analysis and Modeling**
  Annual stormwater runoff modeling
  Annual non-point loading (nitrogen, phosphorus, sediment)
  Annual loading from septic systems (nitrogen)
  Annual point source loading from sewage treatment plants (nitrogen, phosphorus)
  Annual point source discharges requiring NPDES permits

Recommendations for protecting and improving water quality are summarized below. Please note that the Plan's water quality analysis focuses on issues common throughout the watershed, and may not be inclusive of certain local-scale issues and problems. Where there are local-scale problems, recommendations are made to direct future, more detailed studies and actions to address these problems.

1.4.3 Recommendations for Water Quality

Recommendations for improving the water quality of the Schuylkill River watershed are summarized in the table below. These recommendations are based on the water quality analyses described in **Chapter 5.0 Water Quality**. Each recommendation is assigned a unique code number (e.g., **R5.1**) and name, and is cross-referenced to the key water quality issue(s) it addresses. These recommendations are described in more detail in **Section 5.6 Detailed Recommendations from the Water Quality Analysis**, and the page number of Chapter 5 where the detailed description of that recommendation can be found is listed in the *Page* column of this table.

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.1	**Establish a Coordinated, Watershed-wide Monitoring Program with Quality Control Protocols**	EPA, the state and key nonprofits should design a comprehensive watershed-wide monitoring program, providing training for citizen monitoring groups, and with certification protocols to ensure reliable data.	Water quality monitoring	5-21

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Source Pollution**	Urban Best Management Practices such as reduction of impervious surfaces, infiltration and sedimentation basins, and street sweeping should be implemented to decrease water quality and other problems associated with stormwater runoff, and to increase groundwater recharge.	Stormwater runoff Non-point source pollution (nutrients, toxics, sediment/erosion) Water supply	5-23
R5.3	**Encourage Homeowners and Small Businesses to Reduce Non-Point Pollution**	Homeowners, small businesses, and individuals should be educated about how their actions influence water quality, and should be encouraged to clean up after pets, properly dispose of yard and household wastes, properly store cars and vehicles, and to take other measures to reduce non-point source pollution.	Non-point source pollution	5-24
R5.4	**Implement Nutrient Management Practices**	Sound Nutrient Management Practices such as soil and manure testing can help minimize the amount of fertilizer entering streams. These practices should also be implemented in suburban and urban areas where fertilizer is used.	Non-point source pollution (nutrients)	5-24
R5.5	**Implement Agricultural Best Management Practices**	Agricultural Best Management Practices such as no-till planting, contour plowing, and stream bank fencing can help reduce the amount of nutrient and sediment pollution entering streams.	Non-point source pollution (nutrients, sediment)	5-25
R5.6	**Implement Timber Harvesting Best Management Practices**	Timber harvesting Best Management Practices such as proper road construction and preservation of riparian buffers should be used to reduce the amount of sediment and nutrients entering streams.	Non-point source pollution (nutrients, sediment)	5-25
R5.7	**Protect and Restore Riparian Forest Buffers**	Riparian buffers function in a variety of ways to maintain the health of stream systems, and should be protected and restored whenever possible.	Non-point source pollution (nutrients, sediment) Habitat quality	5-26
R5.8	**Protect and Restore Wetlands and Areas of Hydric Soils**	Wetlands provide many benefits including the regulation of stormwater runoff, water quality improvements, and unique and important habitat. Efforts should be made to protect and restore wetlands throughout the watershed. Areas of hydric soils may offer the best potential for wetland restoration.	Non-point source pollution (nutrients, sediment) Stormwater runoff Habitat quality	5-27
R5.9	**Identify and Enforce Sediment and Erosion Control Problems and Violations**	Construction sites contribute a significant amount of sediment to receiving waters. Procedures for monitoring compliance with existing laws should be maintained. Volunteers can be trained to help monitor for existing and potential problems.	Non-point source pollution (sediment/erosion)	5-27

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.10	**Establish Uniform, Watershed-wide Criteria for Permitted Discharges from Sewage Treatment Plants (STPs)**	Criteria for permitted discharges of pollutants such as fecal coliforms vary among different PA DEP regions within the watershed. Uniform criteria should be developed to help regulate and reduce water quality impairment from sewage treatment plants.	Point source pollution (pathogens/nutrients)	5-28
R5.11	**Monitor Nutrients from All Sewage Treatment Plants**	Sewage treatment plants may not monitor all relevant nutrient levels in their effluent. Establishing uniform discharge criteria and monitoring nutrients at all sewage treatment plants would help to assess nutrient loading to receiving waters.	Point source pollution (nutrients from STPs)	5-28
R5.12	**Promote Tertiary Treatment of Sewage Effluent**	Less than half of the treatment plants in the Schuylkill River watershed provide tertiary treatment of sewage effluent. Where effluent is a problem, plants should be upgraded to provide higher levels of treatment.	Point source pollution (nutrients from STPs)	5-28
R5.13	**Identify and Control Discharges of Untreated Sewage from "Wildcat Systems" and Combined Sewer Overflows (CSOs)**	Discharges of untreated sewage from “wildcat” systems and combined sewer overflows represent a threat to human health and aquatic ecosystems. Wildcat systems should be identified and regulated, and CSOs monitored for compliance with existing regulations.	Point source pollution (nutrients, pathogens)	5-29
R5.14	**Establish Septic Education, Registration, Inspection, and Maintenance Programs**	Septic programs would instruct owners about proper care and maintenance of septic systems, and should provide homeowners with a method for testing their septic systems.	Non-point source pollution (nutrients)	5-29
R5.15	**Size and Maintain Culverts and Bridges to Ensure Minimal Impact to Streams**	Culverts and bridges should be sized and located to adequately convey both low flow and storm events. Structures must also be properly maintained and inspected to prevent obstruction, scour and erosion.	Stormwater runoff Non-point source pollution (sediment/erosion)	5-29
R5.16	**Conduct Inventories and Studies to Identify and Remove Dams Where Restoration Benefits Outweigh Present Uses and Effects**	Dams can provide benefits, but also cause a broad range of negative ecological impacts. Inventories and studies should be conducted to determine where dams are on the Schuylkill River and if they should be removed. The benefits of removal (restoration of stream habitat, fish passage, and water quality) may outweigh present uses and/or effects. Where dam removal does not have overall benefits, construction of fish ladders should be studied and implemented where possible.	Habitat quality Water supply	5-30

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.17	**Identify Sources and Mitigate Effects of Acid Mine Drainage**	AMD is a significant source of water pollution in the headwaters of the Schuylkill River watershed. In conjunction with other projects, undocumented sources of AMD should be identified and monitored, and a restoration program initiated.	Acid mine drainage	5-30
R5.18	**Monitor and Regulate Existing and Future Groundwater Withdrawals**	When groundwater withdrawals exceed the sustainable yield of aquifers, water supplies can be threatened, streamflow diminished, and aquatic ecosystems degraded. Existing and future groundwater withdrawals should be monitored and regulated to avoid groundwater depletion.	Water supply Habitat quality	5-31
R5.19	**Support PEMA Removal of Structures from Flood Prone Areas**	The Pennsylvania Emergency Management Agency (PEMA) has established a program, which promotes the acquisition and removal of structures from flood-prone areas. Efforts should be made to support this program.	Stormwater runoff Non-point source pollution	5-32
R5.20	**Fund Studies to Document Watershed Condition and Resources**	Watershed management should be based on sound scientific principles and reliable field data. Studies should be conducted to document watershed resources including detailed water budgets, water quality trends, land cover changes, extent of riparian disturbance, wetland disturbance, and other characteristics.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-32
R5.21	**Support Studies to Assess the Impacts of Mineral Extraction on Water Quality and Quantity**	For mining operations in the watershed, there may be potential metals and sediment impacts on adjacent streams; when closed down, there may be potential groundwater/hydrology impacts. In order to better understand both water quality and water quantity issues in the watershed, these impacts should be assessed.	Point source pollution Habitat quality Water supply	5-33
R5.22	**Complete Comprehensive Water Budget Studies for the 37 Subwatersheds in the Schuylkill Drainage**	Follow-up studies to the current source water assessment (SWA) should conduct combined surface and ground water studies to generate watershed-based water budgets, so that a prioritized strategic plan of action can be developed to preserve the watershed's water resources. The cumulative impacts of water withdrawal, discharge, transfers out of the watershed and recharge also should be considered.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-33

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.23	**Support Cost-Effectiveness Studies on Treating Point Versus Non-Point Source Pollution Impacts**	The current SWA, or follow-up studies, should prioritize which water pollution issues to address first in terms of cost-effectiveness. Subwatershed-based cost-benefit analysis of treating point versus non-point source pollution impacts should direct strategic action on pollution treatment in the watershed.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-33
R5.24	**Support Cumulative Impact Assessments for Point and Non-point Source Pollution**	The current SWA, or follow-up studies, should assess the cumulative impacts of point and non-point pollution, and if possible, also assess the cumulative water extraction, discharge and recharge effects on a subwatershed basis across the entire watershed.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-33
R5.25	**Support Outreach Phase for Implementation of the Schuylkill Source Water Assessment (SWA)**	The current SWA should be implemented through a follow-up outreach phase that ensures the guidelines it provides are adopted by municipalities, point-source facilities, nonprofits and citizens where necessary adopted throughout the watershed. This assessment should be done on a subwatershed basis to facilitate implementation.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-34

1.4.4 Water Quality Subwatershed Guide

To facilitate the use of this Executive Summary and the Schuylkill Watershed Conservation Plan, the table presented below provides key water quality recommendations and issues cross-referenced to the priority areas and subwatersheds to which they refer. While most the water quality recommendations are targeted specifically at the subwatershed scale, a few recommendations from this section are applicable watershed-wide. This table can be used as a quick geographical reference on the key water quality issues and recommendations applying in a given subwatershed of the Schuylkill River watershed. In addition, please refer to the **Reference Table 1A: Municipality Locations by Subwatersheds** for a cross-walked guide to which municipalities are in each subwatershed.

NOTE THAT VALUES IN THE FOLLOWING TABLES PROVIDE RELATIVE PRIORITIES ONLY. ISSUES WITH A LOW RANK MAY STILL BE OF SIGNIFICANT CONCERN IN A GIVEN SUBWATERSHED AT A LOCAL RATHER THAN REGIONAL LEVEL.

*PLEASE REFER TO COMPLETE **Schuylkill Watershed Conservation Plan** FOR FULL DETAILS.*

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	1 = Higher Relative Priority 5 = Lower Relative Priority	Water Quality Monitoring	Urban Development/ Impervious Cover	Runoff as a Percent of Precipitation	Roads and Road/Stream Crossings	Dams	Nitrogen and Phosphorus from Land Cover	Nitrogen from Septic Systems	Sediment from Land Cover	Nitrogen and Phosphorus from Sewage Treatment Plants
	Section in Plan	**5.4**	**5.5.2**	**5.5.3**	**5.5.4**	**5.5.5**	**5.5.6**	**5.5.7**	**5.5.8**	**5.6.9**
	Recommendations Associated with Issue	**R5.1**	**R5.2**	**R5.2**	**R5.7 R5.15**	**R5.16**	**R5.2 R5.4 R5.5 R5.6 R5.7 R5.8**	**R5.14**	**R5.2 R5.5 R5.6 R5.7 R5.8 R5.9**	**R5.10 R5.11 R5.12 R5.13**
	SUBWATERSHEDS									
U/S	East Branch Perkiomen Creek	Watershed Wide Issue - Subwatersheds Not Ranked	3	3	1	3	1	1	2	2
H	French Creek		3	5	3	1	4	2	4	-
H	Hay Creek		3	5	3	4	3	1	1	4
A	Little Northkill/Northkill Creek		5	5	4	3	1	4	2	-
H	Little Schuylkill River (Lower)		5	5	4	5	5	5	4	-
H	Little Schuylkill River (Upper)		4	2	3	2	5	5	4	2
A	Lower Maiden Creek		4	4	4	3	1	3	3	4
H	Lower Manatawny Creek		3	5	3	4	3	1	1	4
U/S	Lower Perkiomen Creek		2	3	3	2	2	1	2	1
A	Lower Tulpehocken Creek		2	4	4	3	1	2	2	3
U/S	Lower Wissahickon Creek		1	1	5	4	5	3	5	-
A	Middle Tulpehocken Creek		4	3	5	2	2	4	2	4
A	Monacacy Creek		5	5	4	4	2	4	1	-
A	Ontelaunee/Kistler Creek		5	5	1	5	2	4	1	3
H	Pickering Creek		3	5	2	1	3	3	3	-
A	Sacony Creek		5	4	1	5	1	2	1	3
U/S	Sandy Run		1	1	4	5	4	4	5	1
U/S	Schuylkill River 1		1	1	2	1	4	2	5	2
U/S	Schuylkill River 2		1	1	2	2	3	5	5	1
U/S	Schuylkill River 3		2	3	2	4	2	1	3	1
H	Schuylkill River 4		2	4	5	5	4	2	3	2
H	Schuylkill River 5		2	3	1	1	5	3	4	2
U/S	Schuylkill River 6	Sub	1	1	5	5	3	4	4	-

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	**1 = Higher Relative Priority** **5 = Lower Relative Priority**	Water Quality Monitoring	Urban Development/ Impervious Cover	Runoff as a Percent of Precipitation	Roads and Road/Stream Crossings	Dams	Nitrogen and Phosphorus from Land Cover	Nitrogen from Septic Systems	Sediment from Land Cover	Nitrogen and Phosphorus from Sewage Treatment Plants
	Section in Plan	**5.4**	**5.5.2**	**5.5.3**	**5.5.4**	**5.5.5**	**5.5.6**	**5.5.7**	**5.5.8**	**5.6.9**
	Recommendations Associated with Issue	**R5.1**	**R5.2**	**R5.2**	**R5.7 R5.15**	**R5.16**	**R5.2 R5.4 R5.5 R5.6 R5.7 R5.8**	**R5.14**	**R5.2 R5.5 R5.6 R5.7 R5.8 R5.9**	**R5.10 R5.11 R5.12 R5.13**
	SUBWATERSHEDS									
A	Schuylkill River 7		4	5	2	2	1	2	2	3
H	Schuylkill River 8		4	4	1	4	5	4	4	2
H	Schuylkill River Headwaters		3	2	1	2	5	5	5	4
U/S	Schuylkill River Tidal		1	1	5	5	2	5	5	-
U/S	Skippack Creek		2	2	1	4	2	1	3	1
H	Swamp Creek		3	5	4	3	3	1	1	3
H	Unami Creek		4	3	3	1	4	1	3	3
H	Upper Maiden Creek		5	5	2	5	3	5	1	-
H	Upper Manatawny Creek		5	5	2	3	4	3	3	4
H	Upper Perkiomen Creek		4	4	1	1	4	2	2	4
A	Upper Tulpehocken Creek		4	4	3	3	1	4	1	4
U/S	Upper Wissahickon Creek		1	2	5	1	3	5	5	1
U/S	Valley Creek		2	2	3	4	4	3	4	-
H	West Branch Schuylkill River		3	2	4	2	5	5	5	3

1.5 Landscape Sustainability

1.5.1 Landscape and Land Use Issues

An assessment of the watershed's natural resources was conducted to identify existing and proposed natural lands and biodiversity resources, assess the value of those resources, and outline a framework for conservation priorities that will facilitate planning and implementation of a sustainable watershed landscape. The goal of promoting a sustainable landscape focuses on: creation of an integrated, connected natural lands vision for the Schuylkill River watershed, incorporating existing and proposed greenspace nodes; and, recognition that protecting a quorum of natural lands will promote landscape sustainability and help preserve water quality.

The following issues related to landscape sustainability were highlighted during the public opinion poll and the public meetings.

- Loss of critical natural lands to development due to rapid urban/suburban sprawl
- Need to encourage responsible growth and offset associated losses of farmlands and wetlands
- Need for open space preservation to assist in water quality preservation
- Need to create and maintain linear parks and greenways as biodiversity connectors and riparian corridors to preserve water quality
- Lack of guidance on ecological management of protected natural lands
- Lack of strategic regional planning for identifying and conserving the watershed's ecological resources

1.5.2 Landscape Analysis

Landscape analysis is a process of considering interrelated spatial features, defining patterns, identifying regional issues and/or ecological and human processes that are likely to cause those patterns, and then recommending solutions to solve the identified problems. A *sustainable landscape* is defined in this Plan as a matrix of natural lands that function together within a defined area to maintain the essential ecological processes that support life, and to maximize and sustain natural biodiversity across a region.

The goal of the landscape analysis was to identify landscapes that will help to sustain the watershed ecosystem, by defining the pattern of greenspace and protected natural areas that can function as an interconnected network to protect the ecological and hydrological processes of the watershed. Landscape analysis within the Schuylkill River watershed was completed on the basis of the 37 subwatersheds shown in the **Watershed Orientation** map. Specific steps taken to achieve the goal of promoting a sustainable landscape in the Schuylkill River watershed were:

- Identification and mapping of existing greenspace components;
- Analysis and mapping of proposed greenspace components based on natural resource values;
- Mapping population projections to establish potential "threat" to watershed resources; and
- Providing recommendations and implementation tools, focusing on the need for strategic planning and institutional capacity building to ensure implementation of these recommendations.

Within the Schuylkill River watershed, a fabric of ecologically significant lands remains in a more or less natural, undeveloped condition. Maintenance of this ecological fabric can provide a critical quorum of land for preservation of good water quality, healthy functioning of the hydrological cycle and mitigation of non-point source pollution throughout the Schuylkill River watershed. However, at present growth rates many of these natural areas could disappear within the next twenty years, primarily lost to development, unless decisive, large-scale, proactive steps are taken to protect, maintain and/or restore these natural resources as soon as possible.

After analysis of the components discussed above, it was recognized that more than 200,000 acres, (i.e., approximately 15%), of the Schuylkill River watershed represent priority lands for conservation or restoration. The **Sustainable Landscape Vision** map shows a network of biodiversity hotsposts, sensitive lands, forested lands and greenspace corridors that represents a template for promoting a sustainable watershed landscape.

A series of maps related to the landscape analysis are included in the online Reference Documents to the Schuylkill Watershed Conservation Plan. Recommendations for protecting and implementing landscape sustainability are summarized below.

1.5.3 Recommendations for Landscape Sustainability

Recommendations for sustaining the landscape of the Schuylkill River watershed are summarized in the table below. These recommendations are based on the landscape analyses described in **Chapter 6.0 Promoting a Sustainable Landscape**. Each recommendation is assigned a unique code number (e.g., **R6.1**) and name, and is cross-referenced to the key landscape or land use issue(s) it addresses. These recommendations are described in more detail in **Section 6.8 Detailed Recommendations for Landscape Sustainability**, and the page number in Chapter 6 where the detailed description of that recommendation can be found is listed in the *Page* column of this table.

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.1	**Establish a Watershed Land Protection Collaborative (WLPC) to Proactively Protect Greenspace**	More than 200,000 acres of potential greenspace across the watershed need to be protected within the next 20 years, to serve as the framework of a sustainable landscape and to ensure the health of the Schuylkill River watershed. A Watershed Land Protection Collaborative composed of watershed conservation groups working together needs to be established, to promote strategic land conservation and efficient resource use.	Loss of natural lands Need for greenspace Strategic conservation	6-23
R6.2	**Refine Prioritization of Watershed Natural Lands using a Standardized Relative Assessment Tool**	The watershed conservation community must take proactive steps to further prioritize high priority, sensitive lands according to their ecological value and degree of threat. Conservation groups should use established relative assessment tools to refine land prioritization and to conserve the high priority potential greenspace identified in this plan.	Loss of natural lands Need for greenspace Strategic conservation	6-24

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.3	**Support Outreach and Education Programs Providing Landowners with Land Preservation Options**	Private citizens, who may have little understanding of the land preservation and ecological management options available to them, own the vast majority of lands proposed for preservation in the watershed. Outreach and education efforts should provide landowners with viable options and guidelines for land preservation and ecological management.	Loss of natural lands Need for greenspace Guidance on ecological management	6-25
R6.4	**Proactively Protect PA Natural Diversity Inventory (PNDI) Sites**	Protecting these identified high-value sites will help maintain the rare species biodiversity reservoir in the watershed. Protection of PNDI areas should be implemented in order of priority and threat, and to ensure a balanced portfolio of species and community biodiversity.	Loss of natural lands Need for greenspace	6-25
R6.5	**Proactively Protect Identified Greenspace Nodes**	Greenspace nodes (e.g., important bird areas, wetlands, floodplains, blocks of contiguous forest cover over 500 acres, and other priority habitat subwatersheds) need to be protected since they represent the biodiversity reservoirs in the watershed. Protection should be implemented in order of priority and threat.	Loss of natural lands Need for greenspace	6-26
R6.6	**Proactively Protect, Restore and Create Identified Greenway Corridors**	Greenway corridors will link greenspace nodes to help maintain environmental viability and connectivity in the watershed. In many cases, they can also serve a dual purpose as riparian buffers. Action should be taken according to priority and threat, where possible.	Loss of natural lands Need for greenspace Landscape connectivity	6-26
R6.7	**Develop Strategic Protection Plans for Identified Subwatersheds in Habitat Zones**	Site-specific plans must be developed for each priority habitat subwatershed to identify appropriate land parcels for permanent protection. Protection should be implemented in order of priority and threat, where possible.	Loss of natural lands Need for greenspace Guidance on ecological management Strategic conservation	6-27
R6.8	**Develop Strategic Restoration Plans for Identified Primary Restoration Subwatersheds**	Site-specific plans must be developed for each priority restoration subwatershed to identify appropriate land parcels for riparian buffer installation and/or reforestation. These efforts should be reinforced with permanent protection where possible, and be implemented according to priority and degree of threat.	Loss of natural lands Need for greenspace Guidance on ecological management Strategic conservation	6-28

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.9	**Develop and Adopt a Strategic Protection Plan for Watershed-wide Agricultural Land Resources**	Develop a watershed-wide plan based on site-specific data (soils, agricultural security districts) and funding, to prioritize agricultural land parcels for protection. Agricultural preservation can serve a supporting role in maintaining landscape sustainability if ecological BMPs and NMPs are implemented and enforced.	Need for greenspace Guidance on ecological management Strategic conservation	6-29
R6.10	**Reactively Protect Natural Resources in the Watershed as Opportunity Arises**	Whenever an unsolicited, high quality, cost-effective natural land protection opportunity arises (i.e., maximum natural land acreage for minimum financial and time resources), it should be evaluated for protection regardless of greenspace and subwatershed priorities.	Loss of natural lands Need for greenspace	6-29
R6.11	**Promote Development of Forest Resource Management Plans on Privately-owned Forest Lands**	The majority of the watershed's forest resources are found on private lands, and owners should be provided guidance on maintaining or restoring these lands to their natural health and viability.	Loss of natural lands Guidance on ecological management	6-30
R6.12	**Control Invasive Species and Deer Densities to Enhance Forest Regeneration of Native Plants**	Demonstration projects, particularly at environmental education facilities, should be developed and supported to address these concerns, especially where the human community is demonstrably engaged in proposed demonstration land management projects.	Loss of natural lands Guidance on ecological management	6-30
R6.13	**Develop Watershed-wide Adaptive Ecological Land Management Guidelines for Protected Lands**	Provide a detailed, standardized tool-kit for adaptive ecological management plans that includes the use of BMPs and NMPs on protected lands. Make this available to the watershed conservation community through a watershed service center.	Guidance on ecological management Strategic conservation	6-31
R6.14	**Establish Community-Based Programs to Implement Adaptive Ecological Management Plans on All Protected Lands by Priority**	By developing Adaptive Ecological Management Plans that can be implemented by community volunteers, neighborhoods can reconnect with the local ecosystems on which they depend. A watershed-wide program should focus on the Urban/Suburban Zone.	Guidance on ecological management Strategic conservation	6-32
R6.15	**Develop and Adopt a Strategic Resources Plan for Watershed-wide Land Protection, Restoration and Ecological Management**	A watershed coalition of interested groups needs to build capacity (funding, personnel, expertise and leverage strategies) and develop a strategic funding plan to ensure sufficient resources to implement the land protection, restoration and management recommendations.	Strategic conservation	6-32

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.16	**Develop an Interactive GIS Resource for the Watershed Community**	Capitalize on the investment made in GIS mapping and analysis for this Plan by making these data available through an interactive tool for use by the watershed conservation community and government agencies.	Strategic conservation	6-34
R6.17	**Establish a Funding Base, Schedule and Distribution Protocol for Updating and Upgrading GIS Mapping**	To address data gaps identified in this Plan, ensure that critical new or updated GIS data are added to the watershed GIS data set as necessary. Mandatory annual GIS data reviews should assess and address update/upgrade needs. Ensure distribution of upgraded GIS database to the watershed conservation community.	Strategic conservation	6-34
R6.18	**Develop Local-Scale Comprehensive Subwatershed River Conservation Plans**	Comprehensive subwatershed plans should be completed for areas in the Schuylkill River watershed not currently covered by local-scale River Conservation Plans.	Guidance on ecological management Need for greenspace Strategic conservation	6-36
R6.19	**Support the Schuylkill River Heritage Corridor Management Action Plan**	The Schuylkill River Greenway Association should be supported by government and watershed nonprofits in its efforts to develop a comprehensive Management Action Plan for the Schuylkill River Heritage Corridor and the National Heritage Area, addressing a full range of cultural, historic, scenic and recreational resource needs.	Need for greenspace Strategic conservation	6-36
R6.20	**Encourage Smart Growth Policies**	A number of smart growth programs exist at the federal, state and local levels, to help guide the development process to ensure sound environmental and economic growth.	Loss of natural lands Need for greenspace	6-37
R6.21	**Support Brownfield Redevelopment Initiatives**	As the complimentary strategy to land preservation, a model redevelopment incentive ordinance with BMPs should be developed. Montgomery County Planning Department would be an ideal choice for developing this text, which could subsequently be distributed to municipalities throughout the watershed.	Loss of natural lands Need for greenspace Strategic conservation	6-38
R6.22	**Support Development of Standardized Demographic, Transit, Infrastructure and Land Use "Change Indicators" for the Entire Watershed**	In order to adequately characterize levels of threat in the watershed so as to better direct conservation, a collaboration of county planning agencies could address the need to develop and maintain periodic updates for critical data that will assist in tracking the development pressure and human population impacts throughout the watershed.	Loss of natural lands Need for greenspace Strategic conservation	6-38

1.5.4 Landscape Sustainability: Guide to Key Subwatershed Characteristics

To facilitate the use of this Executive Summary and the Schuylkill Watershed Conservation Plan, the tables presented below provide key landscape sustainability characteristics, recommendations and issues cross-referenced to the priority areas and subwatersheds to which they refer. While most the landscape sustainability recommendations are targeted specifically at the subwatershed scale, a few recommendations from this section are applicable watershed-wide. This table can be used as a quick geographical reference on the key landscape sustainability issues and recommendations applying in a given subwatershed of the Schuylkill River watershed. In addition, please refer to the **Reference Table 1A: Municipality Locations by Subwatersheds** for a cross-walked guide to which municipalities are in each subwatershed.

NOTE THAT VALUES IN THE FOLLOWING TABLES PROVIDE RELATIVE PRIORITIES ONLY – UNFAVORABLE CHARACTERISTICS WITH A LOWER RELATIVE PRIORITY RANK MAY STILL BE OF SIGNIFICANT CONCERN IN A GIVEN SUBWATERSHED AT A LOCAL RATHER THAN REGIONAL LEVEL.

*PLEASE REFER TO COMPLETE **Schuylkill Watershed Conservation Plan** FOR FULL DETAILS.*

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	**1 = Higher Relative Priority** **5 = Lower Relative Priority**	Estimated Population Increase	Low Habitat Value	<33% Forested Land Cover	High Habitat Value	>70% Forested Land Cover	>60% 1st Order Streams
	Section in Plan	**6.6**	**6.5.1**	**6.5.3**	**6.5.1**	**6.5.3**	**6.5.3**
	Recommendations Associated with Characteristic	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.7 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.8 R6.9 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.8 R6.9 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.11 R6.12 R6.13 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.11 R6.12 R6.13 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.12 R6.13 R6.20 R6.21 R6.22**
	SUBWATERSHEDS						
U/S	East Branch Perkiomen Creek	3	2	-	-	-	-
H	French Creek	2	-	-	3	-	-
H	Hay Creek	2	-	-	1	1	1
A	Little Northkill/Northkill Creek	2	3	-	-	-	1
H	Little Schuylkill River (Lower)	-	-	-	1	1	1

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	**1 = Higher Relative Priority** **5 = Lower Relative Priority**	Estimated Population Increase	Low Habitat Value	<33% Forested Land Cover	High Habitat Value	>70% Forested Land Cover	>60% 1st Order Streams
	Section in Plan	**6.6**	**6.5.1**	**6.5.3**	**6.5.1**	**6.5.3**	**6.5.3**
	Recommendations Associated with Characteristic	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.7 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.8 R6.9 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.8 R6.9 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.11 R6.12 R6.13 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.11 R6.12 R6.13 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.12 R6.13 R6.20 R6.21 R6.22**
	SUBWATERSHEDS						
H	Little Schuylkill River (Upper)	-	-	-	1	1	-
A	Lower Maiden Creek	1	3	1	-	-	-
H	Lower Manatawny Creek	-	-	-	4	-	-
U/S	Lower Perkiomen Creek	1	3	-	-	-	-
A	Lower Tulpehocken Creek	2	2	1	-	-	-
U/S	Lower Wissahickon Creek	-	2	-	-	-	-
A	Middle Tulpehocken Creek	1	3	-	-	-	-
A	Monacacy Creek	1	3	-	-	-	1
A	Ontelaunee/Kistler Creek	3	2	1	-	-	-
H	Pickering Creek	1	-	-	4	-	-
A	Sacony Creek	-	2	-	-	-	-
U/S	Sandy Run	1	3	-	-	-	-
U/S	Schuylkill River 1	-	1	1	-	-	-
U/S	Schuylkill River 2	-	2	-	-	-	-
U/S	Schuylkill River 3	-	1	1	-	-	-
H	Schuylkill River 4	3	-	-	3	-	1
H	Schuylkill River 5	-	-	-	3	-	-
U/S	Schuylkill River 6	1	3	-	-	-	-
A	Schuylkill River 7	3	1	1	-	-	-

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	1 = Higher Relative Priority 5 = Lower Relative Priority	Estimated Population Increase	Low Habitat Value	<33% Forested Land Cover	High Habitat Value	>70% Forested Land Cover	>60% 1st Order Streams
	Section in Plan	**6.6**	**6.5.1**	**6.5.3**	**6.5.1**	**6.5.3**	**6.5.3**
	Recommendations Associated with Characteristic	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.7 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.8 R6.9 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.5 R6.6 R6.8 R6.9 R6.10 R6.12 R6.14 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.11 R6.12 R6.13 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.11 R6.12 R6.13 R6.20 R6.21 R6.22**	**R6.1 R6.2 R6.4 R6.7 R6.10 R6.12 R6.13 R6.20 R6.21 R6.22**
	SUBWATERSHEDS						
H	Schuylkill River 8	-	-	-	2	-	-
H	Schuylkill River Headwaters	-	-	-	1	1	-
U/S	Schuylkill River Tidal	-	1	1	-	-	-
U/S	Skippack Creek	2	2	-	-	-	1
H	Swamp Creek	1	-	-	4	-	-
H	Unami Creek	2	-	-	3	-	-
H	Upper Maiden Creek	1	-	-	3	-	-
H	Upper Manatawny Creek	3	-	-	4	-	1
H	Upper Perkiomen Creek	3	-	-	3	-	-
A	Upper Tulpehocken Creek	3	-	1	-	-	1
U/S	Upper Wissahickon Creek	3	3	-	-	-	-
U/S	Valley Creek	3	3	-	-	-	-
H	West Branch Schuylkill River	3	-	-	3	1	-

1.5.5 Landscape Sustainability: Geographic Guide to Subwatershed Recommendations

NOTE THAT WATERSHED-WIDE RECOMMENDATIONS ARE NOT INCLUDED IN THE FOLLOWING TABLE. ALSO, VALUES IN THE FOLLOWING TABLES PROVIDE RELATIVE PRIORITIES ONLY. RECOMMENDATIONS WITH A LOW RANK MAY STILL BE OF SIGNIFICANT CONCERN IN A GIVEN SUBWATERSHED AT A LOCAL RATHER THAN REGIONAL LEVEL.

*PLEASE REFER TO COMPLETE **Schuylkill Watershed Conservation Plan** FOR FULL DETAILS.*

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	**1 = Higher Relative Priority** **5 = Lower Relative Priority**	Proactively Protect PNDI Sites	Proactively Protect Identified Greenspace Nodes	Proactively Protect Restore &/or Create Identified Greenspace Corridors	Develop Strategic Protection Plans	Develop Strategic Restoration Plans	Develop Strategic Agricultural Protection Plan	Establish Community-Based Ecological Management Prgms	Develop Local Scale Comprehensive Subwatershed River Conservation Plans
	Section in Report	**6.4.2**	**6.4**	**6.4**	**6.5 6.6**	**6.5 6.6**	**6.5 6.6**	**6.4**	**3.6**
	Recommendations Associated with Issue	**R6.4**	**R6.5**	**R6.6**	**R6.7**	**R6.8**	**R6.9**	**R6.14**	**R6.18**
	SUBWATERSHEDS								
U/S	East Branch Perkiomen Creek		2	2	-	-	3	1	-
H	French Creek	1	3	3	4	-	4	-	-
H	Hay Creek	1	3	3	1	-	4	-	-
A	Little Northkill/Northkill Creek	2	1	1	-	2	1	-	-
H	Little Schuylkill River (Lower)	3	3	3	1	-	4	-	-
H	Little Schuylkill River (Upper)	3	3	3	3	-	4	-	1
A	Lower Maiden Creek	2	1	1	-	-	1	-	-
H	Lower Manatawny Creek	-	3	3	5	-	4	-	1
U/S	Lower Perkiomen Creek	2	2	2	-	-	3	1	-
A	Lower Tulpehocken Creek	-	1	1	-	-	1	2	-
U/S	Lower Wissahickon Creek	-	2	2	-	-	-	1	-
A	Middle Tulpehocken Creek	3	1	1	-	-	2	-	-
A	Monacacy Creek	3	1	1	-	-	2	-	2
A	Ontelaunee/Kistler Creek	3	1	1	-	4	2	-	-
H	Pickering Creek	3	3	3	5	-	4	-	-
A	Sacony Creek	2	1	1	-	-	1	-	-
U/S	Sandy Run	-	2	2	-	-	-	1	-
U/S	Schuylkill River 1	4	2	2	-	-	-	1	3
U/S	Schuylkill River 2	4	2	2	-	-	-	1	3
U/S	Schuylkill River 3	4	2	2	-	-	3	1	3*

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	1 = Higher Relative Priority 5 = Lower Relative Priority	Proactively Protect PNDI Sites	Proactively Protect Identified Greenspace Nodes	Proactively Protect Restore &/or Create Identified Greenspace Corridors	Develop Strategic Protection Plans	Develop Strategic Restoration Plans	Develop Strategic Agricultural Protection Plan	Establish Community-Based Ecological Management Prgms	Develop Local Scale Comprehensive Subwatershed River Conservation Plans
	Section in Report	**6.4.2**	**6.4**	**6.4**	**6.5 6.6**	**6.5 6.6**	**6.5 6.6**	**6.4**	**3.6**
	Recommendations Associated with Issue	**R6.4**	**R6.5**	**R6.6**	**R6.7**	**R6.8**	**R6.9**	**R6.14**	**R6.18**
	SUBWATERSHEDS								
H	Schuylkill River 4	3	3	3	4	-	4	2	2
H	Schuylkill River 5	2	3	3	4	-	4	2	1
U/S	Schuylkill River 6	-	2	2	-	-	-	1	3
A	Schuylkill River 7	-	1	1	-	-	1	-	2
H	Schuylkill River 8	3	3	3	3	-	4	-	1
H	Schuylkill River Headwaters	2	3	3	2	-	4	-	1
U/S	Schuylkill River Tidal	-	2	2	-	-	-	1	3
U/S	Skippack Creek	4	2	2	-	3	3	1	-
H	Swamp Creek	2	3	3	5	-	4	-	-
H	Unami Creek	2	3	3	4	-	4	-	-
H	Upper Maiden Creek	2	3	3	5	5	3	-	-
H	Upper Manatawny Creek	1	3	3	4	-	4	-	-
H	Upper Perkiomen Creek	1	3	3	4	-	4	-	-
A	Upper Tulpehocken Creek	2	1	1	-	1	1	-	-
U/S	Upper Wissahickon Creek	4	2	2	-	-	-	1	-
U/S	Valley Creek	4	2	2	-	-	-	1	-
H	West Branch Schuylkill River	2	3	3	3	-	4	-	1

* For the portion in Montgomery County only, since the portion in Chester County is being completed through the Chester County Water Resources Management Plan.

1.6 Institutional Assessment

1.6.1 Institutional and Organizational Issues

Interested stakeholders, including organizations and government entities, are important resources throughout the Schuylkill River watershed. Effective watershed management and conservation action require a cooperative effort on the part of local, regional and national institutions. In particular, the water quality and open space recommendations documented in this Plan cannot be carried out without the concerted, affirmative action of the watershed's organizations and government entities.

Participants in public meetings held during the planning process highlighted the following issues related to watershed institutions in the Schuylkill River watershed:

- Improve coordination among organizations for watershed-wide management;
- Build capacity between public agencies and nonprofit organizations; especially in funding, citizen involvement, training and board development; and
- Increase education/outreach and public awareness of watershed issues.

1.6.2 Institutional Assessment

An assessment of the watershed's institutional framework was conducted to identify major activities of nonprofit and public agency stakeholders, to assess opportunities for watershed-wide coordination, to make recommendations to strengthen existing organizations, and to outline a framework for watershed leadership that will facilitate planning and implementation of projects for sustainable watershed management. This institutional assessment was conducted through a survey of nonprofit organizations and a second survey of public agencies. These surveys were used to assess the watershed's existing institutional framework, to identify watershed activities and organizational needs among institutions, and to make recommendations for effective watershed management.

Understanding that nonprofit organizations fill the vital link between citizen and government action and implementation projects, the primary purpose of the **Nonprofit Survey** was to identify geographic regions in the watershed that are potentially under-served by nonprofit activity, or that may require coordination of nonprofit services to strengthen effectiveness. With that goal in mind, a sample of 30 watershed nonprofits was selected, and these nonprofits were interviewed to determine each organization's mission, activities, geographic service boundaries, funding and organizational support, and opinion of the watershed's most pressing issues and needs. The service area boundaries were converted to digital maps for geographic gap analysis using a Geographic Information System (GIS). Maps of **Nonprofit Service Areas**, and maps showing **Areas Served by Nonprofits** (for given conservation activities) that are potentially under-served or may require nonprofit coordination are found in the online Reference Documents. Please note that these maps are the result of analysis on a survey sample of 30 watershed nonprofits, and do not represent the complete range of nonprofits organizations or activities in the Schuylkill River watershed.

The primary purpose of the **Public Agency Survey** was to determine their agency activities, internal needs and resources available to other organizations, completed and ongoing watershed projects, opportunities for inter-agency and inter-institutional cooperation, and their opinion of critical watershed issues and needs. 64 public agencies were surveyed by interview or by mail. A majority of the responding

agencies represented the northern sections of the watershed, so issues pertinent to those regions of the watershed received more attention in this Plan.

The Public Agency Survey and Nonprofit Survey provided important information about activities, concerns and visions for the Schuylkill River watershed that have been incorporated into this Plan's recommendations, and may be used as a planning tool for empowering local organizations to more efficiently focus and coordinate limited resources where they are most urgently needed, and provide for more effective watershed management.

1.6.3 Recommendations from the Institutional Assessment

Recommendations for improving the institutional framework of the Schuylkill River watershed are summarized in the table below. These recommendations are based on the institutional analyses described in **Chapter 7.0 Institutional Assessment**. Each recommendation is assigned a unique code number (e.g., **R7.1**) and name, and is cross-referenced to the key institutional or watershed management issue(s) it addresses. These recommendations are described in more detail in **Section 7.5 Detailed Recommendations from the Institutional Assessment**, and the page number where the detailed description of each recommendation can be found is listed in the *Page* column of this table.

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R7.1	**Develop Quantitative Indicators/ Measures of Success**	An effort should be made to develop model watershed-wide indicators that can be used by all organizations. Public agencies and nonprofits should develop and use indicators for each project to determine success in order to invest resources wisely and measure progress towards goals.	Improve coordination Plan implementation Resource management Strategic conservation	7-53
R7.2	**Watershed Network**	A watershed network of public, private and nonprofit stakeholders should provide leadership on a watershed-wide basis, and help to coordinate partner activities on a local basis in order to maximize the effect of individual nonprofits' conservation activities.	Improve coordination Build capacity Public awareness Plan implementation Strategic conservation	7-54
R7.3	**Foundation Network**	Foundations should form a network to coordinate funding for watershed activities to meet needs, maximize existing resources, and encourage coordination of conservation activities among organizations.	Improve coordination Build capacity Plan implementation Strategic conservation	7-62
R7.4	**Institutionalize Professional Training**	Both nonprofits and agencies should attend ongoing professional training programs to optimize staff resources.	Build capacity	7-63
R7.5	**Explore Nonprofit – Public Agency Partnerships**	Public agencies and nonprofits should explore partnerships with one another to fill gaps in service, coordinate activities, maximize available resources and optimize staffing.	Improve coordination Build capacity	7-64
R7.6	**Promote Public Awareness of Watershed Issues**	Public outreach, citizen monitoring and other volunteer opportunities, education on watershed location, and watershed boundary signs could help promote public awareness and a "sense of place."	Public awareness	7-64

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R7.7	**Filling Geographic Gaps and Coordinating Service among Nonprofits**	Nonprofits should coordinate to expand their geographic reach, or facilitate the formation of new watershed groups or cooperative partnerships to cover areas of the watershed that may be under-served. Nonprofits operating within the same regions should coordinate activities to leverage resources and maximize environmental benefits. Topical watershed meetings could be convened around specific activities to improve communication and cooperation.	Improve coordination	7-65
R7.8	**Political verses Natural Geographic Service Area Coverage**	Nonprofit groups and public agencies should consider adjusting their service area to represent natural (i.e., subwatershed) boundaries instead of political boundaries. Where possible, entities, such as local governments, that are constricted to political boundaries should coordinate with others within subwatershed boundaries.	Improve coordination	7-66
R7.9	**Comprehensive Nonprofit Survey**	A comprehensive survey of all nonprofits and volunteer groups in the watershed should be conducted to further determine geographic areas and groups to be coordinated.	Improve coordination	7-67
R7.10	**Updated Watershed Directory**	Develop an up-to-date, comprehensive directory of watershed groups and government entities with names, contact information, mission statements, resources and services offered, and geographic service areas to link citizens, nonprofits and public agencies to one another.	Improve coordination Build capacity Public awareness Data clearinghouse	7-67
R7.11	**Watershed Clearinghouse**	An online Schuylkill River watershed clearinghouse should be developed to link and provide resources to nonprofits, local governments, agencies, and citizens in the watershed. The site should include planning documents, the watershed directory, links to partners, GIS data access, funding resources, etc.	Improve coordination Build capacity Public awareness Data clearinghouse	7-68
R7.12	**Watershed Service Center**	A watershed service center with links to technical and organizational expertise should be established to help nonprofits and local governments with their organizational needs.	Build capacity Data clearinghouse	7-70
R7.13	**Diversify Fundraising**	Nonprofits should diversify their funding sources to support long-term organizational growth.	Build capacity	7-70
R7.14	**Grant Guidelines that Support Partnerships**	State agencies and private foundations should use criteria in grant guidelines to encourage proposals that establish working relationships and partnerships among watershed groups, in order to improve coordination and reduce redundancy.	Improve coordination Build capacity	7-71

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R7.15	**Streamlined Grant Application Process**	Where practicable, state agencies and private foundations should coordinate grant programs, in order to improve nonprofit access to funding resources, increase the diversity of proposed projects, and maximize the resources and benefits of grant programs.	Improve coordination Build capacity	7-71
R7.16	**Use Innovative Land Protection Mechanisms**	Use innovative land conservation and funding tools, such as conservation easements, bond initiatives and purchase of development rights, to maximize options for conservation and/or acquisition.	Plan implementation Resource management Strategic conservation	7-71
R7.17	**Re-poll Watershed Community**	Re-poll the watershed population at intervals to survey watershed awareness and progress in education and outreach goals.	Public awareness	7-72
R7.18	**Coordinate Planning Efforts**	All planning efforts should be coordinated to ensure consistency among recommendations at all levels of government and nonprofit activity, and to ensure efficient use of funding, not duplication of efforts.	Improve coordination Plan implementation Strategic conservation	7-72
R7.19	**Fund an Outreach and Adoption Phase to Ensure Plan Implementation**	To ensure implementation of this Plan, an outreach phase needs to be funded to educate interested stakeholders about the plan, how to interpret and use the data and how to incorporate the data into local ordinances, etc. Outreach activities should target local governments, county planning commissions and nonprofit organizations in the watershed.	Resource management Strategic conservation Plan implementation	7-72
R7.20	**Hold Annual or Bi-annual Watershed Summit**	An annual or bi-annual watershed summit of stakeholders to facilitate networking, discussion of major activities, demonstration projects and plan implementation will improve cohesiveness of groups and coordination of conservation activities.	Improve coordination Public awareness Plan implementation	7-73
R7.21	**Schuylkill River Watershed Conservation Coordinator**	A Schuylkill River Watershed Conservation Coordinator should be funded through one of the local nonprofits or state agencies to work with nonprofits and government entities to implement this Plan.	Improve coordination Public awareness Plan implementation	7-73

1.6.4 Institutional Assessment: Relative Priority of Recommendations

To facilitate the use of this Executive Summary and information from the institutional assessment, the table below provides the relative priority and priority areas for implementation of the institutional assessment recommendations by subwatershed. Most recommendations from this section are applicable watershed-wide, although a few recommendations are targeted to specific areas as identified by the Nonprofit Gap Analysis. In addition, please refer to the **Reference Table 1A: Municipality Locations by Subwatersheds** for a cross-walked guide to which municipalities are in each subwatershed.

NOTE THAT VALUES IN THE FOLLOWING TABLE PROVIDE RELATIVE PRIORITIES FOR IMPLEMENTING INSTITUTIONAL RECOMMENDATIONS – RECOMMENDATIONS WITH A LOW

RANK MAY STILL BE OF SIGNIFICANT CONCERN IN A GIVEN SUBWATERSHED AT A LOCAL RATHER THAN REGIONAL LEVEL.

*PLEASE REFER TO COMPLETE **Schuylkill Watershed Conservation Plan** FOR FULL DETAILS.*

1 = Higher Relative Priority **5 = Lower Relative Priority**	**Relative Priority**	**Priority Area for Recommendation**
Institutional Assessment Recommendation		
R7.1 Develop Quantitative Indicators/Measures of Success	1	Watershed-wide
R7.2 Watershed Network	1	Watershed-wide
R7.3 Foundation Network	1	Watershed-wide
R7.4 Institutionalize Professional Training	1	Watershed-wide
R7.5 Explore Nonprofit - Public Agency Partnerships	2	Watershed-wide
R7.6 Promote Public Awareness of Watershed Issues	2	Watershed-wide
R7.7 Filling Geographic Gaps and Coordinating Service among Nonprofits	2	See Section 7.3 Tables and maps of Areas Served by Nonprofits for potential gaps and overlaps in service. Public agencies should also implement where possible.
R7.8 Political versus Natural Service Area Coverage	2	See Section 7.3 Tables and Nonprofit Activity Maps for potential gaps and overlaps in service. Public agencies should also implement where possible.
R7.9 Comprehensive Nonprofit Survey	3	Watershed-wide
R7.10 Updated Watershed Directory	3	Watershed-wide
R7.11 Watershed Clearinghouse	5	Watershed-wide
R7.12 Watershed Service Center	3	Watershed-wide
R7.13 Diversify Funding	3	Watershed-wide
R7.14 Grant Guidelines that Support Partnerships	4	Watershed-wide
R7.15 Streamlined Grant Application Process	3	Watershed-wide
R7.16 Use Innovative Land Protection Mechanisms	3	Watershed-wide, and particularly in conservation areas identified by the Landscape Sustainability Analysis
R7.17 Re-Poll Watershed Community	5	Watershed-wide
R7.18 Coordinate Planning Efforts	2	Watershed-wide, and especially in areas where other municipal, county or regional plans are in progress
R7.19 Fund an Outreach and Adoption Phase to Ensure Plan Implementation	2	Watershed-wide
R7.20 Hold Annual or Bi-annual Watershed Summit	2	Watershed-wide
R7.21 Schuylkill River Watershed Conservation Coordinator	3	Watershed-wide

1.6.5 Institutional Assessment: Recommendations for Nonprofit Activity by Subwatershed

The second table provides an overview, based on the Nonprofit Gap Analysis, of subwatershed priority areas for potential nonprofit coordination (C), priority areas potentially underserved by nonprofits (U), and priority areas for extension of service along geographical boundaries. In addition, please refer to the **Reference Table 1A: Municipality Locations by Subwatersheds** for a cross-walked guide to which municipalities are in each subwatershed.

NOTE THAT AREAS IDENTIFIED IN THE FOLLOWING TABLE PROVIDE INDICATION OF POTENTIAL GAPS AND OVERLAPS IN NONPROFIT ACTIVITIES ONLY, AS BASED ON THE SURVEY OF 30 WATERSHED NONPROFITS.

*PLEASE REFER TO COMPLETE **Schuylkill Watershed Conservation Plan** FOR FULL DETAILS.*

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	**NONPROFIT SURVEY** **KEY:** **C** = **Priority areas for nonprofit coordination** (3 or more local nonprofits working on this activity) **U** = **Priority areas underserved by nonprofits** (0 local nonprofits working on this activity) **E** = **Priority areas for extension of service** along subwatershed boundaries (areas with widely disjunct levels of service)	**ACTIVITIES**									
		Education and Outreach	**Scientific Research**	**Water Quality Testing**	**Water Quality Projects**	**Land Preservation**	**Historic Preservation**	**Recreation**	**Community/Urban Redevelopment**	**Advocacy**	**Park/Preservation Management**
	SUBWATERSHEDS										
U/S	East Branch Perkiomen Creek	**E**	**U**	**U**	**C/E**	**E**	**U**	**E**		**E**	**U/E**
H	French Creek	**C**	**C**	**E**	**C**	**C**	**C**	**C**	**C/E**	**C**	**C**
H	Hay Creek	**C**	**C**	**C**	**C**		**C**	**C**			**C**
A	Little Northkill/Northkill Creek	**C**	**C**	**C**	**C**		**C**	**C**			**C**
H	Little Schuylkill River (Lower)	**C**	**E**	**C**	**C**	**E**		**C**			**E**
H	Little Schuylkill River (Upper)	**C/E**	**E**	**C/E**	**C/E**	**U/E**	**U/E**	**C**	**U**	**U/E**	**E**
A	Lower Maiden Creek	**C**	**C**	**C**	**C**		**C**	**C**			**C**
H	Lower Manatawny Creek	**C**	**C/E**	**C**	**C**		**C/E**	**C**	**E**	**C**	**C**
U/S	Lower Perkiomen Creek		**U**	**U**	**C**		**U**				
A	Lower Tulpehocken Creek	**C**	**C**	**C**	**C**		**C**	**C**			**C**
U/S	Lower Wissahickon Creek		**U**		**C**			**E**			
A	Middle Tulpehocken Creek	**C/E**	**C**	**C/E**	**C**		**C/E**	**C**		**E**	**C**
A	Monacacy Creek	**C**	**C**	**C**	**C**		**C**	**C**			**C**
A	Ontelaunee/Kistler Creek	**E**	**E**	**C/E**	**E**	**E**	**E**	**E**		**E**	**E**
H	Pickering Creek	**C**	**C**		**C**	**C**	**C**			**C**	**C**
A	Sacony Creek	**C/E**	**C**	**C/E**	**C/E**	**E**	**C/E**	**C/E**		**E**	**C/E**
U/S	Sandy Run		**U**		**C**						
U/S	Schuylkill River 1	**U/E**	**E**	**U/E**	**C/E**	**U/E**	**U/E**	**U/E**		**U/E**	**U/E**
U/S	Schuylkill River 2		**U**	**U**			**U**				
U/S	Schuylkill River 3	**C/E**	**C/E**	**E**	**C**	**C/E**	**C**	**C/E**		**C/E**	**C/E**
H	Schuylkill River 4	**C**	**C**	**C**	**C**		**C/E**	**C**		**C**	**C/E**
H	Schuylkill River 5	**C**	**C**	**C**	**C**		**C**	**C**			**C**
U/S	Schuylkill River 6	**C**	**C**	**C**	**C**		**C**	**C**			

Zone (A=Agriculture, H= Habitat, U/S=Urban/Suburban)	NONPROFIT SURVEY **KEY:** **C** = **Priority areas for nonprofit coordination** (3 or more local nonprofits working on this activity) **U** = **Priority areas underserved by nonprofits** (0 local nonprofits working on this activity) **E** = **Priority areas for extension of service** along subwatershed boundaries (areas with widely disjunct levels of service)	ACTIVITIES: Education and Outreach	Scientific Research	Water Quality Testing	Water Quality Projects	Land Preservation	Historic Preservation	Recreation	Community/Urban Redevelopment	Advocacy	Park/Preservation Management
	SUBWATERSHEDS										
A	Schuylkill River 7	C	C/E	C	C		C	C			C
H	Schuylkill River 8	C	E	C	C	E	E	C			E
H	Schuylkill River Headwaters	C		C	C			C			
U/S	Schuylkill River Tidal			U			U				
U/S	Skippack Creek		U	U			U				
H	Swamp Creek	C	E	C/E	C	C	C/E	C	C/E	C	C/E
H	Unami Creek	E	U	U	C/E	E	U	E	E	E	U/E
H	Upper Maiden Creek	C/E	C/E	C/E	C/E	E	C/E	C/E		E	C/E
H	Upper Manatawny Creek	C	C	C	C		C	C			C
H	Upper Perkiomen Creek	C	C/E	C/E	C	C	C/E	C	C/E	C	C/E
A	Upper Tulpehocken Creek	C/E	C/E	C/E	C/E	E	C/E	C/E		E	C/E
U/S	Upper Wissahickon Creek		U		C						
U/S	Valley Creek	C			C	C	C			C	C
H	West Branch Schuylkill River	C		C	C			C			

1.7 Municipality Locations by Subwatersheds

The **Municipality Locations by Subwatersheds** table is provided as a cross-reference tool to assist users in determining which of the 37 subwatersheds of the Schuylkill River watershed a particular municipality falls in. The hope is that users will then be able to better use the summary charts in this Executive Summary, which give issue and recommendation priorities by subwatershed, not municipality.

1.8 Maps

The following five maps (referenced in Sections 1.2 and 1.5) are provided at the end of the stand-alone paper-copy version of the Executive Summary. Otherwise, these maps can be found with all the other primary maps at the end of the paper-copy full report (in the Reference Documents). All maps are also available for review and download from the website: http://www.schuylkillplan.org/.

- **Watershed Orientation** map
  This map presents the subwatershed boundaries, major river sections and outline of the Schuylkill River watershed. The map can be used as a visual reference for recommendations that are targeted at specific subwatersheds.

- **Cities, Towns and Boroughs** map
  Major cities, towns and boroughs within the watershed boundary are presented on this reference map.

- **Major Streams & Tributaries** map
  Major streams and tributaries of the Schuylkill River watershed are presented on this reference map.

- **Subwatersheds & Municipalities** map
  The 37 subwatershed boundaries and the location of municipalities in the watershed are presented on this reference map.

- **Sustainable Landscape Vision** map
  This map presents a vision of a network of potential greenspace, based on sensitive lands, forested lands, biodiversity hotspots and greenspace corridors, which could support a sustainable landscape and healthy watershed ecosystem. Please see Chapter 6.0 for more information.

In addition, the two sets of institutional assessment maps referenced in Section 1.6 can be found in the online Reference Documents at www.schuylkillplan.org.

- **Nonprofit Service Areas** maps
  These maps represent the geographic service area boundaries as reported by the 30 nonprofit organizations surveyed in the Nonprofit Gap Analysis. Please see Chapter 7.0 for more information.

- **Areas Served by Nonprofits** maps
  These maps show the results of the gap analysis on nonprofit activity in the Schuylkill River watershed, based on the geographic service areas and the activity involvement reported by the 30 surveyed nonprofit organizations. These maps were generated by overlaying service area maps of nonprofits who reported involvement in a given activity category (e.g. education and outreach activities). Please see Chapter 7.0 for more information.

1.9 References

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2.0 FOREWORD

This River Conservation Plan for the Schuylkill River watershed has been produced through a partnership between The Conservation Fund (TCF), Natural Lands Trust (NLT) and the Patrick Center for Environmental Research at the Academy of Natural Sciences (PCER - ANS).

The Plan is designed to be a guidebook for municipalities, conservation groups, and citizens interested in taking steps to enhance the long-term health of the Schuylkill River watershed. However, due to the regional nature of the assessments in this project, it is likely that municipalities and nonprofits will be the primary users. Municipalities and nonprofits may, in turn, use the Plan to engage landowners and citizens in implementing the recommendations developed in this Plan.

The Plan focuses on three major areas of interest:

- An analysis of watershed lands required for ecosystem sustainability;
- A broad-scale analysis of water quality; and
- An assessment of watershed institutions (public agencies and nonprofit organizations).

While agricultural, scenic, cultural, historic and recreational resources are acknowledged as critical aspects of the watershed community and part of the comprehensive planning process, they have not been specifically addressed in this Plan due to the agreed-upon scope of work, the scale of the watershed assessment (almost 2,000 square miles) and the limited resources available. A tight focus on the three primary areas of interest was required to meet the goals of the project.

2.1 Goals and Principles

Goals for the Plan were established in the contract with the Pennsylvania Department of Conservation and Natural Resources (DCNR), as follows:

- Identify conservation issues important to local communities and governing agencies;
- Conduct a broad scale inventory and assessment of land and water resources to establish priorities;
- Make recommendations for a watershed-wide conservation agenda to guide future studies and actions at the site-specific, local community level; and
- Make recommendations for a management structure to implement the recommendations of the report.

The Plan includes a summary of findings on existing physical and institutional conditions, input from government agencies, municipal and county officials, as well as private citizens, solicited through public meetings, surveys, and interviews.

The Schuylkill Watershed Conservation Plan is constructed on the general principles noted below. Throughout the report, more specific goals, objectives and recommendations developed from these primary principles are described.

- General Awareness

  The Schuylkill River system should come to be widely understood as a common, connecting resource of local and regional importance and great beauty.

- Coordinated Action

  Through the coordinated actions of all parties – municipalities, agencies, landowners, citizens, institutions, and private groups – the ecology and water quality, as well as beauty of the Schuylkill River, its tributaries and watershed should be preserved and, where possible, improved. Smart Growth polices can be used to help direct new development that is deemed essential to the areas of the watershed where impacts on water and ecological health can be minimized.

- Central Role of Municipalities

  Municipalities, and organizations sponsored by municipalities, should pursue the recommendations found in this Conservation Plan, using matching funding sources such as the Pennsylvania Rivers Conservation Program.

It is important to realize that the landscape, water quality and institutional issues addressed in the Plan are inter-related, making their separation into discrete topics at times artificial. Some of the most important recommendations, for example, a commitment to preserving and enhancing riparian buffers, address multiple issues simultaneously. Repetition has been avoided where possible, although recommendations that address multiple issues have been discussed in several places. This should help readers understand the multiple objectives of these recommendations.

2.2 Project Documentation

The documents produced through this planning effort for the Schuylkill River watershed, and information on where they can be found, are presented below.

- The Executive Summary to the Schuylkill Watershed Conservation Plan

  An Executive Summary to the Conservation Plan is available as a separate document, and also included as Chapter 1 of the Plan. The intent of this summary is to present key issues and conditions in the watershed, and to describe the three focal analyses performed and their related recommendations. A printed copy of the Executive Summary is available to the public on request. Please address requests for printed copies of the Executive Summary to the Natural Lands Trust at the address provided below, or submit requests via the Plan's website, http://www.schuylkillplan.org/.

- The Schuylkill Watershed Conservation Plan

  The complete River Conservation Plan for the Schuylkill River watershed is provided, by section, in PDF format online at http://www.schuylkillplan.org. This document can be downloaded and read using the free Adobe Acrobat™ software available on the Internet. The Plan contains 7 sections:

Chapter 1.0	Executive Summary
Chapter 2.0	Foreword
Chapter 3.0	Watershed Characterization
Chapter 4.0	Identification of Major Watershed Issues

Chapter 5.0	Water Quality
Chapter 6.0	Promoting a Sustainable Landscape
Chapter 7.0	Institutional Assessment

Maps referenced in these chapters of the Schuylkill Watershed Conservation Plan also are provided separately as PDF files on the website. A limited number of printed copies of the full Plan are available for review at the following locations.

- Planning Commissions: Berks, Montgomery and Schuylkill Counties
- National Resource Conservation Service: Berks, Montgomery, and Schuylkill
- Philadelphia Free Library
- Schuylkill Resource Conservation District
- Other locations as noted on the project website at: http://www.schuylkillplan.org.

- Maps

  Color and grayscale maps referenced in the Schuylkill Watershed Conservation Plan can be viewed on the website (http://www.schuylkillplan.org). Maps are referenced by name in the text of the Plan. Printed copies of the maps also are available with the full Schuylkill Watershed Conservation Plan at the selected locations listed above.

- Online Reference Documents

  Supplementary reference documents, such as large tables and general maps related to the water quality, landscape and institutional analyses, are compiled in the online Reference Documents. These documents are referenced in the chapters of the Schuylkill Watershed Conservation Plan. The Reference Documents are available online in PDF format at http://www.schuylkillplan.org. Paper copies of these Reference Documents have been distributed only to the project funders, to the Technical Advisory Committee, and along with the printed copies of the full Plan distributed at selected locations throughout the watershed as noted above.

2.3 Project Team and Funding

The Schuylkill Watershed Conservation Plan was produced with financial assistance from the Pennsylvania DCNR's "Rivers Conservation Program," which awarded a planning grant to the project in 1997. A matching grant also was provided for the project from The William Penn Foundation.

When the Pennsylvania DCNR approves the final version, this Schuylkill Watershed Conservation Plan will be submitted for inclusion on the Pennsylvania Rivers Registry, providing the basis for DCNR matching grants to municipalities and nonprofits that are interested in implementing the recommendations provided in this report. Some of the watershed municipalities and nonprofits have provided a preliminary list of their proposed implementation projects in the online Reference Document **Potential Implementation Projects** to this Plan.

Different sections of the Schuylkill Watershed Conservation Plan were drafted by the project team. Your comments on any sections are welcome. However, please recognize that these comments may not be

addressed directly until the next updating of the Plan. Please address comments to the project team as follows (complete contact information is provided below).

- Executive Summary, Foreword, Watershed Characterization, Identification of Major Watershed Issues and Promoting a Sustainable Landscape (Chapters 1- 4, and 6): Clare Billett, Natural Lands Trust
- Water Quality (Chapter 5): Tom Johnson, Patrick Center for Environmental Research, ANS
- Institutional Assessment (Chapter 7): Anne Desmarais, National Office, The Conservation Fund

Contact information for each project team member is given below, and via the project web page at http://www.schuylkillplan.org. In order to ensure appropriate documentation of your issues and concerns please submit written comments only.

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3.0 WATERSHED CHARACTERIZATION

3.1 Watershed Location

The watershed of the Schuylkill River is located in southeastern Pennsylvania, and includes large parts of Schuylkill, Berks, Montgomery, Chester, and Philadelphia Counties (see the map: **Watershed Orientation**). Smaller areas of Carbon, Lehigh, Lebanon, Lancaster, Bucks and Delaware Counties also lie within the watershed. The Schuylkill River watershed is about 80 miles long and 25 miles wide, and encompasses an area of approximately 1,916 square miles (4,962 sq. km). The Schuylkill River travels approximately 130 miles from its headwaters at Tuscarora Springs in Schuylkill County, to its mouth at the Delaware River in Philadelphia. The principal towns and cities along the mainstem of the river are Pottsville, Reading, Pottstown, Phoenixville, Norristown, Conshohocken, and Philadelphia. See the map: **Cities, Townships & Boroughs**.

For the purposes of this Conservation Plan, the Schuylkill River watershed was subdivided into 37 subwatersheds as shown in the map: **Subwatersheds & Municipalities**. The Schuylkill subwatersheds were designated to facilitate the water quality, landscape sustainability and institutional analyses, and for ease of reference. Subwatersheds were defined at a scale small enough to allow meaningful comparisons, while not exceeding the resolution of the data. The approximate size of each subwatershed is 125 square kilometers or 12,500 hectares (about 31,000 acres). Attempts also were made to delineate subwatersheds so that areas with existing (or in-progress) river conservation plans remained intact. This was done to facilitate the incorporation of issues and recommendations from other plans into the broader Schuylkill Watershed Conservation Plans.

3.2 History, Demographics and Land Use

3.2.1 Early History and Settlement

The first settlers of the Schuylkill River valley were Lenape Indians, mostly of the Unami tribe. Approximately 2,000 Lenapes lived along the Schuylkill, mostly settled in the lower reaches, although villages may have existed in the stretch of river above Phoenixville as well.

It was the Dutchman Arendt Corssen, sailing under the flag of the Dutch East Indies Company in the early 1600's, who gave the river its name: *Skokikl* or hidden creek. It is said that at that time, the mouth of the Schuylkill River was partially obscured by tall bulrushes. However, prior to this time the Lenapes had called the river *Ganshowahanna* or falling waters. It also was known to the Lenapes as *Manayunk*, meaning where we drink.

Four nations, at one time or another, have laid claim to ownership of the Schuylkill River. The Dutch and Swedes were the first settlers in Pennsylvania, but little remains other than the names from these settlements. It was the English under William Penn that formally acquired the lands from the Native American tribes. The United States took possession of these lands after the Revolutionary War.

3.2.2 Demographics and Population Growth

The Dutch and Swedes arrived in the Philadelphia region in the early 1600s. By 1680, a half-century after the landing of the *Mayflower*, Pennsylvania held no more than 700 people of European origin. Delayed by conflicting territorial claims and a perception that the interior was more or less impenetrable, effective

settlement came later in Pennsylvania than in any of the colonies except Georgia (Simkins 1995). This trend began to change after 1680, when William Penn obtained his land charter from King Charles II of England. From the 1680s through the 18th Century, Pennsylvania's population grew faster than the rest of the nation. This population growth resulted from natural increase, and more importantly from immigration, first by English Quakers and German Pietists, then by Scottish, Welsh, and Irish immigrants. **Table 3.1** summarizes population growth trends since the 1700s for Pennsylvania, as compared to the national population growth.

Table 3.1 Population Growth Trends Since the 1700's

Year	PA Population		US Population		PA as a % of US Population
	In Thousands	% increase over previous period	In Thousands	% increase over previous period	
1700	18	-	251	-	7%
1800	602	3,240	1,171	366	51%
1850	2,312	284	23,192	1880	10%
1900	6,302	173	76,212	229	8%
1950	10,498	67	151,326	98	7%
1990	11,882	13	248,710	64	5%
2000	12,281	3	281,422	13	4%

After 1800, the Commonwealth's population growth declined below the national average, as out-migration began to new states in the west. A second wave of mostly Eastern European immigration between 1890 and 1920 added more than a million people each decade to Pennsylvania's population. Pennsylvania was also part of the post World War II baby-boom, but at a lower rate of growth than the rest of the nation. Population growth through natural increase or immigration has stopped almost completely since the 1970s. Pennsylvania now has only about 4% of the nation's population, as compared to 200 years ago when it had more than 50%.

Pennsylvania's present county boundaries did not become fixed until 1878, which has made it difficult to follow regional population patterns. However, from the earliest colonial days, southeast Pennsylvania has been a major center of population growth. The Schuylkill River watershed was settled in the Philadelphia area by the 1700s, in Berks County by the 1720's, and in Schuylkill County by the 1740-1760s. In 1790, when the first Census was taken, nearly 75% of Pennsylvania's 450,000 population lived southeast of the Blue Mountains. In the early 1800s, the population began dispersing into more remote areas, only to retract again in the 1880's as timber harvests declined and agriculture practices became less labor-intensive. A temporary reversal of that trend occurred during the Depression, when urban workers left closed factories and returned to their rural homelands. Since the 1940s, the southeast has consistently been the area of most rapid growth in the Commonwealth.

Within the Philadelphia region, however, there has been significant redistribution of people. Between 1800 and 1940, Philadelphia gained population more rapidly than the surrounding counties. In 1900, Chester, Montgomery, Bucks and Delaware held only 6% (380,000) of the state's population, and Philadelphia 20% (1.26 million). In the 1940s the pattern was about the same, with 28% of the state's population (2.7 million) living in the five-county Philadelphia region of Philadelphia, Chester, Montgomery, Bucks and Delaware Counties. Philadelphia reached its largest population in the 1950s. By 1990, decentralization and suburbanization were in full swing, with only 13% (1.5 million) of the state's population in Philadelphia while 18% (2.2 million) resided in the surrounding four counties.

Population projections through 2010 indicate this trend will continue for the foreseeable future in the Schuylkill River watershed. Berks County and other central parts of the Schuylkill River watershed will see the greatest population growth (between 30-50% increases) under the influence of continued decentralization to the suburbs, and economically induced out-migration from Schuylkill County. See the map: **Estimated Population Change**, which displays projected population growth in the Schuylkill River watershed (Carson 1999). See **Section 6.6** in *Chapter 6.0 Promoting a Sustainable Landscape* for further discussion of this topic.

3.2.3 Historic Land Uses

Primary land uses within the Schuylkill River watershed have changed over the years. Early settlers relied on agriculture and used the Schuylkill River network to transport crops to larger markets downstream. However, the vast natural resources in the watershed, including iron ore, hardwood, and river power, soon created a thriving iron industry. Numerous mills and forges were built along the Schuylkill to support this industry. These contributed to Philadelphia's growth, making it the most populous city in the country during the Revolutionary War.

In response to this growth, Philadelphia damned the Schuylkill River in 1819 and created the Fairmount Water Works. The industrial growth, however, continued to pollute the Schuylkill River, which was the primary drinking water source for the city. In an effort to protect its water supply, the city purchased a large estate (over 5,000 acres) near the water works that became Fairmount Park.

Later, with the discovery of vast coal sources in the northern headwaters, the Schuylkill River became a primary mode of transportation due to the Schuylkill Navigation System: a system of 32 dams and 103 locks. As Philadelphia became the workshop to the world, other factory towns such as Manayunk, Conshohocken, Norristown, and Phoenixville boomed as well. By the early 20th Century, competition from railroads led to the demise of the navigation system. However, numerous dams and canal features remained and many are still in existence today. The dams, while drastically improving navigation, also created obstacles to migratory fish such as shad and Atlantic salmon, and adversely affected these fish populations.

The coal industry peaked in the 1910s. By the 1930s, most of the coal lands had fallen into the hands of county governments, due to failure of paying taxes. Although mines were no longer in operation, leaking acid mine drainage (AMD) and sedimentation continued to affect water quality in the Schuylkill River watershed. Initial steps towards river renewal began 50 years ago when the U.S. Army Corps of Engineers (US ACE) began to dredge the accumulated sediment from the river, which has continued periodically since then. More recently, environmental legislation, spearheaded by the federal Clean Water Act, has resulted in laws governing the discharge of industrial and municipal sewage from point sources and is now focusing on reducing pollution from nonpoint sources.

The outcome of these efforts, along with the river's natural abilities to cleanse itself over time, is a river network on the rebound. This was exemplified by Pennsylvania's designation of the Schuylkill as the state's first scenic river in 1978, River of the Year in 1999, and culminating in its designation as a National Heritage Area in 2000.

3.3 Physical Setting (Physiography)

The geologic formations of the Schuylkill River watershed are part of the Appalachian Highlands, a belt of deformed rocks that stretches from Newfoundland to Alabama (US ACE 1981; Biesecker 1968). The region is

geologically complex due to major episodes of crustal deformation that produced mountain ranges. Because of this complexity, it is useful to discuss the geology of this region by physiographic province and section (see the map: **Geologic Provinces**). Physiographic provinces and sections (sub-divisions of physiographic provinces) are areas within the watershed with similarities in geology, topography, and soils. These characteristics have an important influence on the occurrence and chemical characteristics of surface water and groundwater within the watershed.

The headwaters of the Schuylkill River rise in the Blue Mountain Section of the Ridge and Valley physiographic province. The Blue Mountain Section consists of long, narrow mountain ridges separated by narrow to wide valleys. Very tough sandstones occur at the crests of the ridges, and relatively soft shales, siltstones, and in places limestone and dolomite occur in the lowlands. Soils in this section are characteristically well-drained or moderately well-drained shaly-loam or silt-loam, and have a low to medium erosion potential. Moving in a downstream direction, the Schuylkill River then enters the Great Valley Section of the Ridge and Valley Province. The Great Valley Section consists of gently undulating hills eroded and reformed into shales and siltstones on the north side of the valley, and a lower elevation, flatter landscape developed on limestones and dolomites on the south side. The soils of this section generally are well-drained silt loams with a low to medium erosion potential.

As the Schuylkill River approaches the city of Reading, it crosses into the Reading Prong Section of the New England Province. This Section consists of circular to linear, rounded low hills or ridges that contrast with surrounding lowlands. The hills and ridges are made up of granitic gneiss, granodiorite, and quartzite. The streams eroding into the hills and ridges of this section are short and steep.

Southeast of Reading, the Schuylkill River enters an area of rolling low hills and valleys developed on red sedimentary rock known as the Gettysburg-Newark Lowland Section of the Piedmont Physiographic Province. The soil associations in this section of the Piedmont are characteristically well to somewhat poorly drained silt loams, with a high to medium potential for erosion. Southeast of the Gettysburg-Newark Lowland Section and northwest of the city of Philadelphia, the Schuylkill River crosses into section known as the Piedmont Lowland Section of the Piedmont Physiographic Province. This section consists of broad valleys and low hills developed primarily on limestone and dolomite rock. The soil associations in this section of the Piedmont are generally silt loams, characteristically well to somewhat poorly drained with a high to medium potential for erosion. Northeast of Philadelphia, the Schuylkill River enters the Piedmont Uplands Section of the Piedmont Physiographic Province. This section consists of broad, gently rolling hills and valleys developed mainly on metamorphic rocks called schists. The soil associations in this section are well-drained silt loams with an erosion potential ranging from low to high.

At Philadelphia and near to its mouth, the Schuylkill River crosses into a region of low relief and tidal marshland known as the Atlantic Coastal Plain. The northwestern margin of the Section is marked by a change in slope known as the "fall line" where the relatively flat Coastal Plain joins the higher adjacent Piedmont Upland Section. Soil associations in this are generally well-drained loams with a medium to high erosion potential. The Schuylkill River is a tidal river from the Fairmount Dam south of Manayunk to its mouth.

3.4 Climate and Water Resources

This section provides an overview of climate and water resources within the Schuylkill River watershed. For additional information about climate, physiography, surface water, and groundwater in the Schuylkill River watershed, see Biesecker et al. (1968), and U.S. Army Corps of Engineers (1981).

3.4.1 Climate

The Schuylkill River watershed has a modified continental type climate. Warm and humid summers, moderately cold winters, and ample rainfall distributed throughout the year are characteristic of the region (US ACE 1981). The mean annual temperature for the watershed is 52°F (11°C) with summer and winter averages of 72°F (22°C) and 31°F (0°C), respectively (Biesecker et al. 1968). The rugged topography and higher elevations of the Appalachian Mountains causes greater temperature variations in these areas than in the Coastal Plain and Piedmont areas. Topography and elevation also have a major controlling effect on precipitation in the watershed. Average annual precipitation is highest in the mountainous headwaters region (45-50 in/yr or 114-127 cm/yr) and decrease eastward to the Coastal Plain (43 in/yr or 109 cm/yr). Precipitation is distributed fairly uniformly throughout the year, and is generally sufficient for crops and vegetation throughout the watershed.

3.4.2 Surface Water

Local precipitation is the source for water to rivers, streams, ponds and other aquatic environments within the Schuylkill River watershed. On average in Pennsylvania, about 50% of annual precipitation is evaporated or transpired by plants back to the atmosphere, about 20% runs off into rivers and streams as "stormflow" during rainfall and snowmelt events, and about 30% infiltrates the ground surface and runs off as "baseflow" during dry weather (Fleeger 1999; Biesecker et al. 1968). Rates of streamflow tend to be highest in late winter and early spring due to snowmelt and low evaporation/transpiration rates. The lowest streamflow rates generally occur in late summer and early fall primarily due to high rates of evaporation/transpiration from vegetation.

Water drains from the watershed through a series of successively larger streams known as a drainage network. The concept of a drainage network is well described by Leopold (1997):

> "Water drains from the land through streams that increase in size from small hillside rills to majestic rivers that discharge into the oceans. Each rill, brook, creek, or river receives water from an area or tract of land surface that slopes down toward the channel. Channels, therefore, occupy the lowest part of the landscape. The ridges of the land surface, that is, the rims separating the land that drains into one stream from the land that drains into another, are the watershed divides. The area enclosed by the divide is the drainage area or watershed."

The major tributaries of the Schuylkill drainage network, in downstream order, are Mill Creek, the West Branch of the Schuylkill, the Little Schuylkill, Maiden Creek, Tulpehocken Creek, Manatawny Creek, French Creek, Perkiomen Creek, and Wissahickon Creek (see the map: **Major Streams & Tributaries**). A number of lakes and ponds also occur within the watershed, mostly as reservoirs or small impoundments.

The relative size and location of a stream within a watershed drainage network can be expressed as a numerical value known as the *stream order* (see **Figure 3.1**). The smallest streams that have no tributaries are called first order streams. Where two first order streams flow together, the stream becomes second order. Second order streams only have first-order streams as tributaries. A third order stream is formed when two second order streams come together, and has only second and first order streams as tributaries. This basic pattern is repeated to the highest order stream in the drainage network. As the order of the stream increases, streamflow (flow volume) and flow velocity both increase, while channel gradient decreases. Channel dimensions (width and depth) also increase with stream order, as the channel accommodates the increased flow. At its mouth, the Schuylkill River is a seventh order stream.

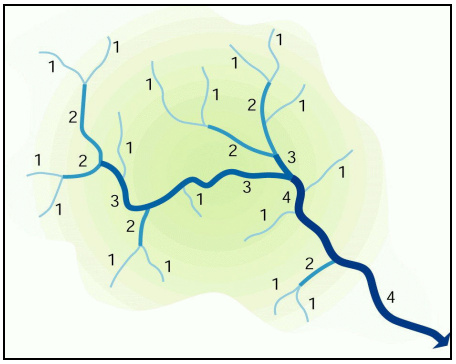

Figure 3.1 Stream Network with Stream Orders

Table 3.2 Summary of Stream Length by Stream Order in the Schuylkill River Watershed

Stream Order	*Kilometers*	*Percent of Streams*
1	2476.58	56.56%
2	863.56	19.72%
3	459.85	10.50%
4	298.68	6.82%
5	124.74	2.85%
6	103.89	2.37%
7	51.34	1.17%

A summary of the total length and percent of streams of each order in the Schuylkill River watershed is shown in **Table 3.2**. It is important to note that small first and second order streams represent a large proportion of the total stream length of the Schuylkill River. Small streams process foods, provide invaluable habitat for aquatic biota, and connect the Schuylkill River to its watershed in profound ways. The health of small streams is therefore of critical importance to the health of aquatic ecosystems throughout the watershed. Regrettably, smaller streams also tend to be the most impacted by human activities. To emphasize the importance of small streams to the health of the larger watershed, an analogy can be made between the tributaries and mainstem of the Schuylkill River and the network of trunk, branches and leaves that make up a tree system (**Figure 3.2**). The mainstem of the river is represented by the trunk of the tree, and the tributaries by successively smaller branches and leaves. Without healthy leaves and small branches to move important nutrients to the trunk and throughout the tree, a tree could not survive. Similarly, without healthy small streams, the Schuylkill River may become ecologically degraded.

Figure 3.2 Comparison of a River System to Tree System

3.4.3 Groundwater

In Pennsylvania, about 30% of annual precipitation on average infiltrates the ground surface to recharge groundwater aquifers (Fleeger 1999). An aquifer is a soil or rock formation that contains and transmits water within soil pores, fractures, joints, and other small cavities. All aquifers are bounded at some depth by an impermeable rock layer that is water tight due to cementation processes and high pressure. Water seeping down from the ground surface will thus collect above the impermeable layer. The top of this saturated zone of the soil is referred to as the water table (Leopold 1997). The water table will fluctuate seasonally and in response to wet or dry years, but in undisturbed watersheds the long-term average water table elevation will remain approximately constant.

Groundwater drains to springs and streams wherever the water table intersects the ground surface. During low flow or drought conditions, groundwater provides nearly all streamflow (Biesecker et al. 1968). Groundwater therefore has a significant influence on streamflow quantity and quality, and is important to maintaining the health of stream ecosystems. In areas where groundwater is used for water supply, it is important that withdrawals do not exceed rates of aquifer recharge to avoid groundwater depletion. Excessive pumping of groundwater from wells can lower water tables, reduce groundwater discharge to springs and streams, and in certain cases entirely de-water small streams that formerly flowed year round (Biesecker et al. 1968). Groundwater depletion is of particular concern in the Piedmont area around Montgomery and Chester Counties. Groundwater resources in the Schuylkill River watershed are discussed in **Section 5.4.1.2** of *Chapter 5.0 Water Quality*.

In the Schuylkill River watershed there are four principal groups of aquifers: unconsolidated deposits, crystalline rocks, carbonate rocks, and clastic rocks. Except for unconsolidated deposits on the Coastal Plain, most aquifers within the Schuylkill River watershed are composed of consolidated rocks (Biesecker et al.

1968). The median water bearing capacities for aquifers in most of the Schuylkill River watershed range from about 20 to 200 gallons per minute (Biesecker et al. 1968). Median water bearing capacities of greater than 200 gallons per minute occur in the carbonate rocks of the Great Valley, and in the unconsolidated deposits of the Atlantic Coastal Plain. Median water bearing capacities of less than 20 gallons per minute occur in parts of the Piedmont in northern Chester and Montgomery Counties (Biesecker et al. 1968).

3.5 Vegetation and Wildlife Issues

Pennsylvania has more than 20,000 species of plants and animals, which may be divided into eight classes, as depicted in the following diagram of Pennsylvania Species Richness (**Figure 3.3**). These classes include Protists, Vascular Plants, Bryophytes and Lichens, Birds, Fish, Mammals, Amphibians and Reptiles, and Invertebrates. Protists and Invertebrates have the greatest number of species.

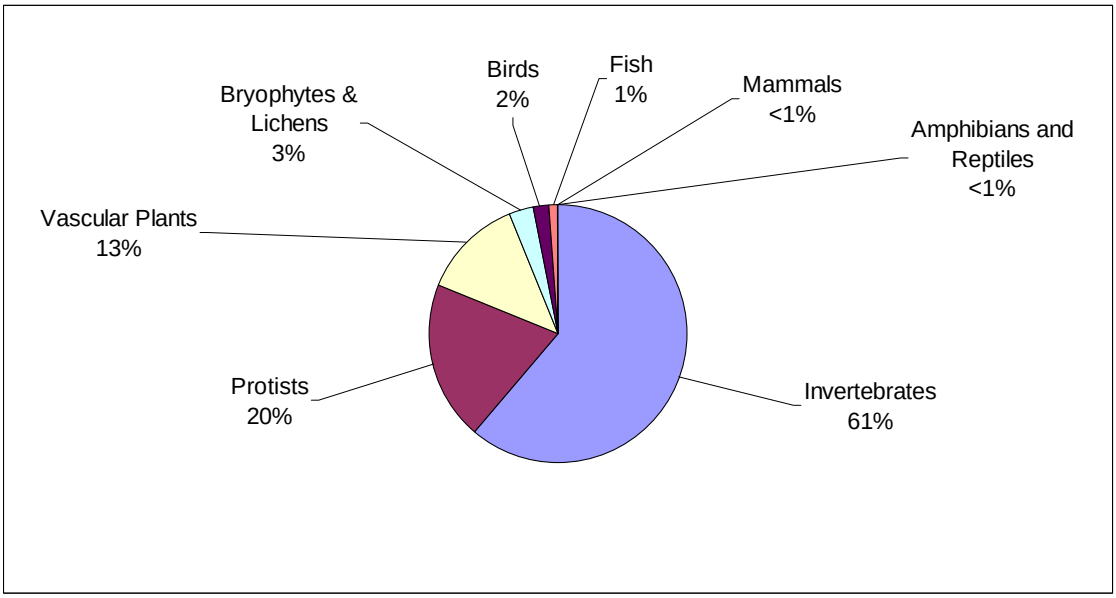

Figure 3.3 Pennsylvania Species Richness (adapted from PA Fish & Boat Commission 1995)

A more thorough accounting of species numbers by class, rarity as well as a discussion of threats to species diversity, is given in *A Heritage for the 21st Century: Conserving Pennsylvania's Native Biological Diversity* (PA Fish & Boat Commission 1995).

Ecologists divide the earth's vegetation types into communities, or recognizable associations of plants. This kind of stable association of plants depends on a certain environment or habitat, and the composition of vegetation changes based on landform, soil, water and climate. Ecologists have divided the earth's living surface into major communities, called biomes, which are complex associations of plants and animals in a region. The composition of animal species in a given region is determined by a number of factors, including vegetation, basic physical resources, inter-species dynamics, and historic patterns of distribution.

Biomes can be subdivided in turn into smaller communities called ecoregions, similar to the way that geology and topography can be described by physiographic provinces. The Nature Conservancy and the Pennsylvania

Department of Conservation and Natural Resources (PA DCNR) Bureau of Forestry have adopted Bailey's ecoregional maps as their standard system of vegetation classification.

The Schuylkill River watershed falls mainly in the Lower New England/Northern Piedmont (LNE/NP) ecoregion, also known as the Piedmont Province. The southern edge of the Great Valley marks the boundary with the Central Appalachians ecoregion to the northwest, which coincides with the Ridge and Valley Province. The city of Philadelphia is built on the dividing line in the southeast with the North Atlantic Coast ecoregion, or the Inner Coastal Plain Province.

Most of the Schuylkill River watershed that is in the LNE/NP ecoregion is in the Oak-Hickory-Tuliptree forest region of the Eastern Deciduous Forest biome. In contrast, the Central Appalachian boundary marks a gradual change in forest type to the White Oak-Hemlock-Hardwood transitional forest zone. Tuliptree is more prevalent in the southeast portions of the watershed, while hemlock and white pines are more prevalent in the Central Appalachian ecoregion. A new and detailed list of *Terrestrial and Palustrine Plant Communities of Pennsylvania* was produced by Fike (1999), documenting 11 types of forest and woodland types in Pennsylvania. However, associated mapping at the regional scale has not yet been carried out to define exactly where these forest types actually occur. In general, the following forest associations characterize the watershed (as defined by Delta Group et al. 1999).

- On dry upper elevations: chestnut oak, sweet birch, scarlet oak, red oak American beech, pignut hickory, black oak, white pine and black gum dominate the forest canopy.
- On cool north-facing slopes: hemlock, white pine, sweet birch, black cherry and red oak.
- In ravines with steep slopes: tuliptree, white oak, black cherry, American beech, red maple, shagbark hickory, ironwood, redbud, and dogwood.
- Along streams and floodplains: American sycamore, red maple, American basswood, river birch, white ash, ironwood, witch hazel, spicebush, elderberry and red-stem dogwood.
- On abandoned, cleared land: succesional native plants such as red cedar, box elder, sumac, black locust, black walnut, blackhaw viburnum, red stem dogwood, goldenrod, asters and many other herbaceous perennials.

Forests are the dominant form of vegetation in Pennsylvania. It is estimated that before colonial settlement around 97-98% of Pennsylvania was forested land cover (Schein and Miller 1995). Forest cover in the Schuylkill subwatersheds in the early 1990s ranged from over 70% forest cover in Schuylkill County and a few other isolated areas, to less than 33% in agricultural and developed sections. For more information, see **Section 5.5.1** in *Chapter 5.0 Water Quality* and the online **Reference Table 5G: Land Cover within Each Subwatershed**.

Apart from large-scale deforestation and loss of virgin and old growth forests, several other changes have occurred in the watershed flora since colonial times. American chestnuts and elms, once dominant elements in the region, have been virtually eliminated in the 20th Century due to imported pathogens. Many hemlocks are currently under attack from the woolly adelgid, another introduced pathogen, while a variety of other diseases are taking a toll on other native canopy trees in the watershed – e.g., ash yellows, anthracnose (dogwood and sycamore), beech blight, etc.

In addition, a wave of non-native (exotic) and/or invasive vegetation is sweeping the region. Invasive or non-native species are those species not naturally occurring in an area, which are quick to establish, may be adapted to highly disturbed or edge environments, and/or lack natural predators and competitors. These plant species

have the ability to invade an area and reduce natural diversity due to their competitive advantages. Eventually, the number of native species may be reduced, while the invasive species may dominate and become the only species surviving in an area. While some parts of the Schuylkill River watershed are probably remote enough that they have seen little impact, it seems likely that the more built-up area around Philadelphia is being affected due to high levels of land cover disturbance. The spreading patterns of these introduced species means that it is just a matter of time until the effects are seen watershed-wide. Some of the worst invasive species in the region are listed in **Table 3.3**.

Table 3.3 Key Invasive Species in the Mid-Atlantic Region

Vines	***Shrubs***	***Trees***	***Herbaceous***
Mile-a-minute	Autumn olive	Norway maple	Japanese knotweed
Japanese hops	Multiflora rose	Tree of heaven	Purple loosestrife
Asiatic bittersweet	*Berberis*	*Mimosa*	Japanese stilt grass
Akebia	Winged *Euonymous*	*Paulownia*	Lesser celendine
Japanese honeysuckle	Privet		Garlic mustard
Porcelainberry	Shrub honeysuckles		*Miscanthus* grasses
Buckthorn			*Pennisetum* grasses

Ecological management plans can be developed to address invasive exotic plant issues. These plans can be particularly effective if run as community-based programs, which leverage human resources to achieve the desired management outcome, while helping to educate the public about the environmental issues in the watershed. State and federal agencies are beginning to acknowledge invasive exotic plant problems in Pennsylvania. Purple loosestrife was recently listed as one of a handful of "Noxious Weeds" by Pennsylvania's USDA office, which listed only agricultural weeds until the past few years. Additional literature is being disseminated to educate the public about the invasive plant issue (PA DCNR 2000), and a web search on "invasive" reveals numerous web sites to search for further information. A good summary can be found at http://www.nps.gov/plants/alien.

There are also imbalances in the watershed's fauna. Most notable is the overabundance of white-tailed deer in the southern portion of the watershed. Before colonial times, it is estimated that the natural deer density was between 8-15 deer per square mile (Natural Resource Consultants, Inc. 1996). Now it is typical for deer populations around suburban Philadelphia to be as high as 25-50 per square mile. Such high deer densities cause unsustainable conditions to develop, particularly in forested natural areas, as native vegetation seedlings are browsed so much that new plants cannot replace the older plants. This high pressure of deer browsing changes the nature of the forest vegetation layers. Since most of the browsing is focused on the herbaceous and shrub layers, a more open zone develops than would normally exist in the forest structure. This in turn reduces the food and cover opportunities for many other animals such as birds, amphibians, reptiles and small mammal species.

Other ecological imbalances are being determined, such as the Asian longhorn beetle and Asiatic earthworm and their impacts on forest soils and ecosystems (Dunmore 2000). The effects of the gypsy moth, another introduced animal, on forest resources in the region are well documented, and management programs have been put in place.

Much more is known about the Commonwealth's terrestrial resources than its aquatic resources, but there are indications that the aquatic resources are more threatened (PA Fish and Boat Commission 1995). At the same time, the U.S. has some of the most diverse aquatic resources in the world, many of which are now known or

assumed to be under threat of extinction. “Inhabitants of freshwater ecosystems have, as a whole, suffered far more than plants and animals dependent on upland habitats such as forests and prairies” (The Nature Conservancy 1998). One of the major issues with aquatic resources is the need to conduct a thorough biological inventory to assess species presence, absence and population trends.

Many of these imbalances in fauna and flora, both terrestrial and aquatic, need to be better documented and addressed in the watershed if we are to achieve a sustainable landscape. Ecological Land Management Plans can be developed to address some of the invasive exotic and species imbalance issues. For further discussion about such plans and how they can be developed and implemented in the Schuylkill River watershed, please see **Section 6.8**, Recommendations **R6.14 and R6.15** in *Chapter 6.0 Promoting a Sustainable Landscape*.

3.6 Watershed Conservation Projects

A brief synopsis of a selection of conservation projects in the Schuylkill River watershed that the planning team is currently aware of is provided below for the convenience of the user. These lists also serve to provide general background and reference for this Plan. Summaries of other conservation plans are provided below by category:

- River Conservation Plans
- Other Current Watershed Plans
- Environmental Education Projects

Please note that acquiring and maintaining these project descriptions in a completely up-to-date status is virtually impossible within the context of this report due to the size of the watershed. The PA DCNR Rivers website (http://www.dcnr.state.pa.us/rivers) houses updated information regarding status of the Rivers Conservation Plans and should be checked regularly for current information. However, there is no single existing repository that houses information on all the other numerous conservation and education projects underway in the watershed.

Clearly, the burden of maintaining this list in a complete and updated format serves to illustrate the need to coordinate conservation and planning activities in the Schuylkill River watershed. The magnitude of this task will require on-going dedicated resources and is one of the key activities that should be undertaken in the future as part of a watershed-wide clearinghouse (see Recommendation **R7.11** in **Section 7.5** of *Chapter 7.0 Institutional Assessment*).

3.6.1 River Conservation Plans

River Conservation Plans (RCPs) aim to develop comprehensive plans for managing watershed resources. These RCPs typically identify significant natural, recreational and cultural resources, as well as issues, concerns and threats to river resources. These plans also may develop recommendations on how to conserve, enhance and restore Pennsylvania’s many streams and rivers. A full outline of a typical RCP and many other details about the program can be found at PA DCNR’s Rivers website (http://www.dcnr.state.pa.us/rivers/newrconhome.htm). This website also includes maps and a brief synopsis of the plans approved for PA DCNR funding that are either underway or have been completed in the Commonwealth. The website is one of the best places to obtain up-to-date information on the status of watershed planning projects in the Commonwealth and within the Schuylkill River watershed.

Of the plans completed to date, most address watershed characteristics, at least on a basic level, as well as biological, water, land and cultural resources. RCPs also document issues of concern in the watershed as evidenced through public meetings and/or literature reviews. However, it should be noted that these plans often have different areas of focus by geography and/or by subject matter. Some, such as the French and Pickering Creeks Plan, focus almost exclusively on surface water resources, while others, such as the Wissahickon Plan, focus more on ecological land management and restoration. Depending on the scale of the plan's assessment, components typically receiving less attention include reviews of zoning and ordinances, land ownership and other site-specific information such as the precise location, size, condition and/or value of land parcels of interest or concern – such as landfills, quarries, etc. This is particularly true where an RCP covers multiple municipalities in the study area, due to the fact that each municipality likely has different zoning and ordinances and because site-specific data is generally unavailable at the municipal level, and only occasionally available in geographic information systems (GIS) format at the County level.

Once a plan has been completed and approved for listing on the Rivers Registry, river support groups and municipalities within these watersheds can apply for future grant funding from PA DCNR and other agencies (e.g., PA Department of Environmental Protection or PA DEP) to conduct implementation and development projects based on the recommendations of the RCP. The registry is used to promote river conservation and to recognize rivers or river segments in communities who have completed RCPs. The Registry is also an avenue to endorse local initiatives by binding them together in a statewide recognition program. In order for a river to be placed on the Registry, it must have an approved plan and local municipal support.

As of January 2001, three of the nineteen rivers listed on the Registry were located in the Schuylkill River watershed.

- Tulpehocken and Cacoosing Creek corridors
- French and Pickering Creeks watersheds
- Wissahickon Creek watershed

Ten other plans in the Schuylkill River watershed were underway as of January 2001, including this plan, for the following subwatersheds.

- Manatawny Creek
- Pigeon Creek and Stony Run
- Sandy Run
- Tulpehocken Creek Watershed
- Maiden Creek
- Chester Countywide Plan
- Upper and Lower Perkiomen Watersheds
- Hay Creek
- Unami Creek
- Schuylkill River watershed

A brief overview of each of these RCPs is provided below, together with additional plan information known about the subwatershed. The PA DCNR website provides a project summary and the name of each project grantee and their contact information for additional information.

- **Maiden Creek (Upper and Lower Maiden Creek, Ontelaunee/Kistler and Sacony Creek)**

A RCP grant was awarded to Berks County Conservancy for work on the Maiden Creek in 1997. Work is still in progress. Pennsylvania State University (PSU) worked with Berks County Conservancy on this project as a Student Technical Experience in Problem-Solving (STEPS) agreement. The project report, *Maiden Creek*

Watershed: Keystone Project 1990-2000, compiles data about the watershed characteristics, land resources, water and biological resources, and concludes with a discussion of issues and strategies for management.

In addition, several other reports have focused on Maiden Creek, including a *Watershed Assessment* report that was prepared in 1998 for EPA and PA DEP by The Cadmus Group, which focused on water quality issues and made recommendations to address them.

A diagnostic *Feasibility Study of Lake Ontelaunee* also was also completed by F.X. Browne, Inc. in April 1992, which looked at the entire watershed as part of the analysis. The report was prepared for the City of Reading Bureau of Water and focuses on water quality, as Lake Ontelaunee is a primary drinking water supply for the City of Reading.

- **Sustainable Watershed Management Program for the French and Pickering Creeks, Pigeon Creek and Stony Run (Schuylkill River 3)**

The preliminary sustainable watershed management plans for these subwatersheds were issued in January 1997 for the French and Pickering Creeks, and August 1998 for Pigeon Creek, Stony Run, and a portion of the Schuylkill River. The *Vision Program for Sustainable Watershed Management*, which covers all these subwatersheds, was issued in the spring of 2000 by the Green Valleys Association with assistance by Cahill Associates and Brandywine Conservancy. A companion Technical Report has been published and distributed.

The *Sustainable Watershed Management Program* was developed for the communities of northern Chester County but the goals are sufficiently broad to be applicable and appropriate for all sub-basins within the Schuylkill River Watershed and beyond. The goals of the program are to sustain the quality and quantity of ground and surface waters, maintain natural stream conditions, and prevent groundwater and surface water contamination.

The vision report notes that the natural water system is sustained where: the flow regimes of the stream have not been significantly altered; worsened flooding has not been created; drying up of streams during drought has not occurred; the water table is maintained to support wells, natural springs, and wetlands; water quality is preserved to support aquatic communities and fisheries; and, where drinking water sources are protected for downstream communities.

This program is being implemented by townships through the adoption of a model stormwater ordinance, the updating of zoning ordinances and the updating of comprehensive plans. In the near future, multi-municipal Integrated Resource Plans for these subwatersheds will be presented to the Delaware River Basin Commission in anticipation that these plans will be incorporated into the Commission's Compact.

- **Wissahickon Creek**

A final report the *Wissahickon Creek River Conservation Plan* was released in December 1999. It was prepared for the Fairmount Park Commission, City of Philadelphia, and Montgomery County Planning Commission by the Delta Group and others. Major plan components include: analyses of natural and cultural factors; restoration goals and strategies; a listing of organizations involved in restoration and best management practices; an inventory of restoration implementation tools; subwatershed planning, projects, and costs; and watershed-wide management alternatives.

The 64 square mile watershed was broken down into 28 subwatersheds. However, specific recommendations were developed for only three of these: the headwaters, Trewellyn Creek, and Cresheim Creek. Watershed-wide management alternatives also were presented including planning, coordination tasks and policy

implementation recommendations.

- **Sandy Run Creek**

The *Preliminary Findings Report for the Sandy Run Creek Watershed Conservation Plan* was prepared by Gaadt Perspectives for the Montgomery County Planning Commission in November 1999. The findings report includes detailed management strategies and actions including greenways, open space outside greenways, pedestrian and bicycle paths and corridors, water resources management, public information and outreach, and funding and administration.

- **Chester County Water Resources Management Plan**

This plan is being created through a partnership of the Chester County Water Resources Authority, Camp, Dresser & McKee, and Gaadt Perspectives. The plan will complement Chester County's Landscapes Plan. The first component of the *Water Resources Management Plan* is essentially a River Conservation Plan for the Chester County. The second component is an RCP for the Brandywine Creek. The plan is in draft format and is being reviewed for completeness. It is expected that the plan will be finalized by spring of 2001.

- **Upper Perkiomen Creek**

The *Preliminary Findings Report for the Upper Perkiomen Creek Conservation Plan* was prepared by Natural Lands Trust and the Pennsylvania Environmental Council for the Upper Perkiomen Watershed Coalition in February 2000. The report addresses six primary subjects: water quality; water quantity; land stewardship; environmental education; public parks, trails, and recreation; and institutional issues.

The report notes that the water quality of the Upper Perkiomen Creek and its tributaries is reasonably good, although there may be some agricultural impacts. The intent of the plan is not so much to restore these creeks as to ensure that they are not degraded. The draft conservation plan is scheduled for completion in fall of 2001.

- **Lower Perkiomen Creek**

A grant to prepare the *Lower Perkiomen Creek River Conservation Plan* was received by the Perkiomen Watershed Conservancy in April 2000. Work is underway.

- **Hay Creek**

A grant to prepare the *Hay Creek River Conservation Plan* was received by Berks County Conservancy in April 2000. Work is underway.

- **Unami Creek**

A *Preliminary Landscape Conservation Plan* is being prepared for part of the Unami Creek watershed by Natural Lands Trust. The project is funded by The William Penn Foundation and is due for completion in 2001. It will focus on assessing the biological resources in the Malborough/Salford Township area of the lower watershed. A second phase of this project, funded by a PA DCNR planning grant, is due for completion in 2002. In addition, Milford Township is in receipt of a PA DEP Growing Greener grant as of summer 2000, to develop a watershed protection plan for the creek, with work underway by F.X. Browne, Inc. Note that the Unami Creek also is within the Upper Perkiomen watershed.

- **Tulpehocken Creek**

A PA DCNR-funded River Conservation Plan is currently being developed for the Tulpehocken Creek and is expected to be completed by spring of 2001. In addition, the following reports have been completed within the

watershed with funding from various government agencies.

- *Forest Resources Report*, USDA Forest Service, November 1996
- *Fish & Wildlife Resources*, USFWS, April 1997
- *Final Watershed Protection Plan and Environmental Assessment*, USDA NRCS & Forest Service, November 1997
- *Tulphehocken Creek Scenic River Study*, Berks County Conservancy (undated)
- *A Qualitative Analysis of Tulpehocken Creek and its Tributaries*, Berks County Conservancy, August 1996

- **Manatawny Creek**

This RCP focuses on integration of growth management concerns with the preservation of agricultural, natural and historic resources, requiring cooperation between two County governments (Berks and Montgomery) as well as sixteen municipalities. The grant was awarded in April 1997 to Berks County Conservancy, and the plan is due for completion and draft review shortly.

3.6.2 Other Current Watershed Projects

Numerous other land use studies and projects are underway in the watershed. The following is not intended to be a complete listing of all projects, but rather an indication of the types of projects that are being undertaken.

- *Schuylkill River Source Water Assessment*. The 1996 Safe Drinking Water Act reauthorization requires states to conduct source water assessments (SWAs) for every community water supply. These assessments will identify significant potential sources of pollution and look at raw water quality at each facility intake. They are not assessments of final water compliance by the water supplier, but instead are meant to provide suppliers and consumers with information about the sources of their drinking water supply.

  Approximately 14,000 drinking water sources in Pennsylvania will be assessed. PA DEP is coordinating this effort statewide. In the Schuylkill River watershed, the Philadelphia Water Department (PWD), Philadelphia Suburban Water Company (PSWC) and Pennsylvania American Water Company have drinking water intakes that together serve more than 1.5 million people. These suppliers have teamed up to perform a joint SWA that will cover the entire Schuylkill River watershed. The plan is now underway, and the first public meeting was held on October 25, 2000.

- *Schuylkill River Valley National Heritage Area*. In September 1999, the Schuylkill River Valley National Heritage Area Act (S. 1584), was introduced in the U.S. Senate by Senator Rick Santorum. The bill was enacted in September 2000 and became Public Law 106-278 on October 6, 2000, designating the Schuylkill River Valley a National Heritage Area. This Act, which names the geographic boundaries as "those portions of Schuylkill, Berks, Chester, Montgomery and Philadelphia that are in the Schuylkill River Watershed," recognizes the national significance of the contribution of the Schuylkill River Valley to the nation's political, cultural and industrial development. The purpose of the Act is to enable local communities to conserve their heritage while continuing to pursue economic opportunities, and to conserve, interpret and develop the natural, historical, cultural and recreational resources related to the industrial and cultural heritage of the area. The Act provides for cooperative projects with other National Heritage Areas in the anthracite coal region and requires development of a Management Action Plan within three years of authorization. An update of the Schuylkill River Heritage Corridor plan is declared to be sufficient to meet this requirement. The act also authorizes the appropriation of up to $1 million per year, with a maximum of $10 million total. It names the Schuylkill River Greenway Association as the

management entity.

- *Schuylkill Watershed Indicators Report*. The Conservation Fund, in partnership with 25 key nonprofit organizations within the watershed, is developing the first Indicators Report for the Schuylkill River watershed. This indicators report will create an important baseline from which future reports can measure progress and trends, as well as draw attention to the environmental, historical, and educational resources within the watershed. In addition, it will foster coordination among the various groups working within the watershed and highlight the activities of participating nonprofit organizations. The report will address multiple watershed issues including water quality, water supply, biological health, greenway development, educational activities, and land use patterns, etc. Anticipated completion is July 2001.

- *Blue Marsh PL566 Implementation Project*. The Lebanon and Berks County Conservation Districts are currently performing the Blue Marsh PL566 Implementation Project. This project involves the dedication of a nutrient management technician to make contact with farmers for the installation of Best Management Practices (BMPs), in order to reduce sediment and nutrient loading in the watershed. Since 1998, $5.9 million in federal grants have been allocated to reduce nutrients and sediments over the next 10 years in the watershed.

- *Schuylkill Riparian Restoration* is being performed by the Schuylkill Riverkeeper in partnership with the Acedemy of Natural Sciences. This project identifies streamside lands in need of restoration, selects sites for BMP installation, designs restoration plans, and involves local citizens and municipalities in installing and maintaining riparian BMPs. 10 miles of degraded streambanks are being restored to reduce sedimentation and pollution in the Schuylkill River and its tributaries.

- The Delaware Estuary Program completed a management plan for the Delaware Estuary in 1996 titled *The Delaware Estuary - Discover its Secrets: A Management Plan for the Delaware Estuary*. This report covers the entire lower Delaware watershed, of which the Schuylkill River watershed is a significant part. Although focusing principally on the estuary, this report is an excellent source of watershed data, technical guidance, and public outreach. Specific actions to address problems in the Delaware Estuary (many of which apply to the Schuylkill River watershed) are presented, covering land management, water use management, habitat and living resources, toxics, education, monitoring, and regional information management.

- *Stoltzfus Farm Streambank Restoration & Sediment Reduction on Limekiln Creek*. Berks County Conservancy has received a Growing Greener Grant to create cattle crossings and access areas as well as to put up streambank fencing along a stretch of the Limekiln Creek.

- *Upper Schuylkill River Watershed Tributary Area Assessment*. The Eastern Pennsylvania Coalition for Abandoned Mine Reclamation currently is working on the Upper Schuylkill River Watershed Tributary Area Assessment in conjunction with the Schuylkill Headwaters Association, the Schuylkill Conservation District, and the Schuylkill Riverkeeper. This assessment, completed in October 2000, located and prioritized mine drainage sites for future remediation and restoration projects. Funding for this assessment was provided by 319 grant funds.

- The Delaware River Basin Commission (DRBC) published its report *Flowing Towards the Future - 21st Century Visions and Directions for the Delaware River and its Watershed* in September 1999. The report was based on input from public meetings held in April and May of 1999. This plan presented five visions for the watershed: an Ecological Vision (habitat and clean environment characterizations); a Water Supply Vision (ample, high quality, and controlled water supply); a Viable, Pleasing Places Vision (human quality

of life); a Vibrant Economy Vision (blending economic and environmental goals); and a Stewardship Vision (personal responsibilities). The report also proposed directions and recommendations for achieving these visions.

- *Upper Schuylkill River Watershed Protection Plan*. The Berks County Conservancy currently is assessing the Upper Schuylkill River watershed from Reading north to the Berks and Schuylkill County line in order to develop a protection and restoration plan.

- *Water Quality Assessment*. The Stroud Water Research Center is complementing the DEP program by conducting a five-year water quality study of aquatic macroinvertebrates at 19 sites throughout the Schuylkill River watershed.

- *Orphan Dam Removal – Manatawny Creek*. The greater Pottstown Watershed Alliance has received funding to remove an orphan dam from Manatawny Creek. The project is part of an initiative to restore the upstream riparian corridor and meet the larger Pennsylvania goal of resolving watershed problems and issues well beyond the life of the grant.

- *Montgomery County Greenway Stewardship Study* is being prepared by the Montgomery County Planning Department. This plan envisions the creation of a greenway along the Schuylkill for the entire county border along the river. A draft of the study was released for public comment and is expected to be adopted in 2001.

- *Schuylkill River Trail* being developed by the Schuylkill River Greenway Association (SRGA) will connect Philadelphia to the headwaters in Schuylkill County while also increasing public access along its route. The Borough of Phoenixville has received a Pennsylvania Heritage Grant for the design of the trail along the south bank of French Creek. Chester and Montgomery Counties have received funding for construction of 19.5 miles of the trail in their respective counties.

- SRGA, the Pennsylvania Fish and Boat Commission and others are developing a Schuylkill River Water Trail to complement other efforts to connect river communities and increase public access to river recreation.

- The *Botanic Trail*, a component of the Schuylkill River Trail, is being developed by the John Bartram Association. The trail will be placed along the west bank of the lower Schuylkill River.

- An abandoned coal-desilting basin is being converted into a *wetland for migratory birds* with a mile long interpretive trail around its perimeter. This is being developed by the Chester County Department of Parks and Recreation.

- *Wissahickon Creek* multi-purpose trail and riparian restoration project is being planned by the Morris Arboretum of the University of Pennsylvania.

- *Hawk Mountain Sanctuary biological inventory* is ongoing, in conjunction with a land management plan to preserve its view shed and open space on adjacent properties.

- *Spring Mountain wildlife habitat protection plan* is being performed by The Perkiomen Watershed Conservancy and other partners.

- *The Schuylkill River Park* is being developed by the Schuylkill River Development Council along the

lower Schuylkill River to promote recreation and draw people to Center City. Also, the *Tidal Schuylkill Master Plan* being undertaken by the Council with funding by PA DCNR will examine conservation planning and revitalization of the riverfront along the tidal portion of the Schuylkill River in Philadelphia.

- Fairmount Park Natural Lands Restoration and Environmental Education Program (NLREEP) is developing plans for *environmental education facilities and programs*, as well as natural area inventories and focused plans for ecological restoration projects throughout six parks in the Fairmount system, including Wissahickon and East and West Park. Final restoration plans are due in 2002.

- *Ryerss Farm Streambank Fencing and Restoration* project is being conducted by the Green Valleys Association. This project provides a riparian buffer and streambank fencing along a 300-foot stretch of Rock Run, a tributary of French Creek.

- *Brights Lane Detention Basin Retrofit Demonstration Project* is being performed by Lower Gwynedd Township. This project is reconstructing a historic detention basin, constructed before consideration was given to pollution removal, in order to better treat the first flush of stormwater.

- *French Creek Scenic Restoration Project* is being conducted by the Green Valleys Association in East Vincent Township, Chester County. This reclamation project involves the demolition of an abandoned slaughterhouse on the banks of French Creek and the replanting of the one-acre site with native plants.

- *Montgomery County Brownfields Project* focuses on redevelopment opportunities at brownfields and old industrial sites primarily along the Schuylkill River.

- *Manayunk Canal restoration* by the Manayunk Development Corporation is restoring the historic Manayunk Canal while promoting environmental stewardship and conserving open space on Venice Island.

- *Phoenixville Redevelopment* is being performed by the Phoenixville Area Economic Development Corporation. This project is renovating a historic, abandoned iron foundry with shops and environmental interpretation. It will also include a link to the Schuylkill River Trail.

- *The Schuylkill Canal restoration* at Mont Clare is being developed by the Schuylkill Canal Association.

- *Valley Creek restoration* activities are taking place through the Valley Forge National Historical Park.

- *The Fairmount Water Works* is being remodeled into an interpretive center by the Fund for the Fairmount Water Works and the Philadelphia Water Department (PWD). The Philadelphia Water Department has begun construction of the Fairmount Water Works Interpretive Center on the river level of this historic landmark. The Interpretive Center will be the environmental education forum for the Philadelphia Water Department on urban, regional, and national water resources and management issues. Programs and exhibits will use the history and technology of the site and the science resources of the Philadelphia Water Department and many area partners to promote the benefits of environmental stewardship to visitors.

3.6.3 Environmental Education Projects

Finally, there are also numerous education efforts ongoing in the Schuylkill River watershed, including the following programs and projects.

- *Schuylkill River Greenway Association* is developing marketing materials to promote the historic, cultural, recreational, and natural resources of the Schuylkill River watershed.

- *Perkiomen Watershed Conservancy* is conducting environmental education programs for all ages, along with public outreach to municipal officials, developers, and other business stakeholders.

- *Peopling of Philadelphia Collaborative, Inc.* is a collaboration of community, school, and business partners creating innovative school curricula to teach environmental science and local history unique to the watershed.

- *Riverbend Environmental Education Center* is restoring its original 1923 Sears Roebuck barn into a state of the art environmental education facility for its 7,000+ annual visitors.

- *Stroud Water Research Center* teaches cutting edge environmental science curricula to teachers and trains volunteer water quality monitors.

- *Schuylkill Center for Environmental Education* provides on-site environmental education to groups and individuals. It also conducts educational outreach off-site to groups in addition to monitoring water quality.

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4.0 IDENTIFICATION OF MAJOR WATERSHED ISSUES

4.1 Introduction

This chapter highlights key watershed issues raised through the public participation process and a review of published literature addressing the Schuylkill River watershed. It is not intended as a definitive discussion of all the issues affecting the watershed. Rather, it is intended to provide a context for the subsequent chapters, and to inform the reader of some of the key public concerns in the watershed.

This chapter begins with a description of the public outreach strategy, and continues with a discussion of issues identified by the watershed public. These issues are discussed in the context of previous watershed studies and literature reviewed in preparation for the development of this Plan.

4.2 Public Outreach Strategy

The public outreach strategy for the Schuylkill Watershed Conservation Plan included:

- A public opinion poll of watershed residents to assess general environmental awareness and watershed issues of concern;
- Three rounds of public meetings, each held at several locations in the watershed, to gather public input on watershed issues, on the draft Plan and recommendations, and on potential implementation projects to be listed in the final Plan;
- The incorporation of expert knowledge and stakeholder participation through a Technical Advisory Committee and literature research; and,
- Creation of the Schuylkill Watershed Conservation Plan website (http://www.schuylkillplan.org) to provide background on the project goals and partners, and serve as the primary distribution mechanism for the draft and final Plan, and all supporting reference maps and documents.

Methods used to identify critical environmental and institutional issues affecting the Schuylkill River watershed are discussed in the following sections.

4.2.1 Public Opinion Poll

In July 1997, a public opinion poll was conducted by the Global Strategy Group, Inc., for The Conservation Fund, to assess the general public's environmental awareness and gather input as to the perceived issues and problems in the watershed. The poll was based on a random sample of 800 adults throughout the seven counties in the Schuylkill River watershed. The number of interviews conducted in each county was directly proportional to the percentage of the total watershed population residing within that county. All data was weighted back to proper proportions of the population such that the overall margin of error was plus or minus 3.5%. Results of the poll are referenced periodically throughout this chapter, and are posted online at http://www.schuylkillplan.org. **Table 4.1** summarizes the results of the public opinion poll.

Table 4.1 Summary of Public Opinion Poll Results

Environmental Education

- 88% support increased public funding for environmental education programs
- 86% said there should be more environmental education programs for adults and children
- 43% said their local high school should be responsible for providing environmental education programs

Recreational Opportunities

- 93% support the development of walking trails and bicycle paths by their county or municipality
- 87% support an increase in public funding for the development of trails and pathways

Water Quality

- 66% said there currently is not enough being done to protect their community's water quality
- 93% would support county or municipal requirements that developers set aside greenspace buffers along local rivers and streams
- 93% support an increase in public funding to improve their local water quality
- 93% support increased public funding for the restoration of degraded rivers and streams

Landscape and Land Use

- 88% said land conservation should keep pace with land development
- 84% said there are economic benefits to preserving open space
- 82% said they would pay more for a home if parks and/or natural areas were nearby
- 90% said they support the purchase of land for parks and natural areas by their county or municipality as a way to improve their environment
- 86% support an increase in government efforts to mitigate sprawl and over-development
- 91% support an increase in public funding for open space and natural areas protection

Environmental and water resource issues were not always the most important issues facing watershed residents. In Philadelphia County, for example, nearly half of the respondents identified crime and drugs as the most important public issues. Schuylkill County residents identified the economy as the most important issue, though this was closely followed by air and water pollution. Over-development and sprawl were noted as the most important issues in Montgomery and Bucks Counties.

4.2.2 Public Meetings

A series of three public meetings were held as part of this project's outreach strategy, to solicit public input into the watershed conservation planning process. Comments received at these meetings are referenced throughout this chapter, and were integrated into the Plan where appropriate. Public comments from these meetings have been compiled and are posted by the date of the meeting on the Schuylkill Watershed Conservation Plan website at http://www.schuylkillplan.org.

In the first round of public meetings, four workshops were held across the watershed during the summer of 1999. Each of these workshops was identical in format with a presentation by the project partners followed by a public comment period. These initial meetings focused on gathering input from watershed stakeholders about important issues in the watershed that could be noted or addressed as part of this Plan.

- The first workshop for Montgomery, Chester, and Bucks Counties was held in the evening of June 14th at the Upper Providence Township Municipal Building in Montgomery County. Comments were solicited from three breakout groups facilitated by the Pennsylvania Environmental Council. Approximately 25 people attended this meeting.

- The second workshop for Schuylkill and Carbon Counties was held the evening of June 17th at the Schuylkill County Agricultural Hall in Schuylkill County. Comments from the 29 attendees were solicited from two breakout groups facilitated by the Schuylkill River Greenway Association.

- The third workshop for Berks, Lehigh, and Lebanon Counties was held the evening of June 28th at the Berks County Agricultural Hall in Berks County. Comments were solicited from three breakout groups facilitated by the Berks County Conservancy. 35 people were in attendance at this meeting.

- The fourth workshop was held for Philadelphia County during the afternoon of August 10th at the Philadelphia Library. The Pennsylvania Environmental Council solicited comments from the attendees in a single group.

A second public meeting series was held in September 2000 to receive public comment on the key findings and recommendations from the draft Schuylkill Watershed Conservation Plan. Meetings were conducted at the same locations as before, and included a one-hour presentation by the project partners, followed by two rounds of simultaneous breakout sessions addressing the three major issue areas: institutional capacity, water quality, and landscape sustainability.

- The workshop for Montgomery, Chester, and Bucks Counties was held the evening of September 26th at the Upper Providence Township Municipal Building in Montgomery County. Comments were solicited from three breakout groups with assistance from the Pennsylvania Environmental Council. 35 people attended this meeting.
- The workshop for Schuylkill and Carbon Counties was held the evening of September 19th at the Schuylkill County Agricultural Hall in Schuylkill County. Comments from the attendees were solicited from three breakout groups with assistance from the Schuylkill River Greenway Association.
- The third workshop for Berks, Lehigh, and Lebanon Counties was held the evening of September 20th at the Berks County Agricultural Hall in Berks County. Comments were solicited from three breakout groups with assistance from the Berks County Conservancy. 25 people were in attendance at this meeting.

- The fourth workshop was held for Philadelphia County during the afternoon of September 27th at the Philadelphia Library. Comments were solicited from the 12 attendees in a single group with assistance from the Pennsylvania Environmental Council.

The third and final round of public meetings was held in March 2001. The goal of these meetings was to review the major recommendations of the draft Plan, and to gather input on potential implementation projects that watershed stakeholders would like to be included in the final Plan. Based on previous attendance, Montgomery, Chester and Bucks Counties were combined with Philadelphia County into a single workshop, held in Conshohocken. Potential implementation projects identified during these meetings, and those submitted separately by watershed municipalities and organizations, were compiled and are listed in the corresponding online Reference Document **Potential Implementation Projects**.

- The workshop for Montgomery, Chester, Bucks and Philadelphia Counties was held the evening of March 20th at the Department of Environmental Protection's Southeastern Office in Conshohocken. Input from the attendees was solicited with assistance from the Pennsylvania Environmental Council.
- The workshop for Schuylkill and Carbon Counties was held the evening of March 28th at the Schuylkill County Agricultural Hall in Schuylkill County. Input from the 9 attendees was solicited with assistance from the Schuylkill River Greenway Association.
- The third workshop for Berks, Lehigh, and Lebanon Counties was held the evening of March 27th at the Berks County Agricultural Hall in Berks County. Input was solicited from the 10 attendees with assistance from the Berks County Conservancy.

4.2.3 Research and Expert Sources

Numerous reports and other documentation on water quality, land use and institutional issues in the watershed were reviewed. These included reports from: federal agencies such as the U.S. Environmental Protection Agency (US EPA) and the U.S. Army Corps of Engineers (US ACE); state agencies including the Pennsylvania Department of Environmental Protection (PA DEP) and the Penn State Environmental Resources Research Institute; and nonprofit organizations such as the Schuylkill Riverkeeper and the Schuylkill River Greenway Association. These reports and documents are included in **Section 4.4 References** below.

In addition to this research, new analyses were performed specifically for this Plan including GIS (geographic information system) based analysis of geographic or programmatic institutional gaps, landscape-level sustainability, and data analysis and water quality modeling.

A Schuylkill Watershed Conservation Plan Technical Advisory Committee (TAC) was assembled and met six times: September 1998; May 1999; December 1999; May 2000; October 2000; and finally April 2001. The purpose of the TAC was to provide expert input and review during the drafting of the Plan. The TAC did not identify new issues, but rather assisted in how these issues were categorized, presented, and addressed in the Plan. The draft Plan was presented to the TAC at the meeting in October 2000 with comments accepted by them through January 2001. At the April 2001 meeting the project partners presented to the TAC a summary of public comments on the draft Plan, as well as how these and the TAC comments would be addressed in the final Plan.

Government agency representatives on the TAC included the U.S. Environmental Protection Agency, National Park Service, U.S. Army Corps of Engineers, Natural Resources Conservation Service, Delaware River Basin Commission, Delaware Valley Regional Planning Commission, Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Department of Environmental

Protection, and a number of representatives from each of the counties in the watershed. Nonprofit representatives included the Montgomery County Lands Trust, Berks County Conservancy, Hawk Mountain Sanctuary, Perkiomen Watershed Conservancy, Pennsylvania Environmental Council, Schuylkill River Greenway Association, and Schuylkill Riverkeeper. Finally, industry representatives on the TAC included the Philadelphia Water Department, Philadelphia Suburban Water Company, GPU Energy, and Berks County Homebuilders Association. A full list of the TAC members is available in the **Acknowledgements** to this Plan as well as on the project website at http://www.schuylkillplan.org/.

4.3 Issues Identification

The issues identified through the public outreach strategy described above, including the public opinion poll, the public meetings and the TAC meetings, have been grouped into several categories for further discussion. Each of these issue areas is described in greater detail below.

- Environmental Education and Outreach Resources
- Recreational and Scenic Resources
- Cultural and Historic Resources
- Water Resources
- Landscape and Land Use Resources
- Institutional Resources

4.3.1 Environmental Education and Outreach Resources

The need for environmental education was expressed at the public meetings throughout the watershed. At the Philadelphia meeting, Philadelphia Water Department noted the need for public education regarding pollution prevention and storm water runoff. The Schuylkill Center for Environmental Education noted the need for common access to watershed information, more focus on regional impacts, bringing together municipal governments, educating institutional landowners, and stressing the economic value of watershed natural resources to city leaders. The Manayunk Development Corporation noted the need for environmental education that reconnects people to water resources in the Schuylkill River watershed.

Roughly one-third of the public opinion poll respondents correctly named the Schuylkill River watershed as the watershed in which they lived. Another third identified their watershed as the Delaware River while the remaining third were not able to name their watershed of residence. 28% of poll respondents thought that the state government should take lead responsibility for protecting and improving the natural resources of the Schuylkill River.

The *Management Action Plan for the Schuylkill River Heritage Corridor* (March 1995) prepared by the Schuylkill River Greenway Association noted the importance of incorporating environmental education and studies of the Schuylkill Corridor into school curricula from kindergarten through college. The plan adopted the slogan “The Corridor is our Classroom” to focus education efforts towards regionalism.

The manner in which the Schuylkill River watershed demonstrates the mingling of natural processes and cultural influences makes it an ideal candidate for use in environmental education. The diversity of animals that use its woodlands and live in its waterways are indicators of health that can be measured by students and citizen volunteers. Investigating the differences in a stream’s water quality and hydrology after it has flowed through a forest, versus downstream of a construction site, may help to demonstrate the

effect of land clearing. The differences in geometry of a stream channel in a pasture as compared to a channel in a forest may tell a story of the effects of agriculture on stream hydrology.

These are just a few examples of topics that can be developed to address three areas of need for environmental education and outreach: school curriculums; programs for municipal officials and nonprofit staff; and citizen programs. These areas of outreach obviously are related: students will grow into voting citizens who, when knowledgeable about the importance of protecting aquatic environments, will elect officials that understand these concerns. A well-developed education and outreach strategy should focus on developing an integrated program that can be incorporated into the regular operations of school systems, municipalities, and conservation organizations.

4.3.2 Recreational and Scenic Resources

Public perception about water quality and public access in the Schuylkill River watershed affect the recreational use of its resources. The public opinion poll found that nearly half of the watershed's residents felt they have a "great deal" of access to public open spaces, rivers, and lakes for recreation, but only 5% "frequently" use these areas for recreation. Yet, about half of the respondents do not think there are enough open spaces in the watershed. Additionally, just over half of the respondents do not think their local rivers and streams are safe enough to swim or wade in.

In addition to these public opinions about the watershed's recreational resources, assuring a high level of recreational opportunities and access was a high priority in Montgomery County and the lower portion of Berks County. This issue was not raised at the other public meetings.

Data obtained for the *Lower Schuylkill River Water Quality Assessment* prepared by US EPA Region III (August 1995) indicated that, except for copper residues, the lower Schuylkill River should be considered fully supporting of fishable use.

The Schuylkill River is part of the Pennsylvania Scenic Rivers System. Specific segments identified in this System, their lengths and scenic classifications are as follows (**Table 4.2**).

Table 4.2 Scenic Rivers Segments in the Schuylkill River Watershed

Stream Segment	***Length (miles)***	***Scenic Classification***
Port Clinton (Forks) to Cross Keys (Bridge)	16.2	Recreational
Cross Keys (Bridge) to Reading (Route 422)	12.3	Modified Recreational
Reading (Route 422) to Douglasville (Bridge)	15.3	Recreational
Douglasville (Bridge) to Fairmount Dam	49.8	Modified Recreational
Route 209 (Highway) to Cressona Route 183 (Bridge)	5.0	Recreational
Cressona Route 183 (Bridge) to Auburn Basin (Spillway)	9.6	Modified Recreational
Auburn Basin (Spillway) to Port Clinton (Forks)	7.4	Recreational
Port Clinton (Forks) to New Ringgold Route 895 (Bridge)	10.9	Pastoral

"Recreational" waterways are readily accessible, may have some development along their shorelines, and may have undergone some impoundment or diversion in the past. "Modified Recreational" waterways may have their flow regulated by control structures upstream. "Pastoral" waterways are free-flowing except for historic or restored mill dams that are capable of or under restoration to support water-based

recreation, fish, and aquatic life. The view from the river or its banks must be predominantly pastoral or farming countryside to qualify for this classification.

Commonwealth policy is to protect and enhance those river segments representative of Pennsylvania's natural and cultural river heritage for the purposes of environmental protection, and the general recreational enjoyment and educational benefit of the public.

4.3.3 Cultural and Historic Resources

Historic structures provide a means for present-day eyes to imagine and understand the lifestyle and landscapes of previous generations. The physical remains of the past are instructional in many ways. For instance, old mills demonstrate the importance of waterpower to early settlement patterns and the beginnings of the industrial revolution. The remains of the Schuylkill River Navigation canal system provide evidence of this impressive water transportation system. Barns and other historic structures show the constantly changing styles of architectural design, as well as the influence of local topography, climate and culture. Preserving our historic and cultural legacy contributes to our sense of place and community identity. In addition, cultural, historical and environmental resources are the basis for bringing tourist revenue to the local economy.

The federal government formally recognized the importance of historic preservation with the inception of the National Register of Historic Places in 1966. The National Register is a list of buildings and districts that have been declared of national significance and therefore are afforded some protection from federal actions that might harm them. Owners of buildings on the National Register also can derive tax benefits from renovating the structures according to standards of the Department of Interior, the administrator of the National Register.

The Commonwealth of Pennsylvania, through its Historic and Museum Commission (PHMC), administers the National Register program within the state. The Pennsylvania Historic District Act 167 of 1961 allows local governments to set up historic districts where demolition, new construction, alteration, and renovation can be regulated to conserve the historic character of the district. Proposals for changes within a Historic District are reviewed by a local Historic Architectural Review Board, which advises the local governing body. Applications for PA Act 167 Historic Districts and for the National Register must be approved by PHMC.

The preservation of cultural and historic resources was widely recognized as an issue at the public meetings in most sub-regions of the watershed. A Berks County resident expressed a desire for historical sites to be integrated with a network of greenways and other environmentally valuable sites.

The 1981 *Feasibility Report of the Schuylkill River Review Study* by the Philadelphia District of the US ACE lists 46 known historical sites within the Schuylkill River watershed in Berks, Chester, Montgomery, and Schuylkill Counties. These include sites listed on the National Register, those with National Register listing pending, sites listed as a National Historic Landmark, and sites recorded by the Historic American Buildings Survey.

The most comprehensive compilation of cultural and historic resources in the watershed is found in *The Management Action Plan for The Schuylkill Heritage Corridor*, which was prepared by the Schuylkill River Greenway Association in March 1995. This plan provides a summary of cultural landscapes and historic resources, as well as recreation/open space resources and transportation resources. Nearly 250 of

these are individually located on one of five location maps. The *Management Action Plan* also discusses and defines cultural landscapes, natural and historic resources, folk life, art and artists, and education.

4.3.4 Water Resources

Results from the public opinion poll suggest that ensuring a reliable and clean source of water as the population growth and development continue is a major concern throughout the watershed. Overall, 56% of the respondents did not think their local streams and rivers were safe enough to swim and wade in. With regard to water quality, 74% of respondents strongly supported increased funding to improve water quality and 72% strongly supported funding for the restoration of degraded rivers and streams. Support for this initiative was particularly notable at the public meetings in Montgomery County.

The following sections provide a more detailed discussion of water resource issues identified based on the public opinion poll, public meetings and documentation review.

4.3.4.1 Urban/Suburban Development and Stormwater Runoff

High rates of urban/suburban development and a need for more comprehensive stormwater management were expressed as major concerns at public meetings throughout the watershed. This issue is of particular concern in the developed and rapidly developing areas of the lower watershed.

In developing watersheds, impermeable rooftops and pavement (impervious surfaces), together with storm drains that channel runoff directly to streams, cause significant changes in the hydrologic and geomorphic characteristics of the watershed. Typical hydrologic effects include increases in peak flow rates and the total volume storm runoff (Schueler 1987). To accommodate these increases, stream channels tend to erode downwards and become wider. Channel erosion can cause reduced development of pool/riffle topography that provides important habitat for aquatic organisms, and sediment eroded from banks can accumulate in the channel as sandbars and other deposits. These changes often lead to stream instability that is characterized by abrupt, episodic, and progressive changes in the location, geometry, gradient, or planform of a river/stream. Unstable channels can destroy property, damage structures, reduce water quality, diminish aquatic (and terrestrial) habitat, and degrade aesthetic quality. Non-point source pollution from urban/suburban areas also is a major concern in stormwater runoff. Because less water infiltrates into the ground when impervious cover is high, reductions in flow during dry periods also are possible. These effects of urban/suburban development impact many streams with the Schuylkill River watershed.

The Stormwater Management Act (Act 167) provides grant monies to counties for developing stormwater management plans in designated watersheds. To date, the following stormwater management plans have been completed or are currently being prepared.

Table 4.3 Stormwater Management Plans Completed or In Progress

Completed Act 167 Stormwater Management Plans

Watershed	County
Stony Creek/Sawmill Run	Montgomery
Rock Run/Gully Creek/Mill Creek	Montgomery
Sacony Creek	Berks

Act 167 Stormwater Management Plans Currently Being Prepared

Watershed	County
Sandy Run	Montgomery
Swamp Creek	Montgomery
Tulpehocken Creek	Berks
East Branch of the Perkiomen Creek	Bucks

4.3.4.2 Non-point Source Pollution

Non-point source pollution is pollution of water resources that derives from a variety of activities occurring over a large geographic area, and accumulates at intermittent intervals related mostly to rainfall or snowmelt runoff. In rural areas, the principal non-point sources are associated with agricultural activities, and the resultant polluted runoff includes sediment, nutrients, and pesticides/herbicides. In urban/suburban areas, non-point pollution sources include pet waste, garbage and litter accumulation on streets, leaking fluids from vehicles, street salting, lawn care chemicals, and construction sites. Urban non-point source pollution includes nutrients and sediment as well as toxic contaminants such as heavy metals, PCB's, oil, and gasoline (Novotny and Chesters 1981).

Non-point source pollution can be a significant water quality problem, and is now a principal focus of water quality regulation under the Clean Water Act (discussed further in *Chapter 5.0 Water Quality*). Because non-point source pollution results from a large number of activities over large areas of the landscape, regulations may affect many people throughout the watershed. Results from the public opinion poll, however, suggest that much of public is not aware of this significance of the problem. The public opinion poll found that 47% of respondents, most notably those in Philadelphia, thought that industrial (point source) pollution has the greatest impact on the quality of rivers and streams in the community. Of those respondents identified as having a high level of environmental awareness, 51% believed municipal waste is more to blame.

The report *Pennsylvania Coastal Non-point Pollution Program* (PA DEP 1995) found that water quality near the coastal zone primarily is affected by non-point source pollution from agriculture and urbanization. Also, the March 1996 draft of the report *Planning for Water Quality Monitoring and Riparian Restoration in the Schuylkill Watershed* (Delaware Riverkeeper Network) noted that non-point source related water quality issues remain a problem throughout the watershed. In the 1996 report *River for Renewal - A Look at the Restoration Potential of the Schuylkill River* (Delaware Riverkeeper Network), runoff from highways, parking lots, and industrial sites were cited as sources of toxic inputs to the river. Several studies also have been conducted by the Penn State University Environmental Resources Research Institute assessing non-point source pollution loading in the Delaware River Basin and throughout Pennsylvania (see Evans et al. 1996).

Nutrient (nitrogen and phosphorus) loading from non-point source pollution also is a major concern in the watershed. Stream nutrient concentrations are one of the principle factors regulating the health and productivity of aquatic ecosystems. Low nutrient concentrations will result in less than optimal growth of primary producers (aquatic plants, phytoplankton), and high nutrient concentrations can result in excessive rates of algae growth leading to oxygen depletion, fish kills, and other ecological impacts of eutrophication. High phosphorus loading often is associated with sediment pollution, because of the tendency of phosphorus to attach to sediments in the water column.

4.3.4.3 Channel Erosion and Sedimentation

High rates of stream channel erosion and bank sloughing associated with urban development and the disturbance of riparian forests can result in significant amounts of sediment entering streams and rivers. As with sediment derived from soil erosion from upland sources, this can be a major problem for water quality and aquatic ecosystems.

Sedimentation from non-point sources has been identified as a particular concern in the watershed. The March 1996 working draft of *Planning for Water Quality Monitoring and Riparian Restoration in the Schuylkill Watershed* (Delaware Riverkeeper Network) noted that suburban developments, mostly around Philadelphia and Reading, have disturbed the original land cover and increased sediment yields in the river. The 1996 report *River for Renewal - A Look at the Restoration Potential of the Schuylkill River* (Delaware Riverkeeper Network) also noted that sediment from non-point sources is one of the major problems facing the Schuylkill River. Numerous causes were cited including deforestation, loss of wetlands, suburbanization, and intensive agricultural practices. A study by F.X. Browne in 1992 estimated that Lake Ontalaunee in Berks County had lost approximately 25% of its volume between 1938 and 1992 due to sedimentation from non-point runoff associated with agricultural activities.

4.3.4.4 Acid Mine Drainage and Other Mining Impacts

Acid mine drainage (AMD) in the headwaters region of Schuylkill County has impacted Schuylkill River water quality for many years. This issue was identified as a major concern during public meetings in Schuylkill County. Desilting basins and controls on mining practices have reduced sediment loads in mine discharge, but acid mine drainage continues to degrade the water quality in the coal region headwaters (Delaware Riverkeeper Network, 1996b). The Pennsylvania DEP confirmed these findings in the 1995 report *Pennsylvania Coastal Non-point Pollution Program*. This report stated that the largest non-point source of pollution in the headwaters is AMD, which contributes significantly to non-attainment of water quality criteria. AMD was not mentioned as a major concern at any other public meeting, however, in spite of the cumulative effects of AMD that may impair water quality in other regions downstream.

The Schuylkill River also has been impacted by vast amounts of culm (extremely fine particles of coal) that were discharged either directly or indirectly into streams from mining operations earlier in this century. In 1927, the US ACE estimated that 38 million tons of culm had accumulated in the Schuylkill River, raising the bed of the river and altering its flood stages. In 1947, Pennsylvania and the US ACE constructed about two dozen desilting pools and modified existing dams to trap silt from flowing into the Delaware River as described in *The Schuylkill River Project Desilting Pools and Impounding Basins* (PA DER 1981). In 1951, 26 million tons of sediment were removed from the river and adjacent flood plains, and in 1954 three million cubic yards of culm were pumped from behind Fairmount Dam. However, even after these efforts coal fines remain in the river. In 1973, fines comprised as much as 50% of the dredgings at sites below the city of Reading.

4.3.4.5 Water Quality Monitoring Data

Insufficient data to identify and assess water quality problems within the watershed was noted as a major issue during public meetings in the Tulpehocken sub-region of Berks County, and the Little Schuylkill sub-region of Schuylkill County. Various watershed conservation groups also highlighted the lack of sufficient data and a lack of funding to support water quality monitoring activity. A general need was expressed for a unified system to collect and store monitoring data watershed-wide.

The report *Evaluation of NPS-Related Features within Pennsylvania's Coastal Non-point Pollution Program Management Areas* (Evans et al. 1996) reviewed available water quality data, and determined that only about half of the parameters of interest have sufficient data to support a long-term trend analysis for the Schuylkill River watershed.

4.3.4.6 Effects of Dams

There are over 280 dams in the Schuylkill River watershed (Delaware Riverkeeper Network 1996b). Most of these are low dams on tributaries. Nine major dams have created over 25 miles of slack water on the mainstem, which is roughly 25% of stream miles between Pottsville and Philadelphia. Dams can provide a number of benefits to the public, including water supply, flood control, and recreation. However, dams also can cause significant ecological impacts, including altered flow regimes and physical habitats, changes in water quality, changes in sediment transport, and changes in resident and migratory fish communities. Three major tributary impoundments, Blue Marsh Reservoir, Lake Ontelauntee, and Green Lane Reservoir, suffer from nutrient over-enrichment as a result of impounded water behind dams.

4.3.4.7 Wastewater Discharges, Non-permitted Discharges, and CSOs

Under the Clean Water Act, all municipalities or industries discharging wastewater to receiving waters must be in compliance with a National Pollution Discharge Elimination System (NPDES) permit. NPDES permits specify the amounts of pollutants that can be discharged to a receiving waterway based on the designated use of the waterway and its ability to assimilate waste. Permits also specify sampling and reporting requirements that must be followed. Water quality and associated ecological impacts still can occur at or below permitted discharge levels, however, particularly during low flow periods when little water flow is available to dilute effluent. In Pennsylvania, the DEP has jurisdiction over the implementation of the NPDES program. The 1995 report *My River is the Schuylkill* (The Academy of Natural Sciences) identified 93 NPDES permitted sewage or industrial discharge sites in the watershed.

Discharges of untreated sewage by non-permitted dischargers can be a more serious threat to water quality. In the Schuylkill River watershed, non-permitted discharges were identified as a major concern during public meetings in Berks and Schuylkill Counties. These so-called "wildcat" discharges occur principally in rural areas, and include homes and other small facilities that discharge their waste directly into adjacent streams. In addition, some small boroughs and townships have central sewage collection systems, but either no wastewater treatment facilities, or facilities that are not effective in removing pollutants.

In urban areas such Philadelphia and Reading, untreated sewage also may be discharged to streams as combined sewer overflows (CSOs). CSOs occur during runoff events when flow through sewers transporting both sanitary sewage and storm water exceed the capacity of treatment facilities, and the excess flow volume is discharged directly to a receiving stream. CSOs are regulated under the NPDES permit program.

In addition, other unintended point-source pollution may occur throughout the watershed, such as sedimentation from quarries and nutrient and chemical pollution from landfills. The report *My River is the Schuylkill* (ANS 1995) documented 32 Superfund sites in watershed, 14 in Montgomery County, seven in Berks, five in Chester, two in Schuylkill, one each in Bucks and Philadelphia Counties.

4.3.4.8 Water Supply and Flooding

Flooding in the Schuylkill River watershed occurs with some regularity in different areas, and was identified as a significant concern during public meetings in Berks County. The particularly large flood associated with Hurricane Agnes in 1972 caused the highest recorded flow rates at the Reading and Pottstown gages (90,000 cfs and 95,900 cfs, respectively), while the highest recorded flow rate at Fairmount Dam was 135,000 cfs in the flood of 1869 (flow rate was 103,000 cfs during Agnes in 1972). It was estimated by the US ACE that Hurricane Agnes caused $141 million (in 1972 dollars) in damages. In the 1990 report *Schuylkill River Basin Limited Reconnaissance Study*, the US ACE concluded that the Schuylkill River and its tributaries continue to cause significant flood damage throughout the watershed, and recommended eight local protection studies as well as a regional flood control study.

Water conservation and the protection of groundwater supplies also was a concern in Montgomery and Berks Counties. Water conservation is important wherever urban development has the potential to reduce groundwater recharge, where significant withdrawals occur, or where geologic characteristics limit groundwater supplies. Excessive pumping of groundwater from wells can lower water tables, reduce groundwater discharge to springs and streams, and in certain cases entirely de-water small streams that formerly flowed year round (Biesecker et al. 1968). Many of the power plants in the watershed consume almost 100% of the water they intake for cooling, where water is converted to steam and vented into the atmosphere. These water flow losses clearly have hydrologic and atmospheric/climatic implications for the region. In developed and developing areas, increases in impervious cover coupled together with storm drains that channel runoff direct into streams can drastically reduce groundwater recharge. Over time, this can result in significant reductions in groundwater supplies, and reduce the amount of groundwater discharged to rivers and streams during dry periods.

An assessment of groundwater resources in parts of Berks, Bucks, Chester, and all of Montgomery Counties found that groundwater withdrawals exceed or threaten to exceed the sustainable yields of local groundwater basins (DRBC 1999). Groundwater depletion in this area already has reduced flows in some streams and dried up others. These reductions in baseflow affect downstream water uses, negatively impact aquatic life, and can reduce the capacity of waterways in the region to assimilate pollutants.

To prevent the depletion of groundwater resources and to protect the rights of lawful users, the Delaware River Basin Commission (DRBC) has established a Southeastern Pennsylvania Groundwater Protected Area in parts of Berks, Bucks, Chester, and all of Montgomery Counties. To protect groundwater resources in this area, the DRBC regulations set withdrawal limits based on an assessment of the cumulative impacts of all withdrawals within groundwater basins.

In summary, considering the input received at the public meetings, the results of the public opinion poll, as well as review of the pertinent documents that address water resource issues in the region, the following topics were determined to be of major concern in the Schuylkill River watershed.

- Need for a coordinated water quality monitoring program and data
- Urban/suburban development and stormwater runoff
- Non-point source pollution from agriculture and urban sources
- Aquatic habitat quality
- Acid mine drainage (in the Schuylkill headwaters region)
- Wastewater and other waste discharges

- Water supply and drinking water source protection

4.3.5 Landscape and Land Use Resources

The most prevalent land use concern expressed at the public meetings was open space preservation and associated issues, such as the loss of farmlands and wetlands. Concern over these issues particularly was notable in the Perkiomen sub-region in Montgomery County and Little Schuylkill sub-region in Schuylkill County, but these issues also were raised in the other public meetings. Support for increased funding of preservation efforts was evident from the public opinion poll of watershed residents. With regard to land preservation, 90% said they support the purchase of land for parks and natural areas by their county or municipality and 91% support an increase in public funding for open space and natural areas protection.

The need to track development trends and ensure that growth occurs in a responsible manner was highlighted as a major concern in Montgomery County, as was the need to create and maintain linear parks and greenways. Active stewardship of the land also was noted as a major issue of concern in Montgomery County. The need to maintain riparian buffers was mentioned as a major issue in all sub-regions. Participants at a Philadelphia public meeting expressed the need to explore the use of zoning overlays and a need to examine existing land use regulations and their enforcement. Concern was expressed over the ineffectiveness of the Municipal Planning Code (MPC) and the lack of regional planning, and there was interest in the proposed new improvements to the MPC and the effect this might have on maintaining landscape sustainability in the watershed.

In addition, many site-specific land use concerns were raised at the public meetings. For example, a proposed power plant on Maiden Creek and another near the Perkiomen Creek were each noted as major concerns. While these concerns were duly noted in the meeting minutes, site-specific issues have not been addressed directly by this Plan as our goal was a regional assessment of the strengths and weaknesses of water resources, sustainable landscape issues and institutional structure. Directly addressing issues of local concern was not a focus of this watershed-scale Plan.

These and other critical sustainable landscape and land use issues also were documented in the Report of the Governor's 21st Century Environment Commission (1998), an excellent resource on issues of sustainable landscapes and development throughout the Commonwealth.

In summary, considering the input received at the public meetings, the results of the public opinion poll, as well as review of the pertinent documents that address landscape and land use resource issues in the region, the following topics were determined to be of major concern in the Schuylkill River watershed.

- Loss of critical natural lands to development due to rapid urban/suburban sprawl
- Need to encourage responsible growth and offset associated losses of farmlands and wetlands
- Need for open space preservation to assist in water quality preservation
- Need to create and maintain linear parks and greenways as biodiversity connectors and riparian corridors to preserve water quality
- Need to address the lack of guidance on ecological management of protected natural lands
- Need to address the lack of a strategic plan for identifying and conserving the watershed's ecological resources

4.3.6 Institutional Resources

The need for more and better inter-agency cooperation regarding planning and land use issues was expressed at the public meetings throughout the watershed. Providing technical and financial assistance and incentives to farmers was noted as a high priority in the agricultural sub-regions. A somewhat related concern was the "weak" Municipalities Planning Code (MPC). Finally, understanding and protecting economic issues related to tourism and redevelopment also was noted as a major concern in various sub-regions.

In Philadelphia, the Philadelphia Water Department noted the need to coordinate activities under the Safe Drinking Water Act and the Clean Water Act. The Manayunk Development Corporation noted the need to balance preservation of open space with continuing development. They also noted that private preservation could be encouraged through demonstration projects performed on public land. Participants at the Philadelphia meeting expressed a need to create a liaison with the City administration and council districts.

In summary, considering the input received at the public meetings, as well as from review of the pertinent documents that address institutional resource issues in the region, the following topics were determined to be of major concern in the Schuylkill River watershed.

- Need for increased environmental education funding and programs for adults and children, to improve awareness and understanding of watershed issues
- Need for improved coordination of services and programs among nonprofits and public agencies in the watershed
- Need for a centralized information clearinghouse to facilitate sharing of institutional resources and to effectively build capacity of watershed organizations
- Need for coordination of watershed-wide water quality monitoring

4.4 References

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5.0 WATER QUALITY

5.1 Introduction

Good water quality is essential to the health and productivity of aquatic ecosystems, and to support a variety of human needs including industrial and domestic water supplies, drinking water, and recreation. Input from watershed stakeholders received from the public meetings, the results of the public opinion poll, and review of relevant literature highlighted the following water resource issues of major concern in the Schuylkill River watershed.

- Need for water quality monitoring data
- Urban/suburban development and stormwater runoff
- Non-point source pollution
- Habitat quality
- Acid mine drainage (in the Schuylkill headwaters region)
- Wastewater and other waste discharges
- Water supply

The following sections provide an overview of water quality in the Schuylkill River watershed based on the Pennsylvania Department of Environmental Protection (PA DEP) water quality assessment, available monitoring data, and landscape/water quality modeling. Water quality analyses and discussion focused on issues and problems common throughout the watershed. Recommendations for protecting and improving water quality are summarized for easy reference in **Section 5.2** below and described in detail in **Section 5.6** of this chapter.

A significant amount of water quality related information for the Schuylkill River watershed is available through the Schuylkill River Sourcewater Assessment Partnership (http://www.schuylkillswa.org). For additional information about water quality and environmental protection regulations in Pennsylvania, see the Pennsylvania Code, Title 25, Environmental Protection (http://www.pacode.com/secure/data/025/025toc.html).

5.2 Summary Recommendations

Recommendations for improving the water quality of the Schuylkill River watershed are summarized in the table below. Each recommendation is assigned a unique code number (e.g., **R5.1**) and name, and is cross-referenced to the key water quality issue(s) it addresses. These recommendations are described in more detail in **Section 5.6 Detailed Recommendations from the Water Quality Analysis**, and the page number where the detailed description of that recommendation can be found is listed in the *Page* column of this table.

Recommendations specific to particular water quality issues/analyses also are summarized (by code, name of the recommendation, summary description, and priority implementation areas or target subwatersheds) in a table at the end of each corresponding section in this chapter. For example, summary recommendations specific to water quality monitoring are found in *Section 5.4.1.4 Recommendations for Water Quality Monitoring*, at the end of *Section 5.4 Water Quality Monitoring*.

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.1	**Establish a Coordinated, Watershed-wide Monitoring Program with Quality Control Protocols**	EPA, the state and key nonprofits should design a comprehensive watershed-wide monitoring program, providing training for citizen monitoring groups, and with certification protocols to ensure reliable data.	Water quality monitoring	5-21
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Source Pollution**	Urban Best Management Practices such as reduction of impervious surfaces, infiltration and sedimentation basins, and street sweeping should be implemented to decrease water quality and other problems associated with stormwater runoff, and to increase groundwater recharge.	Stormwater runoff Non-point source pollution (nutrients, toxics, sediment/erosion) Water supply	5-23
R5.3	**Encourage Homeowners and Small Businesses to Reduce Non-Point Pollution**	Homeowners, small businesses, and individuals should be educated about how their actions influence water quality, and should be encouraged to clean up after pets, properly dispose of yard and household wastes, properly store cars and vehicles, and to take other measures to reduce non-point source pollution.	Non-point source pollution	5-24
R5.4	**Implement Nutrient Management Practices**	Sound Nutrient Management Practices such as soil and manure testing can help minimize the amount of fertilizer entering streams. These practices should also be implemented in suburban and urban areas where fertilizer is used.	Non-point source pollution (nutrients)	5-24
R5.5	**Implement Agricultural Best Management Practices**	Agricultural Best Management Practices such as no-till planting, contour plowing, and stream bank fencing can help reduce the amount of nutrient and sediment pollution entering streams.	Non-point source pollution (nutrients, sediment)	5-25
R5.6	**Implement Timber Harvesting Best Management Practices**	Timber harvesting Best Management Practices such as proper road construction and preservation of riparian buffers should be used to reduce the amount of sediment and nutrients entering streams.	Non-point source pollution (nutrients, sediment)	5-25
R5.7	**Protect and Restore Riparian Forest Buffers**	Riparian buffers function in a variety of ways to maintain the health of stream systems, and should be protected and restored whenever possible.	Non-point source pollution (nutrients, sediment) Habitat quality	5-26
R5.8	**Protect and Restore Wetlands and Areas of Hydric Soils**	Wetlands provide many benefits including the regulation of stormwater runoff, water quality improvements, and unique and important habitat. Efforts should be made to protect and restore wetlands throughout the watershed. Areas of hydric soils may offer the best potential for wetland restoration.	Non-point source pollution (nutrients, sediment) Stormwater runoff Habitat quality	5-27

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.9	**Identify and Enforce Sediment and Erosion Control Problems and Violations**	Construction sites contribute a significant amount of sediment to receiving waters. Procedures for monitoring compliance with existing laws should be maintained. Volunteers can be trained to help monitor for existing and potential problems.	Non-point source pollution (sediment/erosion)	5-27
R5.10	**Establish Uniform, Watershed-wide Criteria for Permitted Discharges from Sewage Treatment Plants (STPs)**	Criteria for permitted discharges of pollutants such as fecal coliforms vary among different PA DEP regions within the watershed. Uniform criteria should be developed to help regulate and reduce water quality impairment from sewage treatment plants.	Point source pollution (pathogens/nutrients)	5-28
R5.11	**Monitor Nutrients from All Sewage Treatment Plants**	Sewage treatment plants may not monitor all relevant nutrient levels in their effluent. Establishing uniform discharge criteria and monitoring nutrients at all sewage treatment plants would help to assess nutrient loading to receiving waters.	Point source pollution (nutrients from STPs)	5-28
R5.12	**Promote Tertiary Treatment of Sewage Effluent**	Less than half of the treatment plants in the Schuylkill River watershed provide tertiary treatment of sewage effluent. Where effluent is a problem, plants should be upgraded to provide higher levels of treatment.	Point source pollution (nutrients from STPs)	5-28
R5.13	**Identify and Control Discharges of Untreated Sewage from "Wildcat Systems" and Combined Sewer Overflows (CSOs)**	Discharges of untreated sewage from “wildcat” systems and combined sewer overflows represent a threat to human health and aquatic ecosystems. Wildcat systems should be identified and regulated, and CSOs monitored for compliance with existing regulations.	Point source pollution (nutrients, pathogens)	5-29
R5.14	**Establish Septic Education, Registration, Inspection, and Maintenance Programs**	Septic programs would instruct owners about proper care and maintenance of septic systems, and should provide homeowners with a method for testing their septic systems.	Non-point source pollution (nutrients)	5-29
R5.15	**Size and Maintain Culverts and Bridges to Ensure Minimal Impact to Streams**	Culverts and bridges should be sized and located to adequately convey both low flow and storm events. Structures must also be properly maintained and inspected to prevent obstruction, scour and erosion.	Stormwater runoff Non-point source pollution (sediment/erosion)	5-29

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.16	**Conduct Inventories and Studies to Identify and Remove Dams Where Restoration Benefits Outweigh Present Uses and Effects**	Dams can provide benefits, but also cause a broad range of negative ecological impacts. Inventories and studies should be conducted to determine where dams are in the Schuylkill watershed and if they should be removed. The benefits of removal (restoration of stream habitat, fish passage, and water quality) may outweigh present uses and/or effects. Where dam removal does not have overall benefits, construction of fish ladders should be studied and implemented where possible.	Habitat quality Water supply	5-30
R5.17	**Identify Sources and Mitigate Effects of Acid Mine Drainage**	AMD is a significant source of water pollution in the headwaters of the Schuylkill River watershed. In conjunction with other projects, undocumented sources of AMD should be identified and monitored, and a restoration program initiated.	Acid mine drainage	5-30
R5.18	**Monitor and Regulate Existing and Future Groundwater Withdrawals**	When groundwater withdrawals exceed the sustainable yield of aquifers, water supplies can be threatened, streamflow diminished, and aquatic ecosystems degraded. Existing and future groundwater withdrawals should be monitored and regulated to avoid groundwater depletion.	Water supply Habitat quality	5-31
R5.19	**Support PEMA Removal of Structures from Flood Prone Areas**	The Pennsylvania Emergency Management Agency (PEMA) has established a program, which promotes the acquisition and removal of structures from flood-prone areas. Efforts should be made to support this program.	Stormwater runoff Non-point source pollution	5-32
R5.20	**Fund Studies to Document Watershed Condition and Resources**	Watershed management should be based on sound scientific principles and reliable field data. Studies should be conducted to document watershed resources including detailed water budgets, water quality trends, land cover changes, extent of riparian disturbance, wetland disturbance, and other characteristics.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-32

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R5.21	**Support Studies to Assess the Impacts of Mineral Extraction on Water Quality and Quantity**	For mining operations in the watershed, there may be potential metals and sediment impacts on adjacent streams; when closed down, there may be potential groundwater/hydrology impacts. In order to better understand both water quality and water quantity issues in the watershed, these impacts should be assessed.	Point source pollution Habitat quality Water supply	5-33
R5.22	**Complete Comprehensive Water Budget Studies for the 37 Subwatersheds in the Schuylkill Drainage**	Follow-up studies to the current source water assessment (SWA) should conduct combined surface and ground water studies to generate watershed-based water budgets, so that a prioritized strategic plan of action can be developed to preserve the watershed's water resources. The cumulative impacts of water withdrawal, discharge, transfers out of the watershed and recharge also should be considered.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-33
R5.23	**Support Cost-Effectiveness Studies on Treating Point Versus Non-Point Source Pollution Impacts**	The current SWA, or follow-up studies, should prioritize which water pollution issues to address first in terms of cost-effectiveness. Subwatershed-based cost-benefit analysis of treating point versus non-point source pollution impacts should direct strategic action on pollution treatment in the watershed.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-33
R5.24	**Support Cumulative Impact Assessments for Point and Non-point Source Pollution**	The current SWA, or follow-up studies, should assess the cumulative impacts of point and non-point pollution, and if possible, also assess the cumulative water extraction, discharge and recharge effects on a subwatershed basis across the entire watershed.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-33
R5.25	**Support Outreach Phase for Implementation of the Schuylkill Source Water Assessment (SWA)**	The current SWA should be implemented through a follow-up outreach phase that ensures the guidelines it provides are adopted by municipalities, point-source facilities, nonprofits and citizens where necessary adopted throughout the watershed. This assessment should be done on a subwatershed basis to facilitate implementation.	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	5-34

5.3 Pennsylvania DEP Water Quality Assessment

The term "water quality" has meaning only in the context of how that water is used. For example, good quality irrigation water might be poor quality drinking water. Use designations for surface waters are set by the State,

and are generally assigned according to the type of aquatic communities or human needs supported. **Table 5.1** lists the designated water uses found in the Schuylkill River watershed. Anti-degradation requirements under the Pennsylvania Code, Chapter 93.4a(b), require that the level of water quality necessary to protect existing uses be maintained. Chapter 93.4b of the Pennsylvania Code also establishes criteria for special protection of water designated as High Quality and Exceptional Value waters. High Quality waters include streams with excellent water quality or aquatic communities. Exceptional Value waters include waters of exceptional ecological significance, or waters meeting High Quality criteria that occur in areas such as state or county parks and forests, wildlife refuges, "wilderness trout streams," or that are of exceptional recreational significance. High Quality and Exceptional Value waters are protected under the anti-degradation requirements in Pennsylvania Code, Chapter 93.4a(c) and 93.4a(d), respectively.

Table 5.1 Designated Water Uses in the Schuylkill River Watershed

Abbreviation	*Use*
WWF	Warm Water Fishes
CWF	Cold Water Fishes
MF	Migratory Fishes
TSF	Trout Stocking
EV	Exceptional Value
HQ	High Quality

In the Schuylkill River watershed, the majority of streams are protected either as Cold Water Fisheries (48%), or Warm Water Fisheries (28%). Exceptional Value streams include sections of Valley Creek in Chester County; Sacony, Hay, Pine, and Furnace Creeks in Berks County; Rattling Run in Schuylkill County; and several other small headwater streams throughout the watershed. High Quality streams include the Pickering and French Creeks in Chester/Montgomery Counties. A complete listing of the designated uses of rivers and streams in the Schuylkill River watershed are in **Reference Table 5A: Water Uses Protected in the Schuylkill River Watershed** in the online Reference Documents.

Section 305(b) of the federal Clean Water Act requires that States submit a Water Quality Assessment Report to the US Environmental Protection Agency (US EPA) every two years. The Pennsylvania 305(b) Water Quality Assessment provides a summary of water quality management programs including water quality standards, and point and non-point source pollution control measures. It also presents a summary of waters attaining and not attaining designated aquatic life uses, and the Pennsylvania Department of Environmental Protection's (PA DEP) plan for achieving a comprehensive assessment of flowing waters. Under section 303(d) of the Act, States are required to provide a list of streams or rivers that would not support their designated use even after required water pollution control technologies have been applied, the source and cause of impairment, a priority ranking, and whether a total maximum daily load (TMDL) is required.

A TMDL is a calculation of the maximum amount of a pollutant a water body can receive and still meet its designated use, and an allocation of that amount to various point and non-point pollution sources. The calculation must include a margin of safety to ensure that the water body can meet certain uses designated by the State, and must account for seasonal variation in water quality. Point source TMDLs are implemented through the NPDES permit process, and for non-point sources, Best Management Practices (BMPs) are employed to address the impairment (US EPA 1991; http://www.dep.state.pa.us). In Pennsylvania, the agency responsible for conducting these studies is the Department of Environmental Protection.

The draft Year 2000 Pennsylvania 303(d) impaired waters list is shown graphically in the map: **303(d) Impaired Waters** (adapted from http://www.dep.state.pa.us), and in table format in **Reference Table 5B: Impaired Streams in the Schuylkill River Watershed** in the online Reference Documents. As of December

2000, roughly 70 percent of the streams within the watershed have been assessed. The most common source of impairment in the urban/suburban zone of the southeastern portion of the watershed is urban stormwater runoff leading to problems with pathogens, flow variability, and nutrients. In the northwest portion of the watershed, the major source of impairment is acid mine drainage and metals contamination. Other threats to water quality include agricultural non-point source pollution, wastewater discharges, and toxic leaks and spills.

5.4 Water Quality Monitoring

This section presents a summary of selected water quality monitoring data. An annotated bibliography of other studies and reports addressing water quality issues in the Schuylkill River watershed is included in the online Reference Documents as **Annotated Bibliography of Water Quality References**.

5.4.1 Water Quality Sampling Data

Water quality varies naturally among different streams, at different positions along a single stream, during runoff events, and seasonally during the year. When watersheds are impacted by human activities, water quality can also vary due to point source discharges, non-point source runoff, and general changes in land use and land cover. To accurately assess water quality within a watershed, monitoring networks must capture the full range of spatial and temporal variability. In the Schuylkill River watershed, water quality data are available for a number of locations and parameters, but generally do not adequately reflect the seasonal and/or spatial variability within the watershed.

The majority of publicly available, compiled water quality data for the Schuylkill River watershed are archived in the US EPA STORET (STOrage and RETrieval) database (http://www.epa.gov/storet/). The STORET database contains water quality data from federal, state, and local agencies, and from several non-governmental organizations. The most common parameters sampled in the Schuylkill River watershed are forms of the nutrients nitrogen (N) and phosphorus (P), but other data such as measurements of pH, conductivity, temperature, turbidity, and metals are available in lesser amounts. It should be noted that the quality of STORET data varies with the source agency or group, and that data not properly validated should be considered only as approximate values. Additional water quality data from government agencies, private industries, water providers, and research institutions may exist within the watershed, but are either not publicly accessible, or the data is not entered and compiled in a digital format.

The following sections provide a summary of nitrogen and phosphorus data collected from surface water and groundwater in the Schuylkill River watershed from 1985 to 1998 based on STORET data. Nitrogen and phosphorus are emphasized due to the relatively large amount of these data available, the importance of nutrient loading to stream health throughout the watershed, and because high levels of these parameters are good indicators of other forms of pollution. High nutrient loading is generally associated with point source discharges such as wastewater treatment plants, concentrated nutrient sources such as animal feed lots and leaking septic systems, and non-point source inputs from agricultural fertilizers, urban runoff, and other sources.

High concentrations of nitrogen and phosphorus nutrients in streamflow are not directly harmful to aquatic life, but can promote excessive growth of algae resulting in oxygen depletion, fish kills, and other ecological impacts in lakes and larger rivers. Although there is currently no aquatic life standard for nitrogen or phosphorus, nutrient criteria are being developed by the US EPA. The drinking water standard for nitrate nitrogen is 10 mg/L as N.

In southeastern Pennsylvania, naturally occurring nitrogen concentrations vary considerably among different streams and throughout the year, but dissolved nitrogen concentrations (sum of nitrate, nitrite and ammonium) greater than about 3 to 5 mg/L as N are considered high (Velinsky et al. *unpublished data*). In general, the productivity of most freshwater ecosystems is limited by dissolved phosphorus. Dissolved phosphorus (phosphate) concentrations of approximately 0.05 to 0.10 mg/L as P are likely to stimulate algae growth and eutrophication in lakes and large, slow-moving rivers. Smaller streams with fast currents, rocky sediments, and diverse assemblages of algae-grazing invertebrates can generally withstand higher levels of dissolved phosphorus.

5.4.1.1 Surface Water

The STORET database includes nitrogen and phosphorus samples from a number of streams during the period from 1985 to 1998 but generally the data are not well distributed throughout the watershed or over time. The areas best represented spatially are the French Creek and Valley Creek subwatersheds, yet many of these sites were sampled only 1-2 times during this period. The areas best represented over time are the main tributaries and mainstem Schuylkill River.

Average values for the total nitrogen concentrations for the Schuylkill River subwatersheds are shown graphically in the map: **Stream Nitrate-Nitrogen**, and the map: **Stream Ammonium-Nitrogen**. Values for the minimum, maximum, average, and median nitrogen concentrations as nitrite+nitrate (NO_2+NO_3) and ammonia+ammonium (NH_3+NH_4) for each sampling location are listed in **Reference Table 5C: Stream Nitrogen Concentrations in the Schuylkill River Watershed** in the online Reference Documents. Average ammonia+ammonium concentrations ranged from less than 0.01 mg/L as nitrogen (N) to greater than 1.0 mg/L as N, with the highest concentrations occurring in Valley Creek and the mainstem Schuylkill River. Average nitrite+nitrate concentrations ranged from about 1.5 to 3.0 mg/L as N, with the highest concentrations also in Valley Creek and the mainstem Schuylkill River.

Average values for the total phosphorus concentrations for the Schuylkill River subwatersheds are shown graphically in the map: **Stream Dissolved Phosphorus**. Minimum, maximum, average, and median dissolved phosphorus concentrations values for each sampling location are listed in **Reference Table 5D: Stream Phosphorus Concentrations in the Schuylkill River Watershed** in the online Reference Documents. Average dissolved phosphorus concentrations ranged from less than 0.01 to greater than 0.20 mg/L as P, with the greatest concentrations occurring in the mainstem Schuylkill River. Average total phosphorus concentrations ranged from about 0.02 to greater than 1 mg/L as P, with relatively high concentrations measured at Skippack Creek, Wissahickon Creek, and the mainstem Schuylkill River.

5.4.1.2 Groundwater

Groundwater is an integral part of the water cycle, and should not be considered as separate from surface water. Any contamination of groundwater has the potential to cause contamination of surface waters and degradation of aquatic ecosystems.

The STORET database contains nitrogen and phosphorus samples from a number of wells located throughout the Schuylkill River watershed between 1985 to 1998. Approximately 90 percent of groundwater samples were taken from residential wells, with the remaining samples taken from schools, country clubs, water authorities, and quarries. Similar to surface water, groundwater was not consistently sampled throughout the watershed and over time. Approximately 40 percent of groundwater locations were sampled only 1-2 times, and are of limited value in assessing long term concentrations.

Average values for groundwater nitrogen concentrations in Schuylkill River subwatersheds are shown graphically in the map: **Groundwater Nitrate-Nitrogen**. Minimum, maximum, average, and median concentrations of nitrite+nitrate (NO_2+NO_3) and/or dissolved and total ammonia+ammonium (NH_3+NH_4) values for each well sampling location are listed in **Reference Table 5E: Groundwater Nitrogen Concentrations in the Schuylkill River Watershed** in the online Reference Documents. Average values for dissolved and/or total ammonia+ammonium were generally between 0.01 and 0.10 mg/L as N. Average nitrite+nitrate concentrations ranged from about 0.10 to 10 mg/L as N.

Average values for groundwater phosphorus concentrations in Schuylkill River subwatersheds are shown graphically in the map: **Groundwater Dissolved Phosphorus**. Values for the minimum, maximum, average, and median concentrations of dissolved and total phosphorus concentrations at each well sampling location are listed in **Reference Table 5F: Groundwater Phosphorus Concentrations in the Schuylkill River Watershed** in the online Reference Documents. Average dissolved phosphorus concentrations ranged from 0.02 to 0.14 mg/L as P. Most average total phosphorus concentrations were between about 0.02 and 0.10 mg/L as P, with a only few sites outside this range.

5.4.1.3 Trends in Surface Water Quality

Long-term data are available for only 6 locations on the mainstem Schuylkill River and main tributaries, which have been used to evaluate trends in the various forms of nitrogen, phosphorus, and chloride from 1984 to 1995 (Evans et al. 1996). Trend analyses were conducted for measured concentrations, flow-adjusted concentrations (determined using relationships between concentration and streamflow rates), and daily mass loads.

Results for the mainstem Schuylkill River at Philadelphia and Pottstown indicate that from 1984 to 1995 at both locations there was a significant downward trend with seasonal dependence for total ammonium-nitrogen, a slight upward trend with a strong seasonal dependence for nitrate-nitrogen, and a significant downward trend for total phosphorus (Evans et al. 1996). The decrease in phosphorus levels may be due to the ban on phosphate detergents in the mid- to late 1980s.

Like nitrogen and phosphorus, dissolved chloride concentrations are a good indicator of water quality degradation. Dissolved chloride showed no consistent trend at either of these locations during the period from 1984 to 1988 (Evans et al. 1996). At the Philadelphia location, however, data collected as early as 1842 suggest significant changes in chloride concentrations have occurred over longer periods of time. Chloride concentrations increased from approximately 2-3 mg/L in the middle 1800s to as high as 82 mg/L in 1999 (Keighton 1968; Evans et al. 1996; Velinsky et al. *unpublished data*). The specific causes of elevated chloride concentrations are not known, but are likely to include wastewater and other discharges, agricultural and urban runoff, and the winter application of road salts.

5.4.1.4 Recommendations for Water Quality Monitoring

Code	*Recommendation*	*Summary Description*	*Priority Area/Target Subwatershed*
R5.1	**Establish a Coordinated, Watershed-wide Monitoring Program with Quality Control Protocols**	EPA, the state and key nonprofits should design a comprehensive watershed-wide monitoring program, providing training for citizen monitoring groups, and with certification protocols to ensure reliable data.	All Zones (Refer to **Section 6.5** in *Chapter 6.0* and **Sustainable Landscape Vision** map for a description of Zones)

5.5 Watershed Analysis and Modeling

Water quality is influenced by natural characteristics of the watershed together with human factors such as point and non-point source pollution, land cover changes, the presence of dams, road crossings, and other stream and watershed disturbances. Various landscape, hydrologic, and human influences that affect water quality in the Schuylkill River watershed were characterized using existing spatial data sets and landscape based water quality modeling. The analysis was conducted according to the 37 Schuylkill River subwatersheds shown in the map: **Watershed Orientation**. As discussed in **Section 3.1 Watershed Location** of *Chapter 3.0 Watershed Characterization* of this Plan, these 37 subwatersheds were defined within the Schuylkill River watershed at a scale small enough to allow meaningful comparisons while not exceeding the resolution of the data. The approximate size of each subwatershed is 125 square kilometers or 12,500 hectares (about 31,000 acres). Note that recommendations for the water quality analysis, including those in *Section 5.4* above, make reference to Agricultural, Urban and Suburban Zones as identified in relation to land cover in **Section 6.5 Subwatershed Analysis** *in Chapter 6.0 Promoting a Sustainable Landscape*. These zones also are displayed graphically in the map: **Sustainable Landscape Vision**.

The following sections describe various watershed characteristics that influence water quality in each of the Schuylkill River subwatersheds, and lists recommendations for reducing or minimizing the impacts of each. Results are presented using maps where numerical values or scores for each subwatershed are classified into quintiles (1/5 of the subwatersheds are contained in each category), and each subwatershed is color coded from blue to brown to show relative condition. Note that the nutrient and sediment loading calculations presented for each subwatershed do not include loading from upstream subwatersheds. Accordingly, subwatersheds with low loadings may experience high nutrient or sediment levels if they are downstream of subwatersheds with high loadings. The purpose of this analysis is to provide a watershed-wide assessment to help target areas within the watershed that contribute most to water quality impairment and associated stream degradation. To identify all the known sources and causes of pollution in any given subwatershed, additional research and modeling is required.

5.5.1 Watershed Land Cover

Watershed land cover has a significant influence on the hydrologic characteristics of the watershed, and is the predominant factor influencing non-point source pollution loading. A land cover data layer for the Schuylkill River watershed was compiled and classified by the Multi-Resolution Land Characteristics Interagency Consortium (MRLC) using LANDSAT Thematic Mapper satellite imagery from 1991-1993 (Vogelmann et al. 1998). The satellite imagery has a resolution of 30 meters, meaning that the landscape is aggregated into 900 square meter blocks – i.e., each block or grid cell in the satellite scene contains a single land cover value for an area measuring 30m by 30m. The satellite data layer was classified into fifteen land cover categories following Anderson et al. (1976).

Land cover for the Schuylkill River watershed is displayed in the map: **Regional Land Cover**. Specific percentages of forested land, agricultural land, and urban/residential land for each of the 37 Schuylkill River subwatersheds are listed in **Reference Table 5G: Percent of Land Cover Within Each Subwatershed of the Schuylkill River** in the online Reference Documents. Forested lands are most prevalent in the upper northwestern part of the watershed (West Branch Schuylkill River, Schuylkill River Headwaters, Upper Little Schuylkill River, Lower Little Schuylkill River, and Schuylkill River 8 subwatersheds). This also is the area of highest elevation in the watershed. Agriculture is most concentrated in a band across northern Berks County, and is otherwise dispersed throughout the middle and lower portions of the watershed (Upper Tulpehocken,

Little Northkill/Northkill Creek, Schuylkill River Mainstem 7, Middle and Lower Tulpehocken, Lower Maiden Creek, and Sacony Creek subwatersheds). Urban/residential land use is greatest in and around the cities of Reading and Philadelphia. Because the MRLC land cover data was compiled around 1991-1993, while significant development has occurred in many parts of the watershed since then, the percentages for urban/residential land use should be considered lower-end values.

5.5.2 Impervious Cover

5.5.2.1 Background

Impervious cover refers to the area of land covered by roads, rooftops, parking lots, and other surfaces that do not allow the infiltration of water into the soil. Impervious cover has a significant impact on the hydrology of watersheds, and runoff from impervious surfaces can be a significant source of stormwater-related habitat degradation and non-point source pollution. The MRLC land cover data does not directly quantify impervious cover, but includes estimates for the amount of impervious cover within each of the urban/residential land use categories (Anderson et al. 1976). Estimates of the percent impervious cover for each of the Schuylkill River subwatersheds were made by choosing the average percent impervious value for each of the MRLC urban/residential land cover categories, multiplying by the amount of land area in each category, and summing the results. **Table 5.2** shows the estimates for percent impervious cover based on MRLC land cover type. The percent impervious cover for the 37 Schuylkill River subwatersheds is shown graphically in the map: **Impervious Cover**. The map resembles the percent urban/residential land cover because the calculations were based on the MRLC land cover data.[1]

Table 5.2 Estimated Percent Impervious Covers for MRLC Land Cover Categories

MRLC Land Cover Type	*% Impervious Assumed by MRLC*	*% Value Used for Calculations*
Low Intensity Developed	50-80	65
High Intensity Residential	80-100	90
High Intensity Commercial/Industrial	80-100	90

The amount of impervious cover in a watershed has been recognized as a key indicator of stream degradation in urban watersheds (Schueler 1998). As development expands, measures should be taken to control and mitigate the impacts of stormwater runoff and associated non-point source pollution. As a guide to assessing the impacts of urban/suburban development on streams, a "Rapid Watershed Assessment" method has been developed by the Center for Watershed Protection. For more information on this method, see the US EPA and Center for Watershed Protection's web page, *Stormwater Managers Resource Center* (http://www.stormwatercenter.net).

1 MRLC provides the following description of developed land cover classes for areas with a high percentage (>30%) of constructed materials. *Low Intensity Residential* includes areas with a mixture of constructed materials (30-80%) and vegetation (20-70%). *High Intensity Residential* includes highly developed areas with a high percentage of constructed materials (80-100%) and low vegetation cover (20%). *Commercial/Industrial* includes infrastructure and all highly developed areas not classified as High Intensity Residential. For more information: http://www.epa.gov/mrlc/classes.html.

5.5.2.2 Recommendations for Impervious Cover

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Source Pollution**	Urban Best Management Practices such as reduction of impervious surfaces, infiltration and sedimentation basins, and street sweeping should be implemented to decrease water quality and habitat problems associated with stormwater runoff, and to increase groundwater recharge.	Urban / Suburban Zone Schuylkill River 2 Upper Wissahickon Creek Sandy Run Lower Wissahickon Creek Schuylkill River 1 Schuylkill River Tidal Schuylkill River 6

5.5.3 Runoff as a Percent of Precipitation

5.5.3.1 Background

The amount of runoff produced by a watershed is a function of climate, physiography, vegetation, and human disturbance of the landscape. In general, steep watersheds with shallow soils and sparse vegetation will generate more runoff than less steep watersheds with deep soils and abundant vegetation. Human disturbances such as impervious cover and other soil and vegetation disturbance will result in greater amounts of runoff. Watersheds with high amounts of runoff are generally more susceptible to non-point source pollution, and potentially at greater risk of flooding. As a simple measure of the runoff characteristics of each subwatershed, annual runoff as a percent of annual precipitation was determined by averaging land cover based runoff coefficients within each subwatershed (National Climate Data Center 1998). Results are shown by subwatershed in the map: **Runoff**.

Runoff as a percent of precipitation is greatest in the southeast part of the watershed where impervious coverage is greatest. Significantly lower percentages are indicated for the northern subwatersheds where there is more forest cover, such as Lower Little Schuylkill River and Upper Maiden Creek subwatersheds. The mostly agricultural mid-section of the watershed falls in between these extremes. High amounts of storm runoff can occur from cropland, especially from row crops where infiltration rates may be low due to soil disturbance. As mentioned previously, the effects of increased runoff associated with impervious coverage and stormwater runoff can be a significant source of habitat degradation and non-point source pollution. As the human population increases and development expands within the watershed, measures should be taken to control and mitigate the impacts of stormwater runoff.

5.5.3.2 Recommendations for Runoff as a Percent of Precipitation

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Pollution**	Urban Best Management Practices such as reduction of impervious surfaces, infiltration and sedimentation basins, and street sweeping should be implemented to decrease water quality and habitat problems associated with stormwater runoff, and to increase groundwater recharge.	Urban/Suburban Zone Schuylkill River 2 Upper Wissahickon Creek Sandy Run Lower Wissahickon Creek Schuylkill River 1 Schuylkill River Tidal Schuylkill River 6

5.5.4 Roads and Road/Stream Crossings

5.5.4.1 Background

Roads and road/stream crossings can have a significant impact on the hydrology and water quality of rivers and streams. Stormwater runoff from roads adjacent to streams can transport contaminants such as sediment, salts, oils, and pesticides used along the road edges. Roads also are corridors where significant amounts of trash and litter accumulate which can be washed into streams during storm events. Where roads cross streams, culverts or bridges can alter the channel size, shape, and/or gradient leading to channel erosion and scour.

As a general measure of stream disturbance due to roads, the number of road/stream crossings was determined for each of the 37 Schuylkill River subwatersheds by overlaying road and stream geographic information system (GIS) data layers. Results of this analysis are shown in the map: **Road/Stream Crossings**. The analysis does not account for the impacts of roads adjacent to but not crossing a stream. To minimize the impacts of roads and road crossings, riparian buffers should be maintained between roads and streams. Culverts and bridges should also be regularly cleaned and maintained, and sized to adequately convey both low flow and storm runoff events.

5.5.4.2 Recommendations for Roads and Road/Stream Crossings

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.7	**Protect and Restore Riparian Forest Buffers**	Riparian buffers function in a variety of ways to maintain the health of stream systems, and should be protected and restored whenever possible.	All Zones
R5.15	**Size and Maintain Culverts and Bridges to Ensure Minimal Impact to Streams**	Culverts and bridges should be sized and located to adequately convey both low flow and storm events. Structures must also be properly maintained and inspected to prevent obstruction, scour and erosion.	All Zones Schuylkill River Headwaters Schuylkill River 8 Ontelaunee/Kistler Creek Sacony Creek Upper Perkiomen Creek East Branch Perkiomen Creek Skippack Creek Schuylkill River 5

5.5.5 Effects of Dams

5.5.5.1 Background

There are approximately 280 dams in the Schuylkill River watershed. Although providing a number of benefits such as flood control and recreation, dams also can cause significant ecological effects (Collier et al. 1996). Dams can adversely affect the health of rivers and streams by altering flow regimes, changing water temperature and chemistry, modifying algae and macroinvertebrate communities, disrupting resident and migratory fish communities, altering channel geomorphology and sediment transport, and impacting physical habitat. In other cases, dams may provide ecological benefits such as trapping sediment or maintaining wetlands.

The number and location dams in the Schuylkill River watershed was obtained from the Pennsylvania DEP Pennsylvania Dams GIS data layer. The number of dams in each Schuylkill River subwatershed is shown in the map: **Number of Dams**. Dam locations are shown in the map: **Dam Locations**. Dam removal should be considered where restoration benefits outweigh present uses and other effects of dams or dam removal.

5.5.5.2 Recommendations for Dams

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.16	**Conduct Inventories and Studies to Identify and Remove Dams Where Restoration Benefits Outweigh Present Uses and Effects**	Dams can provide benefits, but also cause a broad range of negative ecological impacts. Inventories and studies should be conducted to determine where dams are on the Schuylkill River and if they should be removed. The benefits of removal (restoration of stream habitat, fish passage, and water quality) may outweigh present uses and/or effects. Where dam removal does not have overall benefits, construction of fish ladders should be studied and implemented where possible.	All Zones

5.5.6 Nitrogen and Phosphorus from Land Cover

5.5.6.1 Background

The nutrients nitrogen and phosphorus are important regulators of stream productivity. When present in high concentrations, these nutrients can cause over-production and result in harmful algae blooms leading to dissolved oxygen depletion and associated ecological impacts (eutrophication). Stream productivity is particularly sensitive to dissolved phosphorus concentrations. Non-point source nitrogen and phosphorus loads for each subwatershed were calculated using export coefficients based on MRLC land cover types. Export coefficients were chosen based on a literature survey of the most appropriate values for the Schuylkill River watershed (Reckhow et al. 1980; Beaulac and Reckhow 1982; Frink 1991; The Cadmus Group 1998). The use of export coefficients is a simple way to estimate relative nitrogen and phosphorus contributions over large areas. Estimates should not be considered exact values, do not necessarily reflect in-stream concentrations, and should be used only to make relative comparisons of nutrient loading from land cover in different parts of the watershed. The following formula was used for calculating annual nitrogen and phosphorus loads from land cover:

Annual Load (kg/ha) = Land Use within Subwatershed (ha) * Export Coefficient (kg/ha/yr)

The nitrogen and phosphorus export coefficients assigned to each land cover category are shown in **Table 5.3**. Land cover characteristics for each subwatershed were determined from the MRLC land cover data set. See the MRLC website (http://www.epa.gov/mrlc/classes.html) for detailed definitions of these land cover classes.

Table 5.3 Export Coefficients for Nitrogen and Phosphorus

Land Cover	*Nitrogen Export Coefficient (kg/ha/yr)*	*Phosphorus Export Coefficient (kg/ha/yr)*	*Source*
Water	0.00	0.00	Reckhow, et al. 1980
Urban	5.50	1.10	Reckhow, et al. 1980
Hay/Pasture	5.19	0.81	Reckhow, et al. 1980
Row Crops	9.00	2.24	Reckhow, et al. 1980
Lawns/Golf courses	1.52	0.19	Reckhow, et al. 1980
Forest	2.46	0.21	Reckhow, et al. 1980
Wetlands	0.55	0.01	The Cadmus Group 1998
Strip mines/Barren land	8.60	1.50	The Cadmus Group 1998

The estimated nitrogen loads from land cover for each of the 37 Schuylkill River subwatersheds are shown in the map: **Nitrogen from Land Cover**. Subwatersheds with the most agriculture show the highest loadings because of the high export coefficients for agriculture. These subwatersheds are located primarily in the agricultural areas in and around northern Berks County (Upper Tulpehocken, Little Northkill/Northkill Creek, Schuylkill River Mainstem 7, Middle and Lower Tulpehocken, Lower Maiden Creek, and Sacony Creek). The East Branch of the Perkiomen Creek also shows a high level of nitrogen loads. The heavily forested areas in the northwestern part of the watershed show the lowest nitrogen loads due to the low export coefficient associated with forested land cover.

The estimated phosphorous loading from each of the 37 Schuylkill River subwatersheds is shown in the map: **Phosphorus from Land Cover**. Like nitrogen, subwatersheds with high agricultural land cover show relatively high phosphorous loadings, and subwatersheds with more forested land show the lowest phosphorus loadings. Note that results from this analysis reflect only loadings from within a given subwatershed, and do not account for the impact of nitrogen and phosphorus loading from upstream subwatersheds.

5.5.6.2 Recommendations for Nitrogen and Phosphorus from Land Cover

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Source Pollution**	Urban Best Management Practices such as reduction of impervious surfaces, infiltration and sedimentation basins, and street sweeping should be implemented to decrease water quality and other problems associated with stormwater runoff, and to increase groundwater recharge.	Urban/Suburban Zone Schuylkill River 2 Upper Wissahickon Creek Sandy Run Lower Wissahickon Creek Schuylkill River 1 Schuylkill River Tidal Schuylkill River 6
R5.4	**Implement Nutrient Management Practices**	Sound Nutrient Management Practices such as soil and manure testing can help minimize the amount of fertilizer entering streams. These practices should also be implemented in suburban and urban areas where fertilizer is used.	Agricultural Zone Urban/Suburban Zones Upper Tulpehocken Creek Lower Tulpehocken Creek Little Northkill/Northkill Cr. Schuylkill River 7 Lower Maiden Creek Sacony Creek East Branch Perkiomen Cr.

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.5	**Implement Agricultural Best Management Practices**	Agricultural Best Management Practices such as no-till planting, contour plowing, and stream bank fencing can help reduce the amount of nutrient and sediment pollution entering streams.	Agricultural Zone Upper Tulpehocken Creek Lower Tulpehocken Creek Little Northkill/Northkill Cr. Schuylkill River 7 Lower Maiden Creek Sacony Creek
R5.6	**Implement Timber Harvesting Best Management Practices**	Timber harvesting Best Management Practices such as proper road construction and preservation of riparian buffers should be used to reduce the amount of sediment and nutrients entering streams.	Habitat Zone
R5.7	**Protect and Restore Riparian Forest Buffers**	Riparian buffers function in a variety of ways to maintain the health of stream systems, and should be protected and restored whenever possible.	All Zones
R5.8	**Protect and Restore Wetlands and Areas of Hydric Soils**	Wetlands provide many benefits including the regulation of stormwater runoff, water quality improvements, and unique and important habitat. Efforts should be made to protect and restore wetlands throughout the watershed. Areas of hydric soils may offer the best potential for wetland restoration.	All Zones

5.5.7 Nitrogen from Septic Systems

5.5.7.1 Background

Failing or improperly maintained septic systems can be a significant source of nitrogen loading to streams, and are not included in the estimates of nitrogen loads from land cover based on export coefficients. Nitrogen contributions from septic systems were assessed using the methodology outlined by Nizeyimana et al. (1996) in their statewide analysis of Pennsylvania. U.S. Census data were used to obtain the number of households and number of people within each census tract using septic systems for wastewater disposal. Census data were then combined with information on soil permeability and limitations for septic systems, and the expected annual nitrogen load for each subwatershed from failing septic systems was calculated. Soils data were obtained from the Pennsylvania STATSGO data set, and the analysis was conducted using a GIS. The estimated nitrogen loads from septic systems in each of the Schuylkill River subwatersheds are shown in the map: **Nitrogen from Septic Systems**. Note that results from this analysis reflect only loadings from within a given subwatershed, and do not account for the impact of nitrogen and loadings from septic systems in upstream subwatersheds. Results therefore should be used only to make relative comparisons of nutrient loading from septic systems among different subwatersheds.

5.5.7.2 Recommendations for Nitrogen from Septic Systems

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.14	**Establish Septic Education, Registration, Inspection, and Maintenance Programs**	Septic programs would instruct owners about proper care and maintenance of septic systems, and should provide homeowners with a method for testing their septic systems.	All Zones Unami Creek East Branch Perkiomen Creek Skippack Creek Lower Perkiomen Creek Swamp Creek Lower Manatawny Creek Schuylkill River 3

5.5.8 Sediment from Land Cover

5.5.8.1 Background

Non-point source sediment loading from each subwatershed was calculated using the Universal Soil Loss Equation (USLE) developed by the USDA Agricultural Research Station. This method is widely used to predict the amount of soil loss by surface erosion (Brooks et al. 1991, Wishmeier and Smith, 1978). The basic USLE equation is:

A = R * K * (LS) * C * P

where **A** = computed soil loss;
R = rainfall erosivity;
K = soil erodibility factor;
(**LS**) = topographic factor;
C = cropping management factor; and
P = conservation practice factor.

Data for the USLE were compiled from standard R-factor maps in Haan et al. (1994), the state STATSGO soil survey, a digital elevation model (DEM) for the Schuylkill River watershed, and county cropping factors (Hamlett et al. 1992). The conservation practice factor (P) was assumed to be equal to 1 for all subwatersheds. A conservation practice factor of 1 assumes no reduction in soil erosion from agricultural areas due to the use of erosion control techniques. Accordingly, if there are subwatersheds where erosion control techniques are widespread, the USLE estimates may be high for these subwatersheds.

The USLE calculates the total sediment loss from particular parcel of land, but does not account for sediment that may be "trapped" or re-deposited before reaching a stream. Therefore, total sediment loads to streams were calculated using the computed soil loss together with a trapping factor which accounts for the slope of the land, distance to the closest water body, and the type of land cover (Reckhow 1988). The estimated total annual sediment loading to streams from each of the subwatersheds is shown in the map: **Sediment from Land Cover**. Sediment loading is highest in agricultural subwatersheds, and lowest in subwatersheds with the most forested lands. Note that results from this analysis reflect only loadings from within a given subwatershed, and do not account for the impact of sediment loadings from upstream subwatersheds. Results therefore should be used only to make relative comparisons of sediment loading among different subwatersheds.

It is also important to note that sediment loading due to construction and other localized disturbance is not

included in these estimates. Sediment loading from soil disturbance at construction sites can contribute considerable amounts of sediment to streams, especially in rapidly developing subwatersheds. The estimates based on USLE also do not account for sediment loading associated with channel bed and bank erosion, which may be significant in developing areas and in areas where riparian vegetation has been disturbed. Accordingly, although not shown in this analysis, sediment loading may be high in subwatersheds where construction, channel bed and bank erosion, or disturbance of riparian vegetation is common.

5.5.8.2 Recommendations for Sediment from Land Cover

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Source Pollution**	Urban Best Management Practices such as reduction of impervious surfaces, infiltration and sedimentation basins, and street sweeping should be implemented to decrease water quality and habitat problems associated with stormwater runoff, and to increase groundwater recharge.	Urban/Suburban Zone
R5.5	**Implement Agricultural Best Management Practices**	Agricultural Best Management Practices such as no-till planting, contour plowing, and stream bank fencing can help reduce the amount of nutrient and sediment pollution entering streams.	Agricultural Zone Upper Tulpehocken Creek Ontelaunee/Kistler Creek Upper Maiden Creek Sacony Creek
R5.6	**Implement Timber Harvesting Best Management Practices**	Timber harvesting Best Management Practices such as proper road construction and preservation of riparian buffers can reduce the amount of sediment and nutrients entering streams.	All Zones
R5.7	**Protect and Restore Riparian Forest Buffers**	Riparian buffers function in a variety of ways to maintain the health of stream systems, and should be protected and restored whenever possible.	All Zones
R5.8	**Protect and Restore Wetlands and Areas of Hydric Soils**	Wetlands provide many benefits including the regulation of stormwater runoff, water quality improvements, and unique and important habitat. Efforts should be made to protect and restore wetlands throughout the watershed. Areas of hydric soils may offer the best potential for wetland restoration.	All Zones
R5.9	**Identify and Enforce Sediment and Erosion Control Problems and Violations**	Construction sites contribute a significant amount of sediment to receiving waters. Procedures for monitoring compliance with existing laws should be maintained. Volunteers can be trained to help monitor for existing and potential problems.	All Zones

5.5.9 Nitrogen and Phosphorous from Sewage Treatment Plants

5.5.9.1 Background

Sewage treatment plants (STPs) typically receive wastewater, provide treatment, and discharge the treated effluent to nearby streams. Standard treatment methods (primary or secondary treatment) remove most of the suspended solids and pathogens in raw wastewater, but even with secondary treatment less than half of the nitrogen and phosphorous are removed. Higher level or tertiary treatment can effectively remove much of the remaining nutrients, but many STPs do not have the facilities or funding to perform this level of treatment. Although regulated by the EPA National Pollutant Discharge Elimination System (NPDES) permit program, wastewater discharges can impact streams locally below discharge outlets. The influence of STP effluent on streams depends on the volume and concentration of effluent discharged, and the flow characteristics of receiving waters. As wastewater discharges are relatively constant throughout the year, water quality impacts are most pronounced during low flow conditions when insufficient flow is available to dilute the discharge. Nitrogen and phosphorus loadings from 82 major publicly owned sewage treatment plants were estimated for each Schuylkill River subwatershed (see the map: **Public Sewage Treatment Plants**). Loadings were calculated based on estimated effluent discharge volumes, and nutrient concentrations for these plants identified within the Schuylkill River watershed. Discharge volumes could be obtained only for a small percentage of the STPs, and therefore the maximum permitted volumes were used to estimate effluent discharge. Nitrogen and phosphorous concentrations were estimated based on the level of treatment because most plants did not report the nutrient concentrations of their effluent. Of the plants identified, only 29 (35%) treated to the tertiary level, 52 (63%) treated to the secondary level, and one (1%) treated to the primary level. The assumptions made for nutrient concentrations in effluent after different levels of treatment are shown in **Table 5.4** (Thomann 1987).

Table 5.4 Estimated Nutrient Concentrations in Effluent after Different Levels of Treatment

Treatment Level	*Nitrogen Concentration (mg/l)*	*Phosphorous Concentration (mg//l)*
Raw Sewage	40	10
Primary	37	9
Secondary	27	8
Tertiary – Nitrification	26	7
Tertiary - NH3 removal	3	8
Tertiary - P removal	27	1

Annual nitrogen and phosphorus loadings in kg/ha for each subwatershed were calculated by estimating the loads from each STP in kilograms per year, summing within each subwatershed, and dividing by subwatershed area. Results are shown in the map: **Nitrogen from Sewage Treatment Plants**, and the map: **Phosphorus from Sewage Treatment Plants**. Note that results from this analysis reflect only loadings from within a given subwatershed, and do not account for the impact of nitrogen and phosphorus loadings from STPs in upstream subwatersheds. Results should therefore be used only to make relative comparisons of pollution sources among different subwatersheds.

In addition to permitted wastewater discharges, undocumented discharges of raw sewage also are a significant source of nutrients to receiving waters, particularly in the rural headwaters region of the Schuylkill River watershed. These “wildcat” systems should be identified and brought into compliance with existing regulations as quickly as possible. Similarly, combined sewer overflows (CSOs) from urban areas can be a source of nutrient loading. Continuing efforts should be made in the Philadelphia and Reading areas to meet or exceed NPDES requirements, and minimize the frequency and duration of combined sewer overflows. Nutrient loading from undocumented discharges and combined sewer overflows are not quantified in this analysis.

In combination with previously presented data, a rough comparison can be made between nutrient loading from publicly owned sewage treatment plants versus loading from non-point sources (from land cover and septic systems) for each Schuylkill River subwatershed. Because all possible nutrient sources were not quantified in these analyses, comparisons must be considered only as a general indication of the relative contributions from the specific sources mentioned. In general, the data suggest that non-point sources contribute the majority of nitrogen throughout much of the middle watershed, with nitrogen loading from publicly owned sewage treatment plants the predominant source only in the more developed lower watershed areas, including the Upper Wissahickon, Sandy Run, Lower Perkiomen, Schuylkill River 2, Schuylkill River 3, Skippack Creek, and E. Branch of the Perkiomen subwatersheds. Results for phosphorus follow a similar pattern, but with a greater importance associated with inputs from sewage treatment plants throughout the watershed.

5.5.9.2 Recommendations for Nitrogen and Phosphorous from Sewage Treatment Plants

Code	*Recommendation*	*Summary Description*	*Priority Area/ Target Subwatersheds*
R5.10	**Establish Uniform, Watershed-wide Criteria for Permitted Discharges from Sewage Treatment Plants (STPs)**	Criteria for permitted discharges of pollutants such as fecal coliforms vary among different PA DEP regions within the watershed. Uniform criteria should be developed to help regulate and reduce water quality impairment from sewage treatment plants.	All Zones
R5.11	**Monitor Nutrients from All Sewage Treatment Plants**	Sewage treatment plants may not monitor all relevant nutrient levels in their effluent. Establishing uniform discharge criteria and monitoring nutrients at all sewage treatment plants would help to assess nutrient loading to receiving waters.	All Zones Schuylkill River 3 Lower Perkiomen Creek Skippack Creek Upper Wissahickon Creek Sandy Run Schuylkill River 2 Schuylkill River 5
R5.12	**Promote Tertiary Treatment of Sewage Effluent**	Less than half of the treatment plants in the Schuylkill River watershed provide tertiary treatment of sewage effluent. Where effluent is a problem, plants should be upgraded to provide higher levels of treatment.	All Zones
R5.13	**Identify and Control Discharges of Untreated Sewage from "Wildcat Systems" and Combined Sewer Overflows (CSOs)**	Discharges of untreated sewage from "wildcat" systems and combined sewer overflows represent a threat to human health and aquatic ecosystems. Wildcat systems should be identified and regulated, and CSOs monitored for compliance with existing regulations.	All Zones

5.5.10 NPDES Permitted Discharges

Under Section 402 of the Clean Water Act of 1972, all facilities discharging to navigable waters must possess a National Pollutant Discharge Elimination System (NPDES) permit as administered by the US EPA. Facilities permitted for discharge within the Schuylkill River watershed were identified using the EPA's Better Assessment Science Integrating Point and Non-point Sources (BASINS). The compiled information relies on data from the EPA's Permit Compliance System (PCS) for the years 1991-1996 and contains entries for

facilities holding National Pollutant Discharge Elimination permits. Point source discharge locations are shown in the map: **Point Source Discharge Locations**. A full listing of facilities with NPDES permits listed in the EPA PCS, including information about receiving water, flow rates, and parameters present in discharge, can be found in **Reference Table 5H: Facilities with NPDES Permits Listed with the EPA Permit Compliance System** in the online Reference Documents. Quantitative estimates of nutrient loading from point-source discharges other than publicly owned sewage treatment plants were not made due do limitations of the BASINS data. A more complete and up-to-date compilation of all dischargers within the watershed is available through the Schuylkill River Sourcewater Assessment Partnership (http://www.schuylkillswa.org). Additional information about this data can be obtained from the Philadelphia Water Department, Office of Watersheds.

5.6 Detailed Recommendations from the Water Quality Analysis

This section presents detailed recommendations for protecting water quality in the Schuylkill River watershed. Each recommendation is listed in a table by its code, the name of the recommendation, a representative list of appropriate groups/agencies that might implement or guide the implementation of each recommendation, the key water quality issues addressed, and the water quality analysis section(s) of this chapter to which this recommendation corresponds. Each table is followed by a detailed description of the recommendation.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.1	**Establish a Coordinated, Watershed-wide Monitoring Program with Quality Control Protocols**	Multi-stakeholder design team including PA DEP, PA DCNR, US EPA, USGS, volunteer monitoring groups, nonprofits, academics and experts	Water quality monitoring	5.4

Description

One of the findings of this water quality modeling effort has been that reliable, updated data for the watershed are needed. Large portions of the watershed are not covered by local groups, and perhaps not even by regional groups, conducting water quality monitoring or research activities. Furthermore there are numerous volunteer-monitoring activities underway throughout the watershed. Efforts should be made to establish a watershed-wide monitoring network to identify current and future water quality problems within the watershed. Coordinating among groups currently sampling in the watershed would facilitate this process, possibly through the water utilities in the Source Water Protection study.

The general lack of consistent water quality data was discussed thoroughly in a recent US GAO report titled *Key EPA and State Decisions Limited by Inconsistent and Incomplete Data* (GAO RCED-00-54). Although some water quality monitoring is in place through state and federal programs, the GAO report reveals that these data are rarely consistent or comprehensive watershed-wide. Yet, these scientific data are essential for any assessment of watershed quality on a local, statewide or national scale, being critical indicators of ecological health. They are also required for fulfilling legal requirements such as the TMDLs required for pollutants in 303(d) waters. Finally, these water quality indicators are the most visible and tangible expression of watershed health in the public eye.

Despite public interest, citizen activism and pressure from watershed groups, monitoring programs are scarce in most states. Thanks to the presence of strong watershed groups and active citizens, the PA DEP has an opportunity to take a leadership role in this area and partner with local organizations as well as the EPA to design an appropriate basin-wide monitoring system. A key challenge to be addressed is convincing funding sources, which may view monitoring as a form of academic research and disqualify it from their grants, of the critical importance of undertaking this program. Proponents of the monitoring plan should undertake education and outreach to funders to identify likely partners, provide

strong rationale for funding monitoring, and encourage funders to support a basin-wide monitoring effort. The foundation network could be a useful mechanism for funding the monitoring program (see Recommendation **R7.3** in **Section 7.5** of *Chapter 7.0 Institutional Assessment*).

Role of Volunteers in Monitoring

Volunteer water quality monitors play an important role in looking for and documenting water quality problems throughout the watershed. Volunteer monitoring programs also are an effective way of educating and empowering individuals and communities concerned about the environment. For volunteer monitoring programs to be most effective, volunteers must be trained in the proper sampling methods, and the data collected must be subject to some form of quality control. Programs are already in place to train volunteers in sampling methods. To assure data quality, a professionally managed quality control and data validation program should be established, and all data collected by volunteers given a rating according to quality. This program would ideally involve a respected analytical laboratory, and include volunteer analysis of laboratory standards as well as laboratory analysis of samples previously tested by volunteers. Error estimates should be assigned for each sample based on specified quality control protocols. A less rigorous approach, but easier to implement, would be to coordinate sampling by volunteers and professionals at specific times and places, and to check volunteer sampling results against professionally determined results.

Water Quality Monitoring Program

Based on the need for better quality, more comprehensive water quality data, the number of groups and citizens currently testing water quality, the reliability of citizen monitoring, and issue of data storage, several recommendations on components of a Schuylkill River watershed water quality monitoring program follow.

1. Design a Statistical Sampling Scheme. State and federal agencies, along with key nonprofit and academic groups involved in watershed monitoring and research, should cooperate to design a comprehensive watershed-wide monitoring program. This gathering might take the form of a workshop on monitoring design, bringing together experts from these agencies and other groups to develop agreed-upon monitoring standards and sites. Monitoring data collection should address physical, chemical and biological indicators of watershed health. The monitoring design should incorporate comprehensive statistical sampling across the entire watershed as well as intensive sampling at priority sites for conservation or pollution remediation. The Stroud Water Research Center began regular scientific testing on nineteen different tributaries throughout the Schuylkill River watershed in 1994. This study should be incorporated into any larger sampling program along with other sites which have long-term, reliable data so that the historical information is not lost.

   To generally characterize water quality within the watershed, sampling should focus on the mainstem Schuylkill River and mouths of major tributaries. If possible, sampling also should be extended upwards to the mouths of successively smaller tributaries throughout the watershed. Samples should be collected from each location at least four times a year to account for seasonal variation in water quality, and should include at least one sample during the annual low flow in late summer or fall. In addition, samples should be collected periodically during storm runoff events (rainstorms) to monitor water quality changes associated with non-point source loading. At a minimum, sampling should include temperature, pH, conductivity, turbidity, nitrogen, and phosphorus. Other parameters including dissolved metals, toxic organic materials, and pathogens should be sampled where contamination is suspected or to address local issues and concerns. The resulting data should be available on a user-friendly website allowing people to access and use the data. Monitoring could be coordinated with USGS gauging stations to create a network throughout the watershed.

   Long term, continuous streamflow data is another important need within the watershed. Efforts should be made to help prevent the closure of existing USGS streamflow gages, and if possible additional streamflow gauging stations should be installed on tributaries throughout the watershed.

2. Use Available Watershed Resources with Quality Control Protocols or Certification Program. In order to better engage public participation and to incorporate the substantial monitoring activities of citizen groups, a training and certification program to promote the newly-formed monitoring design should be sponsored by interested state and

federal agencies. This training for citizen monitors might include a workshop on the standardized monitoring program, enrollment of citizen activists in collection of monitoring data, and a "certification" that identifies the participant as an active member of the watershed monitoring system. Certified volunteers and participants could participate in multiple levels of monitoring system construction, implementation and data collection. As part of the citizen effort, water quality testing kits will need to be funded and provided to participants. The Stroud Water Research Center has an established citizen water quality training program, named *Stream School*, that could be the critical starting point for creating training programs; additionally, the Schuylkill Riverkeeper, a program of the Delaware Riverkeeper Network, has organized annual Citizen Monitoring Workshops, which could link the designed program to the needed citizen monitors.

One example of a citizen training program is the Citizens Volunteer Monitoring (CVM) Program offered by the PA DEP. This program offers CVM Clinics that are designed for groups of up to 3 people who have sufficient watershed knowledge and technical expertise to design monitoring programs. While the Clinics offer critical technical assistance to watershed groups with some expertise, groups with less expertise and citizens who are interested in participating in a wider monitoring program also should receive training as suggested above. For more information see the US EPA website: http://www.epa.gov/OWOW/monitoring/volunteer/epavm.html.

3. Centralized Data Repository. The development of a monitoring system should provide for a data repository, probably a centralized database, with a designated staff member responsible for data compilation, updating and quality control. The monitoring design also should provide for participant and monitoring staff discussion, for periodic reevaluation of the program using indicators of success, for re-training and training of new participants, for public data access, and use of the data by other agencies and groups in water quality reporting. Ideally, by creating a consistent set of monitoring goals, by accessing and incorporating grassroots resources, and by creating a watershed data repository, the result would be a highly consistent data set that could be used by the state in reporting water quality to the US EPA, or by nonprofits in determining where restoration and remediation efforts need to be focused. This basin-wide monitoring program would make the Schuylkill River a leader in watershed monitoring, providing an example to watersheds in Pennsylvania and beyond.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.2	**Implement Urban Best Management Practices to Maximize the Infiltration of Water and Reduce Urban Non-point Source Pollution**	PA DEP, US EPA, municipalities, nonprofit watershed groups	Stormwater runoff Non-point source pollution (nutrients, toxics, sediment, erosion) Water supply	5.5.2 5.5.3 5.5.6 5.5.8

Description

A variety of best management practices (BMPs) can help prevent and mitigate the effects of stormwater runoff and related non-point source pollution in urban and urbanizing areas. The basic objective of most urban BMPs is to increase the infiltration of water into the soil, thereby reducing stormwater runoff volumes, reducing non-point pollution, and increasing groundwater recharge. In areas currently under development, runoff prevention is an important strategy. Prevention practices include encouraging new planning and zoning to allow urban BMPs, minimizing impervious cover, cluster development/alternative lot configuration, minimizing disturbance during construction, reducing setbacks (distance from the house to the road), decreasing road widths and lengths, installing porous pavement in parking areas, shared parking areas, and installing sidewalks on only one side of the street.

Other methods of encouraging water infiltration include infiltration basins, infiltration trenches/dry wells, and porous pavement (US EPA 1993). Infiltration basins require well-drained soils and groundwater tables at least 2-4 feet below the bottom of the basin, to allow slow percolation of water from the basin through the soil. Infiltration trenches may be used on a smaller scale to infiltrate stormwater runoff. Porous pavement may be used in place of traditional concrete or asphalt, and is well suited to parking areas that receive light use. Vegetated filter strips, grassed swales, terraces and

specially graded areas, reforestation/revegetation, and sedimentation and retention basins also can be used to infiltrate water and reduce non-point pollution. The above practices are suitable for areas undergoing new development as well as those with existing infrastructure.

Many excellent sources of information about urban BMPs are available (Schueler 1987; US EPA 1993; DNREC and Brandywine Conservancy 1997). The EPA and Center for Watershed Protection's web page, *Stormwater Managers Resource Center* (http://www.stormwatercenter.net) also has good information on the impacts of urban development on streams, and stormwater related BMPs.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.3	**Encourage Homeowners and Small Businesses to Reduce Non-Point Pollution**	PA DEP, PA DCNR, County Conservation Districts, nonprofit watershed groups, schools	Non-point source pollution	General

Description

Homeowners, small businesses, and individual citizens play an important role in protecting water quality and general stream health. Though the impact of any one person or business on water quality may be small, the cumulative effects from a large number of people can be substantial. This is particularly important for people living or working adjacent to rivers, stream, ponds and other water bodies. Educational tools and programs should be developed and used to educate people about the impacts of their daily actions on water quality, and how they can reduce non-point source pollution by properly applying lawn fertilizer and chemicals, cleaning up after pets, properly disposing of household wastes, properly storing cars and other vehicles which may leak oil and gasoline, and not dumping trash and yard waste into streams.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.4	**Implement Nutrient Management Practices**	County Conservation Districts, PA DEP, USDA NRCS, County Extension, Penn State University Extension	Non-point source pollution (nutrients)	5.5.6

Description

Non-point source loading of nitrogen and phosphorous from agricultural lands can impact water quality and degrade stream health. Nutrient management practices (NMPs) are designed to help farmers optimize crop growth while minimizing the impact on the environment through careful management of nutrient applications. The Cadmus Group (1998) in their Lake Ontelaunee Watershed report, list the main components of a sound agricultural nutrient management plan as:

Soil testing
Determining nutrient levels in manure
Crediting of residual nitrogen from previous crops
Determining how and when to apply manure
Calibrating the manure spreader
Determining any additional fertilizer needs
Considering erosion and runoff
Conducting a yearly review

Efforts should be made to implement nutrient management practices wherever possible, and particularly in subwatersheds where nutrient loading is a problem. Assistance with the development of nutrient management practices is available from County Conservation Districts, extension services (Penn State University Extension, County Extension), the USDA Natural Resources Conservation Service (http://www.nrcs.usda.gov), and PA DEP (http://www.dep.state.pa.us).

Nutrient management practices should also be encouraged in urban and suburban areas where fertilizer is applied to golf courses, parks and lawns. Landowners, landscapers, and professional groundskeepers should be educated concerning the

proper use and application of fertilizers to minimize nutrient runoff associated with over fertilization. Similar programs should be implemented for the urban/suburban use of pesticides and herbicides. A related issue common throughout the watershed is high nutrient and pathogen loading from large resident populations of geese in public parks and other open space. Efforts should be made to reduce the congregation of geese, especially in areas directly adjacent to water bodies, by proper design and planting vegetation to break sightlines, and discouraging the public from feeding geese.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.5	**Implement Agricultural Best Management Practices**	County Conservation Districts, PA DEP, USDA NRCS, County Extension, Penn State University Extension	Non-point source pollution (nutrients, sediment)	5.5.6 5.5.8

Description

In addition to the nutrient management practices mentioned above, many other methods exist to reduce the amount of non-point source sediment and nutrient pollution from agriculture. Examples of agricultural best management practices include:

Conservation tillage
Contouring
Contour strip cropping
Graded rows
Grassed outlets
Improved soil fertility
Meadowless rotations
No-till plant in prior crop residues
Plow plant systems
Ridge planting
Sod-based rotation
Stream bank fencing
Terraces
Timing of field operations
Winter cover crops

Other agricultural BMPs include establishing and protecting riparian buffers, fencing to control access of livestock and other animals to streams and other water bodies, and controlling runoff from animal feedlots and barnyards. Sources of information that provide additional information and guidance in implementing agricultural best management practices include: PA DEP (*BMP Manual for Livestock and Poultry Operations*); County Conservation Districts; Penn State University Extension; USDA NRCS (http://www.nrcs.usda.gov); and the *Handbook of Non-point Pollution: Sources and Prevention* (Novotony and Chesters 1981). Cost sharing programs are often available to aid farmers in funding implementation of BMPs.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.6	**Implement Timber Harvesting Best Management Practices**	County Conservation Districts, PA DCNR, County Extension, Penn State University Extension	Non-point source pollution (nutrients, sediment)	5.5.6 5.5.8

Description

Timber harvesting operations can be a significant cause of increased sediment and nutrient loading to rivers and streams. Sediment loading associated with logging roads is an especially important problem. To minimize the impacts of timber harvesting operations within the Schuylkill River watershed, best management practices should be employed including implementation of erosion and sedimentation plans, proper road design, no cutting on steep slopes, and maintenance of riparian buffers along all water bodies. For more detail on the function and benefits of riparian buffers see Recommendation **R5.7** below and **R6.6** in **Section 6.8** of *Chapter 6*.

Additional information and guidance in implementing timber harvesting best management practices can be obtained from PA DCNR Bureau of Forestry, County Conservation Districts, County Extension, and Penn State University Extension.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.7	**Protect and Restore Riparian Forest Buffers**	PA DEP (Growing Greener, Stream Releaf), PA DCNR, nonprofit watershed groups, municipalities, PA Fish and Boat Commission	Non-point source pollution (nutrients, sediment) Habitat quality	5.5.4 5.5.6 5.5.8

Description

Streamside or "riparian" forests are important to protecting and improving water resources and aquatic ecosystems throughout the Schuylkill River watershed. Riparian forests are complex ecosystems that help provide high quality food and habitat for stream communities. These forests shade streams, providing optimum light and temperature conditions for aquatic life, and are an important source of leaf litter, large woody debris, and organic matter food to streams (Welsch 1991). Riparian forests also serve as filters or "buffers," mitigating or controlling non-point source pollution by stabilizing stream banks and filtering runoff before it reaches the stream. Used as a component of an integrated management system that includes nutrient management and sediment and erosion control practices, riparian forest buffers can be effective in removing excess nutrients and sediment from surface runoff and shallow groundwater.

Throughout the Schuylkill River watershed, riparian disturbance associated with agricultural and urban development has greatly reduced the area of streambank protected by riparian forests. Riparian disturbance is most common in the agricultural and urban zones of the middle and lower watershed, and in valley bottoms where agriculture and urban development typically occur. Smaller streams (first and second order) are particularly susceptible to riparian disturbance, which can lead to significant impacts on water resources and ecosystem health downstream. The health of a large stream such as the Schuylkill River at Philadelphia is directly related to the health of its many smaller tributaries throughout the watershed.

In order to protect and enhance water resources and aquatic ecosystems, remaining riparian forests within the Schuylkill River watershed should be preserved and extended. In areas where riparian forests have been disturbed, native riparian communities should be re-established wherever possible, especially along sensitive first and second order streams. The protection and restoration of riparian forests is particularly important in areas: where non-point source pollution is a problem; where shallow soils, steep slopes, or land disturbance results in large amounts of storm runoff; where sensitive species or ecosystems exist; and, where significant amounts of riparian forest have been disturbed within a watershed. Riparian buffer protection ordinances are encouraged to protect existing riparian habitats.

Riparian forest buffers will be most effective when used as part of a comprehensive land management program addressing stormwater runoff, nutrient management, and sediment and erosion control practices. Riparian forest buffers should be designed using a 3-zone approach: a zone of undisturbed forest approximately 15 feet wide adjacent to the waters edge; a zone of managed forest about 60 feet wide contiguous with the undisturbed forest zone; and a zone where runoff is controlled contiguous with the managed forest zone. The recommended width for forested buffers varies between about 75 and 150 feet based on soil characteristics, adjacent land-use, and project goals (Welsch 1991). Where the recommended width is not possible, smaller buffers should still be established. Where forested buffers are not desired by landowners, vegetative grass or shrub buffers should be established at a minimum.

There are currently several groups and programs in the Schuylkill River watershed addressing riparian reforestation, and resources are available for further information about planning and implementing a reforestation project. The Heritage Conservancy will complete a detailed inventory of the condition of riparian buffers for all streams in the Perkiomen and Valley Creek Watersheds in spring 2001 (http://www.heritageconservancy.org). The Heritage Conservancy will complete riparian buffer inventories for other streams in the Schuylkill River watershed over the next several years. Efforts should be made through these and other programs to protect and restore riparian buffers wherever possible in the watershed.

For general information on riparian reforestation see Welsch (1991) or Federal Interagency Stream Restoration Working Group (1998). For Pennsylvania, contact the PA DEP Bureau of Watershed Conservation Stream ReLeaf program

(http://www.dep.state.pa.us) and the Pennsylvania Riparian Buffer Initiative Implementation Plan (PA DEP 1999), the PA DCNR (http://www.dcnr.state.pa.us), the PA Fish and Boat Commission (http://www.fish.state.pa.us), or local watershed conservation groups for resources on riparian forest buffers. For discussion of the importance of riparian buffers as green space corridors see Recommendation **R6.6** in **Section 6.8** of *Chapter 6*.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.8	**Protect and Restore Wetlands and Areas of Hydric Soils**	PA DEP, PA DCNR, nonprofit watershed groups	Non-point source pollution (nutrients, sediment) Stormwater runoff Habitat quality	5.5.6 5.5.8

Description

Wetlands play a critical role in regulating the movement of water, nutrients, and other materials within watersheds. Wetlands often function like natural sponges, storing water during floods and slowly releasing it over time, thereby reducing flood heights and volumes of stromwater runoff. Wetlands also influence water quality by acting as sources, sinks, or transformers of nutrients, organic compounds, metals, and other materials. The biologically mediated process of nitrification/denitrification in the nitrogen cycle by wetland bio-organisms can transform the majority of nitrogen entering wetlands, causing between 70% and 90% loss of nitrogen to the atmosphere. Phosphorus entering wetlands can be removed through uptake by plants and soil microbes, with sediment deposition, and by chemical precipitation. Interaction with wetland soils can also remove metals from surface and ground water, and thus is an effective means of mitigating acid mine drainage. Lastly, wetlands act as filters of sediments and organic matter. In general, wetlands with abundant vegetation will be more capable of reducing runoff velocity and removing pollutants from the water than a wetland with less vegetation.

In addition to hydrologic and water quality effects, wetlands also play an integral role in the ecology of watersheds. The combination of shallow water, high levels of nutrients, and primary productivity is ideal for the development of organisms that form the base of the food web and feed many species of fish, amphibians, shellfish, and insects. Many species of birds and mammals rely on wetlands for food, water, and shelter, especially during migration and breeding.

In the Schuylkill River watershed, wetlands reduce the likelihood of flood damage, help control increases in the rate and volume of runoff from urban areas, and improve water quality by intercepting surface runoff and reducing nutrient and sediment loads. Efforts should therefore be made to protect and restore wetlands throughout the watershed. Areas of hydric soils may offer the best potential for wetlands recreation or restoration.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.9	**Identify and Enforce Sediment and Erosion Control Problems and Violations**	PA DEP, County Conservation Districts, municipalities, cooperative extension, US EPA, nonprofit watershed groups, soil conservation districts	Non-point source pollution (sediment, erosion)	5.5.8

Description

Sediment loading from construction sites and other land cover disturbances within the Schuylkill River watershed can degrade habitat and impair stream health. Unlike other non-point source pollution problems, sediment erosion from construction sites is relatively easy to identify, and can be controlled with the use and enforcement of proper erosion and sediment control measures. Examples of these measures include straw bales, silt fences, grassed swales, vegetative filter strips, and sedimentation basins. Most construction projects are required to have erosion and sedimentation plans;

however, plans frequently are either not adequate or not properly maintained, resulting in significant sediment loading to streams. Municipalities and other government agencies should take measures to assure that procedures are in place for monitoring compliance with erosion and sedimentation plans.

In addition, citizen volunteers can be trained to help monitor their watershed for existing and potential erosion and sediment problems. For example, the Delaware Nature Society (http://www.delawarenaturesociety.org) has established a *Soil Watch* program in which volunteers learn what problems to look for in the watershed, and how to report problems to the appropriate agencies and organizations. Such a program could be established in municipalities within the Schuylkill River watershed. Other information and guidance about erosion and sedimentation plans can be obtained from the Pennsylvania Department of Environmental Protection (http://www.dep.state.pa.us), County Conservation Districts, soil conservation districts, and the US EPA (http://www.epa.gov).

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.10	**Establish Uniform, Watershed-wide Criteria for Permitted Discharges from Sewage Treatment Plants (STPs)**	PA DEP, US EPA	Point source pollution (pathogens, nutrients)	5.5.9

Description

Criteria for permitted discharges of pollutants such as fecal coliforms vary among different PA DEP regions within the Schuylkill River watershed. Efforts should be made to establish uniform, watershed-wide criteria for permitted discharges from sewage treatment plants throughout the watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.11	**Monitor Nutrients from All Sewage Treatment Plants**	PA DEP, utilities, municipalities	Point source pollution (nutrients from STPs)	5.5.9

Description

Sewage treatment plants may not monitor all relevant nitrogen and phosphorus concentrations in their effluent. Monitoring and reporting nutrient releases from all sewage treatment plants would provide important information about nutrient loading to Schuylkill River subwatersheds, and would help target plants that may need advanced levels of sewage treatment. This should be emphasized where problems associated with elevated nutrient concentrations, such as excessive algae growth, are observed downstream of discharge locations.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.12	**Promote Tertiary Treatment of Sewage Effluent**	PA DEP, municipalities	Point source pollution (nutrients from STPs)	5.5.9

Description

Effluent from sewage treatment plants can impair water quality, particularly in areas immediately downstream of discharge locations, and during low-flow conditions. Nutrient loading and other pollution from treatment plants is easily identified, however, and for many plants can be decreased by upgrading to advanced tertiary treatment processes. In the Schuylkill River watershed, less than half of the treatment plants currently provide tertiary treatment.

In Schuylkill River subwatersheds with high nutrient loading from treatment plants, water quality improvements could be made by upgrading treatment facilities to provide tertiary treatment. However, the cost of upgrading plants can be high,

and plant upgrades should be evaluated against alternative methods of reducing nutrients, such as non-point focused nutrient management practices and BMPs. Often programs are available through the state and federal government to help financially support municipal efforts to increase the treatment level. Upgrading sewage treatment plants also should be emphasized where problems associated with elevated nutrient concentrations are observed downstream of discharge locations.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.13	**Identify and Control Discharges of Untreated Sewage from "Wildcat Systems" and Combined Sewer Overflows (CSOs)**	PA DEP, municipalities, health departments, utilities	Point source pollution (nutrients, pathogens)	5.5.9

Description

Untreated sewage effluent contains harmful pathogens, high amounts of nutrients, and potentially many other pollutants. Discharges of untreated sewage to rivers and streams represent a serious threat to stream and human health. Illegal discharges of untreated domestic sewage, or "wildcat" systems, are known to occur in the rural headwaters areas of Schuylkill County, and should be located and brought into compliance with existing regulations as quickly as possible. Programs should be established to assist municipalities and property owners who are not able to pay the cost of constructing or upgrading facilities.

Combined sewer overflows in urban areas such as Reading and Philadelphia are another source of untreated sewage discharge within the Schuylkill River watershed. Continuing efforts should be made to meet or exceed NPDES requirements, and decrease the frequency and duration overflows.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.14	**Establish Septic Education, Registration, Inspection, and Maintenance Programs**	PA DEP, health departments, municipalities, nonprofit watershed groups, US EPA	Non-point source pollution (nutrients)	5.5.7

Description

Failing or improperly maintained septic systems can cause high nutrient loading and associated water quality impairment. Septic system siting and permitting for all on-lot disposal systems is regulated under the Pennsylvania Code, Title 25, Chapter 73 (http://www.pacode.com/secure/data/025/chapter73/chap73toc.html). Septic system maintenance is the responsibility of property owners.

To minimize water quality impairment due to septic systems, programs should be established: to educate property owners about how septic systems can impact water quality; to provide guidance about the proper maintenance of septic systems; and, to provide the information and tools necessary for property owners to test their systems to ensure continued proper functioning. The on-lot septic system permitting program is handled by health department officials in Philadelphia, Montgomery, and Chester Counties. In other counties, Sewage Enforcement Officers oversee the program. Education and testing programs should be coordinated with current on-site programs administered by county Sewage Enforcement Officers or health departments.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.15	**Size and Maintain Culverts and Bridges to Ensure Minimal Impact to Streams**	Municipalities, PA Dept. of Transportation, PA DEP	Stormwater runoff Non-point source pollution (sediment, erosion)	5.5.4

Description

Culverts and bridges frequently constrict and change the natural flow of streams resulting in downstream bank instability and erosion. When flows exceed design specifications, generally the 10 or 25 year flood flows, culverts can overflow and cause flooding (Riley 1998). Culverts also can cause flooding when clogged with sediment or debris. During low flows, improperly designed culverts can cause a shallow water barrier that fish and other stream organisms cannot cross.

Culvert structures should be sized and designed to adequately accommodate flood flows as well as low flow channel conditions. In developing areas, culvert design should account for projected growth and associated increases in storm runoff volumes, which can deposit litter, sediment and pollutants into streams. Where problems with flooding or channel erosion persist, culverts should be replaced with bridges that allow the stream to flow without any obstruction. Bridges also must be properly designed to manage flood flows and minimize the accumulation of debris. All culverts and bridges must be inspected and maintained on a regular basis.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.16	**Conduct Inventories and Studies to Identify and Remove Dams Where Restoration Benefits Outweigh Present Uses and Effects**	PA DEP, PA Fish and Boat Commission, nonprofit watershed groups	Habitat quality Water supply	5.5.5

Description

There are approximately 280 dams in the Schuylkill River watershed. Dams can adversely affect the health of rivers and streams by altering flow regimes, changing water temperature and chemistry, altering sediment transport and physical habitat, and disrupting resident and migratory fish communities. Many dams in the watershed no longer serve their intended purpose and/or are potential safety hazards, and have been designated by PA DEP as "orphans" with no legal owner.

In recent years, dam removal has been employed in Pennsylvania and other states as a method for restoring free-flowing stream ecosystems and migratory fish communities. Determining the benefits of dam removal can be complex, and in some cases the ecological benefits of dam removal may be offset by issues related to the release of sediment stored behind the dam, recreational use of the impoundment, or cultural/historical values associated with the dam. Dam removal should be considered where the ecological and/or safety benefits outweigh present uses and other potential impacts of dam removal. Where dam removal is not possible, fishways and fish ladders should be constructed to allow fish passage and migration.

In addition, inventories and a study of existing dams in the Schuylkill River watershed should be done to determine the current uses and benefits. Information about dam removal in the Schuylkill River watershed is available from PA DEP, the Delaware Riverkeeper Network (http://community.homeearth.com/welcome.asp?cn=DRN) and the PA Fish and Boat Commission.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.17	**Identify Sources and Mitigate Effects of Acid Mine Drainage (AMD)**	PA DEP, County Conservation Districts, nonprofit watershed groups	Acid mine drainage	General

Description

Acid mine drainage (AMD) is a significant source of water pollution in the mining region of the Schuylkill River

headwaters. AMD and associated pollutants, including heavy metals, can have severe impacts on aquatic ecosystem health, frequently destroying entire ecosystems. Most, but not all, of this pollution is in the form of discharges from mines abandoned before the 1964 amendment to the Clean Streams Law that required mine operators to treat mine drainage (PA DEP 1999). Since that time, applicants for mining permits have been required to demonstrate that mining would not cause mine drainage pollution following reclamation of the mine.

In current and historic mining areas, undocumented sources of AMD should be identified and monitored to determine the scope and magnitude of impacts to water quality and aquatic ecosystems. A program for restoring streams impacted by AMD should be implemented, and the permitting of new mines should rigorously evaluate the potential for future liability and AMD problems. Restoration should seek to raise the pH of the effluent and reduce metals concentrations in aquatic ecosystems. Potential restoration methods include chemical treatment, and alternatives such as constructed wetlands, limestone channels, and bioremediation techniques. Generally, passive treatment is preferred over methods requiring active management.

The Pennsylvania DEP (1999) recently reviewed the current mine permitting program, and made several recommendations for managing AMD problems.

(1) Better methods should be developed for predicting post-mining manganese problems.

(2) Continuing education for permit reviewers has been very successful in maintaining a high level of technical ability and should be continued.

(3) Pit water and untreated discharge effluents should be sampled and documented on a regular basis.

(4) Special handling and alkaline addition sites warrant increased inspection frequency and should be documented in detail in inspection reports.

(5) Low rates of alkaline addition cannot be relied on to make a marginal permit issueable.

(6) Classification and use of receiving streams should be given consideration in permit decisions.

(7) Caution must be exercised in reviewing permits with all sandstone overburden or where the only source of neutralization potential is in sandstone.

(8) No environmental reason exists to leave coal outcrop barriers in place.

(9) All of the available permit review tools, not just overburden analysis, should be considered in the review of a permit application.

The recently released Upper Schuylkill River Tributaries Assessment Report (L. Robert Kimball & Associates, Inc. 2000) identifies major non-point/acid mine drainage (NPS/AMD) sources within the upper Schuylkill River watershed area, compiles existing available analytical/physical data associated with those discharges, and evaluates the impacts in regard to water quality. Results include a ranking of 35 individual AMD source locations, and identification of eleven priority sites within an area from the headwaters of the Schuylkill River near Tuscarora to the confluence of the West Branch Schuylkill River and the main stem in Schuylkill Haven. For more information contact PA DEP's Bureau of Abandoned Mine Reclamation (http://www.dep.state.pa.us), local County Conservation Districts, or local watershed conservation groups.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.18	**Monitor and Regulate Existing and Future Groundwater Withdrawals**	DRBC, PA DEP, PA DCNR	Water supply Habitat quality	General

Description

Groundwater is an integral part of the water cycle, and should not be considered separate from surface water. During dry weather, groundwater is the principal source of streamflow, and when depleted streams and wetlands can be significantly impacted due to reduced flow. Groundwater supplies vary throughout the Schuylkill River watershed due to differences

in geologic composition, and the balance between recharge from precipitation and discharge as streamflow and from pumped wells. In order to protect existing uses of groundwater as well as stream health, groundwater pumping within the Schuylkill River watershed should be carefully monitored and regulated to ensure that supplies are not depleted.

The Delaware River Basin Commission (DRBC) currently regulates groundwater withdrawals throughout the Schuylkill River watershed. Groundwater depletion is of particular concern in the Ground Water Protected Area of Southeastern Pennsylvania which encompasses parts of Berks, Bucks, and Chester Counties, and all of Montgomery County (DRBC 1999). Groundwater supplies in this area are managed by DRBC through numerical ground water withdrawal limits. This program should be continued, and similar regulations should be considered in other areas where groundwater depletion is a problem. For more information about this program contact the Delaware River Basin Commission (http://www.state.nj.us/drbc).

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.19	**Support PEMA Removal of Structures from Flood Prone Areas**	PEMA, FEMA, County Emergency Management Offices	Stormwater runoff Non-point source pollution	General

Description

In an effort to break the repetitive flood disaster cycle of damage-rebuild-damage, the Pennsylvania Emergency Management Agency (PEMA) has established a Hazard Mitigation Program which promotes the acquisition and relocation or removal of structures from flood-prone areas. The program also supports efforts to flood-proof existing structures and other measures to provide protection or reduce likely damage from future disasters. In addition to safety and property damage issues, removal of structures from floodplains will provide ecological benefits, including reduced non-point source pollution, and reduced stormwater runoff. Efforts should be made to support PEMA removal of structures from flood prone areas. Competitive Hazard Mitigation Grants are available to help residents and business owners with these types of projects. For further information consult the PEMA Hazard Mitigation Office (http://www.pema.state.pa.us), your County Emergency Management Coordinator, or the Federal Emergency Management Agency (FEMA) (http://www.fema.gov).

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.20	**Fund Studies to Document Watershed Condition and Resources**	PA DEP, PA DCNR, US EPA, USDA, private foundations	Stormwater runoff Non-point source pollution Point source pollution Habitat quality Water supply	General

Description

Watershed management should be based on sound scientific principles and reliable field data. In order to develop effective management policies, studies should be conducted to document watershed condition and resources including detailed water budgets, water quality trends, land cover changes, the location and hydrologic/ecological significance of quarries and quarry pumping, the extent of riparian disturbance, wetland disturbance, and other characteristics. A program of basic research and technology transfer should be supported. Research areas of particular concern include: the effects of urban development and other land-use changes on streams; restoration methods and where within the watershed restoration is most needed; evaluation of best management practices; potential problems associated with climate change; and, evaluation of institutional or educational programs for promoting conservation and stewardship. Other studies of value in assessing and managing water resources in the Schuylkill River watershed include the design and implementation of a water quality monitoring network, and studies investigating water use and water balance to determine the limitations of existing surface and groundwater supplies throughout the watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.21	**Support Studies to Assess the Impacts of Mineral Extraction on Water Quality and Quantity**	PA DEP, PA DCNR, US EPA, private foundations	Point source pollution Habitat quality Water supply	General

Description

For mining operations in the watershed, there may be potential metals and sediment impacts on adjacent streams; when closed down, there may be potential groundwater/hydrology impacts. In order to better understand both water quality and water quantity issues in the watershed, these impacts should be assessed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.22	**Complete Comprehensive Water Budget Studies for the 37 Subwatersheds in the Schuylkill Drainage**	PA DEP, PA DCNR, US EPA, private foundations	Stormwater runoff Non-point pollution Point source pollution Habitat quality Water supply	General

Description

Over 3 million people draw their water supply from the Schuylkill basin. A reliable potable water supply needs to be secured, at a minimum, in the Schuylkill River watershed. Ideally, aquatic habitat value also should be secured. Follow-up studies to the current Source Water Assessment (SWA) should conduct combined surface and ground water studies to generate watershed-based water budgets, while also considering the combined impacts of point and non-point pollution, so that a prioritized strategic plan of action can be developed to preserve the watershed's water resources. Where possible, the cumulative impacts of water withdrawal (regardless of well size), discharge, transfers out of the watershed and aquifer recharge should be factored into the source water analysis and strategic plan.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.23	**Support Cost-Effectiveness Studies on Treating Point Versus Non-Point Source Pollution Impacts**	PA DEP, PA DCNR, US EPA, private foundations	Stormwater runoff Non-point pollution Point source pollution Habitat quality Water supply	General

Description

The current SWA, or follow-up studies, should prioritize which water pollution issues to address first in terms of cost-effectiveness. Subwatershed-based cost-benefit analysis of treating point versus non-point source pollution impacts should direct strategic action on pollution treatment in the watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.24	**Support Cumulative Impact Assessments for Point and Non-point Source Pollution**	PA DEP, PA DCNR, US EPA, private foundations	Stormwater runoff Non-point pollution Point source pollution Habitat quality Water supply	General

Description

The current SWA, or follow-up studies, should assess the cumulative impacts of point and non-point pollution, and if possible, also assess the cumulative water extraction, discharge and recharge effects on a subwatershed basis across the entire watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections*
R5.25	**Support Outreach Phase for Implementation of the Schuylkill Source Water Assessment (SWA)**	PA DEP, PA DCNR, US EPA, private foundations	Stormwater runoff Non-point pollution Point source pollution Habitat quality Water supply	General

Description

The current SWA should be implemented through a follow-up outreach/marketing/crosswalk phase that ensures the guidelines it provides are adopted by municipalities, point-source facilities, nonprofits and citizens where necessary adopted throughout the watershed. This assessment should be done on a subwatershed basis to facilitate implementation.

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6.0 PROMOTING A SUSTAINABLE LANDSCAPE

6.1 Introduction

Sustainability is a goal best stated as a direction rather than a destination. Is our society becoming more or less sustainable? As an absolute, sustainability may not be currently achievable in our modern society, but we can take incremental steps towards that goal. Every improvement, however small, however slow, is an important step in the right direction. Hopefully, this Conservation Plan will help to pave the way for a sustainable landscape in the Schuylkill River watershed.

The goal of promoting a sustainable landscape focuses on: creation of an integrated, connected natural lands vision for the Schuylkill River watershed, incorporating existing and proposed greenspace nodes; and, recognition that protecting a quorum of natural lands will promote landscape sustainability and help preserve water quality. The following issues related to landscape sustainability were highlighted during the public opinion poll and the public meetings.

- Loss of critical natural lands to development due to rapid urban/suburban sprawl
- Need to encourage responsible growth and offset associated losses of farmlands and wetlands
- Need for open space preservation to assist in water quality preservation
- Need to create and maintain linear parks and greenways as biodiversity connectors and riparian corridors to preserve water quality
- Lack of guidance on ecological management of protected natural lands
- Lack of strategic regional planning for identifying and conserving the watershed's ecological resources

This chapter provides a summary of the Schuylkill River watershed's existing natural and biodiversity resources based on publicly available geographic information systems (GIS) data and landscape modeling. Data gaps and issues needing further study are identified, and recommendations for protecting and improving the sustainability of the landscape are given. In addition, the issues noted above, as well as many other critical conservation and land use topics, were documented and discussed in the Report of the 21st Century Environment Commission (1998) an excellent resource for reviewing issues of sustainable landscapes and development throughout the Commonwealth (http://www.21stcentury.state.pa.us).

6.2 Summary Recommendations

Recommendations for sustaining the landscape of the Schuylkill River watershed are summarized in the table below. Each recommendation is assigned a unique code number (e.g., **R6.1**) and name, and is cross-referenced to the key landscape or land use issue(s) it addresses. These recommendations are described in more detail in **Section 6.8 Detailed Recommendations for Landscape Sustainability**, and the page number where the detailed description of that recommendation can be found is listed in the *Page* column of this table.

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.1	**Establish a Watershed Land Protection Collaborative (WLPC) to Proactively Protect Greenspace**	More than 200,000 acres of potential greenspace across the watershed need to be protected within the next 20 years, to serve as the framework of a sustainable landscape and to ensure the health of the Schuylkill River watershed. A Watershed Land Protection Collaborative composed of watershed conservation groups working together needs to be established, to promote strategic land conservation and efficient resource use.	Loss of natural lands Need for greenspace Strategic conservation	6-23
R6.2	**Refine Prioritization of Watershed Natural Lands using a Standardized Relative Assessment Tool**	The watershed conservation community must take proactive steps to further prioritize high priority, sensitive lands according to their ecological value and degree of threat. Conservation groups should use established relative assessment tools to refine land prioritization and to conserve the high priority potential greenspace identified in this plan.	Loss of natural lands Need for greenspace Strategic conservation	6-24
R6.3	**Support Outreach and Education Programs Providing Landowners with Land Preservation Options**	Private citizens, who may have little understanding of the land preservation and ecological management options available to them, own the vast majority of lands proposed for preservation in the watershed. Outreach and education efforts should provide landowners with viable options and guidelines for land preservation and ecological management.	Loss of natural lands Need for greenspace Guidance on ecological management	6-25
R6.4	**Proactively Protect PA Natural Diversity Inventory (PNDI) Sites**	Protecting these identified high-value sites will help maintain the rare species biodiversity reservoir in the watershed. Protection of PNDI areas should be implemented in order of priority and threat, and to ensure a balanced portfolio of species and community biodiversity.	Loss of natural lands Need for greenspace	6-25
R6.5	**Proactively Protect Identified Greenspace Nodes**	Greenspace nodes (e.g., important bird areas, wetlands, floodplains, blocks of contiguous forest cover over 500 acres, and other priority habitat subwatersheds) need to be protected since they represent the biodiversity reservoirs in the watershed. Protection should be implemented in order of priority and threat.	Loss of natural lands Need for greenspace	6-26
R6.6	**Proactively Protect, Restore and Create Identified Greenway Corridors**	Greenway corridors will link greenspace nodes to help maintain environmental viability and connectivity in the watershed. In many cases, they can also serve a dual purpose as riparian buffers. Action should be taken according to priority and threat, where possible.	Loss of natural lands Need for greenspace Landscape connectivity	6-26

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.7	**Develop Strategic Protection Plans for Identified Subwatersheds in Habitat Zones**	Site-specific plans must be developed for each priority habitat subwatershed to identify appropriate land parcels for permanent protection. Protection should be implemented in order of priority and threat, where possible.	Loss of natural lands Need for greenspace Guidance on ecological management Strategic conservation	6-27
R6.8	**Develop Strategic Restoration Plans for Identified Primary Restoration Subwatersheds**	Site-specific plans must be developed for each priority restoration subwatershed to identify appropriate land parcels for riparian buffer installation and/or reforestation. These efforts should be reinforced with permanent protection where possible, and be implemented according to priority and degree of threat.	Loss of natural lands Need for greenspace Guidance on ecological management Strategic conservation	6-28
R6.9	**Develop and Adopt a Strategic Protection Plan for Watershed-wide Agricultural Land Resources**	Develop a watershed-wide plan based on site-specific data (soils, agricultural security districts) and funding, to prioritize agricultural land parcels for protection. Agricultural preservation can serve a supporting role in maintaining landscape sustainability if ecological BMPs and NMPs are implemented and enforced.	Need for greenspace Guidance on ecological management Strategic conservation	6-29
R6.10	**Reactively Protect Natural Resources in the Watershed as Opportunity Arises**	Whenever an unsolicited, high quality, cost-effective natural land protection opportunity arises (i.e., maximum natural land acreage for minimum financial and time resources), it should be evaluated for protection regardless of greenspace and subwatershed priorities.	Loss of natural lands Need for greenspace	6-29
R6.11	**Promote Development of Forest Resource Management Plans on Privately-owned Forest Lands**	The majority of the watershed's forest resources are found on private lands, and owners should be provided guidance on maintaining or restoring these lands to their natural health and viability.	Loss of natural lands Guidance on ecological management	6-30
R6.12	**Control Invasive Species and Deer Densities to Enhance Forest Regeneration of Native Plants**	Demonstration projects, particularly at environmental education facilities, should be developed and supported to address these concerns, especially where the human community is demonstrably engaged in proposed demonstration land management projects.	Loss of natural lands Guidance on ecological management	6-30
R6.13	**Develop Watershed-wide Adaptive Ecological Land Management Guidelines for Protected Lands**	Provide a detailed, standardized tool-kit for adaptive ecological management plans that includes the use of BMPs and NMPs on protected lands. Make this available to the watershed conservation community through a watershed service center.	Guidance on ecological management Strategic conservation	6-31

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.14	**Establish Community-Based Programs to Implement Adaptive Ecological Management Plans on All Protected Lands by Priority**	By developing Adaptive Ecological Management Plans that can be implemented by community volunteers, neighborhoods can reconnect with the local ecosystems on which they depend. A watershed-wide program should focus on the Urban/Suburban Zone.	Guidance on ecological management Strategic conservation	6-32
R6.15	**Develop and Adopt a Strategic Resources Plan for Watershed-wide Land Protection, Restoration and Ecological Management**	A watershed coalition of interested groups needs to build capacity (funding, personnel, expertise and leverage strategies) and develop a strategic funding plan to ensure sufficient resources to implement the land protection, restoration and management recommendations.	Strategic conservation	6-32
R6.16	**Develop an Interactive GIS Resource for the Watershed Community**	Capitalize on the investment made in GIS mapping and analysis for this Plan by making these data available through an interactive tool for use by the watershed conservation community and government agencies.	Strategic conservation	6-34
R6.17	**Establish a Funding Base, Schedule and Distribution Protocol for Updating and Upgrading GIS Mapping**	To address data gaps identified in this Plan, ensure that critical new or updated GIS data are added to the watershed GIS data set as necessary. Mandatory annual GIS data reviews should assess and address update/upgrade needs. Ensure distribution of upgraded GIS database to the watershed conservation community.	Strategic conservation	6-34
R6.18	**Develop Local-Scale Comprehensive Subwatershed River Conservation Plans**	Comprehensive subwatershed plans should be completed for areas in the Schuylkill River watershed not currently covered by local-scale River Conservation Plans.	Guidance on ecological management Need for greenspace Strategic conservation	6-36
R6.19	**Support the Schuylkill River Heritage Corridor Management Action Plan**	The Schuylkill River Greenway Association should be supported by government and watershed nonprofits in its efforts to develop a comprehensive Management Action Plan for the Schuylkill River Heritage Corridor and the National Heritage Area, addressing a full range of cultural, historic, scenic and recreational resource needs.	Need for greenspace Strategic conservation	6-36
R6.20	**Encourage Smart Growth Policies**	A number of smart growth programs exist at the federal, state and local levels, to help guide the development process to ensure sound environmental and economic growth.	Loss of natural lands Need for greenspace	6-37

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R6.21	**Support Brownfield Redevelopment Initiatives**	As the complimentary strategy to land preservation, a model redevelopment incentive ordinance with BMPs should be developed. Montgomery County Planning Department would be an ideal choice for developing this text, which could subsequently be distributed to municipalities throughout the watershed.	Loss of natural lands Need for greenspace Strategic conservation	6-38
R6.22	**Support Development of Standardized Demographic, Transit, Infrastructure and Land Use "Change Indicators" for the Entire Watershed**	In order to adequately characterize levels of threat in the watershed so as to better direct conservation, a collaboration of county planning agencies could address the need to develop and maintain periodic updates for critical data that will assist in tracking the development pressure and human population impacts throughout the watershed.	Loss of natural lands Need for greenspace Strategic conservation	6-38

6.3 Background and Procedure

Landscape analysis is a process of considering interrelated spatial features, defining patterns, identifying regional issues and/or ecological and human processes that are likely to cause those patterns, and then recommending solutions to solve the identified problems. In this Plan, the focus is on identifying and conserving landscapes that will help to sustain the watershed ecosystem: by defining the pattern of greenspace and protected natural areas that can function as an interconnected network to protect the ecological and hydrological processes of the watershed.

Specific steps taken to achieve the goal of promoting a sustainable landscape in the Schuylkill River watershed were:

- Identification and mapping of existing greenspace components;
- Analysis and mapping of proposed greenspace components based on natural resource values;
- Mapping population projections to establish potential "threat" to watershed resources; and
- Providing recommendations and implementation tools, focusing on the need for strategic planning and institutional capacity building to ensure implementation of these recommendations.

6.3.1 Sustainable Landscape Analysis

A *sustainable landscape* is defined in this Plan as a matrix of natural lands that function together within a defined area, to maintain the essential ecological processes that support life, and to maximize and sustain natural biodiversity across a region.

Within the Schuylkill River watershed, a fabric of ecologically significant lands remains in a more or less natural, undeveloped condition (see the map: **Regional Land Cover**).

Maintenance of this ecological fabric can provide a critical quorum of land for preservation of good water quality, healthy functioning of the hydrological cycle and mitigation of non-point source pollution

throughout the Schuylkill River watershed. A sustainable landscape is also critical to ensuring human health and quality of life, through source water protection, prevention of floods, and provision of natural/recreational areas and greenspace amenities. However, at present growth rates (see the map: **Estimated Population Change**) many of these natural areas could disappear within the next twenty years, primarily lost to development, unless decisive, large-scale, proactive steps are taken to protect, maintain and/or restore these natural resources as soon as possible.

Within the context of a River or Watershed Conservation Plan, the primary ecological process to consider is the hydrologic cycle, with the unit of land for assessments being the watershed, or subwatershed (see the map: **Watershed Orientation**). Landscape analysis within the Schuylkill River watershed has been completed on the basis of the 37-subwatersheds shown in this map. Identifying components of the landscape within the Schuylkill River watershed that support sustainability of the hydrological cycle is the primary focus of this Chapter of the Schuylkill River watershed Conservation Plan.

In the context of watershed conservation, a sustainable landscape plan can be initiated by identifying high quality natural lands that already have been preserved, or sensitive natural lands that should be protected, and designating them as green nodes and greenways (linking corridors) within a networked landscape system.

Lands requiring habitat creation or restoration also may be identified and proposed as part of a sustainable landscape matrix, but these are considered secondary components in this Plan due to the site-specific nature of these sites and the reduced level of detail that this regional analysis affords. The discussion below therefore focuses on identifying areas of existing, intact natural landscape for protection, although some general recommendations for restoration have been included where possible.

While the resulting greenspace plan provides for a skeleton of ecologically significant lands to support healthy functioning of the hydrological cycle in the watershed, these proposals should be considered a functional minimum. Proposed greenspace should be protected through proactive methods: conservation entities should take active steps to promote the protection of the proposed core greenspace lands. However, additional reactive land preservation efforts should always be considered if cost-effective opportunities arise.

6.3.2 Data Sets and Analysis Components

From the available data for the Schuylkill River watershed, the following components were selected for analysis to define the potential greenspace nodes and corridors of a watershed-wide sustainable landscape plan. These components were selected as the best available data on which to develop a networked plan of sensitive natural lands worthy of protection and of direct utility in sustaining ecological-hydrological processes and/or biodiversity in the watershed. The components supporting this landscape sustainability analysis included the following types of data.

Locational Data

- Protected Lands
- Pennsylvania Natural Diversity Inventory (PNDI)/County Natural Area Inventories
- Pennsylvania Important Bird Areas (IBAs)
- Primary Sensitive Lands: Steep Slopes; Wetlands; and Floodplains
- Secondary Potential Greenspace Nodes and Corridors

Subwatershed Data

- Habitat Value (by taxa group and based on land cover)
- 1st order stream frequency in highly forested landscapes

Where possible, an attempt has been made to prioritize watershed lands within each data type. In many cases, however, due to the scale of this project and the limitations this implies on gathering site-specific data, such prioritization has not been possible. As new GIS data becomes available providing comprehensive and scale-consistent data coverage for the entire watershed, additional analysis of priorities can be undertaken (see Recommendations **R6.2** and **R6.17** in **Section 6.8** below).

A discussion outlining each component and how it informs the sustainable landscape analysis follows. A detailed summary of recommendations and implementation tools is provided at the end of this Chapter in **Sections 6.8 and 6.9** respectively. Notes on additional analyses that could facilitate future preservation efforts also are provided in **Section 6.10**.

6.4 Locational Data Analysis

6.4.1 Existing Greenspace - Protected Lands

Digital data layers representing government-owned lands available from the Pennsylvania Spatial Data Access (PASDA) website (http://www.pasda.psu.edu) were collected and compiled in a GIS database. These data included the following map layers.

- National Parks (4,340 acres ~ 0.35% of watershed area)
- National Forests (none in watershed)
- National Wildlife Reserves (none in watershed)
- State Parks (13,952 acres ~ 1.14% of watershed area)
- State Forests (5,260 acres ~ < 0.43% of watershed area)
- State Gamelands (31,697 acres ~ 2.6% of watershed area)
- County Parks (acreage and percent watershed area unavailable due to imprecise nature of publicly available data)

Note there are additional protected lands within the watershed for which watershed-wide data are not yet available in watershed-wide compiled GIS format, including agricultural easements held by State or County agencies and lands owned by local municipalities. In addition, Pennsylvania Environmental Council (PEC) is compiling a GIS data layer of all available, known locations of privately protected lands, including lands held in fee or under conservation easement by non-government organizations (NGOs): i.e., land trusts, watershed associations and other conservation and environmental education facilities. However, as of May 2001, the privately protected lands data layer was still incomplete and unavailable for inclusion in this Plan. This map layer also will be geographically limited to a five county region of Philadelphia, Chester, Montgomery, Bucks and Delaware Counties. Any of the data layers mentioned here could be very helpful when building the greenspace network for the watershed and should be incorporated into future versions of the watershed greenspace analysis if and when updates are available. See Recommendations **R6.2**, **R6.16** and **R6.17**.

Results and Discussion

The available data sets were compiled and combined to produce one GIS data layer. See the map: **Existing Greenspace**.

Excluding acreage for the county parks (since no acreage data are available with this GIS data set, and other GIS data sets that include these data are not yet available for the entire watershed), the existing government-owned protected lands represent approximately 4.5% of the area of the entire watershed, which is insufficient for promoting a sustainable landscape. Recent Pennsylvania Department of Conservation and Natural Resources (PA DCNR) Bureau of Forestry guidelines for the entire Commonwealth, which are under development as part of a strategy to establish a Pennsylvania Bioreserve system, estimate that natural lands protection could be in the order of 10-20% (Jim Grace, *pers. comm.*). This appears to be a reasonable goal, as long as protected lands are distributed throughout the watershed and are not located all in one region.

Much has been written in the scientific literature to support the concept that connectivity and large preserve areas are required for maintaining biodiversity (see Noss 1997, Peck 1998 and other biodiversity conservation references). While there is still debate about the specifics of bioreserve size and shape, the general consensus is that a system of greenspace nodes and connecting corridors is a necessity to foster landscape sustainability. A good layman's introduction to the subject, with additional technical references other than those provided in this Plan, can be found in Quammen (1996). More discussion on this topic can also be found on The Wildlands Project web page at http://www.twp.org.

The existing greenspace pattern in the Schuylkill River watershed reveals a very uneven distribution of protected lands across the watershed. Most of these lands are concentrated along the Kittatinny Ridge, the majority of which is under the jurisdiction of the Pennsylvania Game Commission. As with the total acreage, the current distribution of existing protected greenspace is insufficient to provide for a sustainable landscape, since there are no connections between these large natural areas and greenspace nodes to foster biological exchange or "cross-fertilization" of natural resources between preserved areas. Without connections and biological exchange (e.g., migration, pollination, and colonization), the greenspace nodes act as isolated "habitat islands," where ecosystem processes and genetic biodiversity could be seriously impacted.

Finally, it should be noted that although "existing greenspace" implies that these lands currently receive adequate conservation protection, in reality their status provides protection mostly from the threat of land conversion and development. This status does not protect these areas from other secondary, cumulative, or random effects and ecological degradation associated with fragmentation, isolation, and incompatible land use on adjacent lands. Adaptive ecological land management that considers natural areas within their larger context of potentially developed and degraded lands is a critical requirement to facilitate sustainability and viability of natural resources in any greenspace plan. This topic is reviewed in more detail in Recommendations **R6.13 and R6.14**, and in **Section 6.9**.

6.4.2 Proposed Greenspace

6.4.2.1 Pennsylvania Natural Diversity Inventory (PNDI) and County Natural Area Inventories

Data was gathered in April 2000 from the Pennsylvania Science Office (PSO) of The Nature Conservancy for records of rare, threatened or endangered "elements" that are currently existing or recorded within the

last 10 years within the Schuylkill River watershed. These data are an equivalent or improved/updated version of what has already been published through the County Natural Area Inventories for the region.

An element can be a species, a natural community, a managed area or an important geologic feature. The county data has been compiled and merged using a GIS to produce a single mapped layer for the entire watershed. PNDI data was unavailable from PSO for Philadelphia County. Also, Dr. Ann Rhoads and other staff of the Morris Arboretum have compiled data for Bucks County rare species and communities. These data have been included in the analysis, but due to differences in data collection and evaluation with PSO's data, cannot be used comparatively. See the map: **PNDI - Site Types**.

Each polygon placed on this map is based on the presence of one or more tracked elements. The shape of each mapped polygon represents a generalized location rather than a precise boundary in order to guard against illegal species collection or disturbance. The results of this analysis can be viewed by element type (e.g., geological feature, rare animal, rare plant, natural community, etc.) in the above map.

In addition, the value of each rare animal or plant element has been determined for the PSO data using a scoring system from low to high. Using a rapid ecological assessment methodology developed as part of an allied project of the Natural Lands Trust (details can be found at http://www.smartconservation.org), the most important information about a PNDI element can be combined into one aggregate score. Essential components considered in the scoring are: global rarity rank and state rarity rank (the rarity of the element on a statewide and global level); and the element occurrence rank (a score assigned to represent the quality of the species occurrence based on its health and viability). The number of elements within one polygon is also a component of the assessment, where polygons with more elements receive higher scores than polygons with fewer elements. See the map: **PNDI - Site Scores**.

Scores for geological, managed area, locally significant and natural community elements were not generated due to inconsistencies or inadequacies in the available data, so no ranking or prioritization for these polygons was provided.

Results and Discussion

The result of the PNDI elements analysis is a clear prioritization for protection of rare or threatened species. Higher scoring sites should be targeted for protection before lower scoring sites, where possible. Sites with the highest scores ideally should be proactively pursued for protection by fee or conservation easement by conservation entities throughout the watershed. Care also should be taken to conserve sites that are representative of the biodiversity pool across the watershed. A biodiversity portfolio should be developed around these priority areas (see Recommendation **R6.4**).

The pattern revealed by both PNDI Type and Score Maps offers a major contribution to the proposed greenspace network, since these sites represent the most critical components of the watershed biodiversity pool. However, it must be emphasized that the polygons are purposefully imprecise, for reasons of confidentiality. It is hoped that ranking the PNDI data through this scoring process will aid watershed conservation entities determine their priorities when considering land and watershed protection over the next twenty years.

If a bona-fide conservation entity is interested in preserving one of these sites, it is recommended that the PNDI representatives at The Nature Conservancy's Pennsylvania Science Office, Middletown, PA be contacted for up-to-date and site-specific data. The NatureServe website (http://www.natureserve.org) also may be useful. Since the global, state and viability ranks of elements are reviewed and adjusted each year by PNDI, it is essential that these ranks be verified prior to making binding commitments to

preservation. It also will be critical to obtain more precise locational information since the polygons shown on these maps are purposefully imprecise. An approved conservation entity should be able to obtain more detailed site-specific data that will help refine land protection goals. Finally, the PNDI scientists also may be able to provide some data on the habitat requirements of the element so that a management plan can be developed to ensure element viability over time.

6.4.2.2 Important Bird Areas (IBAs)

Pennsylvania Audubon has spent several years documenting bird 'hot-spots' within Pennsylvania. While detailed conservation plans have yet to be developed to determine exact site boundaries and acreages for these locations, general areas of interest have been delineated within the Schuylkill River watershed. Sites within the Schuylkill River watershed were located based on mapping provided in the PA Audubon report *A Guide to Critical Bird Habitat in Pennsylvania* compiled by Gary Crossely (1999). Further information regarding the development of the IBA Site Conservation Plans can be obtained from Steve Hoffman, Pennsylvania Audubon Society, http://www.audubon.org/chapter/pa/pa/.

Results and Discussion

The IBA data are part of the proposed watershed greenspace network and are shown as a component of the map: **Sensitive Lands**. There are six IBA sites within the Schuylkill River watershed.

- Hawk Mountain Sanctuary
- Lake Ontelaunee
- Blue Marsh Lake
- Green Lane Reservoir
- Unami Creek Valley
- Great Marsh

These areas are proposed for protection and are shown on the 'proposed greenspace' plan. Precise acres associated with each location are unavailable at this time.

6.4.2.3 Primary Sensitive Lands: Steep Slopes; Wetlands; and Floodplains

Steep Slopes

US Geological Survey (USGS) topographic data were collected in the form of Digital Elevation Models available from the PASDA website, which were then converted in ArcView™ GIS to maps of slope using Spatial Analyst™. The results were digitally combined and converted to show slope categories of 0-8%, 8-15%, 15-25% and those greater than 25%. These categories were selected since they match many municipalities' zoning codes that place certain development restrictions on steep slopes (slopes greater than 15% or 25%).

Results and Discussion

Slopes greater than 25% have been mapped as a primary component of the proposed greenspace plan for the watershed on the map: **Sensitive Lands**.

Many municipalities recognize steep slopes as sensitive habitats, primarily due to their erosion potential, and have adopted steep slope ordinances to protect these sensitive habitats. Due to the historic difficulty of developing these areas, steep slopes also can be some of the least disturbed and most healthy habitat in a township. Despite typically thinner soils on the steeper slopes, these areas usually are dominated by forests which have grown up slowly over time and developed their own pockets of humus and soil to sustain the slope ecosystem. If a complex structure of vegetation layers is present (e.g., intact leaf litter, herbaceous, understory trees and shrubs as well as canopy trees), stormwater runoff and soil erosion can be less than expected given the slope steepness. If vegetation is absent, these areas of steep slope are the prone to erosion damage and subsidence resulting in flood and mudslide hazards, increased runoff volume and velocity, and sedimentation of streams.

Wetlands

National Wetland Inventory maps define different types of federally recognized mapped wetlands in the watershed and are now available digitally from the U.S. Department of the Interior. GIS theme coverages for the entire watershed, with the exception of the Valley Forge USGS quad, have been obtained and combined.

Results and Discussion

National Wetland Inventory locations within the Schuylkill River watershed were mapped as a primary component of the proposed greenspace plan for the watershed in the map: **Sensitive Lands**. In addition, a map: **NWI Types** showing types of wetlands is available in the online Reference Documents.

Where they have been mapped and are of sufficient size, many of these wetland features already are protected through federal wetland laws administered by the US Army Corps of Engineers (US ACE) and the Pennsylvania Department of Environmental Protection (PA DEP). However, not all watershed wetlands may have been mapped on the NWI layer. US EPA estimates indicate that on the order of 50% of wetlands many remain unmapped in Pennsylvania (A. Spingarn, *pers. comm.*). In addition, some mapped wetlands may be too small to receive protection under existing federal wetland laws; for example, wetlands less than 1/3-acre in size are unregulated as of the date of this Plan.

Certain small wetland features in the landscape such as vernal pools, that can be very significant in maintaining local biodiversity and water quality, are usually much less than 1/3-acre in size. Mapping at this regional scale therefore can easily miss them. Since any wetland system less than 15 square meters is unlikely to be identified by the MRLC land cover or NWI wetlands mapping, users should be aware of the likelihood for under-representation of these important wetland components in the GIS analysis. Local groups should be prepared to augment this Plan's assessments with more detailed local data to document small wetlands requiring protection (see Recommendation **R6.17** below and **R5.8** in **Section 5.6** of *Chapter 5.0 Water Quality).* This is also necessary for assessing the quality of those wetlands, which cannot be ascertained through this regional analysis.

Floodplains

Digital data for designated floodplains, as defined and mapped by PA DEP, have been collected and compiled from the PASDA website. These data are considered the best representation of the Federal Emergency Management Agency (FEMA) maps, but are not as accurate as a map of a Global Positioning System's floodplain coordinates. The data are from 1996.

Results and Discussion

Floodplains were mapped as a primary component of the proposed greenspace plan for the watershed (see the map: **Sensitive Lands**). These areas are susceptible to major, regular flood events that could endanger human life. Maintaining sufficient vegetation and healthy hydrology in the floodplain is essential to decreasing flood hazards and to ensuring watershed health.

6.4.3 Secondary Potential Greenspace Nodes and Corridors

A variety of additional digital GIS data are available that can be used to compliment the primary sensitive lands discussed above. These are considered "secondary" components of a potential greenspace plan, since, for the first three at least, political considerations may have been as important as environmental evaluations in their designation.

- Exceptional Value Subwatersheds
- Scenic Rivers
- National Historic Landmarks
- Inactive Railroads

Note that GIS data for long-distance trails also could be an appropriate component in this category, and is generally included in greenways mapping projects. However, it has not been included here due to lack of watershed-wide GIS data and concerns about misrepresenting the value of some of the trails as wildlife habitat connectors.[1]

Each digital data set used for this component of the assessment was obtained from the PASDA website, was published in 1996, and is provided as-is. Additional information on each data layer used in this analysis of secondary greenspace is provided below.

Exceptional Value Watersheds

This digital data represents information from 1992. It shows watershed boundaries for exceptional quality streams, as designated by PA DEP. It should be noted that several comments were obtained during the public meetings indicating that the data layer may not be comprehensive or completely up-to-date. Several people felt that some designated exception value stream watersheds were not represented, e.g., Valley Creek, near Valley Forge Park, and the upper section of French Creek, west of route 100. However, further specific information about which exceptional value watersheds may be missing from the available public data was unavailable. If corrections or updates become available, they should be incorporated in the GIS database and the secondary greenspace analysis for the Schuylkill River watershed (see Recommendations **R6.16** and **R6.17**).

Scenic Rivers

This digital data set represents Scenic Rivers, as designated by PA DCNR, and was generated with data from USGS hydrology data layers and tax parcel maps.

[1] GIS data for existing and proposed long distance trails in the Schuylkill River watershed is difficult to obtain. Even if it were available, it would require careful evaluation to assess each trail's contribution to greenspace connectivity. For example, the Cross-County trail that runs along Plymouth Creek in Montgomery County is essentially a bike path that crosses shopping mall parking lots and mown grass for at least some of it's length. In these areas, it provides no real benefit as a natural areas connector, when compared to the Horseshoe Trail in northern Chester County which is a much more valuable conservation corridor.

National Historic Landmarks

This digital data set represents National Historic Landmarks, as designated by the National Park Service and adopted by PA DEP, and was generated from 1:24,000 USGS topographic maps.

Inactive Railroads

This digital data set represents the location of inactive rail lines digitized from 1:24,000 USGS topographic maps on a stable mylar base and has been adopted by PA DEP.

Results and Discussion

All of the above data sets were mapped as secondary components of the proposed greenspace plan for the watershed in the map: **Sensitive Lands**.

Some components, the inactive railroads for example, may not necessarily be high quality natural lands, but could be important greenway corridor opportunities that may require ecological restoration to provide viable habitat function.

6.4.4 Contiguous Forested Land Cover

The map: **Regional Land Cover** shows land cover conditions for the Schuylkill River watershed and its immediate regional surroundings. These data layer was compiled and classified by the Multi-Resolution Land Characteristics Interagency Consortium (MRLC) using Landsat Thematic Mapper satellite imagery from 1991, 1992, and 1993 (Vogelmann et al. 1998). MRLC satellite imagery has a resolution of 30m, meaning that each pixel in the satellite scene measures 30m by 30m, with the raw satellite data being classified into fifteen different land cover categories.

While it is important to know exactly how much area exists as forest within the watershed, it is also important to know the quality and configuration of that forest. Large, contiguous patches of natural forest are able to support higher numbers and different types of species than small fragmented patches.

A wealth of conservation biology literature documents the importance of patch size for ecosystem function and species preservation (Quammen 1996, pp 385 - 498). In this Plan, a simple attempt was made to identify the largest forest patches existing within the Schuylkill River watershed: specifically, blocks of contiguous forest greater than a certain acreage. This information may be significant in identifying lands for potential preservation and protection.

Results and Discussion

The map titled **Composite Proposed Greenspace** shows contiguous forest patches larger than 500 acres. These patches were isolated using a coarse filter and the MRLC Landsat land cover data. The largest forest patches are in the northern subwatersheds, which are the most forested. Some significant patches also can be seen, however, in the subwatersheds along the southwest border of the watershed, including Schuylkill River 5, Hay Creek, and French Creek.

This is the final data layer added to the potential greenspace plan. It provides the "glue" by which the skeleton of greenspace begins to form a cohesive pattern. This clearly helps to identify the major patterns of preservation that could help to sustain the Schuylkill River watershed landscape.

6.4.5 Additional Greenspace GIS Data

During the Public Meetings, it was noted several times that various other data could be added to the potential greenspace analysis. For example, the unused US ACE desilting basins, already largely in public ownership along the Schuylkill River, were highlighted as wetland restoration opportunities. If restored, these basins could provide terrestrial and aquatic habitat, particularly for bird migrations. A network of restored wetlands could be created in close proximity to the Schuylkill River that would link Hawk Mountain Sanctuary at the Blue Mountain/Kittatinny Ridge and Tinicum Wildlife Refuge in Philadelphia, for example. However, most other suggested components are not yet available as vector-digitized GIS components, and so mapping of such site-specific details could not be easily accomplished for this project. It is recommended that a GIS database be established and upgraded on a regular basis so that such additional GIS data sets can be included in future analysis. See Recommendations **R6.16** and **R6.17**.

6.4.6 Overview of Locational Data Analysis Results

After analysis of the components discussed above, it was calculated that more than 200,000 acres, (approximately 15%), of the Schuylkill River watershed represent sensitive lands that are a high priority for protection. A **Sustainable Landscape Vision** map was developed based on the **Sensitive Lands** map and **Composite Proposed Greenspace** map, as a simplified, conceptual example of a potential greenspace network for the watershed.

Despite the fact that many of the proposed greenspace components currently receive a certain amount of protection under Federal and/or State laws, in reality, policies that afford this protection can change at any time. The goal should be, wherever possible, to provide additional protection for these sensitive habitats and proposed greenspaces by securing them for permanent protection as part of the greenspace network in the Schuylkill River watershed. To do this, several land protection options are available (see **Section 6.9**).

6.5 Subwatershed Analysis

For analysis and comparison purposes, the Schuylkill River watershed was analyzed using 37 subwatersheds (see the map: **Watershed Orientation**). As mentioned previously, a number of criteria were used in delineating the size of watershed selected for use. The scale had to be fine enough that trends could be seen throughout the watershed and comparisons made, yet the analysis could not exceed the resolution of the data. Consideration was also given to the scale of subwatersheds for which watershed conservation plans have been, or are being, developed. A subwatershed scale was selected to facilitate integration of those plans with this project. It was therefore decided that a subwatershed size of about 31,000 acres (i.e., 125 square km or 12,500 ha) would suffice.

Some of the subwatershed maps used and generated in this section, as well as in the water quality modeling section, follow the format used in the report *An Ecological Assessment of the United States, Mid-Atlantic Region: A Landscape Atlas* (Jones et al. 1997). Each subwatershed is color coded to show the relative condition for a given parameter.

As mentioned earlier in Chapters 3 and 5, satellite data showing land cover is available for the southeast PA region, including the Schuylkill River watershed, and dates from the early 1990s. The raw satellite data sets are too large for use with standard desktop computers. Instead, a processed version of the data by MRLC can be used more easily within a GIS. These data has a 30-meter resolution, and within this area spectral signatures for each pixel are averaged and classified by dominant land cover. In other words, if a pixel contains portions of a one-lane road at 10%, a small house and yard at 30% and a deciduous forest at 60%, the pixel will be classified as 100% deciduous forest. This means that large landscape features, such as forest cover, are likely to be overemphasized at the expense of smaller landscape features, such as vernal pools, etc. Although not a perfect solution, this is probably the best, most cost-effective land cover data set currently available for completing the watershed GIS analysis.

Even with the limitations set out above, the MRLC land cover data still gives a good sense of general trends in land cover conditions throughout the watershed area, as shown in the map: **Regional Land Cover**. Forested lands are most prevalent in the upper, northwestern part of the watershed and to a lesser extent as a band in the central part of the watershed. Agriculture is most concentrated in a band across northern Berks County, and is otherwise dispersed throughout the middle and lower portions of the watershed. Urban/residential land use is greatest in and between the cities of Reading and Philadelphia. In aggregate, the maps **Forested Land Cover**, **Agricultural Land Cover**, and **Urban/Residential Land Cover** imply a regional pattern of three distinct zones of land use across the watershed. These areas are referred to as Habitat, Agricultural and Urban/Suburban Zones (see the map: **Sustainable Landscape Vision**).

6.5.1 Habitat Value Based on Land Cover

Each of the fifteen MRLC land cover classes can be valued according to habitat potential. During Natural Land Trust's *Smart Conservation* project these fifteen land cover classes were assigned habitat values ranging from very poor, poor, adequate to good for each of 6 taxa classes (i.e., mammals, birds, herpetofauna (i.e., reptiles and amphibians), invertebrates, plants and aquatics). A panel of regional experts and scientists assigned the habitat values. Information at http://www.smartconservation.org and in the online Reference Documents shows how these habitat evaluations then were applied to each of the 15 MRLC land cover classes, with different evaluations for each of the six taxa groups. These habitat evaluations were converted into analysis maps (see the maps: **Aquatics Habitat Value**; **Birds Habitat Value**; **Herpetofauna Habitat Value**; **Invertebrates Habitat Value**; **Mammals Habitat Value**; and **Plants Habitat Value** in the online Reference Documents). Each land cover class was weighted according to its assigned habitat value and the cumulative average habitat score for each taxa group was generated by subwatershed. A generalized habitat value map was produced, which incorporates the habitat values from each of the contributing taxa maps. This composite of all of the habitat values of the six different taxa groups is shown on the **Summary Habitat Value** map.

Since these assessments are based on land cover data, and since forest and wetland cover types generally were valued higher as habitat than other land cover types, the resulting habitat patterns are somewhat predictable. However, the value of this analysis is to simplify the complexity of the 15-class land cover maps into a habitat map that displays a clearer pattern and summarizes the relative importance of land cover types as natural habitat.

The PA Gap Analysis Project (PA GAP) has used a similar technique, but also has incorporated wildlife range and elevation data into their analysis for Pennsylvania vertebrate assessments (e.g., bird, mammal, herpetofauna and aquatic vertebrates). Since PA GAP's effort was concurrent with this watershed conservation planning project, the simplified version generated by the project team was used rather than

PA GAP's more complex assessments. More on the PA GAP assessment techniques is available at http://128.118.47.95/erri/projects/gappage.htm by following the links for *Wildlife Habitat Relations*. It is recommended that these improved habitat analyses be incorporated into future GIS updates, as they become available (see Recommendation **R6.17**).

Results and Discussion

Based on the resultant map of **Summary Habitat Value**, the following appear to be the highest priority subwatersheds for habitat protection in the Schuylkill River watershed (**Table 6.1**). These areas are focused in two geographically distinct areas, which will be referred to as the Kittatinny Habitat Zone and the Reading Horseshoe Habitat Zone.

Table 6.1 Priority Habitat Zones in the Schuylkill Watershed

Priority	***Kittatinny Habitat Zone***	***Reading Horseshoe Habitat Zone***
Highest (1)	Little Schuylkill River – Lower Little Schuylkill River - Upper Schuylkill River Headwaters	Hay Creek
Medium High (2)	Schuylkill River Eight	
Medium Low (3)	West Branch Schuylkill River	Unami Creek Upper Perkionmen Creek Upper Manatawny Creek Schuylkill River Five Schuylkill River Four French Creek
Lowest (4)	Upper Maiden Creek	Pickering Creek Swamp Creek Lower Manatawny Creek

At the other end of the spectrum, the most impacted subwatersheds that have the lowest habitat value, according to this analysis, are Schuylkill River Tidal and Upper Tulpehocken Creek. The cost of restoring good quality habitat in these areas may not be as cost-effective or as critical in conserving watershed habitat as conserving or restoring lands in some of the higher priority habitat subwatersheds.

6.5.2 Habitat Value by Region

After assessing the pattern of subwatershed habitat values within the Schuylkill River watershed, these results were reviewed as part of the regional pattern that extends beyond the boundaries of the watershed. As mentioned above, the subwatershed analysis indicates two primary regions of habitat value:

- The Kittatinny Habitat Zone
- The Reading Horseshoe Habitat Zone

These two landscape units not only create habitat opportunities within the Schuylkill River watershed but are integral components of more extensive, contiguous habitats of regional significance that extend in a broad southeast-northwest direction beyond the Schuylkill River watershed boundaries.

The Reading Horseshoe, in the central portion of the watershed, is effectively an extension of the Highlands province. The Kittatinny in the upper part of the watershed ties into the larger geologic feature of the Ridge and Valley province. Maintaining the integrity of these habitat zones in the Schuylkill River watershed therefore will have the added benefit of supporting these two larger regional corridors that are significant landscape features and wildlife dispersal corridors for the East Coast.

The key differences between these two habitat zones are that the Kittatinny Zone is probably more ecologically valuable, as compared to the Reading Horseshoe Zone. It is important to note for future funding possibilities that extension of the Highlands Province to include the Reading Horseshoe is under consideration for adoption by the Highlands Coalition (T. Dillingham, *pers.comm.*). The Highlands Province may obtain special standing with several federal programs, such as the Land and Water Conservation Fund and the Forest Legacy Program, which may qualify conservation projects in this area for preferential funding. Attaching additional lands in Pennsylvania to those already designated in New Jersey and New York could result in similar preferential treatment from several potential funding sources.

In addition to these two habitat zones, two other landscape zones stand out from the subwatershed analysis: the Agricultural Zone, that lies north of Reading and south of the Kittatinny Ridge, and the subwatersheds at the south end of the river corridor; and the Urban/Suburban Zone, that is experiencing the most dramatic land use changes and impacts due to decentralization of population from the Philadelphia metropolitan region.

6.5.3 First Order Stream Frequency and Forested Land Cover

"Protecting our water supplies is in large part done through protecting forests. The highest quality water comes from forests: the older the forest, the better the water quality,"(Franklin 1990, in Drengson 1997).

The purpose of this analysis was to establish conservation priorities that will help protect water quality from non-point source pollution by preserving open space. This analysis does not take into account point source pollution such as acid mine drainage or municipal sewage treatment outfalls. It seeks to correlate the health of land cover with stream water quality within each subwatershed of the Schuylkill. The satellite data used and was not of sufficient detail to consider specific riparian conditions in the subsequent analysis, but considers the average land cover conditions for each subwatershed.

6.5.3.1 First Order Streams

Stream order is a "measure of the position of a stream in the hierarchy of tributaries," (Leopold 1994). Stream orders provide a way to organize and analyze stream networks. Often stream order is associated with stream and watershed size, where first order streams are the smallest; however this relationship does not always hold true. First order streams have no tributaries; second order streams only have first order tributaries and so on (see **Section 3.4.2** of *Chapter 3.0 Watershed Characterization* for a discussion of stream order).

The map: **Stream Order** shows the orders for all the streams in the Schuylkill River watershed. **Table 3.1 Stream Orders and Stream Lengths** in *Chapter 3.0* summarizes the lengths for each stream order throughout the watershed. First order streams comprise 56.56% of the stream length in the entire watershed, on average. These first order streams are the headwaters streams and often are the most susceptible to human impacts. These also are the streams that may have the best chances of being preserved, protected, or restored by proper watershed management and planning.

Stream order for the Schuylkill River watershed was generated in Arc/INFO™ GIS software using the networked stream data layer from PA DEP. All stream orders were then visually quality-checked, and first order streams were extracted into a separate GIS data layer.

6.5.3.2 Analyzing Protection Priorities

Using the contiguous forest and first order stream data layers developed for this Plan, as described above, a correlation was run to determine which subwatersheds in the Schuylkill River watershed have the best forest cover relative to the highest frequency of first order streams. This analysis can help prioritize which subwatersheds should be targeted for protecting both forest and water quality resources. Priorities were established by determining the subwatersheds with the highest forest cover and correlating these with subwatersheds that have the highest percent-length of 1st order stream. While this analysis was not detailed enough to determine the health or requirements for restoration of riparian corridors, the general consensus is that forested landscapes promote better hydrologic regimes, reduce nutrient and sediment loads, and help mitigate thermal pollution of water resources.

The 37 subwatersheds within the Schuylkill River watershed were classified by percent of forested land cover and by percent of first order stream frequency (see the map: **First Order Streams & Forest Cover**). The forested land cover analysis was based on MRLC Landsat imagery generated in the early 1990s and was classified as a percentage for the entire land cover within a subwatershed. The first order stream frequency is an index that measures the first order stream's length as a percentage of the total length of streams within each subwatershed.

Results and Discussion

A comparison of the five most forested land cover subwatersheds with the eight subwatersheds having the highest first order stream frequency, shows an overlap of only two subwatersheds (see the map: **Primary Protection Subwatersheds**). These two subwatersheds, Hay Creek and the Lower Little Schuylkill, both have more than 70% forested land cover and 60% first order stream frequency. These areas are generally well forested and have high ecological value for sustaining biodiversity and water quality.

It is known that there are significant impacts from acid mine drainage in the Lower Little Schuylkill. However, because the terrestrial habitat is apparently fairly intact in this subwatershed, it still should be a priority for protection on the assumption that acid mine drainage issues can be addressed at a future date and point sources of pollution may be successfully mitigated.

The second priorities for protection based on this analysis are the Schuylkill River Headwaters and the Upper Little Schuylkill River subwatersheds. These two subwatersheds both have more than 70% forested land cover and between 57.5% and 60% first order stream frequency.

Third priority is the West Branch Schuylkill River subwatershed, which has more than 70% forested land cover and between 55-57.5% first order stream frequency. At this point, a natural break in the analysis makes further prioritization for protection less obvious. **Table 6.2** summarizes the first order stream and forest protection priorities.

Table 6.2 Protection Priorities Based on First Order Stream/Forest Analysis

Stream/Forest Protection Priority	*Kittatinny Habitat Zone*	*Reading Horseshoe Habitat Zone*
Highest (1st)	Little Schuylkill - Lower	Hay Creek
Medium (2nd)	Schuylkill River Headwaters Little Schuylkill – Upper	
Lowest (3rd)	West Branch Schuylkill	

6.5.3.3 Analyzing Restoration Priorities

Using the same analysis procedure, there also was an opportunity to prioritize the subwatersheds for restoration: by analyzing the subwatersheds that have more than 60% first order stream frequency and the lowest levels of forested land cover. These areas would be highly susceptible to habitat and water quality degradation.

Results and Discussion

The map **Primary Restoration Subwatersheds** shows that Upper Tulpehocken subwatershed is a clear priority from a restoration perspective. This subwatershed has more than 60% first order streams but less than 33% forested land cover.

Secondary priorities for restoration are four additional subwatersheds that have greater than 60% first order streams and only 33-55% forested land cover. In order of priority for restoration, these are:

- Little North Kill subwatershed (36% forested cover);
- Skippack Creek subwatershed (37.6% forested land cover);
- Ontelaunee subwatershed (41% forested land cover); and
- Upper Maiden Creek subwatershed (51% forested land cover).

Within these subwatersheds, an assessment of the riparian conditions would further inform prioritization. Local conservation entities could collect the necessary detailed riparian data, and/or localized aerial photography could be reviewed by consultants developing the proposed Strategic Restoration Plans (see Recommendation **R6.8**).

Restoration priorities (primarily in the form of reforestation) could begin with riparian buffers immediately along waterways, and extend into upland areas as the opportunity arises. Upland reforestation could focus initially on marginal agricultural lands and/or steep slopes currently in row crops or other human-influenced land uses. If carried out on private lands, reforestation should be encouraged particularly where permanent protection can be guaranteed to ensure that good returns on this investment.

6.5.4 Overview of Subwatershed Analysis Results

Map: **Watershed Priorities** summarizes the habitat conservation and restoration analysis results discussed above. In addition, at the landscape level, the GIS mapping has revealed several patterns of significance for a greenspace network and landscape sustainability.

- The dendritic pattern of the riparian corridors throughout the watershed, which when combined with riparian buffer creation and protection, offer one of the best opportunities to address the need for landscape connectivity across the watershed.

- The primary importance of the east-west forested landscape-scale feature of the Kittatinny Habitat Zone, both within the Schuylkill River watershed, and as a connecting link in the larger Ridge and Valley province that is integral to habitat connectivity on the East Coast.

- The secondary importance of the east-west forested landscape-scale feature of the Reading Horseshoe Habitat Zone, which is also under the greatest threat from population growth in the next decade.

- The valley in the upper-mid watershed, between the Kittatinny Zone and the Reading Horseshoe, dominated by agriculture. The subwatersheds in this Agricultural Zone become priorities for greenspace corridor and riparian buffer assessment, to maintain ecological connectivity between the Kittatinny and Reading Horseshoe habitat zones. This will encourage ecosystem viability, while agricultural preservation and best management practices also are critical to maintaining environmental health.

- The Urban/Suburban Zone in the lower watershed, south of the Reading Horseshoe, impacted primarily by urban sprawl. Opportunities for open space protection and habitat restoration/creation in this area are unlikely to cause a significant improvement the overall ecological health of the watershed. However, securing riparian buffers (particularly on first and second order streams) while preserving the identified potential greenspaces and managing existing protected lands in this zone will provide scenic, recreation and environmental education benefits to the watershed population that is primarily concentrated in this area.

6.6 Threat Assessment – Population Change

An analysis of population change was performed in the Schuylkill River watershed for the years 1990 to 2010. Population data were obtained from the 1990 Census Bureau for each municipality in the watershed. The geographic municipal boundaries for the state of PA were downloaded from the PASDA website.

A linear regression was performed on the 1990 population of each municipality to project the populations for 2010.[2] The population forecasts were then added to the GIS coverage of municipal boundaries. After finding the 2010 population forecasts for each municipality, a density was calculated, expressed as number of people per unit area. The population density was used to calculate the total number of persons per subwatershed. Note that where only a portion of a municipality was contained in a subwatershed, the density reflects the population for only that portion of the municipality contained in the subwatershed. A few important assumptions were made in calculating the population forecast.

- Population density is assumed to be uniform within each municipality.
- Population densities are assumed to remain constant through time.

[2] Both Montgomery County Planning Commission and the Delaware Valley Regional Planning Commission noted during the comment period for the draft Plan that municipal population projections, which they felt might be more accurate than the linear regression, are available from each County and DVRPC. There were also concerns that the population density assumptions used in this technique could lead to inaccuracies in identifying growth. Please note, therefore, that the data presented in this plan is a rough estimate of growth. Users are encouraged to contact their local County Planning Commission and/or to check DVRPCs website (http://www.dvrpc.org) to obtain growth projections *by municipality* (note that growth projections by subwatershed are not currently available from these agencies).

Results and Discussion

Population change values for each subwatershed for 1990-2010 can be seen in map: **Estimated Population Change**. The results of the population forecast suggest that approximately 75% of the municipalities in the watershed will experience continued growth in population through the year 2010.

The most notable exceptions are Philadelphia County (Tidal Schuylkill River, Schuylkill River 1 and Lower Wissahickon subwatersheds) and the surrounding municipalities, as well as the three most ecologically valuable subwatersheds of the Kittatinny Habitat Zone (Schuylkill River Headwaters, Little Schuylkill River – Upper and Lower). The decentralization in urban populations is a prime factor in the dramatic rise of suburban populations, as is the out-migration typical of more rural, economically challenged areas like Schuylkill County.

For the Kittatinny Habitat Zone, the following table (**Table 6.3**) highlights the threat/habitat issues, based on population growth, habitat value, and protection priority. In this table as in **Table 6.4** below, a value of "1" represents a high priority.

Table 6.3 Threat Issues, Habitat Value and Protection Priorities for Kittatinny Habitat Zone

Medium Threat Subwatersheds (11-20% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
West Branch Schuylkill	3	3
Upper Maiden Creek	4	-
Low Threat Subwatersheds (1-10% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
Schuylkill River 8	2	-
No/Negative Threat Subwatersheds (-22 - 0% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
Little Schuylkill Lower	1	1
Little Schuylkill Upper	1	2
Schuylkill River Headwaters	1	2

Meanwhile, the municipalities in Chester County, directly northwest of Philadelphia (Lower Maiden and Lower Perkiomen subwatersheds), are projected to increase by as much as 55-60% between 1990 and 2010. Montgomery, Chester, Bucks and Berks Counties are expected to experience the effects of urban sprawl most extensively.

Of the 10 subwatersheds that comprise the Reading Horseshoe Habitat Zone, all are projected to experience population growth. Factoring this threat in with habitat value yields the following protection prioritization (**Table 6.4**).

Table 6.4 Threat Issues, Habitat Value and Protection Priorities for Reading Horseshoe Habitat Zone

Most Threatened Subwatersheds (>30% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
Upper Manatawny	3	-
Pickering	4	-
Swamp Creek	4	-
High Threat Subwatersheds (21-30% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
Hay Creek	1	1
French Creek	3	-
Unami Creek	3	-
Medium Threat Subwatersheds (11-20% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
Upper Perkionmen	3	-
Schuylkill River 4	3	-
Low Threat Subwatersheds (1-10% population growth projection)	***Habitat Value***	***Stream/Forest Protection Priority***
Schuylkill River 5	3	-
Lower Manatawny	4	-

From the above analysis, it seems fair to say that the Kittatinny Habitat Zone in general has the highest habitat value, with the lowest threat from population pressure and expansion, while the Reading Horseshoe Habitat Zone has comparatively lower habitat value but is under significantly more threat from projected population growth.

It should be noted further that Lower Little Schuylkill River and Hay Creek have both the highest habitat value and the highest Stream/Forest Protection Priority, but that Hay Creek is under significant population expansion threat, while Lower Little Schuylkill River appears to be less threatened by population growth.

6.7 Conclusions: The Need for a Watershed Land Protection Collaborative

Should the highest habitat value lands be preserved first, regardless of threat, or should the most threatened landscapes be the focus of protection activities, regardless of habitat value? Who makes the final decisions about what should be protected first, given the analysis provided above?

These are difficult questions to answer. It seems likely that some combination of these strategies will be the most effective in preserving and restoring the watershed's sustainable landscape. Ultimately, these questions need to be resolved by a Watershed Land Protection Collaborative. The conservation community in the watershed, together with representatives from other watershed stakeholders from the development, infrastructure, business, industry/commerce and municipal sectors needs to convene and come to consensus around these questions. Part of the solution lies in the fact that different conservation organizations have different service areas across the watershed. These service areas will determine organizational priorities of each group relative to the sustainable landscape priorities highlighted in this Plan. For example, Berks County Conservancy is unlikely to be directly involved in preserving lands in

Bucks County, even if the most threatened, highest quality natural area in the watershed were to be found there.

A Watershed Land Protection Collaborative needs to be established to decide who will take to lead on protecting which conservation resources. The data presented here serve as inputs to those discussions, but the decisions rest finally in the geopolitical arena. The one essential task of the Watershed Land Protection Collaborative (as recommended by this Plan for implementation) should be to ensure that every sustainable landscape resource has been assigned to a conservation organization, and that conservation priorities that are acceptable to the Collaborative are established. The Collaborative's goal should be to ensure that the largest amount of the highest value sustainable landscape resources capturing regional diversity are protected over the next 25 years in a connected greenspace network that is ecologically viable now and into the coming decades, or preferably, centuries. See Recommendation **R6.1** for further discussion of this issue.

6.8 Detailed Recommendations for Landscape Sustainability

This section presents detailed recommendations for promoting a sustainable landscape in the Schuylkill River watershed. Each recommendation is listed in a table by its code, the name of the recommendation, a representative list of appropriate groups/agencies that might implement or guide the implementation of each recommendation, the key land use/landscape issues addressed, and the landscape sustainability section(s) and/or map(s) referenced in this chapter, to which each recommendation corresponds. Each table is followed by a detailed description of the recommendation.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.1	**Establish a Watershed Land Protection Collaborative (WLPC) to Proactively Protect Greenspace**	WLPC composed of watershed nonprofits and government agencies with the resources to pursue land protection	Loss of natural lands Need for greenspace Strategic conservation	Sections 6.5, 6.6, 6.7 Sustainable Landscape Vision map Sensitive Lands map Composite Proposed Greenspace map Watershed Priorities map

Description

More than 200,000 acres of sensitive natural lands have been identified as high priorities for protection in the Schuylkill River watershed. These lands include steep slopes, wetlands and floodplains as primary components and Exceptional Value watersheds, Scenic Rivers, National Historic Landmarks and inactive railroads as secondary components. This acreage is exclusive of contiguous forest blocks >500 acres, and exclusive of additional protection opportunities that may be discovered with further analysis of the primary protection subwatersheds in the Habitat Zones. The 200,000 acre guideline (i.e., 15% of the land area of the watershed) should be considered a functional minimum for promoting a sustainable landscape in the Schuylkill River watershed.

Detailed mapping (see maps listed in the table above) led to the development of a conceptual vision for a proposed greenspace network in the watershed. The map: **Sustainable Landscape Vision** identifies proposed habitat zones, greenspace corridors, habitat links to greenspace opportunities outside the immediate boundaries of the watershed, secondary greenspace nodes in the agricultural and urban/suburban zones, as well as the highest priority subwatersheds for protection and restoration. Greenspace components are distributed throughout the watershed, which will help ensure that a connected network of greenspace is preserved, and help maintain the viability of ecosystem processes, water quality, and species movement across the region.

A Watershed Land Protection Collaborative (WLPC) composed of watershed conservation groups working together needs to be established, to promote strategic land conservation and efficient resource use, and to decide who will take to lead on protecting which conservation resources. The data presented in this Chapter serve as inputs to those discussions, but the decisions rest finally in the geopolitical arena. The one essential task of the Watershed Land Protection Collaborative should be to ensure that every sustainable landscape resource has been assigned to a conservation organization, and that conservation priorities that are acceptable to the Collaborative are established. The Collaborative's goal should be to ensure that the largest amount of the highest value sustainable landscape resources capturing regional diversity are protected over the next 25 years in a connected greenspace network that is ecologically viable now and into the coming centuries.

Watershed-based nonprofits (Land Trusts and Conservancies) should take the lead in proactive land protection. Land Trusts and Conservancies, or indeed any bona-fide conservation entity in the watershed with the eligibility, qualifications and resources to buy land or hold easements, should be encouraged to work collaboratively to promote the common goals and recommendations of land preservation throughout the watershed. PALTA (Pennsylvania Land Trust Association) may be the best vehicle for setting up such a watershed land protection collaborative. Representatives from Forestry, Development, Infrastructure Planning and Commerce/Industry and all municipalities should be invited to participate in implementing the plan's open space goals and sustainable landscape vision. Perhaps a Steering or Technical Advisory Committee can be appointed to oversee activities and coordination.

An overview of protection options is discussed at the end of the sustainable landscape section of this Plan under **Section 6.9 Sustainable Landscape Protection and Implementation Tools**. Use of *Smart Conservation* (http://www.smartconservation.org) or other rapid assessment techniques may help further prioritize which of these sensitive lands to protect first.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.2	**Refine Prioritization of Watershed Natural Lands using a Standardized Relative Assessment Tool**	Watershed conservation nonprofits, academics, scientific experts, government	Loss of natural lands Need for greenspace Strategic conservation	Sections 6.3.2, 6.4.1 Sensitive Lands map Composite Proposed Greenspace map

Description

Given the 200,000 acres of potential greenspace identified by this Plan, the watershed conservation community should take proactive steps to further prioritize high priority, sensitive lands according to their ecological value and degree of threat. Conservation groups should use established landscape analyses and relative assessment tools to refine land prioritization and to conserve the high priority potential greenspace identified in this Plan.

Natural Lands Trust has pioneered a technique called *Smart Conservation* that may meet the needs of this recommendation. The *Smart Conservation* assessment tool is under development, but preliminary results for setting conservation priorities are promising. NLT has tried to incorporate the best conservation science thinking into these assessments by inviting more than a hundred local experts from over eighty organizations and government agencies to provide input and review of the technique. NLT is also interested in having conservation entities learn how to use the tool, so that they can test it by doing their own assessments for conservation sites throughout southeast Pennsylvania. Conservation groups who have ideas to contribute, or who are interested in being involved with developing the technique should contact NLT for further information. For more information, see http://www.smartconservation.org.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.3	**Support Outreach and Education Programs Providing Landowners with Land Preservation Options**	Conservation organizations who have regular contact with landowners, such as Penn State Cooperative Extension, NRCS and nonprofits/land trusts	Loss of natural lands Need for greenspace Guidance on ecological management	General

Description

Private citizens, who may have little understanding of the land preservation and ecological management options available to them, own the vast majority of lands proposed for preservation in the watershed. A growing list of protection and implementation tools balance land protection with landowner needs (see **Section 6.9** for more information). In order to improve the likelihood of protecting these critical resources, outreach and education efforts should provide landowners with viable options and guidelines for land preservation and ecological management.

Several conservation nonprofits already have developed sophisticated materials to help landowners understand their choices regarding protection of their land. These materials could be used as models for the development of educational materials specifically for use in the Schuylkill River watershed. The distribution of these materials to educate landowners about their conservation choices also will raise awareness of land protection and stewardship needs in the Schuylkill River watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.4	**Proactively Protect PA Natural Diversity Inventory (PNDI) Sites**	WLPC, nonprofits and agencies with resources to pursue land protection, along with PNDI staff	Loss of natural lands Need for greenspace	Section 6.4.2.1 PNDI Site Types map PNDI Site Scores map Composite Proposed Greenspace map

Description

This is a sub-recommendation of **R6.1**, intended to highlight the special issues of PNDI sites as a critical component of the proposed greenspace network.

Within the proposed greenspace network, the PNDI sites should be one of the highest priorities for protection. These sites represent the most threatened biodiversity in the watershed, and their preservation will help to maintain species and genetic biodiversity across the watershed (see the maps listed in the table above). PNDI sites are spread throughout the watershed, although some of the highest ranked sites are found within Berks County. Protection of PNDI areas should be implemented in order of priority and threat, and to ensure a balanced portfolio of species and community biodiversity.

The PNDI scores establish clear priorities for protection of rare or threatened species in the watershed. Higher scoring sites should be targeted for protection before lower scoring sites, where possible. Sites with the highest scores should be pursued proactively for protection through fee or conservation easement by conservation entities. Watershed-based nonprofits (land trusts and conservancies) should work collaboratively with support from government to target PNDI sites for protection. **Section 6.9** below provides an overview of land protection and implementation options.

While it is important to protect the highest-ranked or most threatened sites first, it is also important to save a representative sample of sites, which reflect the maximum species diversity across the watershed – i.e., to select sites to maximize a species diversity portfolio. This latter task is currently handicapped by the PNDI species coding

system, which has been established to protect the rare species from poaching and disturbance. Watershed conservation entities, working in conjunction with the PNDI staff, should develop a PNDI portfolio targeted at promoting representative biodiversity.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.5	**Proactively Protect Identified Greenspace Nodes**	WLPC, nonprofits and agencies with resources to pursue land protection	Loss of natural lands Need for greenspace	Section 6.4 Sustainable Landscape Vision map Sensitive Lands map PNDI Site Types map PNDI Site Scores map Composite Proposed Greenspace map

Description

This is a sub-recommendation of **R6.1**, intended to highlight special issues of greenspace nodes as critical components of the proposed greenspace network.

Various government-owned lands already can be considered greenspace nodes within the watershed. However, the overall acreage (4.5% of the watershed) and uneven distribution of these lands suggests that alone they are inadequate to achieve a sustainable landscape. The existing greenspace network needs to be supplemented with the addition of other large area, sensitive natural lands that deserve protection.

Analysis completed for this Plan indicates where sensitive natural lands are throughout the watershed (see the maps noted above). The PNDI and Proposed Greenspace maps document the rationale for, and show the distribution of, proposed greenspace nodes in the watershed. Primary greenspace components include PNDI sites, NWI sites, floodplains, steep slopes, and IBAs. Secondary components represented are Exceptional Value Watersheds, Scenic Rivers, National Historic Landmarks and inactive railroads. Each of these components represents a potential greenspace node or corridor, and identifies greenspace "hotspots" where two or more of components overlap. Protecting these hotspots will efficiently leverage resources; therefore these areas should be among the first targets for conservation action.

Watershed-based nonprofits (land trusts and conservancies) should take the lead in proactive land protection and work collaboratively with public agencies and other watershed stakeholders to implement the sustainable landscape vision. Within the Kittatinny and Reading Horseshoe Habitat Zones, a Strategic Protection Plan (see Recommendation **R6.7**) needs to be developed for each subwatershed before specific greenspace nodes and corridors can be proposed. Use of *Smart Conservation* (http://www.smartconservation.org) or other rapid assessment techniques may help prioritize further which potential greenspace nodes to protect first.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.6	**Proactively Protect, Restore and Create Identified Greenway Corridors**	WLPC, nonprofits and agencies with resources to pursue land protection	Loss of natural lands Need for greenspace Landscape connectivity	Section 6.4 Sustainable Landscape Vision map Sensitive Lands map Composite Proposed Greenspace map

Description

This is a sub-recommendation of **R6.1**, intended to highlight the special issues of greenspace corridors as a critical component of the proposed greenspace network.

Existing and proposed greenspace nodes need to be connected across the watershed by the addition of natural land corridors to ensure biological exchange (e.g., migration, pollination, colonization) and on-going viability of watershed species and populations. In many cases, corridors can serve a dual purpose as riparian buffers, which help protect water quality. If natural land corridors also are considered as recreational opportunities, care should be taken to ensure that the habitat resource is no degraded by excessive or inappropriate human use. Disturbance from recreational use should be carefully monitored and withdrawn if necessary to maintain ecological integrity.

Existing protected lands in the watershed are unconnected, as are the proposed habitat zones and greenspace nodes, unless greenspace corridors are protected. In order to create a sustainable landscape in the watershed, greenspace corridors must play a vital connecting role to ensure biological exchange and habitat resilience throughout the watershed. Analysis completed for this Plan indicates where sensitive natural lands and potential greenspace corridors are located throughout the watershed (see the maps noted above).

Primary components that could serve as greenspace nodes or corridors include PNDI sites, NWI sites, floodplains, steep slopes, and IBAs. Secondary components include Exceptional Value Watersheds, Scenic Rivers, National Historic Landmarks and inactive railroads. Greenspace components that lend themselves to corridor development in particular tend to be the linear elements: floodplains, steep slopes and inactive railroads, along with Scenic Rivers. Greenspace corridors will be important especially within the Agricultural and Urban/Suburban zones, where they can also serve as riparian buffers in deforested landscapes.

Watershed-based nonprofits (land trusts and conservancies) should take the lead in proactive land protection and work collaboratively with public agencies and other watershed stakeholders to implement the sustainable landscape vision. Within the Kittatinny and Reading Horseshoe Habitat Zones, a Strategic Protection Plan (see Recommendation **R6.7**) needs to be developed for each subwatershed before specific greenspace corridors can be proposed. Use of *Smart Conservation* (http://www.smartconservation.org) or other rapid assessment techniques may help prioritize further which potential greenspace corridors to protect first.

Code	***Recommendation***	***Appropriate Partners***	***Issues Addressed***	***Sections/Maps***
R6.7	**Develop Strategic Protection Plans for Identified Subwatersheds in Habitat Zones**	Any watershed conservation entity, or a consortium, with the expertise and experience necessary to develop the plans	Loss of natural lands Need for greenspace Guidance on ecological management Strategic conservation	Sections 6.5.3.2 and 6.6 Primary Protection Watersheds map Summary Habitat Value map Watershed Priorities map

Description

According to the analysis conducted in this Plan, the Kittatinny and Reading Horseshoe Habitat Zones appear to be some of the highest quality remaining natural areas in the Schuylkill River watershed. Detailed, site-specific Strategic Protection Plans should be developed for each of the fifteen subwatersheds in these Habitat Zones. Since it is unlikely they can all be undertaken at the same time, the Subwatershed Protection Plans should be developed in order of priority by considering habitat value, forest/stream priorities and threat (i.e., projected population growth) as noted in the tables in **Sections 6.5** and **6.6**.

Strategic Protection Plans should focus on collection of GIS data for tax parcels and zoning data as well as further refinement of relative values for natural resources within the subwatershed. Landholdings then can be assessed at a site-specific level to evaluate priorities and appropriate strategies for protection. Use of *Smart Conservation* (http://www.smartconservation.org) or other rapid assessment techniques may help further prioritize which potential greenspace nodes to protect first, and within a greenspace node, which parcels are the lynchpins for preservation.

Recommendations from these Plans likely will include traditional (e.g., fee acquisition and easement) as well as non-traditional protection methods, such as: NLT's Growing Greener - Conservation by Design program; municipality zoning and ordinance reviews/suggested improvements; community-based conservation; and adaptive ecological land management guidelines. Other planning tools may be useful to consider, such as Transfer or Purchase of Development Rights (TDR and PDR). An overview of many of these implementation tools is given in **Section 6.9**. Once these subwatershed protection recommendations have been developed, an estimated budget can be generated to implement them, with suggestions for where the funds can be raised to achieve implementation.

River Conservation Plans already have been developed or are about to be initiated for several of the priority habitat subwatersheds (see **Section 3.6**). Obtaining any available data and GIS resources from these plans is strongly encouraged, so that the Strategic Protection Plans can be jump-started where possible. Potential funding sources include PA DCNR – Community Conservation Partnership planning grants (requires a 50% match) and PA DEP Growing Greener Watershed Protection planning grants (matches encouraged but not required). Other sources of watershed funding may include private foundations, community funds, corporate and individual donors. Any watershed conservation entity with GIS capabilities, conservation planning and knowledge of land protection tools should be encouraged to apply for funding from PA DCNR and/or PA DEP Growing Greener, or private foundations, to develop the recommended plans.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.8	**Develop Strategic Restoration Plans for Identified Primary Restoration Subwatersheds**	Any watershed conservation entity, or a consortium, with the expertise and experience necessary to develop the plans	Loss of natural lands Need for greenspace Guidance on ecological management Strategic conservation	Sections 6.5.3.3 and 6.6 Primary Restoration Subwatersheds map

Description

According to the analysis conducted in this Plan, certain subwatersheds in the Agricultural and Urban/Suburban Zones would appear to benefit from some level of habitat and riparian restoration, at least in the form of reforestation. Detailed, site-specific Strategic Restoration Plans should be developed to guide future actions by local conservation groups within the five subwatersheds highlighted for restoration in **Section 6.5.3.3**: Tulpehocken; Little North Kill; Skippack; Ontelaunee; and Upper Maiden Creek. Since it is unlikely all the required plans can be developed at the same time, it is recommended that the first five subwatershed Strategic Restoration Plans should be developed in the order of priority.

To be cost-effective, the Strategic Restoration Plans should focus initially on ensuring maximum riparian buffer coverage along the streams in the priority subwatersheds. The riparian buffers should be created, restored or protected with the understanding that they are also designated greenspace corridors. As such, every effort should be made to reinforce these buffers with permanent land protection. This not only will justify the financial investment made for the restoration, but will ensure that another piece of the watershed greenspace network is secured.

Recommendations of these plans may include restoration guidelines as well as land protection options. An overview of many of these implementation tools is given in **Section 6.9**. Once these restoration recommendations have been developed, an estimated budget can be generated to implement them, with suggestions for where the funds can be raised to achieve implementation.

Berks County Conservancy could take the lead in the Agricultural Zone with Schuylkill Riverkeeper taking the lead in the Suburban/Urban Zone. In conjunction with other local conservation partners e.g., Trout Unlimited Chapters, as well as NRCS, USFWS Partners for Wildlife, PA DEP and PA DCNR, the focus should be on fundraising and Strategic Restoration Plan development. Installation of riparian buffers and habitat restoration should be completed by community groups and volunteers, where possible, to leverage resources and provide environmental education

outreach. Land protection should accompany restoration, which can be facilitated by developing partnerships with land trusts or government agencies who are prepared to hold riparian buffer easements.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.9	**Develop and Adopt a Strategic Protection Plan for Watershed-wide Agricultural Land Resources**	A task force of watershed agricultural conservation groups such as NRCS, PA Dept. of Agriculture and County agencies involved with the agricultural easement programs	Need for greenspace Guidance on ecological management Strategic conservation	General Agricultural Land Cover map

Description

As mentioned in the introductory chapters, the focus of this Plan from inception was on landscape sustainability, water quality and institutional capacity. While agriculture is acknowledged as critical component of the human communities and natural resources in the watershed, and should be a key part of a comprehensive planning process, agriculture has not been addressed specifically in this Plan due to the scale required for the watershed assessment (2,000 square miles) and the limited resources available. A tight focus on the three primary areas of interest was required to meet the goals of the project.

Although not a focus of this Plan, agricultural preservation can serve a supporting role in maintaining landscape sustainability if ecological BMPs and NMPs are implemented and enforced. Agricultural preservation is also a laudable goal in its own right, and has the potential to support a market for tourism. Data should be collected to document where agricultural preservation already has taken place, and to plan where else it should happen, both in its own right and as a support to a sustainable landscape plan for the Schuylkill River watershed.

Agricultural preservation should be addressed through a separate Strategic Protection Plan, ensuring that the goals of agricultural preservation are fully integrated with the goals of this Schuylkill Watershed Conservation Plan. Once agricultural preservation recommendations have been developed, an estimated budget can be generated to implement them, with suggestions for where the funds can be raised to achieve implementation.

Comments collected during the Public Meetings indicated that several, if not all, of the watershed counties now have GIS data of where agricultural easements exist for lands under their jurisdiction. It may be a fairly straightforward process to collect and compile existing agricultural easements as a discrete watershed data layer. Together with soils information, data on the locations of approved agricultural security districts, and targeted tax parcel and zoning data, a plan can be developed to prioritize which lands should be pursued for agricultural easements or other protection.

Government agencies such as NRCS and/or County Planning Agricultural Easement program staff need to work in coordination with watershed conservation groups that facilitate the agricultural easement process, as well as the watershed farming community, to develop a comprehensive plan for the entire watershed. Berks County NRCS and Berks County Conservancy could be encouraged to play a central role in developing this recommendation, establishing a watershed-wide collaboration to develop the Strategic Protection Plan with support as necessary from other County agencies and nonprofits in the Schuylkill River watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.10	**Reactively Protect Natural Resources in the Watershed as Opportunity Arises**	WLPC, nonprofits and agencies with resources to pursue land protection	Loss of natural lands Need for greenspace	General

Description

Land protection is both a science and an art. Strategic conservation planning can indicate where are the best natural lands for protection, which ones are under greatest threat, and in what order they should be preserved to maximize the impact of a limited funding base. However, in the context of a "willing buyer-willing seller" paradigm, prioritized plans may not always be implemented in the order suggested. Land protection is very opportunistic, and subject to changes in the land market and the ability and interest of landowners to participate. Therefore, it is vitally important to maintain a flexible approach to land protection that allows for taking action as good opportunities arise. This "reactive" mode of land protection should be seen as a safety net to more "proactive" land protection based on strategic conservation planning.

The critical difference between proactive and reactive land protection rests with the issue of outreach. Proactive land protection involves conservation organizations targeting key landowners and offering expertise and resources to help protect their lands. Landowners and priority lands are identified ahead of time through conservation planning. By contrast, reactive land protection spends no energy or resources targeting landowners, but responds as opportunities arise based on landowner initiative.

If an opportunity arises that is not part of a strategic protection plan, a decision about the cost-effectiveness of the proposed deal will need to be made. It sometimes can be very difficult to make these decisions, since it is always hard to estimate what will be the opportunity cost of completing an unsolicited deal. Members of the land trust community are working to develop methods to help make such decisions easier, at least by providing rapid assessment techniques such as *Smart Conservation* (http://www.smartconservation.org/) to help evaluate biological value and threat. But it seems unlikely that tools can be developed to help assess opportunity cost. By committing to an unsolicited, out-of-plan land protection deal, a land trust may use resources that might otherwise have been available to complete a proactive, in-plan opportunity arising shortly thereafter.

Land Trusts and conservancies, or indeed any bona-fide conservation entity in the watershed with the eligibility, qualifications and resources to buy land or hold easements, should be encouraged to work collaboratively to achieve the joint goals of land preservation throughout the watershed. PALTA (Pennsylvania Land Trust Association) may be the best vehicle for setting up such a Watershed Land Protection Collaborative (see Recommendation **R6.1**).

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.11	**Promote Development of Forest Resource Management Plans on Privately-owned Forest Lands**	PA DCNR Bureau of Forestry, Penn State Co-operative Extension, NRCS and other conservation groups	Loss of natural lands Guidance on ecological management	General Forested Land Cover map

Description

The majority of the watershed's forest resources are found on private lands. Private landowners of key forested properties should be provided guidance on maintaining or restoring these lands to their natural health and viability. Tailored Forest Resource Management Plans should be developed with the goal of achieving both ecological sustainability and economic returns.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.12	**Control Invasive Species and Deer Densities to Enhance Forest Regeneration of Native Plants**	PA DCNR and PA Game Commission along with interested nonprofits and government agencies	Loss of natural lands Guidance on ecological management	General

Description

Invasive species, including non-native plants and animals such as white-tailed deer, increasingly threaten the stability and biodiversity of ecological communities. Efforts should be made to control invasive species and reduce white-tailed deer densities in the watershed to levels compatible with forest regeneration of native plants. Demonstration projects, particularly at environmental education facilities, should be developed and supported to address these concerns, especially where the human community is engaged in proposed demonstration land management projects. Invasive species management represents an opportunity to improve habitat quality and to provide environmental education for the watershed public.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.13	**Develop Watershed-wide Adaptive Ecological Land Management Guidelines for Protected Lands**	A task force of watershed conservation entities with the expertise and experience necessary to develop the guidelines	Guidance on ecological management Strategic conservation	Section 6.4.1, General

Description

As mentioned in **Section 3.5** of *Chapter 3.0 Watershed Characterization*, many biological resources in the watershed are becoming out of balance with the ecosystem due to disturbance caused by human activities. Introduced invasive species – plant and animal, aquatic and terrestrial, vertebrate and invertebrate – are changing the natural processes and native habitat of the Schuylkill River watershed. For example, it is quite likely there are more rodents and small mammals in the watershed now than in pre-colonial times, due to the extirpation of large carnivores. The intricate checks-and-balances imposed by the natural trophic pyramid - who feeds on whom, who outcompetes whom – has been altered under human influence.

To address the worst of these imbalances, those that most threaten to destabilize the ecosystem, generic ecological management guidelines should be developed for issues that are common throughout the watershed. As a supplement to the generic guidelines, site-specific Adaptive Ecological Management Plans (or resource management plans) should be developed for all existing greenspace nodes and corridors and on an on-going basis as additional land protection is secured. These plans should focus on a holistic approach to re-establishing ecological balance, rather than on the needs of any one species or natural community. The only notable exception should be PNDI sites, where the needs of the rare species or community may be given priority over the needs of common communities or species. Much of the effort in these plans needs to be directed to controlling invasive exotic plant species that are known to destabilize ecosystems. A list of plant species of primary concern in this region, by no means exhaustive, is given in **Section 3.5** of this Plan.

The conservation entity holding the land protection rights on a property should accept the responsibility for developing site-specific Adaptive Ecological Management Plans, while watershed guidelines should be developed for approval by a consortium of watershed conservation stakeholders, including both government agencies and nonprofits. All Adaptive Ecological Management Plans should meet a pre-determined quality assurance/quality control protocol.

Such watershed "governance" issues need to be implemented through a watershed administration system that is described in Recommendation **R7.1**, **Section 7.5** of *Chapter 7.0 Institutional Assessment*. At the state level, the Ecosystem Management Advisory Commission (EMAC)[3] is focusing on similar issues for state-owned lands throughout the Commonwealth, and may be a source of recommendations and innovative solutions for adaptive management.

[3] EMAC is an advisory group of ecological experts that is working with PA DCNR's Bureau of Forestry to address concerns about ecological management and restoration on Bureau of Forestry lands in Pennsylvania.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.14	**Establish Community-Based Programs to Implement Adaptive Ecological Management Plans on All Protected Lands by Priority**	Watershed nonprofits and government agencies	Guidance on ecological management Strategic conservation	Sections 6.4.1 and 6.5

Description

As noted in Recommendation **R6.13**, to ensure viability of a sustainable landscape, there is a clear need for Adaptive Ecological Management Plans to be implemented on protected lands throughout the watershed. The issue of resources to implement these initiatives is an obvious concern. Given the choice of maintaining lands already protected, or protecting more land, concern over urban/suburban sprawl usually dictates a decision to support additional land protection. Usually it is easier to raise funding for land protection than for ecological land management.

However, ecological land management offers some unique opportunities for community outreach. Engaging the human community in managing local greenspace is an excellent way to increase awareness and understanding of the ecological issues in the watershed. By developing Adaptive Ecological Management Plans that can be implemented by community-based volunteers, neighborhoods can reconnect with the local ecosystems on which they depend. At the same time, community-based ecological management implementation can leverage precious resources to the maximum extent possible. For example, between 1987 and 1997 in the Wissahickon Park, a budget of less than $30K/yr was used to great effect planting thousands of native canopy trees, restoring forest canopy gaps that otherwise would be invaded by invasive exotic plants. Hundreds, even thousands, of volunteer hours were harnessed annually. If consultants and contractors had undertaken this work, the costs would have been exorbitant, and much less might have been accomplished. To complement community initiatives that "take back the streets," communities should also be engaged in the race to "take back the forest." Coordination, equipment, materials and publicity costs will be incurred initially, but can be leveraged many times over.

A watershed-wide program that facilitates community-based implementation of Adaptive Ecological Management Plans should focus on the Urban/Suburban Zone. Ecological management programs should be run out of existing environmental education facilities, where possible. A consortium of conservation entities needs to be convened, ensuring that the groups with the technical knowledge and experience to develop such ecological management guidelines and plans work with groups that have community outreach experience and resources. Such watershed "governance" issues need to be implemented through a watershed administration system that is described in Recommendation **R7.1** in **Section 7.5**.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.15	**Develop and Adopt a Strategic Resources Plan for Watershed-wide Land Protection, Restoration and Ecological Management**	PA DEP and PWD could spearhead a task force of watershed conservation entities such as PEC, PA Greenspace Alliance and other nonprofits	Strategic conservation	Sections 6.4.1 and 6.5

Description

There is a shortfall between the financial resources available to protect lands in southeast Pennsylvania and the needs recommended just by this project alone. PA DCNR historically has made available between $4 and $8 million annually to land trusts for conservation projects across the Commonwealth based on a 1% tax from real estate

transactions. Land trusts can apply these funds to conservation planning and land protection projects. Of that amount, perhaps $1.5 million is earmarked for southeast Pennsylvania. Therefore, over 20 years, perhaps $30 million would be available through this program – but these funds must also be used to fund projects in counties that lie outside the Schuylkill River watershed.

A functional minimum of 200,000 acres of designated greenspace nodes and corridors is recommended for protection in the Schuylkill River watershed. To fit the currently-available budget, the average cost of protecting an acre (excluding staff and planning time, just considering purchase price) would need to be less than $150/acre. This seems quite unrealistic given that this is one of the most rapidly developing regions in the Commonwealth, where suburban lots regularly are sold for tens of thousands of dollars/acre, and even agricultural cornfields regularly change hands for $5,000/acre (and sometimes up to $12,000/acre, even with agricultural easements in place). A $30 million budget can purchase only 6,000 acres at $5000/acre. This financial resource base is clearly insufficient to implement the sustainable watershed greenspace network proposed by this Plan.

Of course, less financially resource-intensive methods are available for protecting land. To achieve a sustainable watershed in the Schuylkill, many non-traditional protection methods should used to maximally leverage funding. Planning tools, zoning codes and ordinances enacted by watershed municipalities can assist to some degree, although these public policies, and even federal regulations, can change over time depending on the political climate and economic development pressures. Other conservation design tools, such as NLT's Growing Greener program and "Stormwater Utilities" (see **Section 6.9** below for more information), can also help to some extent, and certainly should be encouraged throughout the watershed. However, even with these policies and tools, there still will be a need to permanently protect as much of the 200,000 acres as possible through fee simple purchase or conservation easement.

It may seem like an impossible task, but there are contemporary examples of projects that have similar price tags. There is precedent for land protection programs that have funding of this order of magnitude. For instance, New Jersey recently passed a bond issue making $100 million available each year for land protection across their state in addition to county and municipal funding programs. In conjunction with all the leverage tools, tax relief incentives and innovative planning techniques that can be brought to bear, this magnitude of funding program would make promoting a sustainable landscape in the Schuylkill River watershed more of a reality.

A funding plan for land protection in the Schuylkill River watershed should be developed, strategizing how to close the apparent funding gap between available financial resources and implementation needs of this plan for the entire watershed. Key stakeholders from the conservation and government communities need to be involved. The Philadelphia Water Department (PWD) and PA DEP could be key players in the development of a watershed-wide Strategic Resources Plan for land protection, ecological restoration and management, for the following reasons:

- The Schuylkill River watershed was one of the highest ranked "Category 1 impacted watersheds" in the Commonwealth, as noted in Table 6 of DEP's *PA Nonpoint Source Management Program:1999 Update*, and is one of the highest priorities for PA DEP attention in fiscal year 2000.
- The Philadelphia Water Department's Office of Watersheds has initiated a Source Water Protection Program in response to a mandate from the federal government (1996 Safe Drinking Water Act). They are trying to assure potable water supplies to the 1.5 million residents of the Philadelphia region and the more than 3 million people who live and work in the Schuylkill River watershed. They will be developing a plan to protect water quality across the Schuylkill River watershed - the *Schuylkill River Source Water Assessment Partnership* - that should be aligned to the maximum extent possible with the water quality and land protection recommendations from this Plan. Their program and this Plan are likely to have many common goals. Common funding sources should be made available to achieve those goals.
- PWD and PA DEP need to spearhead a coalition of government and nonprofit conservation entities in the watershed to secure the funding necessary to ensure that the common goals and recommendations of land and water quality protection are met.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.16	**Develop an Interactive GIS Resource for the Watershed Community**	PA DCNR, PA DEP, DVRPC, PASDA, EPA Region 3, NPS and the US ACE, as well as watershed conservation entities conducting GIS	Strategic conservation	Sections 6.4.1, 6.4.3, and 6.4.5

Description

The paper maps produced for this Plan are only of limited utility to the conservation community who will use them, due to scale and resolution issues. Paper copies are also very inflexible tools for analysis. The real utility of GIS data lies in the ability to select different areas of the watershed to view at greater resolution; understand issues by overlaying different data; combine data to determine patterns that refine conservation thinking; and to incorporate data improvements as they become available. Making this GIS data available so the watershed conservation entities can use it as an interactive tool will ensure that the full potential of the data are realized.

At a minimum, the GIS mapping compiled for this project should be used as the foundation for a watershed-wide GIS database. It could be housed within the watershed clearinghouse or resource center described in Recommendations **R7.11** and **R7.12** in **Section 7.5**, or perhaps on the PASDA website, which has been established as the GIS data clearinghouse for the Commonwealth. Precedent exists for this approach since GIS data sets for Spring Creek watershed are already provided on the PASDA website. PA DCNR could take the lead in establishing whether PASDA could house and maintain the Schuylkill River watershed GIS database under their jurisdiction. A fallback alternative would be distribution of all available GIS data to all interested watershed conservation entities on CD-ROM, but this would limit the ability to add to or update the database over time. If the PASDA initiative is not feasible, a consortium of watershed conservation entities should be convened to develop a cost-effective solution.

However, distributing map data in isolation of the GIS software that allows transformation and analysis of these data are of limited utility. Implementation of the Plan could be facilitated greatly by the development of a user-friendly GIS model illustrating the data in the Plan, in addition to any other information that stakeholders may wish to add. As with simple data distribution, just creating the GIS model does not necessarily ensure its use. To ensure Plan implementation and use of the GIS model, all stakeholders must have the capacity to use GIS technology. This means not only transfer of technology to nonprofit and government stakeholders, but also the education of future users as to GIS systems. Furthermore, users of the GIS model need to be educated about the data incorporated into the model so that information is not misinterpreted or misused.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.17	**Establish a Funding Base, Schedule and Distribution Protocol for Updating and Upgrading GIS Mapping**	PA DCNR, PA DEP, DVRPC, PASDA, EPA Region 3, NPS and the US ACE, as well as watershed conservation entities conducting GIS	Strategic conservation	Sections 6.3.2, 6.4.1, 6.4.3, 6.4.5 and 6.5.1

Description

New GIS data sets are being made available all the time, such as agricultural easements and the PEC privately protected lands mentioned elsewhere. Other standard data, such as soils and geology, can be modified to include missing value-added information that would make these data more targeted, useful and user-friendly for the watershed conservation community. As new watershed projects are completed, their GIS data should be integrated

into the Schuylkill River watershed GIS database or model. Mandatory annual GIS data reviews should assess and address update and upgrade issues.

In addition to these new data, as identified by this Plan, some significant watershed-wide data gaps currently exist that are required for providing the best analysis and conservation resource planning. For example, one of the most significant data gaps is the lack of up-to-date classified digital land cover for the entire watershed. While DVRPC generates land cover data from aerial photography for the PA 5-county region around Philadelphia every 5 years, the other four counties in the watershed are either not completing this task, or are not coordinating with the other counties to ensure that full coverage of the watershed is available in a standardized format. Other examples of conservation data gaps for the watershed that would be invaluable for further planning and assessment purposes are noted below. These data gaps, and other conservation mapping components that were not the focus of this Plan, should be addressed on an on-going basis. Watershed-wide data needs to be compiled in GIS using a standardized system, based on metes and bounds where possible to ensure accuracy. Some of the following data may already have been compiled as partial coverages for the watershed, but, to the best of our knowledge, are unavailable watershed-wide.[4] Besides the data listed below, there may be other data sets that would be very useful.
Recommended watershed-wide data for acquisition/updating:

- Updated land cover (post 1992-4)
- Nonprofit owned protected lands
- Aquifer recharge areas
- Municipal-owned open space (by type – e.g., active recreation vs. passive recreation vs. natural areas)
- County-owned open space (by type – e.g., active recreation vs. passive recreation vs. natural areas)
- Agricultural easements (both government and nonprofit)
- Historic, cultural, recreational and scenic resources
- Riparian corridor assessments.
- Detailed Ecological Landscape Unit Analysis (to provide a more detailed prediction of habitat type than is available from current land cover assessments).
- Superfund sites, landfills, quarries, NPDES permitted facilities and other point-source pollution generators, etc
- Ecological restoration sites/Community-Based ecological restoration and management sites
- Environmental Education sites
- Complete tax parcels
- Complete zoning

All County Planning agencies in the watershed, along with DVRPC, DRBC, DCNR, DEP, PWD, federal agencies, nonprofits and municipalities who posses GIS capabilities, should work collaboratively to address these data needs. A task force needs to be appointed to ensure that watershed-wide GIS data sets are available (ideally free of charge, or at most on an at-cost per download basis) through a GIS clearinghouse such as PASDA or a yet-to-be-established watershed-specific GIS clearinghouse (see Recommendation **R7.11** in **Section 7.5**). The task force also needs to establish data development priorities and protocols for data standards and development, and to administer grants for data compilation and distribution.

[4] Note that as of 5/9/01 PWD and their consultant, CDM, have tried to address the need for a consistent and updated watershed-wide GIS land use/land cover map. This will be done by using the 2000 Census data to project updated land cover changes based on population density in the watershed for use in their Schuylkill Source Water Assessment project. As the best working alternative for updated land cover for the entire watershed (since the last Landsat MRLC data was released from 1992-4), DCNR and DEP should provide financial and any other kind of support necessary to ensure that these data are of sufficient quality to release for public use as soon as possible.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.18	**Develop Local-Scale Comprehensive Subwatershed River Conservation Plans**	Any interested watershed-based conservation entities.	Guidance on ecological management Need for greenspace Strategic conservation	General

Description

Comprehensive subwatershed plans should be completed for areas in the Schuylkill River watershed not currently covered by local-scale River Conservation Plans. Although this Plan established regional priorities, it is too broad a scale for developing detailed local initiatives. Where there is interest, local groups should be prepared to develop local plans that implement some of the generic recommendations developed here, but also factor in critical missing local information.

Several established watershed and conservation groups are interested in conducting site-specific River Conservation Plans for areas underrepresented in the watershed-wide analysis. Other nonprofits and government agencies with the expertise could be used as consultants and resources to help complete these plans where necessary. PA DCNR has recommended that organizations, local nonprofits and municipalities that serve the Schuylkill Headwaters and Little Schuylkill subwatersheds should develop a comprehensive watershed conservation plan for this region. Several local groups, such as the Little Schuylkill Conservation Club, already are engaged in various conservation efforts, such as re-introduction and back-crossing of the American Chestnut, riparian restoration and water quality monitoring. Other groups would benefit from organizational support to generate membership and interests in watershed activities. These local, comprehensive planning efforts should be encouraged and supported by foundations and funding agencies in the watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues*	*Sections/Maps*
R6.19	**Support the Schuylkill River Heritage Corridor Management Action Plan**	Schuylkill River Greenway Association, in conjunction with other watershed conservation entities	Need for greenspace Strategic conservation	General

Description

As mentioned in the introductory chapters, the focus of this Plan from inception was landscape sustainability, water quality and institutional capacity. While scenic, cultural, historic and recreational resources are critical aspects of the watershed community and part of the comprehensive planning process, they have not been addressed specifically in this Plan. Instead, it is recommended that these aspects of the watershed be addressed under a separate Plan, ensuring that the two efforts are integrated and support each other to the maximum extent possible.

The Schuylkill River Valley National Heritage Area (see **Section 3.6.2** in *Chapter 3* for further discussion) is one opportunity to develop such a scenic, cultural, historic and recreational strategic plan for the watershed. The geographic boundaries of the National Heritage Area are "those portions of Schuylkill, Berks, Chester, Montgomery and Philadelphia that are in the Schuylkill River Watershed." The National Heritage Area is charged with recognizing the national significance of the contribution of the Schuylkill River Valley to the nation's political, cultural and industrial development. Its purpose is to enable local communities to conserve their heritage while continuing to pursue economic opportunities and to conserve, interpret and develop the natural, historical, cultural and recreational resources related to the industrial and cultural heritage of the area.

The Schuylkill River Greenway Association is the management entity for this National Heritage Area, and is responsible for developing a Management Action Plan. Many of the resources this plan will focus on have been described and documented in the National Park Service's 1995 Cultural Landscapes Assessment for the Schuylkill River Heritage Corridor. This Management Action Plan should be supported, and could be expanded if necessary, to address the conservation of the full range of cultural, historic, scenic and recreational resource needs in the watershed. Nonprofits and government agencies across the watershed interested in cultural, historic, scenic and recreational issues should be invited to assist the Schuylkill River Greenway Association with the National Heritage Area project activities. It is recommended that additional PA DCNR funding be made available to match National Heritage Area's federal funds if necessary, to ensure that these valuable watershed resources are documented appropriately.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.20	**Encourage Smart Growth Policies**	Municipalities, county planning offices, PA DEP, US EPA, nonprofit watershed groups	Loss of natural lands Need for greenspace	General

Description

In urbanizing areas, it is important that development occurs with as little disturbance as possible to the soil and hydrology of the watershed. Smart growth policies that incorporate urban best management practices can be an effective means for protecting watersheds, and minimizing the development-related impacts of increased stormwater runoff and non-point pollution. Approximately 75% of the municipalities in the Schuylkill River watershed are expected to experience continued growth through the year 2010, with Berks County being the area of the highest potential population increase. Other areas of concern include the expanding suburbs of Philadelphia and Reading, although the expected trend in the watershed is one of out-migration from the suburbs to more rural areas (see **Section 6.6**). Within these areas of projected high growth, county and local governments can help guide the development process to ensure economic and environmental sustainability.

Smart growth policies that help to guide development may include:

- promoting location-efficient development, e.g., encouraging brownfield and infill development, transit-oriented development, and development near existing infrastructure and amenities, through policies that establish redevelopment/revitalization zones, growth management zones, priority funding areas or service districts;
- encouraging mixed land uses and a balance of jobs and housing in regional and site design;
- promoting compact, clustered or conservation-oriented development design that conserves open space and reduces lot size;
- preserving community character through the protection of important local cultural, historic and natural features;
- making necessary changes to zoning and development codes to encourage smart growth; and
- encouraging stakeholder and community collaboration.

See also **Section 6.9** for policies and tools that complement smart growth and assist in land conservation.

A number of programs exist on the federal, state, and local levels to help guide the development of smart growth policies. For more information on smart growth policies being used for watershed protection, see the following resources.

- Pennsylvania Department of Community and Economic Development (http://www.dced.state.pa.us/PA_Exec/DCED/government/land-use.htm)
- The Natural Lands Trust, with the PA Department of Conservation of Natural Resources and the Penn State Cooperative Extension Service, Growing Greener Program: *Conservation by Design* (http://www.natlands.org/Planning/growgreen2.html)

- The Brandywine Conservancy's Municipal Assistance Group (http://www.brandywineconservancy.org)
- Chester County *Landscapes Program* (http://www.chescowedd.org/general.htm#Landscapes)
- 10,000 Friends of Pennsylvania (http://www.10000friends.org/Default.htm)
- PA DEP *Handbook of Best Management Practices for Developing Areas*
- US EPA *Green Communities* program (http://www.epa.gov/greenkit)
- US DOE online *Center of Excellence for Sustainable Development* (http://www.sustainable.doe.gov)
- Livable Communities program and National Livability Resource Center (http://www.livablecommunities.gov)

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.21	**Support Brownfield Redevelopment Initiatives**	Montgomery County Planning Commission, PEC and any other interested and qualified watershed conservation entities	Loss of natural lands Need for greenspace Strategic conservation	Section 6.9.5

Description

As the complimentary strategy to land preservation, a model redevelopment incentive ordinance including BMPs should be developed for watershed-wide application. Montgomery County Planning Department or PEC could be ideal choices for developing this text, which could subsequently be distributed to municipalities throughout the watershed.

Code	*Recommendation*	*Appropriate Partners*	*Issues Addressed*	*Sections/Maps*
R6.22	**Support Development of Standardized Demographic, Transit, Infrastructure and Land Use "Change Indicators" for the Entire Watershed**	DVRPC and interested watershed County Planning Commissions, together with other interested watershed organizations	Loss of natural lands Need for greenspace Strategic conservation	General

Description

In order to adequately characterize levels of threat in the watershed so as to better direct conservation, a collaboration of county planning agencies and other interested organizations could address the need to develop and maintain standardized periodic updates for critical data that will assist in tracking the development pressure and human population impacts throughout the watershed. No agency is currently responsible for such watershed-wide assessment. DVRPC develops some statistics that assess conditions for the lower watershed, but can supply data only for the 5-county region immediately surrounding Philadelphia. Prototypes of such "Change Indictors" are currently under development in Chester County, and these could serve as a model for similar Indicators of Change/Threat to be developed for use in monitoring conditions in each subwatershed of the Schuylkill River watershed. Once developed, these Change Indicators can then be applied to assess conditions on a relative basis for each of the 37 subwatersheds used for analysis in this Plan, with the goal of helping to better direct strategic conservation and land protection activities.

6.9 Sustainable Landscape Protection and Implementation Tools

The following is a brief discussion of and introduction to land protection and implementation tools that could be used to help advance the goals of this project across the watershed. As part of a watershed-wide management structure, these preliminary guidelines could be developed into a more comprehensive and extensive, user-friendly tool-kit for the watershed conservation community.

There are many ways to protect land, with varying levels of protection and restrictions on property and development rights. While government agencies have the power, in certain circumstances, to condemn or "take" land, the tools listed here focus on the "willing buyer – willing seller" paradigm that the nonprofit land trust community operates under, and on local municipal planning tools, such as zoning and ordinance codes.

6.9.1 Fee Simple Purchase

Fee simple purchase is the outright purchase of property for an agreed sum. The fair market value (FMV) of the property is usually established by conducting two appraisals. A sale for less than FMV is referred to as a "Bargain Sale," with the cash-price difference being an eligible conservation donation with resulting potential tax benefits.[5]

Fee Simple Purchase Recommendations

- To be an effective tool landowners have to understand how sales and gifts of land to land trusts can help them achieve their goals and the goals of this Plan. A watershed-wide program of mailings and small meetings should be developed to educate them. For landowners, the emphasis might be on protecting a defined neighborhood, with local citizens providing leadership in this effort. Neighborhood leaders can help craft the specifics of their neighborhood initiative. Municipal officials should be briefed and provided with concise materials on conservation real-estate options, with examples of their use by municipalities in the watershed.
- Find landowners that have make a gift of land or bargain sale and, if they are willing, have them serve as case studies for other potential donors.
- Start a "conservation buyer" network, perhaps on the web, to facilitate the exchange of lands in the watershed that have been or should be preserved. Conservation buyers are people interested in purchasing land for conservation purposes, or under conservation easement restrictions.

6.9.2 Easements

Conservation easements are voluntary restrictions placed on a property to protect selected resource areas. The easement is either donated or sold to another party, usually a conservation organization or government agency. The owner retains all rights in the property except that which is specifically conveyed. For instance, the owner may convey to a conservation organization the right to subdivide the property, the right to log along the stream, and the right to exceed a certain percentage of paved area on the property. The owner retains the right to live on the property, and sell it to someone else. The

[5] Note: For further information on the tax benefits of conservation giving to a bona-fide conservation organization – whether in the form of cash donations, gifts of land, or bargain sales – see Small (1992) or Abbin et al. (1995) in **Section 6.11 References**; or go to the Land Trust Alliance web page at http://www.lta.org. The tax rules on charitable giving are complex and change frequently, so it is very important that any conservation donors retain their own tax lawyer or accountant as an advisor. Conservation entities receiving the conservation gifts should avoid giving tax advice to limit potential liability.

conservation organization has the right and obligation to enforce the terms of the easement in perpetuity. If the easement is donated, its value may be considered a charitable contribution under the federal income tax code.

Easements have an important place in the protection of natural resources, particularly riparian buffers and stream corridors, because they offer a landowner the ability to protect the natural features of a property, without losing the right of ownership. Easements may be an effective estate-planning tool because they may lower the value of the property and its estate taxes, making it easier to pass to a younger generation. Easements may, but do not have to, specify that the public has a right of entry – that decision is up to the landowner. If the public is given the right to enter, it is often along a clearly defined corridor such as a ridgeline or stream.

Easements can be useful to a municipality as a way to provide a trail through common open space as a condition of subdivision approval, or as a means to ensure proper management of common open space. If a landowner is willing, a municipality could even purchase a trail easement to connect parkland or natural areas within a Township or Borough.

As a conservation and tax-planning tool, easements are not particularly well known to landowners. Municipal open space plans mention them as an inexpensive preservation tool, but landowners need to be educated to turn this suggestion into on-the-ground conservation easements. Municipal officials may not have the same experience with easements as land conservancies, and may not have the time to market them effectively.

Easement recommendations

- To be an effective tool, landowners and municipalities have to understand how easements can help them achieve their goals. A watershed-wide easement program of mailings and small meetings should be developed to educate them both. For landowners, the emphasis might be on protecting a defined neighborhood, with local citizens providing leadership in this effort. These leaders can help craft the specifics of their neighborhood initiative. Municipal officials should be briefed and provided with concise materials on easements, with examples of their use by municipalities in the watershed.
- Find one or more landowners willing to donate conservation easements and, if they are willing, have them serve as a case study for other potential donors.
- The cost of negotiating, drafting, and documenting conservation easements can put them out of the reach of many landowners. Funding to provide easements on a sliding scale to interested donors would greatly improve the chances of the program's success.

6.9.3 Conservation Design for Subdivisions

In recent years, planning efforts have increased at the state and county levels within the watershed. These efforts include allocation of County dollars for open space preservation and planning in Bucks, Chester and Montgomery Counties as well as Keystone and Growing Greener funding initiatives at the state level. Increased preservation and planning does not preclude the critical role of local government. Conserving Pennsylvania's important natural landscapes is a challenge that is largely met by the Commonwealth's municipalities. All too often, municipalities adopt land use regulations that are easy to enforce, but that may encourage land development in an sprawling pattern of house lots, streets and lawns. In developing areas, municipal officials often feel they have no choice but to approve conventional subdivisions that

meet ordinance requirements, despite the fact that such proposals may irrevocably consume important resources and permanently alter their community's special character.

Development pressures, coupled with scarce preservation funds mean that communities wishing to conserve natural resources will have to strategically target preservation dollars and carefully plan for growth.

A practical approach to managing growth and conserving land must be relied upon to protect the conservation network envisioned in this Plan. In 1996, NLT, in collaboration with DCNR and Penn State University, launched Growing Greener-Conservation by Design, a statewide conservation-planning program to educate municipal officials in conservation design techniques. The objective of conservation design is to improve the pattern of residential growth as it presses out into the countryside, so that an interconnected network of conservation lands may be identified, designed around and protected from inappropriate changes. The concept for conservation subdivisions has evolved from NLT's efforts to help municipalities add significant land protection standards to their existing land use ordinances, so that conservation approaches will become "institutionalized" within the local planning framework.

In order to implement conservation design, municipalities must make changes to three documents: the Comprehensive Plan; Zoning Ordinance; and Subdivision/Land Development Ordinance. The principal elements of Conservation by Design involve the following.

(1) *Supplementing the Comprehensive Plan to include a Township-wide "Map of Potential Conservation Lands,"* including both "Primary Conservation Areas" (wet, flood-prone, steep slopes) and "Secondary Conservation Areas" (otherwise buildable woodlands, farmland, habitat areas, riparian corridors, cultural landscapes and scenic viewsheds, and other noteworthy features that help define the Township's special character). These maps are displayed in such a manner as to identify an interconnected network of conservation lands for protection.

    A composite "green infrastructure" map is rendered in three shades of green. The darkest green would be reserved for public lands designated for conservation use, properties with conservation easements, and lands owned by conservation organizations such as land trusts. The medium green would show inherently unbuildable lands (wet, flood-prone, and steep slopes), the category called "Primary Conservation Areas." The third and lightest green would include further resource lands such as woodlands, habitat, and agricultural soils that are not otherwise wet, flood-prone or steep, plus a number of other features of the natural and historic landscape that are noteworthy and desired for protection ("Secondary Conservation Areas"). The map is adopted as a guide, showing developers the natural resources that they will be expected to design around as new development occurs.

(2) *Updating the Subdivision Ordinance* to include critical elements such as an expanded Sketch Plan section providing standards for an "overlay sheet" based on the Potential Conservation Lands map, an On-site Visit by Township officials, and a four-step design process that establishes an orderly and logical procedure for analyzing each property in terms of its potential for conservation and development in light of the Township-wide Map of Potential Conservation Lands. The Ordinance should clearly outline a four-step process: identifying conservation areas; positioning house sites; locating streets and trails; and drawing in the lot lines.

(3) *Selectively amending the Zoning Ordinance* to include a "menu of choices" which respect the private property rights of the landowner and require the inclusion of permanent open space and conservation lands into new subdivisions.

In addition to Conservation by Design, communities should consider Transfer of Development Rights (TDR) provisions. Simply stated, TDR preserves land by extinguishing development rights on one parcel and "sending" the density to another parcel. The state enabling legislation hinders broad-scale applications of TDRs for several reasons. First, TDR is voluntary, unlike conservation design, which may be mandated through ordinances. Second, most communities will have to find higher density receiving zones within their municipal boundaries, often an unpalatable solution even when land conservation on a nearby parcel is achieved. The June 2000 revision to the Municipalities Planning Code creates the ability for Townships to engage in joint municipal planning and create inter-municipal sending and receiving zones, which may provide additional opportunities for TDR. Due to the complexity of the technique and difficulty in reaching consensus on receiving zones, TDR will remain an important, but "now and then" tool for land conservation.

For further information, visit Natural Lands Trust's website (http://www.natlands.org) and follow the links for the Growing Greener – Conservation by Design program.

Conservation Design Recommendations

- A number of townships in the watershed are rewriting their zoning ordinances to encourage the use of conservation subdivision design. In Chester County, Wallace, Newlin, West Vincent and London Britain Townships have adopted Growing Greener model ordinances. In Montgomery County, codes were recently adopted by Upper Salford Township. All municipalities throughout the watershed should consider whether such code and zoning reviews would benefit their communities. Numerous models now exist which illustrate the kind of upgrades that can be achieved.
- *Potential Conservation Lands maps* should be prepared at the Township or, ideally, subwatershed level. The "green infrastructure" mapping assists in determining preservation priorities, and guides the location and design of new development.

6.9.4 PA Natural Diversity Inventory Sites

Regulatory protection for PNDI sites or Natural Areas sites seldom is specified in municipal ordinances. In more sophisticated ordinances that offer conservation design provisions, Natural Areas are listed as one of the important areas to be protected in the watershed common greenspace network.

It is interesting to consider that most of the Natural Areas identified in County inventories exist in areas that are either difficult to utilize for agriculture or development (e.g., marshes, or serpentine soils), or in areas long protected by public or institutional ownership. Many of the remaining open spaces, by virtue of their rarity and fragmentation, are becoming important habitat refuges and Natural Areas for the watershed. If additional lands are preserved in the watershed, over time they may mature into important Natural Areas as well.

PNDI Recommendations

- Municipal comprehensive and open space plans should include all PNDI sites and Natural Areas in their Open Space preservation component. The comprehensive plans should discuss the means by which the municipality plans to preserve them. Preservation may occur through:
  - informal agreement with the landowner;
  - part of a general environmental feature overlay zoning district (see Willistown Township's

Environmental Protection Ordinance for a model);
  - donation or fee purchase for parkland; and/or
  - conservation easement donation or purchase.
- Owners of Natural Areas should be informed of the special habitat contained on their property and be offered assistance to manage them.
- All natural features identified in comprehensive and open space plans should be included on preliminary and final subdivision and land development plans.
- Municipalities should require permanent protection and management plans for Natural Areas within new subdivisions.

6.9.5 Redevelopment of Urban/Brownfield Sites

While the more developed townships in the lower watershed may be able to make scant use of clustering and conservation subdivision design, they have an opportunity to improve existing conditions when properties are reviewed for redevelopment. They can also amend their environmental ordinances so that any remaining developable properties are required to plan for restoration and set aside streamside riparian buffers.

Redevelopment means renovating "brownfields," which may involve refurbishing existing structures or demolishing old structures and rebuilding new facilities on previously developed lands. Brownfields development is one of the most important issues in the Schuylkill River Corridor (as identified by Montgomery County Planning Commission's new Schuylkill River Greenway Stewardship Plan study).

Subdivision typically is not part of a redevelopment process. Generally speaking, the Subdivision and Land Development Ordinance (SLDO) controls vehicular circulation, grading and storm drainage, while the Zoning Ordinance controls building setbacks, buffer requirements, and required number of parking spaces. Ideally, these two policies should be designed to work together, to provide incentives to reduce the amount of pavement near the stream, and to install stormwater devices that pass water through vegetation before it reaches the creek.

New zoning standards (especially for lot coverage and stream setbacks) could be established that might render non-conforming some of the current unsustainable development along the stream system. Any future proposals for expansions or changes in land use could be held to the new standards, unless they take advantage of incentives such as allowing a reduced front yard setback and lowered parking requirements, in return for removal of streamside pavement and installation of a buffer planting. The ordinances must be carefully crafted to allow flexibility, to prevent rendering property unprofitable to renovate. Incentives to utilize Best Management Practices (BMPs) are a good technique because the initial development established a precedent that makes requiring complete adherence to new standards unreasonable.

Urban Redevelopment Recommendation

- A model redevelopment incentive ordinance with BMPs should be developed. Montgomery County Planning Department would be an ideal choice for developing this text, which could subsequently be distributed to municipalities throughout the watershed.
- Market the opportunities presented by brownfields as the urban corollary to land protection and conservation planning efforts to protect the watershed's natural resources.

6.9.6 Steep Slope Ordinances

Steep slope ordinances limit, and sometimes prohibit, development on slopes considered too steep to be built upon without danger to public health and safety. Steep slopes erode rapidly if exposed, which can cause silting of streams or landslide. It is also difficult to build safe driveways and roads on steep slopes without excessive grading and disturbance to vegetation. Generally two categories of steep slope are defined:

- slopes that fall one foot for every 6.67 linear feet (15%) to one foot for every four linear feet (25%);
- slopes greater than 25%.

Ordinances governing development on slopes in the second category (slopes > 25%) usually are more restrictive, reflecting the greater erodibility and sensitivity of these slopes. These steep slope areas may be handled as overlay zoning districts, similar to floodplain districts.

In the greater than 25% slope areas (often called Very Steep Slopes), structures and septic fields are usually prohibited. In the 15-25% category (Steep Slopes) buildings and septic systems often are allowed as conditional uses. In other cases a maximum percentage of each slope type may be disturbed (e.g., as in Upper Providence). West Whiteland Township, Delaware County, has a steep slope ordinance which could serve as an effective protection model for the watershed. West Whiteland only permits the crossing of slopes greater than 25% by utility lines and driveways when no other alternative exists. On 15 to 25% slopes, the Township permits emergency access roads and, subject to conditional approval, roads and buildings.

Steep Slope Recommendations

- Steep slopes ordinances should be instituted where they do not currently exist. All such ordinances should include standards limiting development and protecting vegetation on slopes adjacent to the floodplain and small tributaries.

6.9.7 Stormwater and Impervious Surface Ordinances

Excellent recommendations for ordinances and sustainable taxation schemes already have been provided in the Wissahickon River Conservation Plan, page V-10 through V-23 (Delta Group et al. 1999). The following is a brief summary of the highlights, but it is highly recommended that the entire section referenced above be read and implemented where possible in municipalities throughout the watershed.

Stormwater management ordinances should be consistent with approaches presented in Pennsylvania Handbook of Best Management Practices for Developing Areas, PACD (1998). By and large, it is smaller storms that cause most stormwater problems in watersheds. Comprehensive ordinances should provide:

- Performance standards;
- Appropriate storm designs (e.g., detention of the 1- and 2-yr storms);
- Improvement in groundwater recharge, including:
  - Retain first ¾ inch of rainfall on-site (rain barrels);

  - Preserve the same volume of infiltrated rainfall as in pre-development condition (based on annual rainfall); and
- Lists of recommended stormwater management BMPs.

Also, the following are encouraged:

- Reassessment of stormwater management objectives by municipalities;
- Retrofitting grandfathered properties with up-to-date stormwater management levels as they are redeveloped;
- Requirements for the management of roof runoff; and
- Requirements for agricultural lands.

Watershed municipalities should adopt policies and ordinances that incorporate provisions to reward developers and homeowners for using low-impact site design principles, for example, relaxing some permitting requirements or shortening review cycles.

Finally, tangible financial incentives are justified where voluntary measures will substantially reduce infrastructure costs that would otherwise be incurred by municipalities for water treatment, maintenance, repairs or improvements to publicly owned facilities. Stormwater Utilities, a mechanism to fund stormwater facilities and services, are being implemented with greater frequency in the United States. Tax payments can be made to the municipality on the basis on some index of stormwater impact created by the property – such as total impervious area or contiguous impervious area. The revenues from these taxes should be used to fund watershed studies, GIS databases, public works projects (e.g., tertiary treatment sewage treatment plants), and direct subsidies to landowners who install BMPs.

Montgomery County is developing a model stormwater management ordinance, which should be made available for all municipalities in the watershed to review and adopt. In addition, the Stormwater Act 167 allows for improved coordination between municipalities so that stormwater issues can be addressed on a watershed basis.

6.9.8 Private Land Stewardship

Private land stewardship, the which individual property owners care for their land, has a strong influence on the stream system and is one of the fundamental issues that must be addressed in crafting a viable strategic conservation and protection plan for the watershed. Each landowner in the watershed can play an important role in making the landscape in the Schuylkill River watershed as sustainable as possible, regardless of the size of their property.

The strongest response by citizens and municipal officials to the watershed issues in the public survey was to the importance of protecting and enhancing natural habitats. This included equal concern for protection of special habitats, for stabilization of streambanks, and for loss of riparian (streamside) forests. See Recommendation **R5.7** in *Chapter 5.0 Water Quality* for further discussion on this subject.

6.9.9 Management of Public Lands

Management techniques in existing park lands vary according to the use of the land. Woodlands and meadows are found in many of the watershed's open spaces that allow passive recreation. Speaking

strictly from a water quality and wildlife perspective, these are excellent approaches to management of streamside lands. They require little labor to maintain and they provide buffers for sensitive riparian habitats. Large expanses of mowed grass are, from the same perspective, less beneficial to the natural environment, in that grass requires regular maintenance and does not provide the same buffering and habitat qualities as wooded buffers or even native meadows. Even less desirable are the well-used parking areas along stream banks that can be found in municipal and county parks throughout the watershed. For further discussion on public lands management, see Recommendations **R6.13** and **R6.14**.

Public Land Management Recommendations

- Install riparian buffers at least 75 feet-wide, and ideally 100 feet-wide along all watercourses, where feasible.
- Correct or mitigate erosion problems on trails next to streams.
- Provide parking areas at least 75 feet, and ideally 100 feet, from streams. Move existing parking and provide new parking away from streambanks to reduce the potential for non-point source pollution.

6.10 Additional Watershed Resources and Assessments

In addition to those GIS data sets used in this Plan to determine protection and restoration priorities in the Schuylkill River watershed, the following GIS maps have been compiled as supporting documentation for the plan. These maps are available in the online Reference Documents for viewing and downloading from the project website: http://www.schuylkillplan.org. As noted in Recommendations **R6.16** and **R6.17**, the resolution and usefulness of these data sets in PDF and paper is seriously limited. The real utility of these maps and the other GIS data generated for this Plan would be to distribute these data through a centralized database or interactive model to all interested watershed conservation organizations, who then can use them as interactive GIS resources to generate their own targeted conservation assessments. Distribution would ideally be via the web, or if necessary, via CD-Rom.

Aquatics Habitat Value
Plants Habitat Value
Mammals Habitat Value
Birds Habitat Value
Invertebrates Habitat Value
Herpetofauna Habitat Value

Stream Order
National Wetland Inventory (NWI) Types
Slope Classes
Soils
Surficial Geology
Geologic Provinces

PA House Districts
PA Senate Districts
Census Tracts
USGS Quadrangles

Further comments regarding additional data and analysis that could improve future assessments follow.

6.10.1 Watershed-Wide Simplified Geology, Soils and Potential Analysis

6.10.1.1 Surficial Geology

Surficial geology and soils GIS data sets were downloaded and compiled from the PASDA website at http://www.pasda.psu.edu. These two abiotic components potentially are valuable to round out the GIS data set for the watershed, but are of limited value to the watershed-wide analysis in their current state. These data provide multiple listings of geology and soils by name, rather than generalized characteristics by soil or geologic type, which would better inform the GIS analysis. For example, the surficial geology data layer is very complex and provides approximately 84 different named geological formations.

To make these data sets more useful for future GIS analysis, a significant amount of work needs to occur to transform and re-attribute the data. This "value-added" procedure should simplify the data while also ensuring that the most relevant characteristics of the data are available for analytical purposes. For example, the surficial geology data layer could be simplified to show the major geological types of importance to defining ecological assessment: e.g., approximately 9 geological types defined on the basis of the three primary rock types (e.g., sedimentary, metamorphic and igneous) and the three-pH classes of "acidic," "alkaline," and "circumneutral." General characteristics of the geology then can be used more directly as part of the sustainable landscape analysis.

6.10.1.2 Soils

Soil maps have been available in report format for many years from the USDA Natural Resources Conservation Service (NRCS) for each county within the Schuylkill River watershed. These reports and their map components are now being generated digitally. However, not many of these soil maps are currently available within the watershed, and some of the digital maps are based on soil surveys from 40 or 50 years ago. (Tim Craul, *pers. comm.*).

A watershed-wide GIS soils coverage is available from PASDA at a general level, but is not very user-friendly since it again provides soil association names rather than "value-added" characteristics. These data could be made more useful for assessment purposes by modification to show primary soil characteristics. For example, grouping soils by their hydric properties would allow identification of sensitive wetland areas, while attaching standard NRCS soil classes would be useful for determining agricultural preservation priorities. Although not a primary component of a sustainable landscape assessment, which focuses primarily on natural lands, agricultural land preservation can play a secondary or supporting role, particularly if ecological land management policies can be implemented adequately.

As with the simplified watershed-wide geology map, a "value-added" soils map also could be used with the other maps generated in this Plan to help explain the land cover patterns within the watershed and to predict where key habitat types or land cover would most likely or most appropriately be located.

Not surprisingly, soil categories tend to align with surficial geology patterns, since soil type primarily is determined by geology and topography. Climatic factors, while a component of soil development, do not vary enough across the Schuylkill River watershed to have much effect on soil patterns. However, variations in microclimate, particularly in combination with topography and hydrology, can have a very strong influence on local soil type development, and certainly influence local habitat type and quality.

6.10.1.3 Combining Abiotic Environmental Factors to Develop Predictive Analysis Models

Simplified geology and/or soil characteristics data layers can be used in conjunction with any or all of the GIS data layers generated through this Plan to increase understanding of the habitat and land cover patterns that are revealed in the watershed. They may help predict the location of certain more valuable habitats. For example, sedimentary circumneutral or alkaline geology typically supports good agricultural production if slopes are not very steep and soil depth is good, as is true of the agricultural belt that runs through the middle of the watershed to the SW and NE of Reading. Meanwhile, circumneutral or alkaline igneous rocks, such as the diabase ridge that runs through Montgomery and Bucks counties, typically have steeper slopes and shallower soils and have been used little for agriculture. However, these areas are known to support healthy native plant populations due to reduced levels of human-induced disturbance, as well as the fact that base minerals in the rocks provide many of the macro- and trace nutrients essential to healthy plant growth. The thinner soils this geology typically supports also may decrease nitrogen enrichment (especially due to atmospheric nitrogen pollution loading), and perhaps also phosphorous accumulations, potentially giving a competitive advantage to native plant species over non-native invasive plant species which are postulated to thrive in nitrogen and phosphorous enriched environments.

6.10.2 Emerging New Techniques

New techniques that could supplement this preliminary analysis are emerging, as the full potential of GIS analysis is starting to be recognized by multi-disciplinary groups across the country. Some of these techniques may help to bring a higher level of detail and precision in landscape-scale analysis. Since the inception of this project, several techniques have been initiated elsewhere in the nation that, with adaptation to this region, could assist with further prioritization of natural area preservation or restoration priorities. One example is the Contiguous Block/Ecological Landscape Unit Analysis under development by The Nature Conservancy. A brief description of that new technique follows.

6.10.2.1 Ecological Landscape Unit and Block Analysis

The Nature Conservancy (TNC) has developed a technique within GIS to analyze ecoregions using abiotic factors to predict ecological landscape components, known as Ecological Landscape Units (ELUs). Details are available at http://www.fws.gov/r5gis, by following the links to data download page then to *The Nature Conservancy Connecticut River Watershed report*. Using factors such as geology, slope and elevation within an ecoregion, the model can predict where different ecosystem components, such as acid ridge tops and alkaline bogs, would be found:

> "Potential natural vegetation is determined directly by environmental gradients such as nutrient availability, moisture and temperature. These environmental gradients are driven by more broad determinants such as geology, climate and topography. Therefore, in order to produce predictive maps the gradients thought to drive vegetation must be mapped or modeled themselves. From the compiled data…we derived several information layers to assist in developing predictive vegetation models at the community alliance level. Primarily we used three key layers: lithography, elevation and landform."

These ELUs can help define ecological habitats and land cover, at a level of detail greater than can be derived from Landsat Thematic Mapper MRLC land cover classes. For example, MRLC imagery will define woodlands by three or four major types: coniferous; broadleaf; mixed; forested wetland; etc. However, using the ELU technique, greater detail can be predicted in the forest cover type, perhaps even allowing for identification down to the vegetation community level.

The Block Analysis technique then can be implemented as a filter on the ELU data to select blocks of contiguous habitat of each ecological unit. For example, perhaps the best (in terms of size and quality) acid ridges consisting of scrub oak could be picked out for priority protection in a portfolio of natural habitats across the region. TNC has used this technique to identify landscape blocks of between 15,000 and 25,000 acres as part of their national ecoregional analysis. NLT is currently investigating ways to regionalize TNC's model to highlight ELUs of smaller scale, between 500 and 15,000 acres, since few landscapes in SE PA meet TNC's contiguous habitat size criteria.

Development of this technique was not possible within the scope of this Plan. However, it is strongly recommended that GIS analyses such as these be pursued in later implementation phases of the Schuylkill River conservation planning process to further refine and prioritize conservation efforts.

6.10.2.2 Soil Erodibility Index

Various soil erodibility indices have been developed, based on land cover vegetation class, slope, hydrology and soil type. These indices are useful for identifying areas of high erosion and high erosion mitigation potential for water quality management. One such index is the Agricultural Relative Runoff Sensitivity Index (ARRSI) developed by Lawson (1996), which is a simple algebraic combination of:

- soil erodibility (K) value derived from USGS SSURGO dataset for that soil series;
- slope, derived from a Digital Elevation Model;
- Topographic Relative Moisture Index (TRMI) (Parker 1982) or Topographic Convergence Index (TCI) (Bevin and Kirkby 1979; Wolock 1993), a measure of accumulative hydrologic flow;
- land cover vegetation class, ranked according to the amount of runoff expected (e.g., water has value of 0, agriculture/urban = 1 and dense forest = 4); and
- Euclidean distance from streams.

These layers are combined and weighted with the constant factors a, b, and c, where a+b+c = 1.

ARRSI = a (soil erodibility*slope) + b (TRMI or TCI) + c (ranked land cover*distance from stream)

The advantage of this index is that it serves as a "value added" slope/sensitivity measure. It combines soil erodibility and slope steepness in modeling soil erosion potential, and weights the runoff areas by the type of intercepting vegetation, while including the actual hydrologic flowpaths as represented by the TRMI or TCI models.

A soil erodibility index could be overlaid with water quality information to show areas of high erodibility and pollution (mitigation priorities); areas of high erodibility but low pollution (future areas of concern/sensitive lands); and areas with low scores for erodibility and pollution (stable or conserved areas).

6.10.2.3 Preservation of Lands with High Recharge & Stormwater Retention Potential

There is an opportunity to integrate some of the water quality and sustainable landscape recommendations through future analysis. For example, Recommendation **R5.18** *Monitor and Regulate Existing and Future Groundwater Withdrawls*, could be partially addresses if sites with high groundwater recharge potential were permanently protected from development. In the same way, areas with high stormwater retention

potential, such as wetlands, could also provide a valuable water quality resource. Further analysis of these overlapping issues in the future would benefit future conservation planning in the watershed.

6.10.2.4 The Need for Improved Land Cover Data

Although GIS mapping has improved tremendously over the last decade, finding up-to-date data to perform analyses on the scale of the Schuylkill River watershed is still difficult to achieve cost-effectively. Because land cover is a critical component of many water quality, development and landscape sustainability analyses, finding up-to-date, higher quality land cover data set for the watershed should be a funding and program priority. As the availability and affordability of digital aerial photography and GPS-referenced aerial videography gradually improves, and as desktop computer capacity to process the large size of these files increases, better land cover data will be available to make future landscape scale assessments easier to conduct.

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7.0 INSTITUTIONAL ASSESSMENT

7.1 Introduction

Interested stakeholders, including organizations and government entities, are important resources throughout the Schuylkill River watershed. The water quality and open space recommendations suggested in the prior chapters cannot be carried out without the concerted, affirmative action of the watershed's organizations and government entities. Therefore, the Schuylkill Watershed Conservation Plan would not be complete without an assessment of the watershed's organizations and government entities. The institutional assessment was conducted to determine how to maximize individual conservation activities and strengthen the institutional framework in the watershed. Specifically, the goals of this assessment were:

- to identify major conservation activities;
- to assess opportunities for watershed-wide coordination;
- to make recommendations for strengthening existing organizations; and
- to outline a framework for watershed leadership that will facilitate planning and implementation of projects for sustainable watershed management.

The institutional assessment addressed several key issues that were raised through the public outreach process, including: the need to improve coordination between and among nonprofit groups and government entities at all levels (local, municipal, state and federal); the need to build capacity of local government and nonprofit groups; and, the need to increase public awareness of watershed issues. Other key concerns raised by the watershed public were the need for coordination in water quality monitoring, and the need for a centralized clearinghouse of watershed data and information.

The institutional assessment was conducted through a survey of nonprofit organizations and a second survey of public agencies. The primary purpose of the Nonprofit Survey was to identify geographic regions in the watershed that are potentially under-served by nonprofit activity, or that may require coordination of nonprofit services to strengthen effectiveness. With that goal in mind, a sample of watershed nonprofits was selected, and these nonprofits were interviewed to determine each organization's geographic service area boundaries, mission and activities. The primary purpose of the Public Agency Survey was to determine activities, needs and resources available from various entities, to compile agency profiles and list of completed/ongoing projects, and to identify opportunities for inter-agency and inter-institutional cooperation. Again, the ultimate goal of this institutional assessment was to develop recommendations for more effective watershed management.

7.2 Summary Recommendations

Recommendations for improving the institutional framework of the Schuylkill River watershed are summarized in the table below. Each recommendation is assigned a unique code number (e.g., **R7.1**) and name, and is cross-referenced to the key institutional or watershed management issue(s) it addresses. These recommendations are described in more detail in **Section 7.5 Detailed Recommendations from the Institutional Assessment**, and the page number where the detailed description of each recommendation can be found is listed in the *Page* column of this table.

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R7.1	**Develop Quantitative Indicators/ Measures of Success**	An effort should be made to develop model watershed-wide indicators that can be used by all organizations. Public agencies and nonprofits should develop and use indicators for each project to determine success in order to invest resources wisely and measure progress towards goals.	Improve coordination Plan implementation Resource management Strategic conservation	7-53
R7.2	**Watershed Network**	A watershed network of public, private and nonprofit stakeholders should provide leadership on a watershed-wide basis, and help to coordinate partner activities on a local basis in order to maximize the effect of individual nonprofits' conservation activities.	Improve coordination Build capacity Public awareness Plan implementation Strategic conservation	7-54
R7.3	**Foundation Network**	Foundations should form a network to coordinate funding for watershed activities to meet needs, maximize existing resources, and encourage coordination of conservation activities among organizations.	Improve coordination Build capacity Plan implementation Strategic conservation	7-62
R7.4	**Institutionalize Professional Training**	Both nonprofits and agencies should attend ongoing professional training programs to optimize staff resources.	Build capacity	7-63
R7.5	**Explore Nonprofit – Public Agency Partnerships**	Public agencies and nonprofits should explore partnerships with one another to fill gaps in service, coordinate activities, maximize available resources and optimize staffing.	Improve coordination Build capacity	7-64
R7.6	**Promote Public Awareness of Watershed Issues**	Public outreach, citizen monitoring and other volunteer opportunities, education on watershed location, and watershed boundary signs could help promote public awareness and a "sense of place."	Public awareness	7-64
R7.7	**Filling Geographic Gaps and Coordinating Service among Nonprofits**	Nonprofits should coordinate to expand their geographic reach, or facilitate the formation of new watershed groups or cooperative partnerships to cover areas of the watershed that may be under-served. Nonprofits operating within the same regions should coordinate activities to leverage resources and maximize environmental benefits. Topical watershed meetings could be convened around specific activities to improve communication and cooperation.	Improve coordination	7-65
R7.8	**Political verses Natural Geographic Service Area Coverage**	Nonprofit groups and public agencies should consider adjusting their service area to represent natural (i.e., subwatershed) boundaries instead of political boundaries. Where possible, entities, such as local governments, that are constricted to political boundaries should coordinate with others within subwatershed boundaries.	Improve coordination	7-66
R7.9	**Comprehensive Nonprofit Survey**	A comprehensive survey of all nonprofits and volunteer groups in the watershed should be conducted to further determine geographic areas and groups to be coordinated.	Improve coordination	7-67

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R7.10	**Updated Watershed Directory**	Develop an up-to-date, comprehensive directory of watershed groups and government entities with names, contact information, mission statements, resources and services offered, and geographic service areas to link citizens, nonprofits and public agencies to one another.	Improve coordination Build capacity Public awareness Data clearinghouse	7-67
R7.11	**Watershed Clearinghouse**	An online Schuylkill River watershed clearinghouse should be developed to link and provide resources to nonprofits, local governments, agencies, and citizens in the watershed. The site should include planning documents, the watershed directory, links to partners, GIS data access, funding resources, etc.	Improve coordination Build capacity Public awareness Data clearinghouse	7-68
R7.12	**Watershed Service Center**	A watershed service center with links to technical and organizational expertise should be established to help nonprofits and local governments with their organizational needs.	Build capacity Data clearinghouse	7-70
R7.13	**Diversify Fundraising**	Nonprofits should diversify their funding sources to support long-term organizational growth.	Build capacity	7-70
R7.14	**Grant Guidelines that Support Partnerships**	State agencies and private foundations should use criteria in grant guidelines to encourage proposals that establish working relationships and partnerships among watershed groups, in order to improve coordination and reduce redundancy.	Improve coordination Build capacity	7-71
R7.15	**Streamlined Grant Application Process**	Where practicable, state agencies and private foundations should coordinate grant programs, in order to improve nonprofit access to funding resources, increase the diversity of proposed projects, and maximize the resources and benefits of grant programs.	Improve coordination Build capacity	7-71
R7.16	**Use Innovative Land Protection Mechanisms**	Use innovative land conservation and funding tools, such as conservation easements, bond initiatives and purchase of development rights, to maximize options for conservation and/or acquisition.	Plan implementation Resource management Strategic conservation	7-71
R7.17	**Re-poll Watershed Community**	Re-poll the watershed population at intervals to survey watershed awareness and progress in education and outreach goals.	Public awareness	7-72
R7.18	**Coordinate Planning Efforts**	All planning efforts should be coordinated to ensure consistency among recommendations at all levels of government and nonprofit activity, and to ensure efficient use of funding, not duplication of efforts.	Improve coordination Plan implementation Strategic conservation	7-72

Code	*Recommendation*	*Summary Description*	*Issues Addressed*	*Page*
R7.19	**Fund an Outreach and Adoption Phase to Ensure Plan Implementation**	To ensure implementation of this Plan, an outreach phase needs to be funded to educate interested stakeholders about the plan, how to interpret and use the data and how to incorporate the data into local ordinances, etc. Outreach activities should target local governments, county planning commissions and nonprofit organizations in the watershed.	Resource management Strategic conservation Plan implementation	7-72
R7.20	**Hold Annual or Bi-annual Watershed Summit**	An annual or bi-annual watershed summit of stakeholders to facilitate networking, discussion of major activities, demonstration projects and plan implementation will improve cohesiveness of groups and coordination of conservation activities.	Improve coordination Public awareness Plan implementation	7-73
R7.21	**Schuylkill River Watershed Conservation Coordinator**	A Schuylkill River Watershed Conservation Coordinator should be funded through one of the local nonprofits or state agencies to work with nonprofits and government entities to implement this Plan.	Improve coordination Public awareness Plan implementation	7-73

7.3 Nonprofit Organization Survey

7.3.1 Background and Procedure

Understanding that nonprofit organizations serve as the vital link between citizen and government action, and implement important watershed projects, key organizations in the Schuylkill River watershed were surveyed. The purpose of the survey was to conduct a preliminary nonprofit "gap analysis" —i.e., to identify specific geographic areas within the watershed that may be under-served by nonprofit programs and areas where nonprofit programs need coordination due to the coexistence of several groups

The three main criteria for selecting the nonprofits surveyed included groups that had a variety of missions, were geographically diverse throughout the watershed, and had active implementation projects and programs. A number of conservation directories were used to compile a preliminary list of nonprofits that was refined through consultation and in-depth input from the Berks County Conservancy, the Pennsylvania Environmental Council, and the Schuylkill River Greenway Association, with help from The Conservation Fund. Organizations not listed in the directories or unknown to the selecting groups were not included in the preliminary list of approximately 60 organizations. In addition to these staffed nonprofit groups, there may be citizen groups active in the watershed that were not part of this initial survey of nonprofit service coverage.

Following refinement of the list, 30 nonprofits were chosen for the survey, to form a representative sample of nonprofit activity in the watershed. This survey was not intended to be comprehensive, but rather to be a first-step analysis of the watershed's nonprofit framework: to begin the dialogue of how to address areas under-served by nonprofits, and how nonprofits can work together more effectively towards watershed conservation. Some of the groups that are active in the watershed but were not included in the Nonprofit Survey include the Upper Perkiomen Watershed Coalition, the Monocacy Hill Conservation Association, the Historic Preservation Trust of Berks County and the Friends of the Manayunk Canal.

After selecting the 30 nonprofit targets, a survey was developed to cover four general topic areas. The survey posed the following questions:

1. *What geographic areas does the nonprofit organization serve*?
2. *What types of activities are conducted by the nonprofit organization*?
3. *How is the nonprofit organization funded/supported?*
4. *What is the greatest need for the watershed?*

Nonprofit groups marked their geographic area of service on county and subwatershed maps. The service area boundaries were converted to digital maps for gap analysis using a geographic information system (GIS). Maps of the stated service area boundaries of the nonprofits surveyed for this Plan are accessible in the online Reference Documents as **Nonprofit Service Area** maps. It should be stressed that these service area maps reflect the information given directly by the nonprofits, and may not perfectly reflect the true spatial extent or particular service locations of these nonprofits. For example, the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) primarily works in Schuylkill and Carbon Counties, but also partners with organizations in parts of Berks County; therefore, EPCAMR included Berks County in its service area map.

Information on nonprofit activities was grouped into 10 categories, and nonprofit input on funding, capacity and watershed needs summarized for analysis and future reference. A full address list of nonprofit organizations surveyed for the institutional assessment is included in the **Nonprofit Organization Contact List** in the online Reference Documents.

7.3.2 Results of the Nonprofit Survey

7.3.2.1 Geographic Gap Analysis

The 30 nonprofits surveyed in the Schuylkill River watershed were diverse in mission and geographic reach. **Table 7.1a Nonprofit Service Areas and Activities** and **Table 7.1b Continuation of Nonprofit Service Areas and Activities**, show the participation of the 30 nonprofits surveyed in each of the 10 activity types, and their corresponding geographic coverage. The geographic areas served range from a local community level to an international level. Nonprofits indicated whether their involvement in a specific type of activity was of primary, secondary or limited focus. The indication of focus was intended to clarify the level of involvement of each nonprofit surveyed in each activity, in order to discriminate between those activities that are the main focus of a group's resources and those activities in which the nonprofit is only peripherally involved.

Table 7.1a Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Advocacy*	*Land Preservation*	*Recreation*	*Redevelop-ment*	*Research*	*Water Quality Projects*
Watershed	Schuylkill River Watershed	Academy of Natural Sciences – Patrick Center for Environmental Research	No	No	No	1	1 Local to Inter-national	1 Local to Inter-National
Watershed	Schuylkill River Watershed	Schuylkill River Greenway Association	3	2	1	1	No	No
Watershed	Schuylkill River Watershed	Schuylkill Riverkeeper of the Delaware Riverkeeper Network	1	No	3	No	3	2
Watershed, Regional to International	Varies According to Activity	Hawk Mountain Sanctuary Association	No	1 Within Sanctuary Viewshed	2 On-site Only	No	1 Local to Inter-national	No
Watershed, Local to International	Schuylkill River Watershed	Stroud Water Research Center	No	No	No	No	1	2
Regional	Eastern PA, Southern NJ, and the DE, MD, VA Peninsula (most activity is in Bucks, Chester, Montgomery, Delaware, and Philadelphia Counties)	Natural Lands Trust	3	1	No	No	3	3

Table 7.1a Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Advocacy*	*Land Preservation*	*Recreation*	*Redevelop-ment*	*Research*	*Water Quality Projects*
State	PA	Pennsylvania Environmental Council	1	No	3	2 Bucks, Chester, Montgomery, Philadelphia, and Delaware Counties (also near Harrisburg, Wilkes-Barre, Meadeville, and Pittsburgh offices)	2	2 Bucks, Chester, Montgomery, Philadelphia, and Delaware Counties (also near Wilkes-Barre, Meadeville, and Pittsburgh offices)
Regional	Delaware River Watershed	Heritage Conservancy	3	1 Primarily in PA & NJ	No	3 Primarily in PA	2 Primarily in PA & NJ	2 Primarily in PA & NJ
Regional and State	Eastern PA	Morris Arboretum-University of PA	2 Statewide	2	2	3	1 Statewide	2
Regional and State	Bucks, Chester, Montgomery, Delaware, and Philadelphia Counties	Schuylkill Center for Environmental Education	No	2 On-site Only	1 On-site Only	No	1 Statewide	1 Watershed-Wide
Regional	Eastern PA	Wildlands Conservancy	3	1	1 Lehigh Watershed	2 Lehigh Watershed	3 Lehigh Watershed	1 Lehigh Watershed

Table 7.1a Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Advocacy*	*Land Preservation*	*Recreation*	*Redevelop-ment*	*Research*	*Water Quality Projects*
Regional	Anthracite Coal Region in Eastern PA	Eastern Pennsylvania Coalition for Abandoned Mine Reclamation	1	1	No	No	No	1
County	Berks	Berks County Conservancy	2	1	3	1	1	1
County	Chester	Brandywine Conservancy	3	1	No	No	2	2
County	Berks	Trout Unlimited – Tulpehocken Chapter	No	No	2	No	No	1
County	Berks	Kutztown University Environmental Science Forum	No	3	3	No	1	3
County	Schuylkill	Schuylkill County Conservancy	1	2	1	1	3	1
County	Montgomery	Montgomery County Lands Trust	2	1	2	1	No	3
Subwatershed	French and Pickering Creek	French and Pickering Creeks Conservation Trust	1	1	3	3	1	2
Subwatershed	Wissahickon Creek, to Philadelphia City Boundary	Friends of the Wissahickon	1	2	No	No	No	2
Subwatershed, County	Valley Creek, Northern Chester	Green Valleys Association	1	2	2	No	1	1
Municipal, Subwatershed	West Tridiferenn Township, Valley Creek	Open Land Conservancy	1	1	1	No	No	2

Table 7.1a Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Advocacy*	*Land Preservation*	*Recreation*	*Redevelop-ment*	*Research*	*Water Quality Projects*
Subwatershed	Perkiomen Creek	Perkiomen Watershed Conservancy	1	1	3	No	No	1
Subwatershed	Schuylkill River in Schuylkill County	Schuylkill Headwaters Association	No	No	1	No	No	1
Subwatershed	Tidal Schuylkill	Schuylkill River Development Council	1	1	1	1	2	2
Subwatershed	Perkiomen Creek	Trout Unlimited – Perkiomen Chapter	1	3	2	No	3	1
Subwatershed	Wissahickon Creek	Wissahickon Valley Watershed Association	1	1	1	No	No	2
Municipal	Phoenixville	Phoenixville Iron Canal & Trails Association	1	2	1	2	No	1
Municipal	40 mile radius of Pottstown	Greater Pottstown Watershed Alliance	2	No	2	No	2	1
Municipal	Lower Merion Township	Lower Merion Conservancy	2	1	2	No	1	1

Table 7.1b Continuation of Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Water Quality Testing*	*Education and Outreach*	*Historic Preservation*	*Park/Preserve Management*	*Other*
Watershed	Schuylkill Watershed	Academy of Natural Sciences – Patrick Center for Environmental Research	1	1	No	3	Maintenance of museum site
Watershed	Schuylkill Watershed	Schuylkill River Greenway Association	No	1	1	1	Manage state and national heritage areas; develop regional land and water trail system
Watershed	Schuylkill Watershed	Schuylkill Riverkeeper of the Delaware Riverkeeper Network	2	2	No	No	Citizen action: organize watershed groups, facilitate education and advocacy
Watershed, Regional to International	Varies According to Activity	Hawk Mountain Sanctuary Association	No	1 Local to National	No	1 On-site Only	Wildlife monitoring
Watershed, Local to International	Schuylkill River Watershed	Stroud Water Research Center	1	1	No	No	
Regional	Eastern PA, Southern NJ, and the DE, MD, VA Peninsula (most activity is in Bucks, Montgomery, Chester, Delaware, and Philadelphia Counties)	Natural Lands Trust	No	3	3	3	Conservation/land use planning

Table 7.1b Continuation of Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Water Quality Testing*	*Education and Outreach*	*Historic Preservation*	*Park/Preserve Management*	*Other*
State	PA	Pennsylvania Environmental Council	No	1	No	No	
Region	Delaware River Watershed	Heritage Conservancy	No	2	1	2	
Region and State	Eastern PA	Morris Arboretum - University of PA	3 On-site Only	1 Mid-Atlantic Region	1 On-site Only	2 On-site Only	Greenway activities
Region and State	Bucks, Chester, Montgomery, Delaware, and Philadelphia Counties	Schuylkill Center for Environmental Education	1 State-wide	1 State to Inter-national	2 On-site Only	1 On-site Only	Land restoration/stewardship
Region	Eastern PA	Wildlands Conservancy	1 Lehigh Water-shed	1 Lehigh Water-shed	No	2 Lehigh Watershed	
Region	Anthracite Coal Region in Eastern PA	Eastern Pennsylvania Coalition for Abandoned Mine Reclamation	1	1	No	No	Watershed group organization & development, planning, grant-writing assistance, training, tours
County	Berks	Berks County Conservancy	2	2	1	3	
County	Chester	Brandywine Conservancy	No	2	2	3	Use/growth management
County	Berks	Trout Unlimited – Tulpehocken Chapter	2	2	No	No	

Table 7.1b Continuation of Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Water Quality Testing*	*Education and Outreach*	*Historic Preservation*	*Park/Preserve Management*	*Other*
County	Berks	Kutztown University Environmental Science Forum	3	1	3	3	
County	Schuylkill	Schuylkill County Conservancy	2	1	3	No	
County	Montgomery	Montgomery County Lands Trust	No	1	No	2	Collaborative partnerships/watchdog for Montgomery County for land preservation
Subwatersheds	French and Pickering Creek	French and Pickering Creeks Conservation Trust	No	1	1	1	
Subwatershed	Wissahickon Creek, to Phila. City Boundary	Friends of the Wissahickon	No	1	1	2	
Subwatershed, County	Valley Creek, Northern Chester	Green Valleys Association	1	1	2	2	
Municipal Subwatershed	West Tridiferenn Township, Valley Creek	Open Land Conservancy	No	1	3	1	
Subwatershed	Perkiomen Creek	Perkiomen Watershed Conservancy	No	1	No	No	
Subwatershed	Schuylkill River in Schuylkill County	Schuylkill Headwaters Association	1	1	No	No	
Subwatershed	Tidal Schuylkill	Schuylkill River Development Council	No	1	No	1	Planning

Table 7.1b Continuation of Nonprofit Service Areas and Activities

KEY: 1 = Primary activity
2 = Secondary activity
3 = Peripheral activity
No = Not an activity of the nonprofit organization.
Note: Activities occur in the organization's primary geographic area unless otherwise noted.

Geographic Focus	*Primary Geographic Area*	*Organization*	*Water Quality Testing*	*Education and Outreach*	*Historic Preservation*	*Park/Preserve Management*	*Other*
Subwatershed	Perkiomen Creek	Trout Unlimited – Perkiomen Chapter	2	2	3	3	
Subwatershed	Wissahickon Creek	Wissahickon Valley Watershed Association	2	1	3	1	
Municipal	Phoenixville	Phoenixville Iron Canal & Trails Association	2	1	2	3	
Municipal	40 mile radius of Pottstown	Greater Pottstown Watershed Alliance	2	2	No	3	
Municipal	Lower Merion Township	Lower Merion Conservancy	1	1	1	No	

Table 7.2 lists the nonprofit activities reported, along with the number and percentage of organizations actively involved in that type of programming. The "other" category in includes activities such as wildlife monitoring, planning, training, citizen action/grassroots organization, and technical assistance.

Table 7.2 Number and Percentage of Nonprofits Participating in Each Activity

	Nonprofits Participating	
Activity	***Percent of Groups***	***Number of Groups (of 30)***
Education/outreach	100%	30
Water quality projects	93%	28
Land preservation	77%	23
Recreation	77%	23
Advocacy	77%	23
Park/preserve management	70%	21
Research	67%	20
Water quality testing	60%	18
Historic Preservation	57%	17
Community/urban redevelopment	40%	12
Other	37%	11

Table 7.3 shows nonprofit participation in each activity broken down according to the level of focus for that activity: i.e., whether the activity is a primary, secondary or peripheral focus of the organizations polled. As shown in these two tables, the majority of the nonprofits surveyed conduct education and outreach, land preservation, recreation, and water quality projects.

Table 7.3 Percentage of Nonprofits Participating in Each Activity by Level of Focus

	Percent of Nonprofits Participating by Level of Focus		
Activity	***Primary***	***Secondary***	***Peripheral***
Education/outreach	73%	23%	3%
Water quality projects	47%	37%	10%
Land preservation	47%	23%	7%
Recreation	30%	27%	20%
Advocacy	43%	17%	17%
Park/preserve management	23%	20%	27%
Water quality testing	27%	27%	7%
Historic preservation	23%	13%	20%
Research	33%	17%	17%
Community/urban redevelopment	20%	10%	10%

The following discussion details the geographic gap analysis findings for each type of nonprofit activity, based on the subwatersheds designated in the map: **Watershed Orientation**. It should be noted that nonprofit groups serving the entire watershed or larger geographic areas, and groups which are involved in a specific activity on an on-site only basis, were not included in the gap analysis and are listed by name on the maps of Areas Served by Nonprofits for each activity, as referenced by activity name in the sections below. Although some groups reported offering services across the entire watershed, it is not likely that this service is truly comprehensive watershed-wide. Addition of these groups to the maps could skew the discussion of local services. Therefore, these groups were removed from the gap analysis, resulting in a more conservative assessment of nonprofit service across the watershed.

For the local nonprofits included in the gap analysis, the service areas mapped represent the areas as reported by the organizations themselves. These boundaries may not reflect the actual distribution of an organization's services, as some groups may have drawn their boundaries larger than the service area they realistically cover. Nonprofits may have a limited capacity to lead comprehensive efforts throughout their designated service area. The responses reveal the area in which organizations operate, not necessarily where they have fully focused efforts. For example, a county-wide organization may have a few, targeted projects in various areas or communities of that county, rather than leading a wide-spread effort throughout their entire designated service area.

Because groups with greater than watershed-wide coverage or with site-specific coverage were removed from the mapping analysis, and because only a sampling of nonprofit groups were surveyed, the maps and discussion below should be interpreted carefully. The maps and tables of nonprofit overlap and gaps by activity highlight where local efforts may be concentrated, and indicate the probable intensity and distribution of nonprofit service throughout the Schuylkill River watershed. The maps should not be interpreted as a definitive analysis of all nonprofit activities in the watershed. Gaps represent areas that *may* be under-served by nonprofits, while overlaps indicate *potential* areas for improved cooperation.

- **Nonprofits Conducting Education and Outreach Activities**

Based on the results of the geographic analysis, the majority of the Schuylkill River watershed is fairly well served by nonprofits for education and outreach. All 30 organizations surveyed engage in education and outreach activities in the watershed at some level, and for 73% (22) of them, this is a primary activity. Of the 30 nonprofits surveyed, 10 conduct education and outreach activities throughout the entire watershed and were not included in the gap analysis map. These organizations are listed separately in **Table 7.4**. Additionally, the Wildlands Conservancy conducts education and outreach primarily within the Lehigh Watershed and also was not included in the map. However, none of the local groups surveyed served portions of the Schuylkill River 1 subwatershed, and this may represent an area under-served by nonprofits conducting education and outreach.

Examples of education and outreach activities reported by the nonprofits surveyed include: education projects funded by the Schuylkill River Greenway Association for the State and Federal Heritage Corridor; educational programs at Hawk Mountain Sanctuary and the Schuylkill Center for Environmental Education; workshops and conferences that are held by the Heritage Conservancy; and educational exhibits or signage at the Morris Arboretum and the Academy of Natural Sciences.

Table 7.4 Nonprofits Conducting Education and Outreach Activities Watershed-wide

Hawk Mountain Sanctuary Association	Pennsylvania Environmental Council
Heritage Conservancy	Schuylkill Center for Environmental Education

Morris Arboretum/University of PA	Schuylkill Riverkeeper
Natural Lands Trust	Schuylkill River Greenway Association
Patrick Center for Environmental Research - Academy of Natural Sciences	Stroud Water Research Center

The map: **Education & Outreach** displays areas in the watershed served by one, two, three or more of the nonprofit groups surveyed. Areas not served by any of the local nonprofits surveyed appear white (including areas that may be served by the nonprofits listed in *Table 7.4*); areas of overlap appear in tones of gray, according to the number of overlapping nonprofits in that area. The geographic gap analysis revealed many portions of the watershed where several organizations overlap in conducting education and outreach. The following **Table 7.5** lists nonprofit involvement for those areas where there are several local groups working on education and outreach. Again, it should be noted that the map and table show areas in which the local organizations report they operate, and do not include the services of the watershed-wide nonprofits listed in *Table 7.4* above. There may be a discrepancy between a nonprofit's reported service area, and where they actually focus on that activity within the greater service area.

Table 7.5 Nonprofit Education and Outreach: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Northwestern Quarter of Schuylkill Watershed (Including Schuylkill River 8 Subwatershed and Lower Little Schuylkill River Subwatershed North)	Schuylkill County	Schuylkill Headwaters Association Schuylkill County Conservancy E. PA Coalition for Abandoned Mine Reclamation
Schuylkill River 8 and Little Schuylkill River Lower Subwatersheds	Berks County	Schuylkill Headwaters Association E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown Environmental Science Forum
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Brandywine Conservancy Greater Pottstown Watershed Alliance
French Creek Subwatershed	Berks County	French & Pickering Creeks Conservation Trust Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum
	Remainder and Majority of French Creek Subwatershed (Chester County)	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Brandywine Conservancy
Schuylkill River 3 Subwatershed	Chester County	Brandywine Conservancy Greater Pottstown Watershed Alliance French & Pickering Creeks Conservation Trust Green Valleys Association

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Pickering Creek Subwatershed	Entire Subwatershed	French & Pickering Creeks Conservation Trust Green Valleys Association Brandywine Conservancy
Valley Creek Subwatershed	Entire Subwatershed	Open Land Conservancy Brandywine Conservancy Green Valleys Association
Schuylkill River 4 Subwatershed	Chester County	Brandywine Conservancy Trout Unlimited - Tulpehocken Chapter Green Valleys Association French & Pickering Creeks Conservation Trust Greater Pottstown Watershed Alliance
	Montgomery County	Montgomery County Lands Trust Trout Unlimited - Tulpehocken Chapter Greater Pottstown Watershed Alliance
	Berks County	Berks County Conservancy Trout Unlimited - Tulpehocken Chapter E. PA Coalition for Abandoned Mine Reclamation Greater Pottstown Watershed Alliance Kutztown University Environmental Science Forum
Upper Perkiomen Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Perkiomen Watershed Conservancy Kutztown University Environmental Science Forum Trout Unlimited - Perkiomen Chapter
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Montgomery County Lands Trust Trout Unlimited - Perkiomen Chapter
	Lehigh and Bucks Counties	Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Perkiomen Chapter
Swamp Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Perkiomen Watershed Conservancy Kutztown University Environmental Science Forum Trout Unlimited - Tulpehocken Chapter
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Montgomery County Lands Trust Trout Unlimited - Tulpehocken Chapter
Lower Manatawny Creek Subwatershed	Berks County	Greater Pottstown Watershed Alliance E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum Trout Unlimited - Tulpehocken Chapter
	Montgomery County	Greater Pottstown Watershed Alliance Berks County Conservancy Montgomery County Lands Trust Trout Unlimited - Tulpehocken Chapter

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Large North Central Portion of Watershed	Remainder and Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum Trout Unlimited - Tulpehocken Chapter

** The watershed-wide organizations engaging in education and outreach overlap with all of the above groups.*

- **Nonprofits Conducting Research Activities**

One third of the watershed nonprofits surveyed engage in research as a primary activity, while a total of 67% (20) pursue research at some level of focus. Of these 20 nonprofits, 9 conduct research throughout the entire watershed, and were not included in the gap analysis map (see **Table 7.6**). The Wildlands Conservancy conducts research primarily in the Lehigh Watershed and also was not included in the map.

For this study, research activities were defined as any scientific research, other than water quality testing, conducted by the nonprofits. Examples of research activities include: Morris Arboretum's inventory of the flora of Pennsylvania; numerous scientific studies by the Patrick Center for Environmental Research and the Stroud Water Research Center; Hawk Mountain Sanctuary's research on birds of prey; and the Heritage Conservancy's aerial assessment of riparian buffers in the Schuylkill River watershed.

Table 7.6 Nonprofits Conducting Research Activities Watershed-wide

Hawk Mountain Sanctuary Association	Pennsylvania Environmental Council
Heritage Conservancy	Schuylkill Center for Environmental Education
Morris Arboretum/University of PA	Stroud Water Research Center
Natural Lands Trust	Schuylkill Riverkeeper
Patrick Center for Environmental Research - Academy of Natural Sciences	

Geographic analysis suggested that the northern and central portions of the Schuylkill River watershed are fairly well served by nonprofits engaging in research activities, as displayed in the map: **Research**. The highest concentration of research activities occurs in Berks and Chester Counties, especially in the French Creek, Pickering Creek, Schuylkill River 3, Schuylkill River 4, Lower Manatawny and Upper Perkiomen subwatersheds. **Table 7.7** describes nonprofit involvement for those subwatersheds where there are several nonprofits conducting research. Most of the subwatersheds located in Montgomery, Bucks, and Philadelphia Counties are not covered by any of the nonprofits surveyed other than the seven noted watershed-wide groups, and represent potential gaps in local nonprofits conducting research activities.

Table 7.7 Nonprofit Research: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
French Creek Subwatershed	Berks County	French & Pickering Creeks Conservation Trust Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum
	Chester County	French & Pickering Creeks Conservation Trust Berks County Conservancy Brandywine Conservancy Green Valleys Association
Pickering Creek Subwatershed	Entire Subwatershed	French & Pickering Creeks Conservation Trust Brandywine Conservancy Green Valleys Association
Schuylkill River 3 Subwatershed	Chester County	Brandywine Conservancy Greater Pottstown Watershed Alliance French & Pickering Creeks Conservation Trust Green Valleys Association
Schuylkill River 4 Subwatershed	Berks County	Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance
	Chester County	Brandywine Conservancy Greater Pottstown Watershed Alliance French & Pickering Creeks Conservation Trust Green Valleys Association
Upper Perkiomen Creek Subwatershed	Berks County	Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Trout Unlimited - Perkiomen Chapter
Lower Manatawny Creek Subwatershed	Berks County	Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance
Large North Central Portion of Watershed	Remainder and Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum

** The watershed-wide organizations engaging in research overlap with all of the above groups.*

- **<u>Nonprofits Conducting Water Quality Testing</u>**

A total of 18 (60%) organizations out of the 30 surveyed engage in water quality testing activities of some kind throughout the watershed. However, only eight groups consider water quality testing a primary activity. Of the 18 nonprofits, four conduct water quality testing watershed-wide and were not included on the corresponding map (see **Table 7.8**). Additionally, the Wildlands Conservancy conducts water quality testing primarily in the Lehigh Watershed and the Morris Arboretum conducts water quality testing within the Arboretum. Both of these organizations also were not included in the map.

Table 7.8 Nonprofits Conducting Water Quality Testing Watershed-wide

Schuylkill Center for Environmental Education	Schuylkill Riverkeeper
Patrick Center for Environmental Research - Academy of Natural Sciences	Stroud Water Research Center

The geographic analysis revealed that while much of the watershed is covered for water quality testing, there are areas that may not be well addressed by local nonprofit organizations (see the map: **Water Quality Testing**). Subwatersheds that may be under-served for water quality testing by nonprofits include: the Unami Creek, East Branch of the Perkiomen Creek, Lower Perkiomen Creek, Skippack Creek, Schuylkill River 2 and Schuylkill Tidal. Additionally, portions of the Schuylkill River 1 subwatershed may be under-served by nonprofits doing water quality testing. Many watershed areas are served by three or more organizations conducting water quality testing within specific subwatersheds. **Table 7.9** outlines those subwatersheds in which there are several local nonprofits working on water quality testing.

The geographic results of this analysis may not represent the true state of water quality testing in the Schuylkill River watershed. While much of the watershed appears to be covered by groups conducting testing, a finding by the Patrick Center for Environmental Research at the Academy of Natural Sciences has been the lack of consistent and comprehensive water quality data. Even though watershed groups report that their service areas cover much of the watershed, there remains the question of which streams really have ongoing monitoring efforts, and what kind of data is being collected. Additionally, it should be noted that there are many volunteer monitoring efforts and other agency monitoring projects underway that are not included in this analysis. However, currently there is no comprehensive, watershed-wide monitoring program for the Schuylkill River watershed.

Table 7.9 Nonprofit Water Quality Testing: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	Phoenixville Iron Canal & Trails Association Berks County Conservancy Green Valleys Association Greater Pottstown Watershed Alliance
French Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum
Upper Perkiomen Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Trout Unlimited - Perkiomen Chapter Kutztown University Environmental Science Forum
Swamp Creek	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Trout Unlimited - Tulpehocken Chapter Kutztown University Environmental Science Forum
Schuylkill River 4 Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Lower Manatawny Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Greater Pottstown Watershed Alliance
	Montgomery County	Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Greater Pottstown Watershed Alliance
Large North Central Portion of Watershed	Remainder and Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Kutztown University Environmental Science Forum

** The watershed-wide organizations engaging in water quality testing overlap with all of the above groups.*

- **Nonprofit Organizations Conducting Water Quality Projects**

A total of 28 (93%) out of 30 nonprofits surveyed engage in water quality projects, such as stream bank restoration, throughout the watershed. Fourteen groups consider water quality projects one of their core activities. Of the 30 nonprofits surveyed, seven conduct water quality projects throughout the entire watershed and were not included in the gap analysis map (see **Table 7.10**). The Wildlands Conservancy conducts water quality projects primarily in the Lehigh Watershed and also was not included in the map. The Pennsylvania Environmental Council, which was included in the gap analysis map, has water quality projects near its Philadelphia office that encompass Bucks, Chester, Delaware, Philadelphia, and Montgomery Counties.

Examples of water quality projects include: streambank restoration on Paper Mill Run by the Morris Arboretum; a Manatawny Dam Removal Study by the Patrick Center for Environmental Research; the Heritage Conservancy's riparian restoration projects; and technical assistance to other organizations by the Stroud Water Research Center in the development of water quality projects.

Table 7.10 Nonprofits Conducting Water Quality Projects Watershed-wide

Heritage Conservancy	Schuylkill Center for Environmental Education
Morris Arboretum/University of PA	Schuylkill Riverkeeper
Natural Lands Trust	Stroud Water Research Center
Patrick Center for Environmental Research - Academy of Natural Sciences	

Areas of overlap and those potentially under-served by nonprofits are presented visually in the map: **Water Quality Projects**. The entire watershed is served by at least one local organization of those surveyed, and many areas are served by several nonprofits conducting water quality projects. **Table 7.11** describes nonprofit involvement for those subwatersheds where there are several groups working on water quality projects. Again, there may be other groups not surveyed, or citizen groups, or public agencies involved in water quality projects that were not represented in this survey.

Table 7.11 Nonprofit Water Quality Projects: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Northwestern Quarter of Schuylkill Watershed (Including Schuylkill River 8 Subwatershed and Lower Little Schuylkill River Subwatershed North)	Schuylkill County	Schuylkill Headwaters Association Schuylkill County Conservancy E. PA Coalition for Abandoned Mine Reclamation
Schuylkill River 8 and Little Schuylkill River Lower Subwatersheds	Berks County	Schuylkill Headwaters Association Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	Phoenixville Iron Canal & Trails Association Berks County Conservancy Brandywine Conservancy French & Pickering Creeks Conservation Trust Green Valleys Association Greater Pottstown Watershed Alliance Pennsylvania Environmental Council
French Creek Subwatershed	Berks County	French & Pickering Creeks Conservation Trust Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum
	Remainder and Majority French Creek Subwatershed (Chester County)	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Brandywine Conservancy Pennsylvania Environmental Council
Pickering Creek Subwatershed	Entire Subwatershed	Green Valleys Association French & Pickering Creeks Conservation Trust Brandywine Conservancy Pennsylvania Environmental Council
Valley Creek Subwatershed	Entire Subwatershed	Green Valleys Association Open Land Conservancy Brandywine Conservancy Pennsylvania Environmental Council
Schuylkill River 3 Subwatershed	Chester County	Green Valleys Association Greater Pottstown Watershed Alliance Brandywine Conservancy French & Pickering Creeks Conservation Trust Pennsylvania Environmental Council
	Montgomery County	Greater Pottstown Watershed Alliance Pennsylvania Environmental Council Montgomery County Lands Trust
Schuylkill River 4 Subwatershed	Chester County	Green Valleys Association Trout Unlimited - Tulpehocken Chapter Greater Pottstown Watershed Alliance French & Pickering Creeks Conservation Trust Brandywine Conservancy Pennsylvania Environmental Council

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Schuylkill River 4 Subwatershed	Montgomery County	Trout Unlimited - Tulpehocken Chapter Greater Pottstown Watershed Alliance Montgomery County Lands Trust Pennsylvania Environmental Council
	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Trout Unlimited - Tulpehocken Chapter Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance
Upper Perkiomen Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Perkiomen Chapter Kutztown University Environmental Science Forum
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Perkiomen Chapter Montgomery County Lands Trust Pennsylvania Environmental Council
	Lehigh & Bucks Counties	Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Perkiomen Chapter Pennsylvania Environmental Council
Lower Perkiomen Creek Subwatershed	Entire Subwatershed (Montgomery County)	Perkiomen Watershed Conservancy Montgomery County Lands Trust Pennsylvania Environmental Council
East Branch Perkiomen Creek	Montgomery County	Perkiomen Watershed Conservancy Montgomery County Lands Trust Pennsylvania Environmental Council
Skippack Creek Subwatershed	Entire Subwatershed (Montgomery County)	Perkiomen Watershed Conservancy Montgomery County Lands Trust Pennsylvania Environmental Council
Swamp Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Tulpehocken Chapter Kutztown University Environmental Science Forum
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Tulpehocken Chapter Montgomery County Lands Trust Pennsylvania Environmental Council
Lower Manatawny Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Greater Pottstown Watershed Alliance Kutztown University Environmental Science Forum

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Lower Manatawny Creek Subwatershed	Montgomery County	Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Greater Pottstown Watershed Alliance Montgomery County Lands Trust Pennsylvania Environmental Council
Upper Wissahickon Creek and Sandy Run Subwatersheds	Entire Subwatersheds (Montgomery County)	Montgomery County Lands Trust Wissahickon Valley Watershed Association Pennsylvania Environmental Council
Lower Wissahickon Creek Subwatershed	Philadelphia County	Friends of the Wissahickon Wissahickon Valley Watershed Association Pennsylvania Environmental Council
	Montgomery County	Montgomery County Lands Trust Wissahickon Valley Watershed Association Pennsylvania Environmental Council
Schuylkill River 2 Subwatershed	Chester County	Brandywine Conservancy Green Valleys Association Pennsylvania Environmental Council
Schuylkill River 1 Subwatershed	Part of Subwatershed in Montgomery County	Lower Merion Conservancy Montgomery County Lands Trust Pennsylvania Environmental Council
Large North Central Portion of Watershed	Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Trout Unlimited - Tulpehocken Chapter Berks County Conservancy Kutztown University Environmental Science Forum

** The watershed-wide organizations engaging in water quality projects overlap with all of the above groups.*

- **<u>Nonprofit Organizations Conducting Land Preservation Activities</u>**

77% (23) of the nonprofits surveyed engage in land preservation activities throughout the watershed. Land preservation is a primary activity for 47% (14) of the surveyed groups. Of the 23 nonprofits, five conduct land preservation throughout the entire watershed, and were not included in the gap analysis map (see **Table 7.12**). The Hawk Mountain Sanctuary and the Schuylkill Center for Environmental Education conduct land preservation activities related to their specific sites and also are not included in the map. Hawk Mountain conducts land preservation activities within the viewshed of its sanctuary property and the Schuylkill Center conducts land management on its site only. Aside from these watershed-wide and site-specific groups, none of the local nonprofits surveyed were active in land preservation for portions of the Schuylkill River 1 and Upper Little Schuylkill River subwatersheds.

Examples of land preservation activities include: the Schuylkill River Trail, under development by the Schuylkill River Greenway Association; the Morris Arboretum's analysis identifying strategic lands to be preserved; and the more conventional land preservation activities of land trusts and conservancies.

Table 7.12 Nonprofits Conducting Land Preservation Activities Watershed-wide

Heritage Conservancy	Schuylkill River Greenway Association
Morris Arboretum/University of PA	Wildlands Conservancy
Natural Lands Trust	

As shown by the map: **Land Preservation**, most of the Schuylkill River watershed is covered by at least one local organization and, in many cases, there are three or more organizations working on land preservation within the same subwatershed. **Table 7.13** describes nonprofit involvement for those subwatersheds where there are several local groups working on land preservation.

Table 7.13 Nonprofit Land Preservation: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Brandywine Conservancy
French Creek Subwatershed	Berks County	French & Pickering Creeks Conservation Trust Berks County Conservancy Kutztown University Environmental Science Forum
	Remainder and Majority French Creek Subwatershed (Chester County)	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Brandywine Conservancy
Pickering Creek Subwatershed	Entire Subwatershed	Brandywine Conservancy Green Valleys Association French & Pickering Creeks Conservation Trust
Valley Creek Subwatershed	Entire Subwatershed	Brandywine Conservancy Green Valleys Association Open Land Conservancy
Schuylkill River 3 Subwatershed	Chester County	Brandywine Conservancy Green Valleys Association French & Pickering Creeks Conservation Trust
Upper Perkiomen Creek Subwatershed	Berks County	Trout Unlimited - Perkiomen Chapter Berks County Conservancy Perkiomen Watershed Conservancy Kutztown University Environmental Science Forum
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Montgomery County Lands Trust Trout Unlimited - Perkiomen Chapter
	Lehigh & Bucks Counties	Trout Unlimited - Perkiomen Chapter Berks County Conservancy Perkiomen Watershed Conservancy
Swamp Creek Subwatershed	Berks County	Berks County Conservancy Perkiomen Watershed Conservancy Kutztown University Environmental Science Forum
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Montgomery County Lands Trust

** The watershed-wide organizations engaging in land preservation overlap with all of the above groups.*

- **Nonprofit Organizations Conducting Historic Preservation Activities**

A total of 17 out of 30 surveyed organizations engage in historic preservation activities in the Schuylkill River watershed. Historic preservation is the primary activity of only seven (23%) of these 17 groups. In addition, three of these nonprofits conduct historic preservation throughout the entire watershed and were not included in the geographic gap analysis (see **Table 7.14**). Two organizations, the Schuylkill Center for Environmental Education and the Morris Arboretum, conduct historic preservation activities on their respective sites only and are also not included in the map. There are a number of historic preservation societies that were not part of our survey but were mentioned during the public meetings, and should be included in future surveys and as part of the watershed nonprofit network.

Table 7.14 Nonprofits Conducting Historic Preservation Watershed-wide

Heritage Conservancy	Schuylkill River Greenway Association
Natural Lands Trust	

The map: **Historic Preservation** shows that approximately one third of the entire watershed is not served by surveyed local nonprofits working on historic preservation. This area includes the Unami Creek, East Branch of the Perkiomen Creek, Lower Perkiomen Creek, Skippack Creek, Schuylkill 2, and the Schuylkill Tidal subwatersheds. Additionally, portions of the Schuylkill 1, Schuylkill 3, and Schuylkill 4 subwatersheds were not served by the local nonprofits surveyed. These areas represent potential gaps in nonprofit historic preservation activities that could be filled by existing nonprofits with environmental or historic preservation missions.

Overlap by three or four organizations occurs in the French Creek, Pickering Creek, and Valley Creek subwatersheds and portions of the Upper Perkiomen Creek and Schuylkill River 3 subwatersheds. Additionally, the remaining subwatersheds in Berks County are served by at least three local organizations. **Table 7.15** lists specific areas where these organizations overlap in historic preservation.

Table 7.15 Nonprofit Historic Preservation: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Brandywine Conservancy
French Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation French & Pickering Creeks Conservation Trust Berks County Conservancy Kutztown University Environmental Science Forum
	Remainder and Majority French Creek Subwatershed (Chester County)	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Brandywine Conservancy

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Pickering Creek Subwatershed	Entire Subwatershed	Green Valleys Association French & Pickering Creeks Conservation Trust Brandywine Conservancy
Valley Creek Subwatershed	Entire Subwatershed	Green Valleys Association Brandywine Conservancy Open Land Conservancy
Schuylkill River 3 Subwatershed	Chester County	Green Valleys Association French & Pickering Creeks Conservation Trust Brandywine Conservancy
Upper Perkiomen Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum Trout Unlimited - Perkiomen Chapter
Large North Central Portion of Watershed	Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum

** The watershed-wide organizations engaging in historic preservation overlap with all of the above groups.*

- **Nonprofit Organizations that Conduct Recreation Activities**

A total of 23 out of 30 organizations (77%) engage in recreation activities in the watershed, but only nine of these (30%) consider recreation a primary activity. Of the 23 nonprofits, four address recreation throughout the entire watershed and were not included in the corresponding map (see **Table 7.16**). The Hawk Mountain Sanctuary and the Schuylkill Center for Environmental Education conduct recreation activities on their respective sites. The Wildlands Conservancy conducts recreation activities primarily in the Lehigh Watershed. All three of these organizations are also not included in the geographic analysis map. Areas where none of the surveyed local nonprofits engage in promoting or developing recreation activities include parts of the Unami Creek, Upper and Lower Little Schuylkill River, East Branch of the Perkiomen Creek and the Schuylkill River 1 and 8 subwatersheds. These areas may represent opportunities for existing nonprofits to expand their recreation activities.

Examples of recreation activities include: the effort to extend a trail from Forbidden Drive in Fairmount Park to Fort Washington Park by the Morris Arboretum; the Schuylkill Center for Environmental Education's field trips and field excursions; the Bike and Boat Program and the management of the D & L Trail by the Wildlands Conservancy; the development of the Schuylkill River Land and Water Trails by the Schuylkill River Greenway Association; and the activities of many other organizations developing and maintaining walking, hiking, or biking trails.

Table 7.16 Nonprofits Conducting Recreation Activities Watershed-wide

Hawk Mountain Sanctuary Association	Schuylkill Riverkeeper
Morris Arboretum/University of PA	Schuylkill River Greenway Association
Pennsylvania Environmental Council	Wildlands Conservancy
Schuylkill Center for Environmental Education	

Most of the Schuylkill River watershed, including a portion of every subwatershed, is served by at least one local organization for recreation. The map: **Recreation** displays areas that may be under-served or need coordination by nonprofits for recreation. Many subwatersheds are served by 3 or more nonprofits with recreation activities as part of their mission as described in **Table 7.17**.

Table 7.17 Nonprofit Recreation: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Northwestern Quarter of Schuylkill Watershed (Including Schuylkill River 8 Subwatershed and Lower Little Schuylkill River Subwatershed North)	Schuylkill County	Schuylkill Headwaters Association Schuylkill County Conservancy E. PA Coalition for Abandoned Mine Reclamation
Schuylkill River 8 and Little Schuylkill River Lower Subwatersheds	Berks County	Schuylkill Headwaters Association E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown Environmental Science Forum
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Greater Pottstown Watershed Alliance
French Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown Environmental Science Forum French & Pickering Creeks Conservation Trust
	Remainder and Majority French Creek Subwatershed (Chester County)	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy
Schuylkill River 3 Subwatershed	Chester County	Green Valleys Association French & Pickering Creeks Conservation Trust Greater Pottstown Watershed Alliance
Upper Perkiomen Creek Subwatershed	In Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown Environmental Science Forum Trout Unlimited - Perkiomen Chapter Perkiomen Watershed Conservancy
	Montgomery County	Montgomery County Lands Trust Berks County Conservancy Trout Unlimited - Perkiomen Chapter Perkiomen Watershed Conservancy
	Lehigh & Bucks Counties	Berks County Conservancy Trout Unlimited - Perkiomen Chapter Perkiomen Watershed Conservancy
Swamp Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown Environmental Science Forum Trout Unlimited - Tulpehocken Chapter Perkiomen Watershed Conservancy

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Swamp Creek Subwatershed	Montgomery County	Montgomery County Lands Trust Berks County Conservancy Trout Unlimited - Tulpehocken Chapter Perkiomen Watershed Conservancy
Lower Manatawny Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown Environmental Science Forum Trout Unlimited - Tulpehocken Chapter Greater Pottstown Watershed Alliance
	Montgomery County	Montgomery County Lands Trust Berks County Conservancy Trout Unlimited - Tulpehocken Chapter Greater Pottstown Watershed Alliance
Schuylkill River 4 Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Trout Unlimited - Tulpehocken Chapter Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance
	Chester County	Greater Pottstown Watershed Alliance Trout Unlimited - Tulpehocken Chapter Green Valleys Association French & Pickering Creeks Conservation Trust
	Montgomery County	Montgomery County Lands Trust Greater Pottstown Watershed Alliance Trout Unlimited - Tulpehocken Chapter
Large North Central Portion of Watershed	Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum Trout Unlimited - Tulpehocken Chapter

** The watershed-wide organizations engaging in recreation activities overlap with all of the above groups.*

- **<u>Nonprofit Organizations that Conduct Community/Urban Redevelopment Activities</u>**

A total of 12 out of 30 (40%) surveyed organizations reported involvement in community/urban revitalization or redevelopment activities in the watershed. However, only 6 nonprofits (20%) considered redevelopment one of their primary activities. Of the 12 nonprofits involved with this type of activity, four address redevelopment throughout the entire watershed, and were not included in the gap analysis map, as listed in **Table 7.18**. The Wildlands Conservancy conducts redevelopment activities primarily in the Lehigh Watershed and was not included in the map. The Pennsylvania Environmental Council, which is included in the gap analysis map, conducts redevelopment projects near its Philadelphia, office in Bucks, Chester, Delaware, Philadelphia, and Montgomery Counties.

Examples of redevelopment activities include: the Heritage Conservancy's Conservation Enterprise Program which funds "green" business; the Patrick Center for Environmental Research's urban park restoration project in Fairmount Park; the urban street tree planting program of the Morris Arboretum; and the brownfield redevelopment program of the Pennsylvania Environmental Council.

Table 7.18 Nonprofits Conducting Redevelopment Activities Watershed-wide

Heritage Conservancy	Morris Arboretum/University of PA
Patrick Center for Environmental Research - Academy of Natural Sciences	Schuylkill River Greenway Association

Much of the Schuylkill River watershed is served by at least one local group conducting redevelopment activities; however, there are a few areas where local groups overlap as displayed in the map: **Redevelopment**. The majority of redevelopment activities by surveyed nonprofits occur in the French Creek, Swamp Creek, and Upper Perkiomen subwatersheds. Besides the organizations serving the entire watershed, none of the surveyed local nonprofits serve portions of the Unami Creek and the upper Little Schuylkill subwatersheds. The Valley Creek subwatershed and portions of the Schuylkill River 1, Unami Creek, East Branch of the Perkiomen Creek, Lower Wissahickon Creek are served only by the Pennsylvania Environmental Council, which has a large service area and may or may not be actively conducting redevelopment activities in these areas at this time. The generally lower level of nonprofit service for redevelopment activities represented by our gap analysis may reflect the fact that local governments and/or the business community, rather than the nonprofit community, commonly address this activity. Overlap by three organizations does occur in the Phoenixville area, the majority of the French Creek Subwatershed, and the Montgomery County sections of the Lower Manatawny Creek, Swamp Creek, and Upper Perkiomen Creek Subwatersheds. See **Table 7.19** for the specific areas where overlap occurs.

Table 7.19 Nonprofit Community/Urban Redevelopment: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Pennsylvania Environmental Council
French Creek Subwatershed	Chester County	French & Pickering Creeks Conservation Trust Berks County Conservancy Pennsylvania Environmental Council
Lower Manatawny Creek, Swamp Creek, and Upper Perkiomen Creek Subwatersheds	Montgomery County	Berks County Conservancy Pennsylvania Environmental Council Montgomery County Lands Trust

** The watershed-wide organizations engaging in community/urban redevelopment overlap with all of the above groups.*

- **Nonprofits that Conduct Advocacy Activities**

A total of 23 (77%) out of 30 watershed nonprofits surveyed engage in advocacy activities, and 13 of these (43%) make advocacy a primary activity. Of these 23 nonprofits, 7 conduct advocacy activities throughout the entire watershed, and were not included in the gap analysis map (see **Table 7.20**).

Examples of advocacy activities include the Morris Arboretum's involvement in state advocacy committees, and the Schuylkill River Greenway Association's work in obtaining designation of the State and Federal Heritage Corridor.

Table 7.20 Nonprofits Conducting Advocacy Watershed-wide

Heritage Conservancy	Schuylkill Riverkeeper
Morris Arboretum/University of PA	Schuylkill River Greenways Association
Natural Lands Trust	Wildlands Conservancy
Pennsylvania Environmental Council	

The map: **Advocacy** shows that the Schuylkill River watershed is well covered by local organizations having advocacy as a part of their mission. A considerable amount of overlap occurs throughout the region, and there are few areas where groups do not engage in advocacy activities. Subwatersheds not served by local groups include portions of the Upper Little Schuylkill River and Schuylkill River 1. The French Creek subwatershed is the most heavily concentrated area, with six organizations conducting advocacy activities in different portions of the watershed. The six organizations are: the Green Valleys Association, Berks County Conservancy, French & Pickering Creeks Conservation Trust, Phoenixville Iron Canal and Trails Association, the Brandywine Conservancy, and E. PA Coalition for Abandoned Mine Reclamation. Several other subwatersheds have three or four organizations conducting advocacy activities, as detailed in **Table 7.21** below.

Table 7.21 Nonprofit Advocacy: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Brandywine Conservancy Green Valleys Association Greater Pottstown Watershed Alliance
French Creek Subwatershed	Berks County	French & Pickering Creeks Conservation Trust Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation
	Remainder and Majority French Creek Subwatershed (In Chester County)	Green Valleys Association French & Pickering Creeks Conservation Trust Berks County Conservancy Brandywine Conservancy
Schuylkill River 3 Subwatershed	Chester County	Green Valleys Association French & Pickering Creeks Conservation Trust Brandywine Conservancy Greater Pottstown Watershed Alliance
Schuylkill River 4 Subwatershed	Berks County	Greater Pottstown Watershed Alliance E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy
	Chester County	Green Valleys Association French & Pickering Creeks Conservation Trust Brandywine Conservancy Greater Pottstown Watershed Alliance

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Upper Perkiomen Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Perkiomen Chapter
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Montgomery County Lands Trust Trout Unlimited - Perkiomen Chapter
	Lehigh & Bucks Counties	Berks County Conservancy Perkiomen Watershed Conservancy Trout Unlimited - Perkiomen Chapter
Swamp Creek Subwatershed	Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Perkiomen Watershed Conservancy
	Montgomery County	Berks County Conservancy Perkiomen Watershed Conservancy Montgomery County Lands Trust
Lower Manatawny Creek Subwatershed	Berks County	Greater Pottstown Watershed Alliance E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy
	Montgomery County	Greater Pottstown Watershed Alliance Berks County Conservancy Montgomery County Lands Trust

** The watershed-wide organizations engaging advocacy overlap with all of the above groups.*

- **Nonprofit Organizations that Conduct Park/Preserve Management**

70% of nonprofits surveyed (21 out of 30) engage in park/preserve management activities in the watershed. Only 7 of these (23%) consider park preservation a primary activity. Of these 21 nonprofits, four manage or are consultants in the management of preserves or conservation lands throughout the entire watershed and were not included in the gap analysis map (see **Table 7.22**). Three organizations manage the preserve where they are located and are not included in the gap analysis map: Hawk Mountain Sanctuary Association; Morris Arboretum/University of PA; and Schuylkill Center for Environmental Education. Another organization, the Wildlands Conservancy, is not included in the map because it manages five preserves in the Lehigh Watershed.

Examples of park/preserve management vary according to the organization. These examples include: the Schuylkill River Greenway Association's management of the State and Federal Heritage Corridor and the management of lands in the Schuylkill River Land and Water Trail System; the Patrick Center for Environmental Research's consultation and research which aides other organizations in the management of preserves; and the Heritage Conservancy and Natural Lands Trust management of their own preserves.

Table 7.22 Nonprofits Conducting Park/Preserve Management Watershed-wide

Heritage Conservancy	Natural Lands Trust
Patrick Center for Environmental Research - Academy of Natural Sciences	Schuylkill River Greenway Association

The map: **Park/Preserve Management** shows that a majority of the watershed is served by at least one local organization participating in land management activities. The greatest concentration of activity is in the French Creek, Valley Creek, Pickering Creek, and the Upper Perkiomen Creek subwatersheds, as well as the subwatershed areas located in Berks County. Additionally, the Upper and Lower Wissahickon, Sandy Run, and portions of the Schuylkill River 3 and 4 subwatersheds are well served by local organizations. See **Table 7.23** for specific areas where three or more organizations overlap.

Besides the organizations serving the entire watershed, none of the surveyed local groups serve portions of the Schuylkill River 1, Unami Creek, East Branch of the Perkiomen Creek, and the upper Little Schuylkill subwatersheds. These areas may be under-served by nonprofits for land management.

Table 7.23 Nonprofit Park/Preservation Management: Specific Areas Where 3 or More Local Organizations Overlap*

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Small Part of Schuylkill River 3 and French Creek Subwatersheds	Phoenixville Area	French & Pickering Creeks Conservation Trust Berks County Conservancy Phoenixville Iron Canal & Trails Association Brandywine Conservancy Green Valleys Association Greater Pottstown Watershed Alliance
French Creek Subwatershed	Berks County	French & Pickering Creeks Conservation Trust Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum
	Remainder and Majority French Creek Subwatershed (Chester County)	Berks County Conservancy Brandywine Conservancy Green Valleys Association French & Pickering Creeks Conservation Trust
Pickering Creek Subwatershed	Entire Subwatershed	Brandywine Conservancy Green Valleys Association French & Pickering Creeks Conservation Trust
Valley Creek Subwatershed	Entire Subwatershed	Brandywine Conservancy Green Valleys Association Open Land Conservancy
Schuylkill River 3 Subwatershed	Chester County	Brandywine Conservancy Green Valleys Association French & Pickering Creeks Conservation Trust Greater Pottstown Watershed Alliance
Upper Perkiomen Creek Subwatershed	In Berks County	Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Trout Unlimited - Perkiomen Chapter
	Montgomery County	Berks County Conservancy Montgomery County Lands Trust Trout Unlimited - Perkiomen Chapter
Lower Manatawny Creek Subwatershed	Berks County	Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance

Area of Schuylkill Watershed	*Specific Geographic Area Where Overlap Occurs*	*Overlapping Groups*
Lower Manatawny Creek Subwatershed	Montgomery County	Berks County Conservancy Greater Pottstown Watershed Alliance Montgomery County Lands Trust
Schuylkill River 4 Subwatershed	Berks County	Berks County Conservancy E. PA Coalition for Abandoned Mine Reclamation Kutztown University Environmental Science Forum Greater Pottstown Watershed Alliance
	Chester County	Brandywine Conservancy Green Valleys Association French & Pickering Creeks Conservation Trust Greater Pottstown Watershed Alliance
Large North Central Portion of Watershed	Majority of Berks County	E. PA Coalition for Abandoned Mine Reclamation Berks County Conservancy Kutztown University Environmental Science Forum

** The watershed-wide organizations engaging in park/preserve management overlap with all of the above groups.*

- **Nonprofits Conducting Other Activities**

Besides the specific activities discussed above (education, research, water quality testing, advocacy, etc.), nonprofit organizations engage in other types of activities. Other types of nonprofit activities include: land use planning and consulting; watershed group organization and development; grant writing assistance; training; tours; wildlife monitoring; collaborative partnerships; and citizen action organization for watershed groups.

7.3.2.2 Funding Sources

Besides inquiring into nonprofits' boundaries and missions, the survey researched how nonprofits throughout the watershed are financially supported. As expected, the environmental nonprofit community receives support from very diverse sources. Included among the sources of funding are: membership; foundations; government agencies; fundraising events; university-related funding; endowments; service/contract income; rental income; retail sales income; and corporate sponsorship (see **Table 7.24**).

Table 7.24 Schuylkill River Watershed Nonprofit Organizations' Funding Sources

30 Nonprofit Organizations	*Membership*	*Foundation*	*Government*	*Fundraising*	*University-Related*
Number of Organizations	29	24	30	21	5
Percentage	96%	80%	100%	70%	8%
Other/List	Contract Services, Corporate Donations, Investment Income, Endowments, Facilities and Rental Income, Admission Fees, Retail Sales				

Table 7.25 List of Corporations and Foundations Supporting Watershed Organizations, presents a list of funding sources that have supported conservation groups and projects in the watershed. Note that this is not a comprehensive list of all foundations giving to conservation efforts in the watershed.

Table 7.25 List of Corporations and Foundations Supporting Watershed Organizations

The 1957 Charity Trust
Albert Trust
Arcadia Foundation
Association of New Jersey Environmental Commissions
Helen D. Groom Beatty Trust
Bell Atlantic Foundation
Elaine and Vincent Bell Foundation
Archie W. & Grace Berry Foundation
Blue Mountain Foundation
Border Books-donations
Bryn Mawr Trust
Burket-Plack Foundation, Inc.
Claniel Foundation
Colonial Oaks Foundation
Geraldine R. Dodge Foundation
Dolfinger-McMahon Foundation
Green Mountain Energy Resource
John & Chara Haas Charitable Trust
Hatfield, Inc.
John M. Hopwood Charitable Trust
The Stewart Huston Charitable Trust
Kaiser Foundation
T. James Kavanaugh Foundation
Kenelm Foundation
Lehigh Valley Community Foundation
Lilliput Foundation
George & Miriam Martin Foundation
Martin Foundation
The McLean Contributionship
Merck & Company
Montgomery County Foundation
Moyer Packing Company
Warren V. Musser Foundation
Oxford Foundation
PA Outdoor Writers Association
Partnership for the Delaware Estuary
Patriot Bank
PECO Energy Company
William Penn Foundation
Perkiomen Creek Watershed Improvement Corporation
Pew Charitable Trusts
Philadelphia Community Foundation
Philadelphia Suburban Water Company
Rhone-Poulenc Rorer
Ridley Pool
Quaker Chemical
Quaker Chemical Foundation
Maxwell Strawbridge Charitable Trust
Strawbridge Foundation of Pennsylvania
Suburban Cable
Teleflex Foundation
Union Pacific
United Fund of Collegeville
Univest Corporation
Wyomissing Foundation

While the Nonprofit Survey revealed information about sources of funding, it did not attempt to examine what percentage of revenues are generated through any one type of funding source, such as foundations and government, which are limited growth sources of income. However, a recent informal funding survey of several nonprofits in the watershed was conducted by Dr. Jon Roush. Dr. Roush, a specialist in strategic planning for the environmental nonprofit sector, was hired by The Conservation Fund to learn about the capacity building needs for the nonprofit sector in the Schuylkill River watershed. Dr. Roush's survey found that the typical nonprofit polled emphasized foundation and government sources of income in their fundraising strategy. The study revealed that foundations contributed over 40% of revenues to Schuylkill nonprofit organizations, as compared to the national average of 15% or less. Individual donations accounted for only 13% of revenues, while the national average for individual philanthropy is 85%. One conclusion is that nonprofits in the watershed rely heavily on private foundations, and therefore need to diversify their funding sources and concentrate on cultivating membership/individual donors in order to grow successfully.

Nonprofits in the Schuylkill River watershed generate revenue from a wide variety of sources. Diversified fundraising should be a goal for every nonprofit to protect against sudden changes in funding. Foundation and government funders are generally considered limited funding sources because these sources may not grow in proportion with an organization's needs and cannot be depended upon for the long-term. Therefore, organizations relying on these sources will be limited in their growth and long-term sustainability. Nonprofits that rely primarily on foundation and government support should develop a realistic fundraising plan that emphasizes other sources, including individual donors and memberships.

7.3.2.3 Nonprofit Areas of Greatest Need

In addition to learning about how watershed nonprofits generate revenue, the survey inquired into what organizations view as the areas of greatest need for the watershed. Responses to this question are discussed below and have been addressed and incorporated into the pertinent sections of *Chapter 4.0 Identification of Major Issues*. As **Table 7.26** demonstrates, the nonprofits interviewed answered this question in two different ways. Some answered by stating the greatest need for their own organization; others answered the question by stating their view of the watershed's greatest needs.

Table 7.26 Categories and Examples of Nonprofit Organizations' Watershed Needs

Category	*Example*
Funding	▪ Training ▪ Development ▪ Fundraising ▪ Buying land
Education and Outreach	▪ Operational expenses ▪ Increasing staffing ▪ Conducting monitoring programs and other citizen requested programs
Institutional	▪ Operational expenses ▪ Improving computers and other equipment ▪ Increasing staffing ▪ Improving volunteer base

Category	*Example*
Government and Organizational Coordination	▪ Making municipal planning expertise of NGOs available to municipalities ▪ Reducing lack of coordination and overlap of effort resulting from different regulations and policies at state level ▪ Improving coordination between government organizations and NGOs ▪ Improving coordination among NGOs ▪ Being cognizant of environmental justice issues and lack of representation of minority groups or geographic areas within the watershed ▪ Taking an interdisciplinary approach locally and regionally
Legislative	▪ Marketing the message of responsible growth and natural resource conservation/protection to change the land ethic and improve environmental awareness ▪ Legislating natural resource conservation to improve development patterns and balance future growth
Technical	▪ Improving monitoring programs and quality of data ▪ Coordinated and compatible GIS mapping and training to groups who use it, available on CD-ROM ▪ Information and technology management ▪ Unified information systems to store and correlate information

- **Funding**

Funding was listed by many organizations as an area of greatest need. From an internal standpoint, many organizations would like additional funding to support overhead expenses, such as computers, personnel and operating expenses. Other nonprofits desired funding for actual projects, such as land acquisition and water quality monitoring. Some nonprofits thought that a funding system should be institutionalized in the watershed, to help groups obtain funding and to address key watershed needs.

- **Education and Outreach**

Many nonprofits surveyed recognized education and outreach as a vital part of watershed management, to raise awareness and stewardship, and thus to improve resources and quality of life. However, many organizations felt constrained by a lack of funding to support the staff needed to respond to citizens who request services or information from them.

- **Nonprofit Capacity**

The survey revealed that nonprofit organizations face many challenges with internal operations. Overall, nonprofits spoke to the basic organizational challenges they face, such as: how to develop and manage a board of directors; how to recruit and mobilize volunteers, interns and staff; the need for general management support in accounting, bookkeeping and other day-to day operations; and how to allocate resources to meet public demand. All of this reveals that the nonprofit community as a whole needs help in building capacity to meet their organizational needs and effectively carry out their missions. The Needs Assessment Survey of Schuylkill River watershed groups conducted by Dr. Jon Roush supports the general findings of this survey, that nonprofits should build capacity and attend to basic, organizational needs. Dr. Roush's study revealed that nonprofits need support and professional development in three priority areas: fundraising, strategic planning, and board management or development.

- **Government and Organizational Coordination**

Several of the nonprofits surveyed noted their desire for increased coordination between the private and public sectors. Groups addressed the need for more governmental and organizational coordination, and also the need to supply local governments with the tools and resources they need to make well-informed decisions.

- **Legislative/Policy Changes**

A few organizations stated that legislation should be developed to institutionalize conservation values: e.g., to balance future growth and economic development while protecting open space and agricultural lands, and to develop special zoning for natural resource conservation.

- **Technical Assistance**

Technical assistance was included in many agency responses. Issues ranged from general technical assistance, information and technology management and the need for unified information systems to store and correlate information, to GIS mapping, accessibility and training.

7.4 Public Agency Interviews and Analysis

7.4.1 Background and Procedure

A public agency interview process was included to provide balanced input into the Schuylkill Watershed Conservation Plan. The public agency interviews supplied important information about activities, concerns and visions for the watershed that have been incorporated into the plan's recommendations, and may be used as a planning tool for empowering local organizations to more efficiently focus and coordinate limited resources where they are most urgently needed.

A list of watershed agencies was developed to provide a representative sample of all government levels (federal, state, county, local, municipal and regional agencies) with pertinent public responsibilities throughout the watershed. A full list of public agencies interviewed is in **Public Agency Contact List** in the online Reference Documents. Key public officials in the watershed were interviewed to ensure the cooperation of these relevant public agencies, to promote and support coordination with existing natural resource management plans, and to obtain further input into major watershed issues and completed or ongoing projects.

Before interviewing agency representatives, a standard survey was developed by researching other watershed surveys (see the online Reference Document: **Public Agency Survey**). Over 90 agencies were selected to participate in the interviews. However, only 64 public agencies responded in the interview process from November 1999 through February 2000. Forty-three interviews were conducted personally and the rest were conducted by mail. The three local nonprofit partners, representative of geographic regions within the watershed, who administered the survey were: the Berks County Conservancy (covering Berks, Lebanon and Lehigh Counties); the Pennsylvania Environmental Council (covering Chester, Delaware, Philadelphia, Bucks and Montgomery Counties); and the Schuylkill River Greenways Association (covering Schuylkill and Carbon Counties). As a majority of the responding agencies represented the northern sections of the watershed, issues pertinent to those regions of the watershed may have received more attention in the analysis of agency responses. Resource Dynamics, Inc. helped to organize and coordinate the interviewing effort. The following discussion summarizes the responses to the Public Agency Survey.

7.4.2 Results and Discussion

7.4.2.1 Agency Activities and Responsibilities/Objectives

A variety of agencies were interviewed, reflecting many different types of regulatory and non-regulatory responsibilities. Approximately 40% of the agencies interviewed have some regulatory responsibilities. These regulatory responsibilities include: sediment and erosion control; water pollution discharge permits; safe drinking water protection; zoning and local stormwater requirements. Non-regulatory agencies promote and assist with conservation and restoration of the outstanding cultural, recreational and natural resources within the Schuylkill River watershed; develop plans to manage growth, redevelopment and transportation; and offer technical assistance, conducting studies and providing financial assistance, education, and training. Many agencies also work to facilitate partnerships with communities and municipalities for environmental, conservation and natural resource projects. In summary, the public sector reports collectively that they address all areas of watershed concern. See **Table 7.27** for a list of the agencies interviewed, their general responsibilities and resources offered to outside organizations.

Table 7.27 Watershed Agencies, Responsibilities and Resources Offered to Outside Organizations

Level of Government	*Agency*	*Purpose and Responsibility*	*Resources Offered*
Federal	Office of Surface Mining	Regulate coal mining impacts; aid in abandoned mine issues	Financial, educational, technical
Federal	National Park Service	Conservation of natural, recreational, and cultural resources	Financial, educational, technical, communications, political access and process
Federal	US Army Corps of Engineers	Water resources planning, development, streambank and habitat restoration; regulatory authority with PA DEP for construction within U.S. waters	Technical, planning, engineering and construction
Federal	USDA - Forest Service	Technical and financial assistance in forestry related projects	Financial, educational, technical, training, communications, political access and process
Federal	USDA - Natural Resource Conservation Service	Assistance for soil and water conservation	Financial, educational, technical, training, communications, political access and process
Federal	US Fish and Wildlife Service	Wetland violations; highways; 404 permit review	Financial, technical
State	PA DCNR - Bureau of Forestry	Aid landowners in the care of their forests; improve riparian forest buffers	Financial, educational, technical, communications
State	PA DCNR - Bureau of Parks and Recreation	Planning leading to River Conservation Plans; River Conservation Program, Keystone Grant Program	Financial, educational, technical, training, communications, political access and process
State	PA DCNR - Bureau of Topographical and Geologic Survey	Describe topography and bedrock geology; collect water well records	Technical

Level of Government	*Agency*	*Purpose and Responsibility*	*Resources Offered*
State	PA DCNR - Conservation & Natural Resources Advisory Council	Evaluating DCNR grants program; involving citizens and local governments in DCNR decisions	Financial, educational, technical, training, communications, political access and process, advocacy
State	PA Fish & Boat Commission	Enforcement of boating, fishing and water quality issues	Educational, technical, training, communications
State	PA DEP - District Mining Operations	Regulate all mining activities; acid mine drainage remediation	Financial, educational, technical
State	PA DEP - Bureau of Watershed Conservation	Coordinate 319 Clean Water Act Grants Programs	Financial, educational, training
State	PA DEP - Bureau of Mining and Reclamation	Permitting and compliance for mineral extraction; watershed restoration projects	Financial, educational, technical, political access and process
State	PA DEP - Water Management Program	Administer 537 Sewage Facilities Program	Financial, educational, technical
State	PA DEP - Bureau of Abandoned Mine Reclamation	Reclamation of abandoned mine sites; manage Schuylkill River Project; bond forfeiture actions	Financial, technical, limited construction abilities
State	PA DEP - Regional Watershed Coordinator	Regulatory agency – elimination of sewage discharges and AMD	Financial, educational, technical, training, communications
State	PA Department of Transportation (DOT)	Manage transportation design and construction projects	Financial, educational, technical
State	PA Game Commission	Wildlife habitat improvement	Educational, technical
State	Wild Resource Conservation Fund	Inventory native wild plants and non-game wildlife	Financial, other (as approved by other state agencies)
Regional	Delaware River Basin Commission (DRBC)	Planning and permitting water withdrawals and wastewater discharge	Technical, political access and process
Regional	Delaware Valley Regional Planning Commission (DVRPC)	Develop land use and open space plans for region; various other environmental, transportation, and land use studies	Educational, technical, training
Regional	Fairmount Park Commission	Maintenance of streams, dams, landscaped areas, buildings; regulate park use	Educational, technical, training
Regional	Southeastern Pennsylvania Transportation Authority (SEPTA)	Transportation	None
County	Berks County Conservation District	Conservation of natural resources, especially those relating to water quality	Educational, technical, training, communications, political access and process
County	Berks County Planning Commission	Transportation planning; stormwater management; review of subdivision and land development	Financial, technical, training, communications
County	Bucks County Planning Department	Assistance to municipalities with open space planning, ordinance development, and site designs	Educational, technical, training
County	Bucks County Planning Commission	Identify and preserve cultural and natural areas, county open space	Educational, training, communications

Level of Government	*Agency*	*Purpose and Responsibility*	*Resources Offered*
County	Carbon County	Advise on community development issues; regulatory activities – reviews of projects involving zoning and subdivision regulations	Communications
County	Chester County Conservation District	Sustainable use of natural resources; work with watershed associations; regulatory activities – erosion and sediment control, review NPDES permits	Financial, educational, technical, communications
County	Chester County Parks & Recreation Department	Provide recreation activities; promote greenways and river access; construct trails; enhance biodiversity	Financial, technical
County	Chester County Planning Department	Sub-development reviews; sewage facility reviews; implementing county comprehensive plan	Financial, technical, training
County	Chester County Water Resources Authority	Encourage sound watershed management	Educational, technical
County	Eastern Schuylkill Recreation Commission	Trail projects; AMD	Communications, political access and process
County	Lebanon County Commissioners	Watershed preservation; recycling, pollution prevention; greenways	Educational, political access and process
County	Lebanon County Conservation District	Soil and water conservation; farmland preservation; erosion and sediment control; nutrient management	Educational, technical, communications, political access and process
County	Lehigh Valley Planning Commission	Open space and agricultural preservation	Educational, technical
County	Montgomery County Association of Township Officials	Sharing ideas on environmental issues and projects with member municipalities	Educational, communications
County	Montgomery County Planning Commission	Plans to address growth and redevelopment; review development plans; perform studies to protect natural resources and improve transportation	Financial, educational, technical, training, political access and process
County	Penn State Cooperative Extension	Research information for agriculture	Educational, technical, training, communications
County	Philadelphia Planning Commission	Approval of site plans and erosion and sediment controls; review of compliance for stormwater, contamination, and floodplain regulations	Educational, technical, training, communications, political access and process
County	Philadelphia Urban Resources Program	Vacant land restoration and improvements	Financial, educational, technical
County	Philadelphia Water Department	Drinking water source protection; stormwater permits; wet weather water quality/quantity concerns	Educational, technical, training, communications, political access and process
County	Schuylkill County Association of Township Supervisors	Advocate for local townships; clean water; healthy environment	Communications, political access and process

Level of Government	*Agency*	*Purpose and Responsibility*	*Resources Offered*
County	Schuylkill Conservation District	Watershed protection; clean streams; regulatory activities - NPDES and erosion and sedimentation plan reviews	Financial, educational, technical, training, communications, political access and process
County	Schuylkill County Cooperative Extension Office	Education for persons engaged in agricultural enterprises	Educational, technical, training
County	Schuylkill County Planning Commission	Planning; transportation planning; zoning and subdivision permits	Financial, educational, technical, political access and process
County	Schuylkill County's Vision	County strategic planning process	Network facilitation
County	Schuylkill County Municipal Authority	Water and wastewater authority	Technical
County	Schuylkill County - Real Estate Development and Office of Solid Waste and Resource Management	Manage coal lands, bridges, county roads, flood control dams, solid waste disposal, recycling	Financial, educational, technical, political access and process
Municipal	Borough of Port Clinton	Municipal authority for Port Clinton	None
Municipal	City of Pottsville - Recreation Commission	Recreation programming	Facilitation of volunteers
Municipal	Schuylkill Township	Governing; road maintenance	Political access and process
Municipal	Schuylkill Haven Borough	Operate electric, water, and sewer for borough and nearby areas	Technical, communications, political access and process
Municipal	Towamencin Township	Install best management practices; regulatory activities - zoning ordinances	Demonstration projects to serve as educational model
Nonprofit*	E. PA Coalition for Abandoned Mine Reclamation	Works with watershed groups and others interested in mine reclamation	Financial, educational, technical, training, communications, political access and process, monitoring
Nonprofit*	Schuylkill River Greenway Association	Schuylkill River Greenway development; manage Schuylkill River Heritage Initiatives (a state program)	Financial, educational, technical, communications, political access and process, problem solving

**Nonprofits invested with some regulatory responsibilities.*

In order to understand what types of activities predominate public work, part of the survey gathered information on activities in which public agencies have focused and invested resources. These activities are listed by category in **Tables 7.28** and **7.29** for current projects and completed projects, respectively.

Table 7.28 Categories of Current Public Agency Activities

Agency Activity	*Percent of Agencies Participating*
Projects (physical, restoration)	44%
Planning Tools/Studies/Assessments	28%
Education and Outreach	10%
Acquisition/Open Space Preservation	7%
Inventories/Ecological Monitoring	6%
Partnerships/Coalition-building/Special Designations	3%

Table 7.29 Categories of Completed Public Agency Activities

Public Agency Projects	*Percent of Agencies Participating*
Projects (physical, restoration)	40%
Planning Tools/Studies/Assessments	23%
Partnerships/Coalition-building/Special Designations	11%
Education and Outreach	11%
Inventories/Ecological Monitoring	2%
Acquisition/Open Space Preservation	2%

Tables 7.30a and **7.30b** list specific examples of the types of projects which public agencies are working on or have completed. A more detailed list of public agency projects is recorded in the online **Reference Table 7A: Detailed List of Public Agency Projects**. The level of involvement in each category of public agency project is summarized and discussed in the sections following the tables.

Table 7.30a Specific Ongoing Public Agency Projects

ONGOING PROJECTS					
Physical Projects	***Planning***	***Education***	***Acquisitions, Open Space***	***Inventories***	***Partnerships***
Streambank fencing	Preliminary remedial assessment plans	Forest stewardship program	Habitat acquisition assistance and stream bank preservation	Groundwater level monitoring and mapping	Working to establish the Schuylkill River National Heritage Area
Establishing warm season grasses and non-game wildlife	River Conservation Plans	Adult and youth education	Acquisition of agricultural easements by Lehigh County	Digital geologic maps of Pennsylvania	Partnerships to manage Schuylkill River Water Trail
Acid mine drainage treatments	Watershed action strategies	Commercial horticulture	200,000 acres of farmland preservation	County inventories of wild flowers and non-game wildlife	Philadelphia Urban Resources Partnership

ONGOING PROJECTS					
Physical Projects	***Planning***	***Education***	***Acquisitions, Open Space***	***Inventories***	***Partnerships***
Constructed wetlands	Regional watershed plans	Land conservation practices	Acquisition and easements of adjacent properties as part of the Natural Lands Restoration	Stream flow monitoring with USGS	Vision Program Partnership: 70 of 73 municipalities have a MOU regarding the Landscapes Plan that makes them eligible for funds and technical assistance
Riparian forest buffers	Open space land use plans	Sustainable agriculture, open space education program	Roxborough open space preservation (evaluating parcels for acquisition or protection)	Precipitation monitoring (volunteer based)	
Sewerage discharge controls	Nutrient management plans	Crop and stock management practices	County open space acquisition through planning and parks recreation departments	Stream coordination monitoring (physical biological and chemical)	
Expansion of water treatment filtration plants	Watershed assessments	Rural and urban living projects and activities		County-wide brownfields inventory	
Fish ladder projects					

Table 7.30b Specific Completed Public Agency Projects

COMPLETED PROJECTS					
Physical Projects	***Planning***	***Education***	***Acquisitions, Open Space***	***Inventories***	***Partnerships***
AMD related restoration and remediation	Schuylkill Heritage Plan	Earth Yes—environmental education for youth	Conservation Reserve Program – 500 acres around the Green Lane Reservoir	Inventory of natural and cultural resources	Penn Ridge Greenway on the East Branch of the Perkiomen
Diversion wells and constructed wetlands	Effects of Urbanization on Eastern Chester County	Teaching urban youth about natural resources	Acquisition of the Thun and Bartram rail/trail project properties	Agricultural inventory in the French-Pickering Creek	Garnering involvement and support from Trout Unlimited
Hazardous waste site clean ups	An airport logging plan	Stormwater management BMPs for urban areas			Work with Coldwater Tributaries Action Council

COMPLETED PROJECTS					
Physical Projects	***Planning***	***Education***	***Acquisitions, Open Space***	***Inventories***	***Partnerships***
Improved access, lighting and signage at local parks	County Landscape Plan and other municipal level OSPER plans promoting open space	Teacher training on AMD issues			Ongoing work with farmers on agricultural practices
Environ-mental and historic restoration projects in Manayunk	Information about creating livable communities	"Preserving Our Places" a historic preservation manual			Hosting district meetings
Improving a failing sewer system	County natural resources plan including soils, farmland, significant natural features and model ordinances	Five public programs to promote better care of forest resources and to provide educational opportunities on public forest resource issues			Reminding DCNR of the need to involve citizens and local governing officials in decisions that vitally affect their interests
Riparian restoration projects	A land use policy report, "New Regionalism"	Managing the First Annual River Sojourn			

- **Projects**

44% of agencies have completed projects and 40% are currently engaged in on-the-ground, physical improvement projects in the watershed. These projects cover a variety of activities such as: streambank fencing; establishing warm season grasses and non-game wildlife; acid mine drainage treatments; constructed wetlands; improvements to riparian forest buffers; sewage discharge controls and expansion of water treatment filtration plants; headwaters dredging; park, nature preserve, trail and bike path creation and enhancements; and bridge replacement and rehabilitation.

- **Planning Tools, Studies and Assessments**

Agencies have completed an impressive list of planning tools, studies and assessments addressing issues throughout the watershed. 28% of agencies currently have planning projects, with 23% having completed planning projects. Some of these efforts include: preliminary remedial assessment plans; River Conservation Plans (creating a management plan with recommendations throughout a watershed); watershed action strategies (identifying pollution sources and potential remediation actions); regional watershed plans; open space/land use plans; countywide comprehensive plans; stormwater plans; conservation planning on private and agricultural land; and nutrient management plans.

- **Education and Outreach (Fostering Stewardship)**

Public agencies cover a broad spectrum of education and outreach activities in the watershed. Although comprising only a small percentage of the overall projects in both ongoing (10%) and completed (11%) categories, education and outreach efforts are targeted at a wide range of audiences. Educational projects include: a forest stewardship program; adult and youth education on commercial horticulture, land conservation practices, sustainable agriculture, integrated pest management, agronomy and livestock, crop and stock management practices; family living including childcare, nutrition, and food safety; 4-H efforts including rural and urban living projects and activities; and leadership and youth education projects conducted in cooperation with school systems. Other educational programs focus on stormwater management practices, teacher training on acid mine drainage issues, and a conservation leadership school. The Natural Lands Restoration and Environmental Education Program (NLREEP) by the Fairmount Park Commission provides a variety of activities including: development of a master restoration plan and implementation of high priority projects; a trail master plan; expansion of environmental education facilities and programs; and expansion of volunteer efforts.

Outreach focuses on coalition-building activities, such as: regular meetings of special committees and township supervisors; planning stewardship programs for county-owned properties; working with communities and nonprofit organizations to build a sense of regional identity for the Schuylkill River watershed; and managing the Schuylkill River Sojourn.

- **Acquisition/Open Space Preservation**

Although only a small percentage of public agency activity is focused on land acquisition and/or open space preservation (7% for ongoing and 2% for completed projects), the public sector is facilitating land preservation. Specific projects include: habitat acquisition assistance and streambank preservation work with the Schuylkill County Conservancy and Wildlands Conservancy; acquisition of agricultural easements by Lehigh County; 200,000 acres of farmland preservation; acquisition and easement of additional adjacent properties as part of the NLREEP; Roxborough open space preservation (evaluating parcels for acquisition or protection and county open space acquisition through planning and parks and recreation departments); the Conservation Reserve Program (500 acres around the Green Lane Reservoir);and the acquisition of the Thun and Bartram rail/trail project properties.

- **Inventories/Ecological Monitoring**

A relatively small number of public agencies interviewed are conducting (6%) or have conducted (2%) a number of inventory projects in the watershed. These projects include: GIS inventories for conservation and natural resources protection; digital geologic maps of Pennsylvania; county inventories of wild flowers and non-game wildlife; a variety of data gathering and research projects, stream flow monitoring with USGS, groundwater level monitoring and mapping, groundwater quality monitoring, stream condition monitoring (physical biological and chemical), precipitation monitoring (volunteer based); and a countywide brownfields inventory. The list also includes an inventory of natural and cultural resources and an agricultural inventory in the French and Pickering Creek subwatersheds.

- **Partnerships/Coalition-building/Special Designations**

Although one of the most important categories for building watershed stewardship, agencies engaging in these activities were fewer than expected. Only 3% of agencies surveyed currently are involved in partnerships or coalition-building, although 11% have completed partnership projects. Special designations refer to a very specific activity and were grouped in this category due to the small percentage of these types of projects.

The types of partnerships and coalition-building projects ranged from working to establish the Schuylkill River National Heritage Area to promoting the Vision Program Partnership, an MOU (memorandum of understanding) among 70 municipalities regarding a Landscapes Plan that makes them eligible for funds and technical assistance. Other examples include working with the Eastern Schuylkill Recreation Commission, the Schuylkill Headwaters Association and the Pennsylvania Fish and Boat Commission to develop and manage the Schuylkill River Water Trail from the headwaters to the confluence with the Delaware. There were a few responses that focused on urban issues. These involved the Philadelphia Urban Resources Partnership, whose goal is to create a network and forum for agencies and nonprofits interested in urban ecological restoration. Completed projects include: the Penn Ridge Greenway on the East Branch of the Perkiomen where seven to eight municipalities worked on common issues relating to the greenway and trails; garnering involvement and support from Trout Unlimited; work with Coldwater Tributaries Action Council (founded by the Conservancy and Trout Unlimited in 1996); and ongoing work with farmers on agricultural practices.

The Public Agency Survey responses suggest that there are opportunities for increased cooperation among the nonprofit and public sectors. Based on the low percentage of projects, public agencies may wish to partner with nonprofits to leverage activity for: education and outreach; open space acquisition; research and resource inventories; and partnerships/coalition-building. These activities contribute in a number of ways to sustainable watershed management, as highlighted below.

- Education and outreach activities increase public awareness and involvement in watershed conservation. Whether through recreation, volunteer activities, school field trips, or formal training opportunities, public agencies can ensure that local communities are informed and committed to preserving their land and water legacy today and for the future.

- Land acquisition and open space protection is increasingly recognized as a critical component of watershed preservation. Environmental issues like non-point source pollution, stream sedimentation, wildlife health and habitat quality often result from inappropriate adjacent land uses. By increasing open space and protected lands in the watershed through direct acquisition, conservation easements or other land protection tools, public agencies and their partners can improve water and habitat quality, and may provide new opportunities for public access, recreation and education.

- Good environmental management is grounded in good scientific research. While public agencies and nonprofits have amassed important information about the Schuylkill River watershed, additional research and monitoring are required to understand the health and functioning of this aquatic ecosystem. In addition to basic biological inventories and chemical studies, it is essential that agencies and local organizations work together to develop a watershed-wide research and monitoring program.

- Overlap and gaps in activities and services provided by public agencies and nonprofits could be addressed with partnerships and coalition-building. The larger geographic area and importance of tributaries implicit in watershed management demands a higher level of coordination and cooperation than for traditional river conservation planning. For example, an effective watershed monitoring design requires thorough sampling across the tributaries and rivers of the watershed. Public agencies may fill a vital gap by facilitating coordination among nonprofits and local groups through innovative partnerships and coalitions.

7.4.2.2 General Threats, Solutions and Agency Needs

Besides gathering information concerning public agency activities in the watershed, the survey identified major threats perceived by agencies in the watershed, approaches to addressing these threats, and internal agency needs to better meet conservation issues. These answers provided additional input on major issues in the watershed aside from those elicited at the public meetings. Many of these responses have been incorporated into the recommendations, and into *Chapter 4.0 Identification of Major Watershed Issues*.

When asked to list the primary threat to natural resources in the watershed, the most frequent answers were: acid mine drainage; non-point source pollution from both rural, urban and urbanizing areas; water pollution from improper sewage treatment; and sprawl/growth/development issues (see **Table 7.31**). The "other" category that accounts for 34% of the responses were a very small percentage of the overall responses. Answers that fell into the "other" category ranged from over-population of white tailed deer, to erosion and sediment loading from agricultural land and apathy of public attitude. Because 69% of the responding agencies represented the northern sections of the watershed (primarily Berks and Schuylkill Counties), this may account for the importance assigned to acid mine drainage and related mining issues along with sewage-related issues.

Table 7.31 Primary Threats to Resources Within Public Agency Jurisdiction

Perceived Threat to Resources	*Percent of Agency Responses*
Acid Mine Drainage and Related Mining Issues	27%
Nonpoint Source Pollution/General Pollution	18%
Sewage Issues	12%
Sprawl/Growth/Development	12%
Other (issues receiving only one or two responses)	34%

Besides identifying primary threats to watershed resources, agencies were asked to provide innovative approaches and solutions (both regulatory and non-regulatory) to solve these threats. It was clear from the responses that the agencies thought in terms of identifiable, physical implementation projects rather than in terms of general solutions (see **Table 7.32**). Among the proposed solutions, project implementation (both acid mine drainage and others) received the highest response, followed by comprehensive planning and partnerships/team approaches to addressing the threats. The 20% of the responses attributed to the "other projects" category ran the gamut from deer management and water quality projects by nonprofits, to water quality monitoring, streambank fencing and even housing rehabilitation programs. The fact that funding, education, enforcement and acquisition each received less that 10% of the responses could imply that either agencies are not geared toward working in these areas, or that they do not feel that these approaches are as innovative or effective as physical implementation projects.

Table 7.32 Suggested Innovative Approaches and Solutions/Projects to Solve Perceived Threats

Types of Projects	*Percent of Agency Responses*
Acid Mine Drainage and Related Mining Issues	20%
Other	20%

Innovative Solutions	*Percent of Agency Responses*
Comprehensive Planning	11%
Team Approach/Partnerships	11%
Financial	8%
Educational	8%
Enforcement	5%
Acquisition	5%

The survey revealed that 48% of the public agencies believe they need increased financial support to address the identified threats in the watershed (see **Table 7.33**). Regulatory and/or policy changes were noted as additional needs to solve watershed threats. These include passage of Growing Greener legislation, sprawl legislation, and enforcement legislation; all fairly general responses. Other responses that accounted for less than 15% of the answers included: expansion of the support base (i.e., watershed associations and volunteers), increases in staff/personnel and improved planning.

Table 7.33 Additional Resources Needed to Address Threats

Additional Resources Needed	*Percent of Agency Responses*
Financial	48%
Regulatory/Policy Changes	25%
Expansion of Support Base/Watershed: Associations/Volunteers	12%
Personnel Increases	9%
Improved Planning Process	2%

When asked what groups are best positioned to solve watershed problems, agencies overwhelmingly agreed by 81% that watershed partnerships, made up of a combination of the public, private and nonprofit sectors working together on projects, are the most successful method of addressing watershed threats. The remaining 19% of the responses varied based on what the agency interviewee considered major threats and, in some cases, one specific public agency was suggested as most appropriate for dealing with this threat. Agencies and nonprofits specifically mentioned included: NRCS; Farm Service Agency; county conservation districts; PA Game Commission; PA Fish Commission; PA DEP; Chambers of Commerce; economic development agencies; E. PA Coalition for Abandoned Mine Reclamation; Penn Vest; Schuylkill Headwaters; conservancies; schools; museum commissions; USGS, and the Borough Day Committees.

Again, while a strong majority of the agencies interviewed stated that a partnership of agencies and watershed organizations are best suited to solve problems, only 3% of agencies are actively involved in the partnership approach. It can be concluded that there is ample opportunity for increasing the number of partnerships as agencies recognize the efficacy of partnerships but are not participating in them currently.

7.4.2.3 Opportunities for Agency Partnerships

While the above section addresses the threats and solutions suggested by the public sector, this section discusses activities around which partnerships may be established.

In general, public agencies offer many different types of opportunities in which other organizations can cooperate. When asked about the best opportunities for other agencies or nonprofit organizations to work

cooperatively on projects, 19% of the agencies cited planning and program development (see **Table 7.34**). Examples of planning and program development include promoting the forest stewardship program, involving the county commission with projects, and developing and promoting the Partners for Fish and Wildlife. Another example is the Rivers, Trails and Conservation Assistance Program, a public outreach program of the National Park Service that assists local communities, state and local governments and other federal agencies in planning, design and organizational development related to river conservation, trail and greenway development and other similar projects that enhance the environment. Other agencies noted that they can provide assistance with funding and submission of grant applications; some of these agencies include the PA Game Commission, PA DEP and Carbon County Office of Planning and Development. Suggestions for "hands-on" support and acid mine drainage projects included coordinating acid mine drainage projects that involved several organizations and funding sources, streambank fencing, creation of wetlands and stormwater management. Significantly, 5% or less of the agencies stated that they had opportunities for building alliances, education, technical support and design.

Table 7.34 Opportunities for Organizations to Work Cooperatively with Public Agencies

Opportunity for Cooperative Activity	*Percent of Agency Responses*
Planning/Program Development	19%
Providing Assistance with Funding/Submission of Applications	11%
Projects/Hands-on Support	11%
AMD Project Support	11%
Watershed Association Projects and Regional Organizations	8%
Alliance Building	5%
Education	5%
Technical Support	5%
Design	3%

In the survey, the public agencies recognized the values of working cooperatively. Some of the benefits they highlighted include the value of working together to learn from one another's experiences, identifying problems, and working together to solve them. Elements of success also were noted. These include working toward a common goal, creating "buy-in" and commitment, leveraged funding, and demonstrating citizen support through nonprofit involvement and increased public awareness.

Public agencies surveyed offer many resources and programs to help other public agencies and nonprofit organizations. Specifically, many agencies offer educational support, technical assistance, financial grants, communication/public relations support and access to the political process. Other available resources include comprehensive planning, engineering and construction, grant writing assistance and facilitating volunteers (see **Table 7.35**). Additionally, *Table 7.27 Watershed Agencies, Responsibilities and Resources Offered to Outside Organizations* above is a reference on specific types of resources offered by these agencies.

Table 7.35 Agency Resources Available to Other Public Agencies or Nonprofit Organizations

Agency Resources Available to Other Groups	*Percent of Agency Responses*
Financial	49%
Educational	60%
Technical	50%
Training	19%
Communication/Public Relations	39%
Political Access/Process	44%
Other	14%

Resources listed under the "other" category included:

- Comprehensive planning, engineering and construction;
- Demonstration projects on public land that can serve as model for education;
- Grant writing assistance;
- Advocacy for citizen interests;
- Facilitate volunteers; and
- Some limited construction capabilities.

On the other hand, when asked what agencies require in order to be more effective in carrying out their responsibilities in the watershed, the survey revealed the public sectors' internal needs. Answers showed that public agencies chose general funding, technical assistance and regulatory modifications as their top three priorities (see **Table 7.36**). Other areas identified for capacity building were increased support through watershed associations, volunteer cultivation, agency staffing, better intra-agency communication and improved public relations. Other noted needs included inter-agency liaison, agency funding, and mechanisms for informing landowners and others of available information and resources.

Table 7.36 Internal Agency Needs for Increased Effectiveness in Achieving Mission

Internal Agency Needs	*Percent of Agency Responses*
Government grants/general funding	21%
Technical assistance	15%
Regulatory modifications	14%
Better communication with other agencies	11%
Other	11%
Public relations	6%

As increased general funding was a priority need for agency effectiveness, the survey inquired into what funding methods agencies have pursued for watershed protection efforts. Government grants and cost share programs make-up more than half of the funding methods pursued by public agencies for watershed protection efforts, followed by the leverage provided through partnerships or cooperative efforts. Foundation support, special taxes, general funds, membership, corporate, concessions and sales and bond initiatives individually comprise a very small percentage of the methods pursued.

7.4.2.4 Measures of Success

Developing standard measures of success for specific types of projects is important. These measures benchmark improvements to watershed resources in order to better target priority projects and financial resources. The 21st Century Environment Commission recognized the importance of indicators in its recent 1998 report. In 1999, PA DEP issued its first statewide indicators report, entitled "State of the Environment."

Public agencies were asked to suggest measures of success that would demonstrate progress in dealing with watershed issues. Their answers weighed heavily in favor of data-supported implementation projects (i.e., increase in total number of acres preserved, measurable improvements in water quality, etc.). The second most numerous responses highlighted specific programs and organizational improvement. Education and financial measurements received a minor response (see **Tables 7.37** and **7.38**).

Table 7.37 Suggested Types of Measures of Success to Demonstrate Progress

Types of Measures of Success	*Percent of Agency Responses*
Physical improvements, restoration (data supported)	59%
Programmatic/organizational	35%
Educational	3%
Financial	1%

Table 7.38 Suggested Specific Measures of Success

Type	*Suggested Measures of Success*
Physical	▪ Miles of streamside forests developed, miles of stream banks fenced ▪ Number of acres returned to native grasses ▪ Numbers of acres conserved, restored, and protected ▪ Number of wildcat sewers and AMD discharges eliminated ▪ Abundance of aquatic life ▪ Number of stream miles open to migratory fish
Programmatic/ Organizational	▪ Number of streams removed from 303(d) impaired waters list ▪ Number of new watershed organizations, number of sustainable watershed organizations ▪ Amount of increase in water sampling points for AMD areas ▪ Number of municipalities with stormwater management plans in place
Educational	▪ Visitation at education sites
Financial	▪ Amount of increased funds for reclamation

Many public agency representatives responded enthusiastically to the subject of indicators/measurements of success. In general, the agencies interviewed understood the value and necessity of measuring progress. However, based on the responses, it was clear that many of these representatives had not thought about the subject before and that this issue had not been incorporated into the public sectors' general method of operation.

7.4.2.5 Most Important Issues Identified for Plan Inclusion

A major goal of the survey was to identify important watershed issues that should be addressed by the plan. Agencies were asked to rank 19 categories of issues in order of importance. Agencies considered the top watershed issues to be land use planning, containing urban/suburban sprawl and revitalizing urban centers, watershed based planning and habitat protection and enhancement (**Table 7.39**).

Table 7.39 Public Agency Ranking of the Most Important Issues in the Watershed

Category of Watershed Issue	*Ranking*
Land use planning	1
Containing urban and suburban sprawl/revitalizing urban centers	2
Watershed based planning	3
Habitat protection and enhancement	3
Greenways implementation/open space preservation/park expansion and recreation/public access	4

Category of Watershed Issue	*Ranking*
Water quantity/stormwater and flooding	4
Inter-governmental cooperation/communication	4
Wetlands loss	5
Acid mine drainage	6
Current and ongoing industrial impacts/brownfields/superfund sites	6
Water conservation education/awareness	6
Government funding	7
Water treatment/sewage treatment/septic systems/sewage regulations	8
Farmland protection	9
Farm waste management	9
Farming incentives	9
Cultural resources protection	10
Economic development	11
Designated mineral extraction areas	11

The table echoes the overall need for comprehensive planning and cooperation to address water and land use planning issues. Many of the more specific topics listed here, such as sprawl, greenways and open space preservation, mine drainage, wetlands loss, etc., would be addressed best through a proactive watershed planning effort that solicited input from various stakeholders and focused on developing a long-term landscape design and management plan to preserve cultural, ecological and economic resources.

7.5 Detailed Recommendations from the Institutional Assessment

This section presents detailed recommendations for building institutional capacity in the Schuylkill River watershed. Each recommendation is listed in a table by its code, the name of the recommendation, a representative list of appropriate groups/agencies that might implement or guide the implementation of each recommendation, the key institutional/organizational issues addressed, and the section(s) in this chapter to which each recommendation corresponds. Each table is followed by a detailed description of the recommendation.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.1	**Develop Quantitative Indicators/Measures of Success**	Key nonprofits and public agencies in the watershed	Improve coordination Plan implementation Resource management Strategic conservation	7.4.2.4

Description

Although most respondents to the Public Agency Survey had not previously considered developing measures of success to demonstrate progress in meeting conservation goals, this issue received strong support from agency staff. We recommend that public agencies and nonprofits in the watershed work together to establish common, quantitative indicators or measures of success to benchmark the effectiveness of projects and management efforts. In order to guide the efficient use of resources, successes and failures need to be documented using indicators to close the feedback loop – i.e., to benchmark the effectiveness and impact of collective watershed-wide efforts and individual efforts. These indicators should be integrated into programs and projects as a general method of operation.

Indicators should be representative of the status of a broad spectrum of resources. Measures of success should be used for water quality, landscape and institutional goals; e.g., include standards and bio-indicators of water quality, measures of landscape stability and conservation progress, and measures for institutional cooperation, financial goals and educational outreach. Indicators can be developed by: (1) identifying the resource to be measured; (2) selecting an appropriate indicator to measure that resource; and (3) determining whether sufficient information is available to support the use of that indicator.

Many nonprofits and public agencies in the watershed could participate in determining appropriate quantitative indicators. Measures of success should be developed collaboratively, perhaps through regular watershed forums (see Recommendations **R7.2**, **R7.7** and **R7.20** below). A current project of 25 diverse nonprofits facilitated by The Conservation Fund is developing some indicators for the Schuylkill River watershed. Further information on indicators can be obtained from EPA Region 3. Other model indicator reports include publications by the Chesapeake Bay Foundation, the Sierra Nevada Business Council, the Delaware Estuary Program, and the Brandywine Valley Association.

See **Tables 7.37** and **7.38** for indicators identified by the public agencies surveyed in this study.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.2	**Watershed Network**	Watershed stakeholders, including private sector, citizens, nonprofits and public agencies at local and regional scale	Improve coordination Build capacity Plan implementation Strategic conservation	General

Description

The need for coordination between watershed stakeholders was heard through the public meetings, the Public Agency Survey, and the Nonprofit Survey. The most effective way to establish coordination among watershed stakeholders is to institutionalize an organizational framework in the watershed – i.e., a watershed network. The purpose of a watershed network would include the following.

(1) Provide a forum to exchange information and facilitate communication among representatives from local, subwatershed, regional, state, and federal interests.

(2) Act as a "think tank" to cooperatively determine general priorities in the watershed that need to be addressed on a local level, how to efficiently meet designated priorities through cooperative projects and local action, and to maintain the ongoing implementation of the Schuylkill Watershed Conservation Plan.

(3) Work closely with a funding network to obtain funding for priority projects (see Recommendation **R7.3** below).

(4) Gain increased legislative attention for watershed resources and groups.

(5) Increase funding to watershed projects from outside sources by working on a large-scale, cooperative basis.

(6) Raise public awareness of watershed resources.

A watershed network will be most effective if a diversity of stakeholders are involved. Stakeholders should include private sector businesses, nonprofits, and all levels of government. Leadership and structure of the watershed network should be discussed openly among watershed stakeholders for a democratic process and maximum "buy in" from potential participants. The following sections illustrate several different case studies of potential models for a watershed framework. The case studies presented here are intended to provide models for possible institutionalization of a watershed framework in the Schuylkill River watershed. What structure is appropriate for this watershed remains to be determined by stakeholder groups.

Watershed Network Case Studies

The concept of a watershed network, council, coalition or alliance is relatively new. Nevertheless, a few prominent examples reveal a variety of internal organization and purposes. In fact, the purpose and mission of the network greatly influences the structure of the organization and the constituency that it serves. Though most of these alliances share the common objective of bringing diverse interests together, each does so in slightly different ways and with distinct goals. The following are case studies of five watershed alliances that may serve as models for a proposed Schuylkill River Watershed Network.

Case Study 1: Androscoggin Watershed Council

The Androscoggin Watershed Council is a collaborative effort of diverse interests in the Androscoggin River watershed of New Hampshire and Maine. It is coordinated by the Appalachian Mountain Club and consists of approximately 50 members representing industry, nonprofit organizations, individuals, and municipal, state and federal governments. The primary goal of the Council is to bring the diverse interests within the watershed together under the same objective of publicizing and promoting the Androscoggin River as a resource. This is a goal that serves multiple interests because the river's reputation has suffered in the eyes of local citizens due to heavy pollution.

The Council originated from a series of yearly conferences on the river that were held by the Maine Department of Environmental Protection and the Androscoggin Valley Council of Governments. Regional meetings then were convened to determine the need for a watershed council, and missions and goals were drafted and presented at subsequent public meetings. The organizing committee, which was composed of various organizations, developed a strategic plan for the Council that included an organizational structure and short-term goals. The Council was formed officially on July 23, 1999.

The Council is not an advocacy organization due to the diversity of interests within the membership. Instead, it serves as an educational institution that promotes the river as a recreational resource. It does not implement specific projects within the watershed, except for an annual canoe trek that garners a large amount of publicity for the river. Other projects managed by the Council include water quality sampling and a review of New Hampshire and Maine Water Quality Standards. Other specifically approved projects are carried out by subcommittees of the Council's Steering Committee.

Structure and Responsibilities

The Council consists of a Steering Committee, various subcommittees, an Executive Committee, and an annual Nominating Committee, as well as its general membership base. The Steering Committee meets quarterly and is responsible for the following aspects of watershed management and institutional coordination:

- Developing policy;
- Reviewing and proposing amendments to the bylaws of the council;
- Reviewing and approving membership to the council;
- Setting the annual meeting agenda;
- Approving an annual budget;
- Establishing an ongoing strategy to address the needs of the council;
- Forming subcommittees to carry out the needs of the council;
- Overseeing activities of the subcommittees; and
- Planning conferences, events, and other functions for members and the public.

Steering Committee members are elected by the membership for two-year terms and are evenly distributed among the diverse interests. The Steering Committee consists of representatives from the following sectors and members:

- three large businesses;
- three small businesses;

- three nonprofit organizations;
- three governmental agencies;
- three municipalities;
- three private individuals; and
- four person Executive Committee.

Executive Committee members are elected for one-year terms and come from organizations other than those serving on the Steering Committee. The Executive Committee meets monthly and is responsible for the following tasks:

- Providing oversight of the organization;
- Developing annual budgets for Steering Committee approval;
- Approving fiscal agreements with subcommittees of the council;
- Advising the Executive Director and staff of the overall operations of the council; and
- Requesting specific project reports of the organization.

The Executive Committee is responsible for the day-to-day operations of the Council. This includes bringing new issues to the Steering Committee meetings for consensus or a vote. When the Steering Committee approves a new agenda, subcommittees of the Steering Committee are convened to carry out that agenda due to the absence of permanent staff. Subcommittee involvement is voluntary and consists of members from the Steering Committee. Sample subcommittees include Communications, Riparian Buffers, Community Partnerships, and Education.

The Executive Committee also is responsible for creating annual and project-related budgets. Budgets are built from the bottom-up. Subcommittee members are asked what they think they will need to complete their mission for the upcoming year. The Executive Committee uses these responses to create the annual budget, which then is presented to the Steering Committee for a vote.

The Nominating Committee, which is appointed by the Executive Committee four months before Steering Committee elections, is responsible for several key tasks, including:

- Soliciting nomination input from members;
- Providing a listing of nominees to the Steering Committee two months prior to the annual meeting;
- Presenting a slate of nominees at the annual meeting for vote by the membership; and
- Verifying credentials of nominees at the annual meeting, verifying credentials of any nominees from the floor at the annual meeting, and providing any additional support function as deemed necessary by the Steering Committee and the Chairperson of the Council.

Policy Development

The policies of the Council are based on its organizational goals, which were drafted before the council was officially created. Input was gathered during a series of public meetings and the goals were approved when the Council convened. The Council does develop new policies, but they usually come out of the previously agreed upon goals. This ensures that, in the early stages of the development of the organization, new policies will not be contentious for Council members. Most new policies or projects that are brought to the Steering Committee for approval usually are issues where there most likely would be a consensus. If there is not a consensus on a new policy or project, the Steering Committee will vote on whether to adopt the policy or implement a new project. A quorum is needed to pass any contentious issue. A 2/3-majority vote must be achieved for Guiding Principle and Council Policy Decisions.

Engaging Business and Communities

The participation of business and local communities is essential to the success of the watershed council. Engaging business has not been a problem for the Androscoggin Watershed Council. Businesses have realized that, as the reputation of the river as a valuable resource grows, they stand to benefit just as much as the nonprofit or local communities. The more attractive the area becomes the more appealing it is to new industry and tourism.

Additionally, citizens will gain a better view of current industry, as industry participates in an organization that is working to improve the watershed and the region. Industry also is a major landowner in the watershed and should be interested in the developments of the Council.

The participation of towns is equally important to the success of the council; however it has been more difficult to include them. This is partially because historically these New England towns have been independent. The challenge is to educate the towns on regional planning and the possible benefits of participating in Council discussions. One of the Council subcommittees, called Community Partnerships, makes presentations to local communities about the Council's goals, and the benefits of membership and attendance in the Council.

Key Strengths and Weakness

According to the coordinator of the Council, a key weakness of the organization is that they cannot advocate for water quality and water quality standards, due to the diversity of interests represented. However, having a diverse membership base allows for a more balanced discussion, which is the greatest strength of the Council. Additionally, many of the landowners and funding institutions within the watershed are represented, and are informed of conservation opportunities and the needs of the Council. This encourages the participation of local nonprofit groups.

Information on the Androscoggin Watershed Council was obtained from Marcel Polak and from the Council's website at http://www.andro-watershed.org.

Case Study 2: Saginaw Bay Watershed Initiative Network (WIN)

The Saginaw Bay Watershed Initiative Network (Saginaw Bay WIN) was initiated in 1994 by the Dow Chemical Company in partnership with The Conservation Fund, to maximize funding resources and conservation efforts in the watershed. The Network consists of members from the community, business, conservation organizations, government, and foundations. The Saginaw Bay WIN was created to enhance the quality of life in the watershed through a network of regional projects. Because a primary goal is to implement projects, the member organizations composing WIN work closely with a group of regional and local foundations.

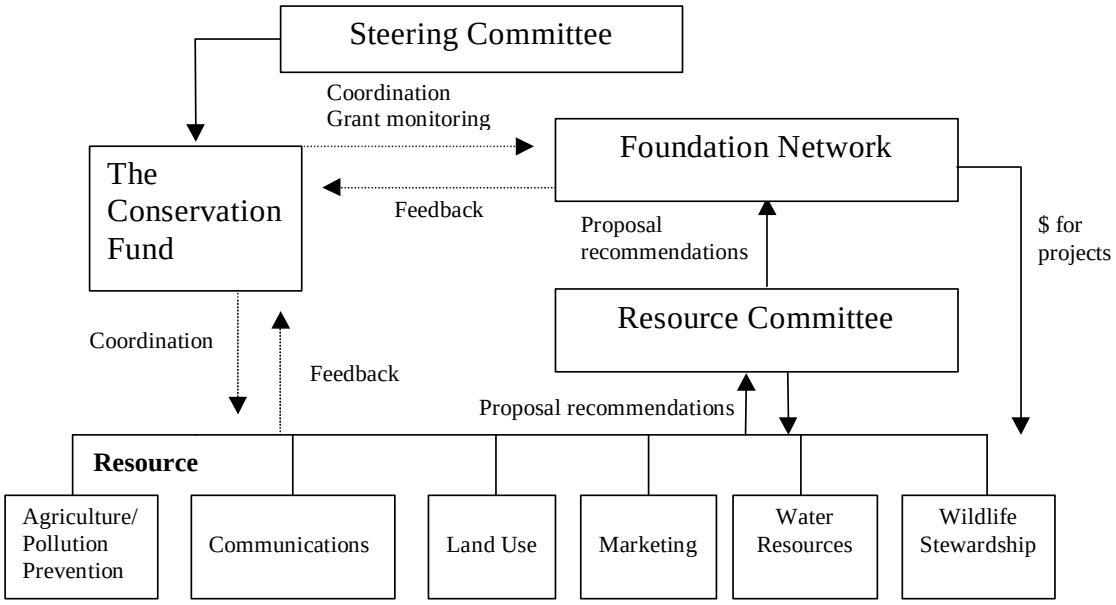
Structure and Responsibilities

There is a four-tiered structure to the Saginaw Bay WIN, consisting of six resource groups, a resource committee, a foundation network, and a steering committee. Each member of WIN belongs to one or more of the resource groups depending on interest: land use; water resources; wildlife stewardship; agriculture/pollution prevention; communications and marketing. The project implementation process starts with individual members who develop project proposals. Proposals then are submitted to the appropriate resource group and are peer-reviewed to ensure that they are within the Network's mission. The resource groups also provide peer review and input. If a project is approved by the resource group, it is forwarded to the Resource Committee, which includes every member of WIN. The Committee meets twice a year to vote on proposals, which are accepted and passed on to the Foundation Network (discussed below), or sent back to the resource group for further clarification. Proposals that are not recommended to the foundation network by the Committee still can be submitted independently to foundations.

A network of foundations works closely with WIN to implement projects. The Foundation Network consists of foundations and grant-making organizations of all sizes, geographical boundaries and missions. Once the Resource Committee recommends a proposal, it is reviewed at a meeting of foundation network members. If there is unanimous approval by the Foundation Network, a project will be funded from a dedicated pool of resources for the WIN. Network members can abstain from voting if a proposal does not meet their specific foundation criteria, purpose or geographic scope. The Foundation Network makes the final decision as to whether or not a project will be funded.

The Saginaw Bay WIN is coordinated by The Conservation Fund. Specifically, the Fund schedules and advertises meetings, facilitates communication among members, interacts with public agencies and other nonprofits, and publicizes WIN events. The Fund does not influence WIN decisions; however, it develops and reviews proposals, and monitors grant projects funded by the Foundation Network.

A Steering Committee manages the WIN's activities and coordination efforts, and serves as the Board of Directors. The Steering Committee is comprised of five people who represent key network members. The organizational structure of the Saginaw Bay WIN is shown below.



Key Strengths and Weaknesses

A lack of communication and collaboration among resource groups was cited by members as a weakness of this network's structure. Several strengths were noted as well. WIN's structure is unique in that it promotes project implementation by matching projects with a broad range of funding sources. Second, proposals pass through a peer review process ensuring that those recommended to the Foundation Network are likely to succeed and to address the needs of the watershed. Furthermore, peer review by nonprofits and foundations ensures maximum coordination of projects and resources, as everyone is informed of what projects are implemented and funded. Third, the broad range of resource groups allows for a variety of interests to participate, ensuring diverse project proposals to the Foundation Network. Lastly, there is a sense of ownership among the local groups, since the coordinators take a "hands-off" approach and allows the Network members to be credited with successes.

Engaging Business

Unlike the Androscoggin Watershed Council, business participation in the Saginaw Bay WIN has been limited to a few key players, and the recruitment of business has been slow, mostly because the WIN focuses on project implementation. WIN expects to have more business participation in the future and will use a number of resources to recruit new business.

As the goals and mission of the Network are non-confrontational, participation should be attractive to the business community. Additionally, since WIN has support from government agencies and economic development organizations, the business community should look more favorably upon the Network. This is a key point. As business interests realize that there is support from like-minded organizations and that the Network is not anti-business, they should become more comfortable with the Network. Lastly, as the region benefits from the work of the Network, tourism for the area should increase and more business opportunities should arise.

Several methods of engaging business were mentioned. First, the Network is looking to engage businesses that have a direct link to the Saginaw Bay. An increase in the quality of life in the Bay watershed should increase business opportunities for tourism, recreation, or development based businesses. Next, the Network would like to become more visible to the business community, through participation in the chamber of commerce and festivals or events. WIN also hopes to use member's relationships with local businesses to engage their participation in the Network.

Information on the Saginaw Bay Watershed Information Network was obtained from Mike Kelly, Jay West, the Saginaw Bay WIN website at http://www.saginawbaywin.org, and from the Conservation Fund's Great Lakes Office website at http://www.conservationfund.org/conservation/sustain/gloindex.html.

Case Study 3: Henry's Fork Watershed Council (ID)

The Henry's Fork Watershed Council was chartered by the Idaho legislature in 1994, in response to the growing demand for communication among diverse interests within the Henry's Fork Basin. Preceding the formation of the Council was the passage of the Henry's Fork Basin Plan by the Idaho legislature in 1993. Immediately after passage, it was apparent that there needed to be a consensus-building process that included all interested parties, in order to effectively carry out the recommendations and goals of the Basin Plan.

The specific duties of the council, as outlined by the Idaho legislature, are as follows.

- Cooperating in resource studies and planning that go beyond jurisdictional duties.
- Respecting the roles, water rights, and other rights of each member of the basin.
- Reviewing and analyzing watershed projects and Basin Plan recommendations.
- Suggesting priorities for implementation of Basin Plan recommendations.
- Coordinating funding for research, planning, and monitoring programs.
- Serving as an educational resource to both the Idaho Legislature and the general public.
- Communicating the Council's progress through reports, the media, and other educational presentations.

Structure and Responsibilities

The Council consists of citizens, scientists, nonprofits and agency representatives. Council meetings first bring these diverse interests together, then break out into work sessions. The three work groups include a citizen group, a technical team, and an agency roundtable. The Council is co-facilitated by the Fremont-Madison Irrigation District and the Henry's Fork Foundation. The facilitators are responsible for the Council's administration and coordination, as well as facilitating work group meetings. Additionally, they are responsible for coordinating public information activities and for submitting an annual report to the Idaho legislature.

Any organization initiating a project within the watershed is urged to bring it before the Council for endorsement. This includes public agencies, nonprofit organizations, and Council members. A project is presented before the full Council and the Council then breaks out into its three work groups. Each work group is facilitated by one member from the Henry's Fork Foundation, and one member from the Fremont-Madison Irrigation District. The work groups ensure that each individual feels comfortable speaking in their setting and that the observations of different-minded people (scientists, citizens, government) are equally presented to the full Council.

After the work groups discuss the project, the full Council is reconvened. Each work group presents the major points from their discussions to the rest of the Council and states whether or not they endorse the project. All three work groups must endorse a project for it to be endorsed by the full Council. Occasionally, the full Council will make recommendations on how the proposal could be modified in order to receive the Council's endorsement. If the Council is especially interested in a project or an issue area, a subcommittee may be formed to guide the developments of the project.

Projects within the Basin are reviewed by the Council using what is called the Watershed Integrity Review and Evaluation (WIRE) process. WIRE evaluates projects using following ten criteria.

- Does the project reflect a total watershed perspective?

- Credibility of research and data.
- Does it identify resource problems and workable solutions?
- Does it understand basics of water supply?
- Management of the project.
- Does it emphasize sustainable ecosystems?
- Does it address social and cultural concerns?
- Does it address and help sustain the local economy?
- Is there cooperation among all parties and coordination among all groups and agencies?
- The legality of the project.

Projects endorsed by the Council through the WIRE process may seek funding assistance, political support, or interagency cooperation in their implementation. There is a limitation to how much the Council can fund (usually around 10% or $2000) through a common source of funds, flowing from the Henry's Fork Watershed Fund and the state. An annual "State of the Watershed" Conference is held each fall to monitor the progress of Council-endorsed projects and to present research and monitoring results.

The Henry's Fork Watershed Fund was established by the State of Idaho to help fund projects in the Basin and to defray Council administrative expenses. The Watershed Fund also receives contributions from the private sector.

A watershed center, which is maintained by the Henry's Fork Foundation, has been established to provide a library, database repository, and a central focal point for Council needs. The watershed center houses the following operations and provides the following services.

- A research facility for agency and university scientists with computer stations and a GIS system that integrates research within the watershed.
- A library where anyone can check out books, periodicals, and maps.
- A center for the operations of the Watershed Council.
- A center for the Education and Outreach of the watershed council.
- A central place for community information such as tourism booklets, etc.

Information on Henry's Fork Watershed Council was obtained from Susan Steinman, and from the Council's website at http://www.henrysfork.org.

Case Study 4: Alliance for the Chesapeake Bay

The Alliance for the Chesapeake Bay was founded in 1971 for the purpose of increasing public involvement in restoration, as well as to educate the Chesapeake Bay Program and the general public on policy and restoration issues. The Alliance is not an advocacy organization as it strives to provide unbiased interpretations and analyses of Bay issues and Chesapeake Bay Program policies.

The Alliance is incorporated as a nonprofit organization and is fully staffed, including staff working out of the Chesapeake Bay Program offices. It is funded through a combination of Federal, State, and foundation sources. The Alliance not only serves its membership base, but the general public as a whole. Alliance projects are implemented by the staff, who may partner with member organizations. Additionally, the Alliance may carry out some of the Chesapeake Bay Program Initiatives.

Structure and Responsibilities

A Board of Directors, who set up general guiding criteria for the Alliance, governs the Alliance. There are no specific policies of the Alliance, as it is comprised of a diverse set of interests and wishes to remain unbiased. Instead of setting policy, the Board may recommend certain issues on which the Alliance should focus. Since the Board represents the diversity of interests within the Alliance, there does not have to be consensus on a given issue or recommendation. Additionally, the Board does not have to give final approval on specific projects.

Subcommittees may form within the Board of Directors and serve to give general direction on an issue. It is the job of the Alliance staff to take this direction and initiate and implement a project to will address the particular issue.

The Board of Directors is comprised of 26 members with six officers: a President, Secretary, Treasurer, and a Vice President for each state (PA, MD, VA). The Alliance also is comprised of three program areas through which the majority of its projects are completed.

1. The *Watershed Stewardship* program area addresses physical projects within the watershed and strives to promote community involvement in water quality and habitat improvement. Specific activities of the Watershed Stewardship program may include habitat and riparian restoration, monitoring programs, pollution prevention programs, trail and sojourn development, and grants to watershed organizations. It also trains volunteers, watershed organizations, and businesses with the skills necessary to complete physical and monitoring projects.

2. The *Information and Outreach* program area develops and distributes journals, newsletters, news releases, and other in-depth publications on the Chesapeake Bay. All publications attempt to approach each issue from an unbiased perspective and to present the facts to the public and to Chesapeake Bay Program policy makers.

3. The *Public Policy* program area fosters public participation on policy issues. Specifically, the goal is to connect local efforts with regional efforts. This is done through conferences, forums, workshops, and a 25 member Citizens Advisory Committee to the Chesapeake Bay Program, which includes representatives from industry, environmental groups, local government, agriculture, and education.

   The Citizens Advisory Committee serves by providing the Chesapeake Bay Program with advice on policy issues and how they will affect the public. If possible, members of the advisory committee will also communicate the policies of the Chesapeake Bay Program back to their constituency.

Information on the Alliance for the Chesapeake Bay was obtained from Pat Devlin and from the Alliance's website at http://www.acb-online.org.

Case Study 5: Mississippi River Basin Alliance

The Mississippi River Basin Alliance was started in 1992 and is a staffed, nonprofit group with 152 member organizations, most of which focus on social justice and conservation. The Alliance's members represent a broad range of interests within the Mississippi River Basin including agriculture, community-based development, conservation (fish and wildlife), cultural preservation and tourism, general environmental issues, environmental education, health and toxics, labor, and religious, environmental and social justice. The Alliance serves as a communication network linking organizations in the lower and upper portions of the Basin. It does this through a newsletter, website, and educational materials.

The priority focus areas of the Alliance are sustainable agriculture, wetlands restoration, water quality and toxics, and navigation. Foundation support largely determines these priority areas. Additionally, the Alliance attempts to primarily address issues that are Basin-wide, as there is no overarching public agency responsible for the Mississippi River Basin and member organizations do not have the capacity to focus on these issues.

Structure and Responsibilities

A 16-person Coordinating Council meets on a quarterly basis and is responsible for setting Alliance policy. The Coordinating Council members represent a cross-section of geography, race, and interest area within the Alliance. Membership within the Coordinating Council is determined by a vote of the overall Alliance at the annual meeting. At the annual meeting 1/3 of the Coordinating Council members are voted in for three year terms.

The process of setting Alliance policy begins with members bringing a resolution to the Coordinating Council. A committee is formed by the Coordinating Council to discuss and refine the resolution. The resolution then is brought back before the Coordinating Council who can recommend it for approval. After passing the Council's

recommendation, there are two periods where the membership may comment on the resolution. The resolution then is brought before the Alliance and can be adopted by a majority vote.

Alliance members may participate in one of a number of subcommittees that carry out the Alliance's activities. Examples of the subcommittees are as follows.

- Programs and Projects
- Communication and Networking
- Funding and Membership
- Structure and Nominations
- Environmental Health
- Annual Meetings
- Finance

The Alliance also has a small full-time staff that is responsible for the day-to-day operations of the Alliance. This includes addressing Basin-wide issues, building up member organizations, and maintaining communication among groups. The Alliance also provides members with grant training, other fundamental training, and some technological assistance. At present, they do not provide grants to members for specific projects.

Information on the Mississippi River Basin Alliance was obtained from Jim Falvey, and from the Alliance's website at http://www.mrba.org.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.3	**Foundation Network**	Funding agencies and private foundations serving the watershed	Improve coordination Build capacity Plan implementation Strategic conservation	General

Description

Nonprofits and public agencies alike face critical funding needs to support their activities. Due to limited staff capacity, many nonprofits do not have development staff and thus are challenged in cultivating funding. Public agencies may face limited staff time or lack of funds for implementing conservation projects. Institutionalizing a system for conservation funding in the watershed would help provide the critical link between funders and watershed nonprofits, agencies and local governments.

We recommend the formation of a foundation network to coordinate funding for watershed activities. This network, including representatives of funding agencies and private foundations, would help funders learn what types of programs are being funded in the watershed, which could stimulate new proposals and projects. In addition the foundation network would work on leveraging and attracting new sources of funding for watershed management. The network of funders also could play a role in ensuring implementation of priority projects identified in this Plan and other watershed efforts. Based on the results of this Plan, priority areas for future funding might include: professional training and capacity building of local organizations; funding a basin-wide monitoring program; and implementation of land protection activities that support the conservation of critical habitats and landscape connectors and water quality. All watershed foundations, funding agencies and private corporations, actively involved in or seeking to support watershed management in the Schuylkill River watershed, should participate in the foundation network.

One example of an institutionalized watershed funding system is the Saginaw Bay WIN Funding Network, consisting of diverse regional and local funders, that has been successfully operating since 1994 in Saginaw Bay, Michigan. Funders from throughout that region have created a small pool of funds dedicated to the watershed. These funders meet biannually to discuss conservation projects and decide which projects will be funded from the dedicated watershed pool. Prior to presentation to the Funding Network, proposals receive substantial scrutiny

through a peer review process. Only those proposals unanimously approved by the Funding Network are awarded funds from the dedicated pool. This peer review system assures funders that funded projects are practicable, have local support, and are important to the health and management of the watershed. In addition, peer review permits groups to cooperatively expand and revise proposals based on mutual expertise. At the same time, watershed groups are assured that proposals supported by watershed stakeholders and presented to the Funding Network have a high probability of being funded.

Members of the Funding Network continue to support projects through their own individual programs, and according to their organizational missions. However, the funding network dedicates additional funds for broad-scale watershed activities that might not otherwise receive funding. In addition, the network facilitates communication, so that funders are up-to-date on projects being funded through members' individual programs, and may coordinate to better implement these projects. The process drives cooperation and coordination, maximizing limited resources and environmental benefits. The Saginaw Bay model of a watershed funding network has proven that new sources of funding become available as coordination improves and public awareness of an organized broad-scale effort increases. See Recommendation **R7.2**, Case Study 2 for more information on the Saginaw Bay funding and watershed networks.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.4	**Institutionalize Professional Training**	Agencies and nonprofits in the watershed	Build capacity	General

Description

Two of the greatest needs highlighted by public agencies and nonprofits were increased staffing and resources. Professional training is one solution to maximize staff effectiveness and employee skills. In order for the environmental movement to maximize resources and take advantage of new opportunities, environmental professionals need new tools and skills to efficiently address watershed challenges. Public agency representatives highlighted needing technical assistance, increased communications efficiency, improved public relations and increased staffing. Nonprofit groups also requested training on technical assistance, fundraising, strategic planning, volunteer coordination, operations, and board management. Training programs should focus on leadership and organizational management as well as on watershed issues and technical tools for resource management.

An ongoing professional training program for public, nonprofit and private conservation professionals should be institutionalized in the watershed. Continuing professional training and development should be incorporated into daily operations. Groups and/or public agencies need to develop training courses targeted to the Schuylkill River watershed. To facilitate this, private funders and/or a foundation network should help provide resources for training and professional development. Alternately, the state and nonprofit leadership should encourage members to attend training programs currently offered by organizations like the US Fish and Wildlife Service, the Land Trust Alliance, The Conservation Fund and other national agencies and nonprofits. The state or appropriate nonprofits also might consider developing partnerships with academic institutions for technical training on GIS and other tools for conservation, or with corporate training programs for courses on leadership and organizational management.

The increasing number of local grassroots organizations, along with new sources of state and federal funding, have created an unprecedented demand for professional training on conservation and sustainable development. While present training programs are an excellent resource for some groups, the majority of local organizations do not have the time, staff or resources to pay for travel, lodging and registration fees of traditional on-site education programs. One solution to this problem is the development of distance learning programs for nonprofit and agency staff. Distance learning programs are flexible in the timing and method of distribution, and can allow the "student" to take a course at their own pace, on their own time. Programs may be distributed through a variety of media, including computer-assisted training, video, audio, interactive satellite broadcast, and videoconferencing. Done properly, distance learning can provide the high-quality, flexible, customized and locally accessible education and training required by nonprofits and other local groups. The Conservation Fund, in cooperation with the USFWS National Conservation Training Center and others, is initiating a series of distance learning programs for grassroots groups.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.5	**Explore Nonprofit – Public Agency Partnerships**	All nonprofits, agencies and local government in the watershed	Improve coordination Build capacity	General 7.4.2.3

Description

Because problems in one reach of the watershed may affect water quality and habitat quality elsewhere, watershed issues often are best addressed through coordinated efforts. Over 80% of the Public Agency Survey respondents said that partnerships were best suited to solve watershed problems, in spite of the only 3% of agencies currently engaged in such partnerships. In terms of services offered, the public sector generally is not engaged in direct education and outreach, land acquisition or coalition building. These areas present opportunities for watershed nonprofits to fill project gaps that may not be adequately addressed by the public sector. Additionally, both public agencies and nonprofit groups noted their need for increased staffing to be more effective. Taking a conservative approach to increased funding, agencies may wish to build their internal capacity by instituting formal outreach programs to watershed associations in order to leverage resources and personnel, and vice versa. Furthermore, many agencies suggested regulatory and policy changes; the nonprofit community could be a valuable partner to advocate changes in these areas.

On the other hand, the public sector has services and experience that would fill needs of local and regional nonprofit groups. In addition, the private sector, a potentially rich source of funding, technical expertise and support, has not been fully engaged in watershed activities. To mutually leverage their activities in these areas and to supplement their training needs, public agencies should partner with nonprofits and the private sector. Establishing and coordinating partnerships between the public and nonprofit sectors can be implemented through watershed meetings, a watershed directory, and most importantly, a watershed network (see Recommendations **R7.2**, **R 7.7**, **R7.10** and **R7.20**).

Professional Mentoring and Outreach

We also see a unique training opportunity from partnerships among agencies and nonprofits. Different groups can offer assistance or mentoring on technical, public outreach and institutional issues. Public agencies have institutional and funding-related resources that nonprofits need, and nonprofit groups can provide grassroots training and information that public agencies may need. In addition to formal professional training, nonprofit groups and public agencies with professional expertise should be encouraged to form mentoring relationships and staff exchanges with watershed groups in need of organizational or technical assistance. Informal training and staff exchanges could promote nonprofit understanding of local government planning issues, and local government understanding of watershed environmental issues, as discussed below in Recommendation **R7.6** below. Topical watershed meetings, the watershed directory, and the watershed clearinghouse also would facilitate mentoring relationships (see Recommendations **R7.2**, **R7.7**, **R7.10** and **R7.20**).

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.6	**Promote Public Awareness of Watershed Issues**	Nonprofits, agencies and citizen groups engaged in education and public outreach	Public awareness	General

Description

Public meetings throughout the watershed revealed the need to raise public awareness of the valuable resources, both natural and cultural, within the Schuylkill River watershed. The public opinion poll suggested that some watershed residents were not familiar with the name or the geographic extent of their watershed. General public outreach, citizen monitoring or other volunteer opportunities, education on watershed address and watershed boundary signage could help promote public awareness and a "sense of place."

Signage, made of local materials or stenciled on roads, could be placed to mark the boundaries of the watershed along with stream names, and assist in public outreach. A logo could be designed for use on signs or road surfaces to show where drivers and pedestrians enter and leave the watershed. Other watersheds, such as the Chesapeake Bay have used such logos to raise awareness very effectively. To minimize scenic degradation, the logos for the Schuylkill River watershed could be applied directly to road and sidewalk surfaces rather than as mounted, vertical signage.

Education projects might help residents identify their "watershed address" as well as providing information about key functions of the Schuylkill River watershed. Nonprofits, citizen groups and agencies involved in public education and outreach should consider incorporating broader concerns related to watershed health into their materials, as well as creative ways of enhancing the population's "sense of place" in the watershed. For example, drinking water source protection is a compelling health issue and one way to engage public awareness about the importance of a healthy watershed. Projects that market Schuylkill River watershed assets (both cultural and natural resources and their functions) can raise awareness of the watershed's many economic, ecological, cultural and aesthetic benefits. Similarly, citizen-based monitoring and volunteer efforts bring the public in direct contact with their environment. Providing opportunities for the public to experience and participate in the maintenance of their watershed can improve public awareness and commitment to long-term sustainable resource use.

As was noted during one public meeting, many nonprofits and school districts educate school children about watershed issues; however, outreach to adults also must occur. Ideas on how to reach adults included the following.

- Design a standard watershed exhibit, common resources slide show, or video that could be used by many different nonprofits providing educational outreach.
- Promote public education and distance learning opportunities accessible through the Internet, satellite or local television stations.
- Coordinate with public libraries and other public areas to display and promote educational materials and resources on watershed issues.
- Widely advertise opportunities for citizen involvement and community celebration of the watershed, particularly activities for young adults, families and senior citizens. Examples of community participation include river clean-up days, citizen monitoring, community planning or "visioning" charettes, river festivals, historic and cultural festivals, expert-led hikes, group recreation and birding opportunities. Community planning and "visioning" events are a powerful way to develop public awareness and support for conservation and sustainable development. EPA Region III offers a Green Communities Assistance Kit, an online, step-by step guide for planning and implementation, that can assist communities in taking action.
- Improve outreach to municipal government officials. Local governments hold a great deal of responsibility through their planning powers. Yet many local officials do not fully understand the environmental issues at stake in planning and development. Local governments and nonprofits need to learn how to better communicate with one another. Therefore, nonprofit representatives should be educated on local government issues, such as zoning, sewage and planning. Likewise, local government representatives should be educated on basic watershed ecology and environmental issues affected by their policies.
- Instill a sense of river stewardship through strategies that involve a direct connection to the river and encouraging the formation of Riverkeeper-type groups for advocacy and outreach.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.7	**Filling Geographic Gaps and Coordinating Service among Nonprofits**	See *Tables 7.3* to *7.23* and corresponding activity maps for potential overlap and gap areas and specific nonprofits	Improve coordination	7.3.2.1

Description

The Nonprofit Survey revealed that certain subwatersheds may be under-served by local nonprofit groups while other subwatersheds appear to be well covered by several nonprofit groups. Generally, the headwaters and parts of the lower Schuylkill River watershed are less well served by local groups, although some watershed-wide groups may serve these areas. Considering the high ecological value of these areas for landscape stability and ecosystem health, the headwaters should be a target for coordinating nonprofit conservation and restoration activities. The lower Schuylkill River watershed should be targetede for community and urban redevelopment, education and outreach activities.

In order to address potential geographic gaps, the State, funders and nonprofit groups should study the feasibility of expanding the existing nonprofits' geographic reach to cover areas of the watershed that are under-served, or facilitate the formation of new watershed nonprofits, volunteer organizations, or partnerships of existing groups. In order to address areas with several local organizations, groups should work cooperatively to maximize effectiveness through leveraging expertise and resources. In certain cases where nonprofit groups do not take the lead, the State and regional foundations may want to assist in convening these cooperative efforts.

Convene Topical Watershed Meetings

One way to improve coordination and maximize cooperative efforts is to convene topical watershed meetings to discuss ways for government and nonprofits to bridge gaps and work cooperatively in areas served by multiple groups. Topical watershed meetings should be convened around watershed activities (e.g., education and outreach) identified by the Nonprofit Survey and the Public Agency Survey, in the geographic areas where overlap or gaps in nonprofit activities occur. Local nonprofits, watershed-wide, regional and national nonprofits, public agencies and citizen stakeholders should be represented at these meetings. To maximize results, a neutral party should convene these meetings.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.8	**Political verses Natural Geographic Service Area Coverage**	See nonprofit activity maps in *Section 7.3.2.1* for specific nonprofits with boundary issues; also applies to watershed public agencies	Improve coordination	General 7.3.2.1

Description

Some of the geographic gaps in nonprofit service revealed through the Nonprofit Gap Analysis are a result of nonprofit groups providing services along political boundaries. Public agencies likewise may be restricted to political boundaries that are in conflict with local geography and service needs. Nonprofit groups should consider expanding their service areas to represent geographic boundaries, and not political boundaries, in order to maximize their benefit to natural resources. Public agencies and local governments may be constricted along political boundaries but can coordinate with other entities across these political boundaries and along natural, subwatershed boundaries. Organizations that expand their services across political boundaries may benefit from access to new funding sources. For example, the Delaware Basin Regional Commission has successfully financed individual projects by combining funding from more than one political area. One example of progress in this area for public agencies is the recent focus of Resource Conservation Districts on working within and across watershed boundaries and the recent hiring of approximately 45 Watershed Specialists for Pennsylvania.

Table 7.1 lists the primary geographic focus areas for each of the nonprofit organizations surveyed in this analysis. These focus areas are displayed graphically in the Nonprofit Service Area maps in the online Reference Documents. These Service Area maps formed the basis for the Nonprofit Gap Analysis and the nonprofit activity maps referenced in *Section 7.3.2.1* and available in the online Reference Documents.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.9	**Comprehensive Nonprofit Survey**	All nonprofits and volunteer groups in the watershed	Improve coordination	7.3.2.1

Description

A comprehensive watershed-wide survey should aim to locate all nonprofits and volunteer groups, in order to identify true gaps and overlaps in nonprofit service, to include groups more effectively in the watershed-wide planning process, and to obtain a more detailed understanding of the established nonprofit framework. The survey should include the full range of local, regional and national nonprofits and other volunteer groups working in the Schuylkill River watershed.

Consultation with local partners produced an estimate of over 60 staffed and around 100 citizen groups active in the watershed who should be included in a comprehensive survey. To efficiently reach watershed groups, the survey staff should identify key nonprofits and citizen groups who are in contact with smaller or more local groups; for example, the Berks County Conservancy, the Schuylkill Riverkeeper, the Schuylkill River Greenways Association or the Pennsylvania Environmental Council. These key contacts could provide lists of nonprofit and citizen groups in their area to be added to the survey list. These groups should in turn be contacted to notify them of the survey effort and to ask about other watershed groups not already on the list. Once a comprehensive list has been compiled, a brief survey should be circulated to all the groups in the watershed. The survey responses should be monitored to encourage the greatest participation possible. The survey itself might contain questions related to service area boundaries and activities, as well as information important for an updated watershed directory (see Recommendation **R7.10** below).

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.10	**Updated Watershed Directory**	All nonprofits, volunteer groups, environmental action committees and appropriate public agencies in the watershed	Improve coordination Build capacity Public awareness Data clearinghouse	General

Description

The institutional assessment revealed that a single, updated resource on watershed organizations and public agencies was lacking. Assembling an updated directory of watershed entities would be a simple and valuable implementation step. An updated Schuylkill River watershed directory should be made available in both printed and web-based format, and should include information such as the name, contact information, mission and service areas of each organization. The updated watershed directory should include all staffed and volunteer groups in the watershed. One example of an institutional directory is the *1998-1999 River and Watershed Conservation Directory* produced by the River Network and the National Park Service Rivers, Trails and Conservation Assistance department. In this Directory, groups are organized by major watershed area. A directory for the Schuylkill should be organized into subwatersheds or major river sections. The directory should include more detailed information such as specific projects and activities, maps of service area boundaries, and specific streams or river reaches where each group is active.

PA DCNR has initiated a directory of watershed organizations that could form the basis for this updated Schuylkill River Watershed Directory. A comprehensive watershed nonprofit survey would facilitate the compilation of a Schuylkill River Watershed Directory (see Recommendation **R7.9**).

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.11	**Watershed Clearinghouse**	Watershed-wide data coverage to benefit nonprofits, local governments, public agencies and citizens	Improve coordination Build capacity Public awareness Data clearinghouse	General

Description

To improve access to critical information, a Schuylkill River watershed clearinghouse should be developed as a resource for the watershed population. This web-based service would hold various watershed-related documents and network information, including the watershed directory, links to active organizations, frequently asked questions, this Watershed Conservation Plan and other related reports and technical data. The clearinghouse could facilitate partnerships, mentoring, volunteer coordination and resource sharing among public agencies and nonprofits. The watershed clearinghouse should include data coverage to benefit nonprofits, local governments, public agencies and citizens.

The website would also provide gateway access to the Schuylkill River Watershed GIS database, and potentially, to an interactive mapping tool to improve public outreach and adaptive management. In addition, the clearinghouse could contain information on the proposed foundation network, sources of funding and grant-writing tips, links to the proposed watershed service center, and general information on watershed health, management and opportunities for public participation, serving as outreach and education for the people of the watershed. See Recommendations **R7.3** and **R7.12** for further information on the foundation network and service center.

The following examples of web-based data clearinghouses describe some existing resources for watershed issues. Each example presents strengths and weaknesses of the site relevant to the creation of a Schuylkill River watershed clearinghouse.

- The EPA's Watershed Information Network (http://www.epa.gov/win), provides access to a large amount of information on watersheds. The Information Network is a gateway for three separate websites from the US Geological Survey, Purdue University, and the US EPA. The featured sites each focus on a different watershed issue. The USGS site focuses on science and provides information on current projects, scientific publications, and data access. The US EPA link is to the *Surf Your Watershed* site, which provides an assessment of conditions within a given watershed, as well an analysis of the quality of data used in these assessments.

  The Purdue University website link is called *Know Your Watershed*, and is an excellent resource for information on watershed conservation. The website provides links to watershed partners, including state watershed contacts, a national watershed network, and links to national organizations that provide funding. Inside the national watershed network link there is an additional searchable interface for locating other watershed managers who have dealt with similar projects or issues. A comparable type of project or issue database could work well in a relatively small watershed such as the Schuylkill, but would require voluntary posting of documents and reports by individual groups. The Purdue website also has helpful educational information: for example, a description of Total Maximum Daily Loads (TMDLs). This type of information would be helpful to small nonprofit managers within the Schuylkill River watershed who might need information on public agency programs and policies.

  In addition to these links, the interface provides general educational information on what a watershed is, the water cycle and watershed ecology, policy related to clean water, and on potential threats to watershed health. This basic information is a good public outreach tool. A Schuylkill River watershed clearinghouse at minimum should provide links to this information, and potentially contain information on state clean water laws and new developments in legislation that affect watershed management.

  As a caution against providing too much information, the EPA's Watershed Information Network website can be overwhelming when trying to answer a specific question. The proposed Schuylkill River clearinghouse

should not include so much information that it becomes ineffective. Additionally, information should be as accessible and well-organized as possible, with breakdown menus and a site directory.

- The EPA's Watershed Tools Directory (http://www.epa.gov/OWOW/watershed/tools), is a list of links grouped into twelve general categories. The links provide the user with information on how to order the "tools" which include publications, computer programs, or datasets. A strength of this website is its easy-to-use, searchable interface, which enables the user to quickly find the specific tool they need based on a subject of interest.

- The Center for Watershed Protection maintains a website at http://www.cwp.org with a variety of scientific and policy-related information on watersheds. The center provides links to actual and sample ordinances for communities to use as models for developing local policy, a very useful tool for nonprofits and local governments. The Schuylkill River watershed clearinghouse could take this one step further, and provide model grant proposals for different types of projects, and sample monitoring programs for community volunteers or organizations.

- The American Rivers website (http://www.americanrivers.org) has several interesting ideas that could be implemented in a Schuylkill River watershed clearinghouse. One example is that of an issue-specific message board. The American Rivers page hosts message boards and chat rooms where interested people can discuss and exchange ideas. They also occasionally host an "issue expert" who facilitates discussion and provides in-depth information, and is available for contact after the chat session.

  American Rivers' website is organized by river campaign. Each river campaign has its own section on the website, in which the user learns about local threats to water quality and action to mitigate these threats. The Schuylkill River watershed clearinghouse could be organized similarly along river reaches or subwatersheds, to address the diversity of local threats in the different sections of the river. Alternately, data and information could be organized by the following issues and/or geography:

  - acid mine drainage/headwaters;
  - agricultural/central portion of the watershed; and
  - industrial/central and southern portion of the watershed.

- The River Network's website (http://www.rivernetwork.org) provides information on watershed resources useful for other nonprofits and citizen groups. Resources posted on this site include a directory of funding sources in New England, a calendar of events, links to other organizations' and agencies' online resources, the online National Directory of River and Water Organizations (forthcoming), and links to online resources on general organizational issues for nonprofits.

- The Pennsylvania Department of Environmental Protection's Office of Water Management website (http://www.dep.state.pa.us/dep/deputate/watermgt/watermgt.htm) provides a well-structured interface for accessing information on watershed issues. The website contains a list of fact sheets on several of the most critical issues within the watershed. A detailed listing of fact sheets on almost any issue related to watershed management would serve watershed organizations well throughout the Schuylkill River watershed.

  The PA DEP website also has links to actual TMDL's that have been approved by the DEP, which a Schuylkill River watershed clearinghouse could link to and explain in further detail. Another feature of the DEP site is information on dams and dam safety. This could be included in several ways, including a layer in the GIS database, a searchable function that provides information on each dam in the watershed and its uses, and fact sheets on dams, dam safety, and dam removal within the watershed.

- The Chesapeake Bay Program (http://www.chesapeakebay.net) provides a wide variety of information and links. Resources on this website include a database of environmentally-sound design practices, featured projects, a Watershed Leadership Kit, CBP workshop schedule, a database of model ordinances, various publications and educational information, and an example of a watershed directory along with contact information for partner organizations. This site also includes an annotated list of community resources offered

by partner members, including resources for environmental assessment, community visioning and planning, funding, public outreach, implementation and resource guides.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.12	**Watershed Service Center**	Nonprofits and local governments in the watershed	Build capacity Data clearinghouse	General

Description

The Nonprofit Survey found that many watershed organizations face basic operational challenges, such as: developing and managing a board of directors; staffing; the need for general support in accounting and bookkeeping; and how to allocate resources and decide upon priorities to meet public demands. Another recent survey supported these findings and determined that Schuylkill River watershed nonprofits need help in the following areas: non-foundation-based fundraising; marketing/communications; board management/development; and strategic planning.

A service center should be developed to aid not only nonprofit groups but also local governments. Regional and national nonprofits could help with design and service options at the service center. One nonprofit might take responsibility for leadership of maintenance of the service center. The service center would be a "one-stop-shop" and help to link nonprofits and local governments with approved technical or organizational experts. This would provide nonprofits with critical services, at a lower overall cost, because the nonprofits would not be required to staff for these services. For example, a nonprofit could use the service center to locate a marketing consultant for particular projects, as needed. One example of an online service center is a new federal website, http://www.nonprofit.gov, which provides links to federal government agencies and resources that support nonprofit efforts, including information on grants and partnership programs. A pilot service center for the Schuylkill River watershed could be the first step in building a model state-wide resource with both localized and generalized information. This would encourage cooperation and resource sharing not only within, but also across, watershed boundaries.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.13	**Diversify Fundraising**	Nonprofits in the watershed, especially smaller groups with funding needs	Build capacity	7.3.2.2

Description

A recent informal survey of many nonprofits in the watershed found that most nonprofits target foundation and government sources of income in their fundraising strategy. The study revealed that foundations contributed over 40% of revenues as compared to the national average of 15% or less. Individual donations accounted for only 13% of revenues, while the national average for individual philanthropy is 85%. One conclusion is that nonprofits in the watershed need to diversify their funding sources away from dependence on private foundations.

Nonprofits in the Schuylkill River watershed generate revenue from a wide variety of sources. Diversified fundraising should be a goal for every nonprofit to protect against sudden changes in funding. Foundation and government funders are viewed as limited funding sources because these sources may not grow in proportion with an organization. Therefore, organizations may have limited growth potential if they rely primarily on these sources. Those nonprofits that rely heavily on foundation and government support should develop a realistic fundraising plan that emphasizes other sources, such as the market of individual donors. Watershed funding is needed for internal, organizational development needs, salaries, and fundraising plans to ensure nonprofits will be able to persist.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.14	**Grant Guidelines that Support Partnerships**	State agencies and private foundations funding watershed projects	Improve coordination Build capacity	7.4.2.3

Description

Public agencies surveyed for this project stated that partnerships were often the most effective way to address watershed issues. Besides convening watershed meetings to facilitate regional cooperation, state agencies and private foundations currently supporting projects in the Schuylkill River watershed can drive cooperation and efficiency within the watershed by including written, formalized criteria in grant guidelines, giving preference to proposals that establish real, working relationships or partnerships among watershed groups.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.15	**Streamlined Grant Application Process**	State agencies funding watershed projects	Improve coordination Build capacity	General 7.3.2.2

Description

The Nonprofit Survey revealed that many groups need more funding but have difficulty fundraising due to staff size and time limitations. To facilitate nonprofit funding, increase project proposals/grant applications and to maximize state funding sources, state grant programs should coordinate grant deadlines and application forms where possible. Streamlining the grant application process would improve nonprofit access to state resources and maximize funding resources across agencies. This process, which may vary significantly from one agency to another, currently is prohibitively complex and time-intensive, particularly for smaller grassroots organizations. Developing a common application, and if possible, common deadlines across different agencies would improve the grantmaking process for nonprofits and agencies alike. Additionally, streamlining the fundraising effort will lead to a greater number and diversity of applications, thereby maximizing funding resources. A group of private foundations making grants to the watershed community already have streamlined their application process via a common application through the Delaware Valley Grantmakers, as the first step toward facilitating watershed funding. However, these groups do not yet observe a common set of criteria for making grant decisions, nor do they follow a common deadline for application and grant approval. Ideally both the state and private grant-making process should be streamlined.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.16	**Use Innovative Land Protection Mechanisms**	Watershed nonprofits and agencies involved in land protection	Improve coordination Resource management Strategic conservation	General 7.3.2.2

Description

Nonprofits and agencies can increase their funding base and conservation potential by using innovative land conservation and funding mechanisms. Numerous bond initiatives were passed through the nation in in 1999 and 2000, some of which supplied essential funds for land acquisition or other conservation initiatives. The Public Agency Survey found that only 3% of public agencies have used bond funding to support their programs. Experienced nonprofits and other agencies could share information and technical assistance on innovative funding sources such as bond initiatives, and land protection mechanisms such as conservation easements and purchase or transfer of development rights. In addition, heritage projects that conserve historical, cultural, and agricultural features may serve as buffers or connectors for conservation lands, and contribute to landscape sustainability.

Innovative land protection mechanisms might be shared among nonprofits and public agencies through topical watershed meetings, through the watershed clearinghouse, or other existing communication media and networks (see

Recommendations **R7.2**, **R7.7** and **R7.10**). Professional training programs should provide information on how to use these tools for conservation. Some existing training opportunities, such as those provided through the Land Conservation Leadership Program, already offer "how to" courses on these subjects.

See also **Sections 6.9** and **6.10** for an in-depth discussion of some innovative implementation tools and assessment methods for watershed conservation and management.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.17	**Re-poll Watershed Community**	Schuylkill River watershed public	Public awareness	General

Description

The public opinion poll conducted by The Conservation Fund showed the need for outreach to enhance public awareness about watershed address and watershed issues. Re-polling the watershed community at established time periods provides a measure of success for watershed action and management. It also provides critical information about watershed use by local citizens, and trends in demography that will affect future watershed health.

The opinion poll should survey a statistical sample of the Schuylkill River watershed population. This population should be determined using the most recent census data available. Polling questions should be oriented more towards watershed conservation issues and assessing the environmental awareness of watershed citizens.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.18	**Coordinate Planning Efforts**	Watershed-wide, all levels of government planning	Improve coordination Plan implementation Strategic conservation	General

Description

As learned through this planning process, many other municipal, county, regional and subwatershed plans are underway or have been completed. One outstanding issue is the need to better coordinate these various planning efforts to ensure that the funding from the state and other agencies/foundations is well spent. Improved coordination means improved communication between local governments, nonprofits and all entities connected with the planning processes.

All planning efforts should be coordinated to ensure consistency among recommendations at all levels of government and nonprofit activity, and to ensure efficient use of funding, not duplication of efforts. For example, River Conservation Plans need to be coordinated with county plans, regional comprehensive plans and even the Municipal Planning Code. Entities involved in completing these plans, such as nonprofit groups, county planning commissions and municipalities, need to communicate concerning priorities and goals.

Please refer to **Section 3.6.1** for a brief discussion of other River Conservation Plans and ongoing regional planning efforts in the Schuylkill River watershed.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.19	**Fund an Outreach & Adoption Phase to Ensure Plan Implementation**	Watershed County Planning Commissions, in conjunction with other watershed stakeholders, nonprofits and government agencies	Resource management Strategic conservation Plan implementation	General

Description

To ensure implementation of the Schuylkill Watershed Conservation Plan, an outreach phase needs to be funded to educate interested stakeholders about the Plan, how to interpret and use the data and how to incorporate the data into local ordinances, etc. The River Conservation Program, administered by PA DCNR, provides some financial incentives to municipalities to implement the recommendations in this document, by allowing them to apply for matching funds for implementation projects. The online Reference Document **Potential Implementation Projects** includes a list of suggested projects for implementing this Schuylkill Watershed Conservation Plan.

Much could be done to ensure that the recommendations from this Plan are actively adopted by government agencies across the watershed. The Plan recommendations and GIS mapping relevant to each municipality should be provided in a user-friendly manner so that they can be incorporated into local zoning codes and ordinances. Municipalities, County Planning Commissions and state agencies in the watershed need to be made aware of how they can modify their plans, zoning ordinances and funding programs to support implementation of this Plan. This would guarantee a "first line of defense" at the municipal level where, due to the requirements of the Municipal Planning Code, many of the day-to-day decisions about land use are made. Besides educating government entities in order to implement the Plan, nonprofit stakeholders need to understand the Plan.

Since Berks, Montgomery and Schuylkill Counties are almost wholly within the Schuylkill River watershed, it seems logical for these County Planning Commissions to spearhead the development of a task force to foster adoption of the Plan by the municipalities under their jurisdiction. These organizations could facilitate the integration of Plan recommendations by ensuring compliance in County plans, and assisting municipalities in their jurisdiction with adoption of these recommendations. The other watershed counties also should be invited to join the task force to foster adoption of the Plan by municipalities in their jurisdiction. Watershed nonprofits should assist as necessary.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.20	**Hold Annual or Bi-annual Watershed Summit**	Watershed stakeholders from government, private and nonprofit sectors and citizens	Improve coordination Public awareness Plan implementation	General

Description

An annual or bi-annual watershed summit of stakeholders would facilitate networking, discussion of major activities, demonstration projects and plan implementation to achieve broad-based cohesiveness among groups and coordination of activities. The summit should include all stakeholders cutting across sectors, expertise to draw in private founders, nonprofit groups, businesses, and government entities. Through these large meetings, broad watershed goals can be discussed and agreed upon.

The Schuylkill Riverkeeper Program has an established annual water monitoring congress that could be expanded to include a one-day agenda dedicated to environmental professionals operating in the watershed.

Code	*Recommendation*	*Priority Areas or Institutions*	*Issues Addressed*	*Sections*
R7.21	**Schuylkill River Watershed Conservation Coordinator**	Nonprofit or state agencies, watershed-wide	Improve coordination Public awareness Plan implementation	General

Description

A Schuylkill River Watershed Conservation Coordinator should be funded through one of the local nonprofits or state agencies to work with nonprofits and government entities to implement the plan. The Conservation

Coordinator could be the person who would conduct the outreach and education activities discussed in Recommendation **R7.19** above. Additionally, there is a real need to coordinate the many other existing plans, such as other river conservation plans, watershed rapid assessment programs, and so on. Besides promoting the implementation of the Schuylkill Watershed Conservation Plan, the Conservation Coordinator should promote implementation and coordination of other existing plans.

7.6 References

Delaware Estuary Program. September 1996. The Delaware Estuary Plan: Comprehensive Conservation and Management Plan for the Delaware Estuary. Available by calling the Delaware Estuary Program at 1-800-445-4935; or online at: http://www.delep.org.

United States General Accounting Office. March 2000. Water Quality: Key EPA and State Decisions Limited by Inconsistent and Incomplete Data. Report to the Chariman, Subcommittee on Water Resources and Environment, Committee on Transportation and Infrastructure, House of Representatives (GAO/RCED-00-54). Available online at: http://www.gao.org.