The Spring Creek Watershed Plan
Phase 1 Final Report

Our Challenges and
A Direction for the Future

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Introduction

The goal of the first phase of the Spring Creek Watershed Plan has been to distill numerous existing plans, research, and data into a clear and concise statement of the challenges facing this watershed and recommend ways that its citizens can meet these challenges in the future. The Phase 1 Final Report addresses this goal in the following sections:

- A Challenge – Solution Matrix that organizes the Watershed's existing problems and their potential solutions
- A synthesis of the research conducted in this phase of the project, which includes discussion of the organizational framework chosen to clearly describe the Watershed's challenges, the available methods that were identified to address the challenges, and the problems and solutions that require further study or refinement
- Four Appendices that summarize the project's compilation and analysis of existing local plans and studies, reference the review of regional and national watershed and water resource management plans, list a collection of water-related studies that will prove to be valuable in subsequent watershed projects, and present the United States Geological Survey (USGS) Conceptual Model Report.

The Challenge – Solution Matrix

The Challenge – Solution Matrix seeks to clearly and succinctly describe the Watershed's challenges by identifying its water resource problems, potential solutions, and the data gaps that still exist. To do this effectively, we compiled and reviewed the multitude of relevant existing plans and studies within and beyond the Spring Creek Watershed. Once the Project Management Team (PMT) came to a consensus about the problems to be addressed, a format to communicate these problems clearly to the community was developed. A review of the structure of existing watershed and water resource plans helped to determine the most effective way to share this information to motivate and empower the community to take additional action.

The framework of the Matrix outlines the four major components of the Spring Creek Watershed's water resources – its surface water, ground water, water supply, and the connection between land use and water resources. Each of these components is then further dissected. Within each section, several problems and challenges are expressed, followed by potential actions that the community could take to address them. The listed actions are general in nature because many of them will need additional development, refinement, or community discussion before they can be implemented. The Matrix also references which of the researched existing plans recommended the specific solutions and actions, and additionally notes whether taking action may fix past problems, prevent future problems, or both.

Research Synthesis and Discussion

Surface water

Surface water is the first component of the Matrix, and it is divided into two main sections - natural drainages and engineered drainages. Within the natural drainage system, many of Spring Creek's problems have been documented in the Pennsylvania Department of Environmental Protection's (DEP) Aquatic Investigations of Spring Creek and its tributaries. The problems related to the engineered drainages are tied directly to the increasing development and rising population of the Watershed.

Groundwater

Within the groundwater system, recharge and discharge are two important natural mechanisms in a karst environment. Challenges related to the recharge element involve direct sinkhole conduits to the aquifer, critical closed depression recharge zones, and the diffuse recharge that takes place throughout the Watershed's limestone valleys. Groundwater discharge is characterized by springs that resurface as the sources of our flowing streams and by the wetlands and marshes that naturally filter pollutants from both the ground and surface water systems.

Water Supply

The issue of water supply links the surface water and groundwater systems with the growing communities of the Spring Creek Watershed. The communities must understand the implications of removing water from the natural system for human consumption and use by ensuring clean and plentiful drinking water, protecting the sources of our wells, effectively treating the water after its use, and safely reintroducing the water into the natural system. Source water issues are divided into constructed wells and natural springs. Wastewater challenges involve the public treatment facilities and the private on-lot and community wastewater treatment alternatives. Beneficial Reuse is a concept that links treatment and consumption in the Spring Creek Watershed by recharging the aquifer.

Land Use and Water Resources

Many of the land use decisions that are made on a daily basis by municipal officials in the Spring Creek Watershed both influence, and are influenced by, our water resources. Land use issues are best approached from the perspectives of the past and the future. The PMT has identified problems that have resulted from decisions made in the past that must someday be fixed, given enough time and resources. We have also identified future land use and water resource management challenges that can be alleviated with proper visioning and planning.

Water Resources Monitoring: The State of the Natural System

To fully understand the health of a watershed, it is necessary to develop a process for monitoring critical physical, chemical, and/or biological parameters within the streams. Once established, monitoring should continue consistently in order to establish an accurate baseline of data. Over time, change – both positive and negative – can be tracked against this baseline. The Spring Creek Watershed Community has been monitoring the streams of the watershed since 1998 according to a protocol designed by a committee of local water resource experts. These data are critical to effective water resource decision-making in the future.

A Look to the Future

A discussion of the community's future water resource management goals and objectives will summarize the major themes found in the Challenge – Solution Matrix. Continued public momentum and consistent water resource monitoring will be critical to advancing the Spring Creek Watershed Plan towards its ultimate implementation. Authorizing an effective implementing agency and ensuring sustainable funding will be instrumental in addressing the Watershed's challenges and ensuring the protection of all of the interrelated components of the water resource system.

Appendices

- Appendix A is a review of local plans, studies, and data that relate to water resource management in the Spring Creek Watershed.
- Appendix B is a review of watershed and water resource plans beyond the Watershed, for both content and structure.
- Appendix C is a list of watershed related studies that will be useful to water resource managers in future phases of watershed planning and implementation.
- Appendix D is the Conceptual Model Report, developed by the USGS, which provides the detailed physical description of the Spring Creek Watershed. As an element of the Spring Creek Watershed Plan project, USGS is using the Spring Creek Watershed to create a combined surface and ground water numerical computer model that will predict the consequences to water quality and quantity of specific water resource management and land use decisions. The model's success is dependent on continuous, high-quality data. The Conceptual Model Report is a detailed data compilation that will guide USGS in creating the numerical model over the next few years.

List of Acronyms

BMP	Best Management Practice
CCCD	Centre County Conservation District
CCPO	Centre County Planning Office
CRPA	Centre Regional Planning Agency
CTWA	College Township Water Authority
DCED	Pennsylvania Department of Community and Economic Development
DEP	Pennsylvania Department of Environmental Protection
GIS	Geographic Information Systems
MPC	Pennsylvania Municipalities Planning Code; Act of 1968, P.L. 805, No. 247
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PCE	Perchloroethylene
PFBC	Pennsylvania Fish and Boat Commission
PMT	Project Management Team (management committee for the Spring Creek Watershed Plan project made up of representatives from DEP, Spring Creek Watershed Commission, CCPO, CRPA, UAJA, USGS, and ClearWater Conservancy)
POTW	Publicly - Owned Treatment Works
PSU	The Pennsylvania State University
SBWJA	Spring-Benner-Walker Joint Authority
SCBWA	State College Borough Water Authority
SCWC	Spring Creek Watershed Community
TCE	Trichloroethylene
TMDL	Total Maximum Daily Load
TU	Spring Creek Chapter of Trout Unlimited
UAJA	University Area Joint Authority
USGS	United States Geological Survey
WRMP	Water Resources Monitoring Project of the Spring Creek Watershed Community
ZOC	Zone of Contribution

Spring Creek Watershed Challenge - Solution Matrix (page 1 of 4)

(The numbers in the matrix refer to specific plans listed in Appendix A and B)

Major Watershed Component	**Challenges** (what needs addressed)	**Solutions** (how to address it)	Solution Already been Studied	Solution Needs to be Further Developed	Opportunity to Solve Past Problems	Opportunity to Solve Future Problems
Surface Water System						
Natural Drainages	Declining Stream baseflow	Decrease Well Withdrawal	**15,*18***	**X**		**X**
		Increase Groundwater Recharge	***18***	**X**		**X**
		Protect Sinkhole Recharge Areas	***18***	**X**		**X**
		Restore and Protect Riparian Buffers	**4,*18***			**X**
	Increased Sedimentation	Manage Stormwater More Effectively	**5,12,*18,21,25***	**X**		**X**
		Manage Agricultural Lands More Effectively	**5,*18,21,22,23, 24,26,27,38***			**X**
		Restore and Protect Riparian Buffers	**4,17,*18,21,25, 29,30***		**X**	**X**
		Dredge Streams		**X**	**X**	
	Thermal Modification	Restore and Protect Riparian Buffers	**4,8,*18,25,27,29,30,36***			**X**
		Decrease Heated Stormwater	**15,*18***	**X**		**X**
		Identify and Fix Warm Point Sources	**15,*18,36***	**X**	**X**	**X**
	Declining Biotic community	Restore and Protect Riparian Buffers	**4,8,11,*18,21,25, 26,27,29,30,36***			**X**
		Reduce/Remove Sediment from Streams	***25***			
		Create In-stream Habitat	***25***			**X**
	Riparian Buffer Removal	Educate Individual Riparian Landowners	**4,5,8,11,*18,21, 26,29,30***		**X**	**X**
		Educate Land Developers	**11,*18,29,30***		**X**	**X**
		Stabilize Stream banks	***18,26,28,29,30, 34***		**X**	**X**
		Fence Stream banks in Agricultural Areas	**5,17,*18,21,23, 26,34,38***		**X**	**X**
		Replant Riparian Buffers	**5,8,11,*18,21,27, 28,29,30,32,34, 38***		**X**	**X**
	Riparian Buffer Protection	Educate Individual Riparian Landowners	**4,5,8,*18,22,23, 26,34***		**X**	**X**
		Create Municipal Ordinances/Modify Zoning	**5,6,8,9,10,*18, 21,28,29,30,34***	**X**		**X**
		Acquire Easements/Purchase Land	**4,5,6,8,*18,23, 24,28,29,30,32***	**X**		**X**
		Purchase/Acquire Riparian Buffers	***28***			**X**
Engineered Drainages	Ineffective Stormwater Management	Implement Act 167 Plan	**2,*18,19***			**X**
		Offer Incentives for BMP Use				**X**
		Devise BMP Technology	***18,22,28***		**X**	**X**
	Existing Malfunctioning Stormwater Basins	Identify Priority Retrofit Basins	***28***	**X**		**X**
		Secure Funding	***28***	**X**		**X**
		Find Technical Assistance				**X**
		Work through Municipalities		**X**	**X**	**X**

Spring Creek Watershed Challenge - Solution Matrix (page 2 of 4)

(The numbers in the matrix refer to specific plans listed in Appendix A and B)

Major Watershed Component			**Challenges** (what needs addressed)	**Solutions** (how to address it)	Already been Studied	Needs to be Studied Further	Opportunity to Solve Past Problems	Opportunity to Solve Future Problems
Groundwater system								
	Natural Recharge							
		Point (sinkholes)	Sinkhole Protection	Create Municipal Ordinance/Zoning	**6,*18,19***			X
				Educate Individual Landowners	***18***			X
				Discourage Sinkholes for Stormwater				X
			Sinkhole Cleanup	Organize Cleanup Days	**5,*20***		X	X
				Educate Individual Landowners	***18***			X
				Fine Illegal Dumpers				X
		Sponge	Identification and Protection of Sponge areas	Identify Critical Recharge Areas (GIS)	**17**	X		X
				Educate Landowners				
				Develop Methods of Protection	**6,17,*18,21***	X		X
		Diffuse	Increase in Impervious Cover	Implement Stormwater BMPs for New Development	**2,6,*18,27,28***			X
				Offer Incentives		X		X
				Adopt Municipal Ordinance for Open Space	**6,*18***	X		X
				Retrofit Existing Developments	***18,28***	X	X	
			Groundwater Contamination	Map Contamination Sites				X
				Identify Sources of Contamination		X		X
				Cleanup Known Contamination		X		X
				Monitor Remediated Sites				X
	Natural Discharge							
		Springs	Poor Water Quality	Identify all Spring Sources				X
				Cleanup Contaminated Springs		X		X
				Monitor Remediated Sites				X
				Establish an Alert System for Changes		X		X
		Wetlands/Marshes	Declining Groundwater Levels	Encourage Groundwater Recharge		X		
				Reduce Imperviousness in New Development				
				Retrofit Imperviousness in Existing Development				
			Encroachment from Development	Identify and Prioritize Natural Discharge areas for protection	**12,*18,21,25,27, 38***			X
				Acquire Conservation Easements	**5**			X

Spring Creek Watershed Challenge - Solution Matrix (page 3 of 4)

(The numbers in the matrix refer to specific plans listed in Appendix A and B)

Major Watershed Component		Challenges (what needs addressed)	Solutions (how to address it)	Already been Studied	Needs to be Studied Further	Opportunity to Solve Past Problems	Opportunity to Solve Future Problems
Water Supply							
Source Water							
		Protection of Reservoirs	Increase Public Awareness about Drinking Water	***18,20,21***			
	Streams						**X**
			Assess Source Water	***18,19,20,21***			**X**
			Monitor Surface Reservoirs	***20***			**X**
	Wells	Insufficient Wellhead Protection	Identify 1 Year ZOC				**X**
			Assess Source Water	***18,19,20,21,23, 24,35,38***			**X**
			Implement Well Construction Ordinances				**X**
			Develop Wellhead Protection Ordinances/Zoning	**5,*19,20,23,38***			**X**
			Acquire Conservation Easements on 1 Year ZOC	**5,6,*20***			**X**
			Purchase Land in 1 Year ZOC	**5,6,*20***			**X**
		Unacceptable Water Quality	Protect Source Water Areas	***18,20***	**X**		**X**
			Continually Monitor Source Water Areas	***20***			**X**
			Apply Treatment Methods		**X**		**X**
		Insufficient Water Quantity	Develop Groundwater Monitoring Network	**15,*20***			**X**
			Institute Water Conservation Program	**6, 17,*18,19,20, 24,35,37***	**X**		**X**
		Difficulty Projecting Future Needs	Prepare Watershed-wide Buildout Analysis	***20,24***	**X**		**X**
			Enforce RGB with ordinances	**17,*20***	**X**		**X**
		Conserving Water	Calculate Water Budgets	**17,*18,19,20,27,***	**X**		**X**
			Educate Landowners	***18,20,21***	**X**		**X**
			Institute Water Conservation Program	**6,*18,19,20,21,37***	**X**		**X**
	Springs	Unacceptable Water Quality	Identify all Spring Sources				**X**
			Monitor Water Quality				**X**
Wastewater							
	POTW	Capacity	Recycle Treated Wastewater	**15,*18***	**X**		**X**
			Institute Water Conservation Program	**6,*18***	**X**		**X**
		Impact of Discharge on Streams	Evaluate New Treatment Methods	**18**	**X**		**X**
			Institute Water Conservation Program	**6,17,*18***	**X**		**X**
			Protect and Restore Riparian Buffers			**X**	**X**
		Impact of Upstream Influences	Address Thermal Pollution Upstream		**X**		**X**
	Private On-lot/ community	Failing Systems	Educate Septic System Owners	***18,22,23,26,27***			**X**
			Perform Site Inspections	***18,22,24,26,27, 29,30,32***		**X**	**X**
			Empty Septic Systems Periodically	***18,22,23,26,32***		**X**	**X**
			Use Known Technologies for Repair	***18,23,27***	**X**	**X**	**X**
		Insufficient Routine Maintenance	Educate Septic System Owners	***18,21,22,23,27***			**X**
			Perform Site Inspections	***18,22,26,27,29, 30,32***			**X**
		Placement in Inappropriate Locations	Identify Proper Soils		**X**	**X**	**X**
			Guide Development to Proper Soils		**X**	**X**	**X**
	NPDES Phases I & II	Industrial Point Source Discharge	Ensure violators work with DEP			**X**	**X**
			Monitor permits	***24***	**X**	**X**	**X**
			Establish TMDLs in Watershed	**10,*18,35***	**X**		**X**
		Municipal NPDES Education	Educate Municipal Engineers	***18,23***	**X**		**X**
			Encourage Cooperation of Permit Holders		**X**		**X**
			Initiate Public Education Watershed-wide	***18***	**X**	**X**	**X**

Spring Creek Watershed Challenge - Solution Matrix (page 4 of 4)

(The numbers in the matrix refer to specific plans listed in Appendix A and B)

Major Watershed Component	**Challenges** (what needs addressed)	**Solutions** (how to address it)	Already been Studied	Needs to be Studied Further	Opportunity to Solve Past Problems	Opportunity to Solve Future Problems
Land Use and Water Resource Planning						
Past Land Use Decisions	Increases in Impervious Cover	Educate Development Community	**10,*18,24,28***			X
		Identify Areas with Excess Impervious	***28,36***	X	X	X
		Implement Stormwater Retrofit BMPs	***28,29,30,32,34,36,38***		X	
	Development in Inappropriate Areas	Identify Known Areas Inappropriate for Development	**5,6,8,17,*21,29,30***	X		X
		Educate Development Community		X		X
		Identify Appropriate Growth Areas		X		X
		Protect Inappropriate Areas from Development	**6,17,*19,21,29,30***	X		X
	Increases in Stormwater Runoff	Encourage Stormwater BMPs	**11,*18,28,32,36,38***	X	X	X
		Identify Retrofit Opportunities	**11,*18,28,29,30,32,36,38***	X	X	X
		Procure Partners and Funding	**11,*18,28,29,30,32,36,38***	X	X	X
		Identify New Basin Areas	***28,36***	X	X	X
	Impaired Streams	Determine Causes of Impairment	**15,16,*32***	X		X
		Identify Sources of Impairment	**15,16,*32***	X		X
		Identify Potential Stream Impairments				
		Prioritize Impaired Stream Reaches		X		X
		Create Specific Action Plans for Remediation		X		X
Future Land Use Decisions	Protection Ability of Current Ordinances	Assess with Codes and Ordinances Worksheet	***18,24,29,30,32,35,36***	X		X
		Work with Municipal Managers and Staff	***18,19,29,30***	X		X
	Protection of Riparian Areas	Develop Riparian Overlay Zoning Ordinance	**4,5,6,8,9,*29,30***	X	X	X
		Acquire Conservation Easements	**4,5,6,8,*24,28,29,30***			X
		Educate Riparian Landowners	**4,5, 11,*18,21,25,27,28,29,30***	X	X	X
	Protection of Natural Resource Areas	Develop Specific Protection Criteria	**6,10,17,18,*19,24,25,27,29,30,35,38***	X		X
		Map Specific Protection Areas	**6,9,10,17,18,*19,24,25,27,29,30,35,38***	X		X
		Develop Resource Overlay Zoning Ordinance	**6,8,10,*29,30***	X		X
	Environmental Education for Municipal Officials	Work with Municipal Managers and Staff	***18,29,30,38***	X		X
		Determine Environmental Education Needs	**11,*18,21,29,30,36,38***	X		X
		Develop Concise Teaching Documents	***29,30,38***	X		X
		Determine Best Teaching Techniques	***21,29,30,36,38***	X		X
Overall Items to Address						
	Long-term Monitoring of Watershed Health	Support Spring Creek Watershed's Water Resources Monitoring Project	**10,15,17,*21,22,23,24,25,26,27,32,36,37,38***	X		X
	Coordinated Authority over Water Resources	Research/Create Watershed Entity	**10,*18,19,20,35,37***	X	X	X

Section 1: Surface Water

Surface water is the first component of the Matrix and it is divided into two main sections - natural drainages and engineered drainages. Within the natural drainage system, many of Spring Creek's problems have been documented in DEP's Aquatic Investigations of Spring Creek and its tributaries. The problems related to the engineered drainages are tied directly to the increasing development and rising population of the Watershed.

Natural Drainages

Challenges

1. Declining Stream Baseflow

   Although no studies have directly noted an overall drop in watershed baseflow, recent drought conditions from 1998-2001 led to dry stream beds in segments of Slab Cabin Run and Buffalo Run. Some of the concern in the Slab Cabin Run subbasin specifically stems from the supposition that the dry stream was not due solely to the drought. Two of the State College Borough Water Authority's (SCBWA) main water supply well fields are located in close proximity to the stream and may be contributing to the groundwater draw-down and subsequent dry stream. Regardless of the extent of SCBWA's influence on streamflow in the Slab Cabin Run subbasin, the possibility of not having water flowing in our streams is a serious problem that should be analyzed and addressed.

   Potential Solutions

   i. Decrease well withdrawal
      1. Implement water conservation measures
      2. Encourage more well fields to disperse the impact on groundwater

   ii. Increase groundwater recharge
      1. Encourage stormwater recharge Best Management Practices (BMPs)
      2. Beneficial Reuse of treated wastewater

   iii. Protect sinkhole recharge areas
      1. Overlay zoning
      2. Modify the subdivision and land development process

   iv. Restore and protect riparian buffers
      1. Plant trees to increase stream cover and decrease stream evaporation
      2. Implement voluntary landowner management programs
      3. Discourage removal and encourage restoration of buffers in the subdivision and land development process

2. Increased Sedimentation

   Sedimentation was one of the noted causes of impairment in 13.2 of the 16.2 degraded stream miles in the Spring Creek Watershed. This type of impairment has two main sources. Agricultural fields along rural tributaries like Slab Cabin Run, Buffalo Run, and Cedar Run contribute sediment during storm events, especially along reaches without proper riparian buffers. In more urban areas, like on Thompson Run, large volumes of stormwater erode streambanks, causing excess silt to accumulate in the streams. Increased sediment from both main sources coats the streambed, suffocating macroinvertebrate life and deterring trout reproduction.

Potential Solutions

i. Manage stormwater more effectively
    1. Encourage on-site recharge instead of retention and discharge
    2. Encourage BMPs in new development
ii. Manage agricultural lands more effectively
    1. Encourage streambank fencing on agricultural lands
    2. Promote contour farming
    3. Implement rotation programs for grazing livestock
iii. Restore and protect riparian buffers
    1. Establish buffer widths to effectively filter sediment
    2. Establish a riparian buffer conservation zone
    3. Promote voluntary landowner management programs
iv. Dredge streams

3. Thermal Modification

Spring Creek has a long history as a high quality trout fishery. Trout need cool water, for its ability to dissolve oxygen. Trout suffocate from lack of oxygen when water temperature exceeds 65°F. Cool groundwater (50°F – 55°F) issuing from springs provides abundant base flow to Spring Creek. However, stormwater flowing over developed and paved surfaces and piped to the streams has a much higher temperature. Removal of riparian buffers and point discharge of warm municipal and industrial wastewater also contribute to temperature problems.

Potential Solutions

i. Restore and protect riparian buffers
    1. Maintain intact riparian buffers to shade the stream
ii. Decrease heated stormwater and impervious cover
    1. Encourage smart growth patterns over sprawling development patterns
    2. Decrease parking requirements and encourage shared parking through ordinances
    3. Infiltrate stormwater instead of retaining it where possible
iii. Identify and fix warm point sources
    1. Review NPDES I permits to determine permitted discharges
    2. Investigate other non-permitted point source discharges
    3. Identify funding for retrofit projects

4. Declining Biotic Community

Over the past 40 years, DEP and the Pennsylvania Fish & Boat Commission (PFBC) have conducted numerous studies of the macroinvertebrate community in the Spring Creek Watershed. In addition to physical and chemical testing, the diversity and numbers of a stream's biological community are key indicators of stream health. Spring Creek Watershed's studies have shown a declining trend in both total numbers of macroinvertebrates and species diversity in some specific stretches of the watershed. The macroinvertebrate community is the basis for the entire stream ecosystem, and it is important to understand how to protect it.

Potential Solutions

i. Restore and protect riparian buffers
ii. Reduce and/or remove sediment from streams
iii. Create in-stream habitat
    1. Add rip-rap, boulders, woody debris to stream

5. Riparian Buffer Removal

Riparian buffer areas are quickly becoming a major focus of water resource management, as the environmental community begins to truly understand the importance and function of buffers in terms of overall watershed health. This understanding must be transferred to the general public and key decision-makers within the watershed. Riparian buffers are sometimes removed as land use intensifies due to a lack of protection during the land development process. Individual riparian landowners may also remove or damage riparian areas. These damaged buffers must be returned to their natural state.

Potential Solutions

i. Educate individual riparian landowners
    1. Establish an educational series through the newspapers
    2. Identify all riparian landowners and create a mailing to them
    3. Hold a public meeting about the importance of riparian buffers
    4. Utilize the school system to spread the word through the students
ii. Educate land developers and offer incentives to promote buffer protection
    1. Offer a workshop for land developers
    2. Initiate an Open Space Trading program in the watershed
    3. Establish density trading for protection of riparian property during development
iii. Stabilize streambanks
    1. Plant native woody species that will grow deep roots and stabilize the bank soils
iv. Fence streambanks in agricultural areas to keep livestock out of streams
    1. Work with the adjacent Penns Valley Conservation Association to establish a program in the Spring Creek Watershed (they have a very good program started already)
    2. Work with the Centre County Conservation District (CCCD) to acquire funding, supplies, and plants for specific projects
v. Replant riparian buffers and maintain them in the first few years
    1. Acquire trees and assistance through the Chesapeake Bay Program and CCCD programs
    2. Organize volunteer groups to assist in the planting (Boy Scouts, civic groups, schools, etc.)

6. Riparian Buffer Protection

Understanding all of the important functions that riparian buffers serve - filtering nutrients and sediment, providing shade to reduce stream temperature, stabilizing streambanks, etc. - it is important for the community to preserve riparian buffers that are currently intact and fully functioning. Mature buffers function effectively, whereas newly planted buffers may take years to become established. Existing buffers look better than newly planted buffers. Economically, it is less costly to preserve existing buffers than to replant them. Some popular ways to protect existing buffers are through good stewardship practices, land purchase, conservation easement acquisition, or overlay zone creation for riparian areas.

Potential Solutions

i. Educate individual riparian landowners about good land stewardship practices
ii. Create a municipal ordinance or overlay zone to protect buffers
iii. Acquire conservation easements
    1. Work with ClearWater Conservancy or other land trusts to discuss easement options
    2. Explore municipal conservation options
iv. Purchase or acquire riparian buffers

1. Work with ClearWater Conservancy or other land trusts to discuss easement options
2. Explore municipal conservation options

Engineered Drainages

Challenges

1. Ineffective Stormwater Management

   For years, stormwater runoff has been viewed as a nuisance. The outdated "pipe it to the stream" philosophy of stormwater management has led to some serious inefficiencies and problems in the system. Poor calculations and assumptions of storm event volumes, building in floodplains, and limited respect for upstream and downstream impacts have produced flooding problems in the watershed. The Thompson Run subwatershed illustrates all of these problems, in a concentrated area, and their numerous ramifications.

   Potential Solutions
   i. Implement the Act 167 Stormwater Management Plan for the Spring Creek Watershed by municipal ordinance
   ii. Offer incentives for BMP use
      1. Tax breaks
      2. Higher density open space development
   iii. Devise innovative technologies for better stormwater management

2. Existing Malfunctioning Stormwater Basins

   One way to alleviate past stormwater management problems is to physically retrofit malfunctioning stormwater basins. Some of these "problem areas" were identified in the Act 167 Stormwater Management Plan, but little has been done so far to discuss how to fix them (methods, cost, time, and ramifications). The first step of many is to fully inventory and understand the problem areas, with the intent of fixing them.

   Potential Solutions
   i. Identify priority basins and stormwater problem areas through GIS and on-site analysis
      1. Identify sources of problems and affected areas
      2. Develop a ranking system to prioritize projects
   ii. Secure funding for retrofit projects
      1. Determine the costs of retrofitting specific priority areas
      2. Identify sources of funding to retrofit problem areas
   iii. Find available technical assistance
      1. Volunteer experts in the community
      2. Organizations with expertise
      3. Other communities with similar problems/experiences
   iv. Work through the municipalities
      1. Use municipal engineers to identify and prioritize problem areas
      2. Municipalities may be eligible for funding to retrofit problem areas through the state (DCED)

Section 2: Groundwater

Within the groundwater system, recharge and discharge are two important natural mechanisms in a karst environment. Challenges related to the recharge element involve direct sinkhole conduits to the aquifer, critical closed depression recharge zones, and the diffuse recharge that takes place throughout the Watershed's limestone valleys. Groundwater discharge is characterized by springs that resurface as the sources of our flowing streams and by the wetlands and marshes that naturally filter pollutants from both the ground and surface water systems.

Natural Recharge

Challenges

Point Recharge (sinkholes)

1. Sinkhole Protection

   Thousands of sinkholes have been identified in the Spring Creek Watershed, created by our limestone geology and topography. Sinkholes are conduits for surface water to enter the groundwater aquifer. They are an important source of recharge to streams and wells, but they have the potential to transfer pollutants quickly to the groundwater. Sinkholes have been discovered and stabilized with fill during the development process and they have also been used for stormwater management in some locations in the watershed. Sinkholes should be protected and buffered in order to continue to perform their natural recharge functions without increasing the risk of pollution or sinkhole malfunction.

   Potential Solutions

   i. Create municipal zoning or subdivision and land development ordinances to protect sinkholes through non-disturbance and buffers
   ii. Educate individual landowners
      1. Identify landowners with sinkholes on their property, inform them of how to best care for sinkholes, encourage property owners to keep them clean
   iii. Discourage the use of sinkholes for stormwater management
      1. Identify the connection of specific sinkholes from source to mouth to understand groundwater flow and the potential impact on drinking water
      2. Encourage BMPs for streams and swales discharging to sinkholes

2. Sinkhole Cleanup

   Historically, sinkholes have been popular dumpsites, amplifying the groundwater pollutant threat and creating a problem that is difficult to fix, especially in larger sinkholes. In the past few years, several groups in the watershed have targeted sinkholes for volunteer cleanup. A more structured process should be developed to identify, prioritize, and clean problem sinkholes.

   Potential Solutions

   i. Organize Cleanup Days
      1. Build upon ClearWater Conservancy's annual volunteer Watershed Cleanup Day
      2. Partner with PA Cleanways to develop a Centre County Chapter
      3. Focus municipal attention on sinkholes, potentially through the MS4 public involvement and outreach process
   ii. Educate individual landowners about sinkholes

iii. Fine illegal dumpers
    1. Monitor known problem areas
    2. Work with Centre County Solid Waste Authority

Sponge Recharge

1. Identify and Protect Critical Sponge Recharge Areas

Across the watershed, there are critical pieces of land that have the proper soils, geology, and slopes to recharge abnormally large volumes of water to the groundwater system during storms or snow melt events. These critical recharge areas have not yet been identified and mapped throughout the watershed, but can be identified through field observation. A good example of a critical recharge area is the field that Penn State is studying and protecting at the low point of the Fox Hollow drainage basin. Critical recharge areas are important to identify, protect, and enhance because they facilitate the groundwater recharge that is vital to the streams and water supplies of the watershed.

Potential Solutions

i. Identify sponge areas using GIS and on-site analysis
    1. Work with local engineers and hydrogeologists to identify specific criteria for identifying critical recharge areas
    2. Use GIS software to map these areas
ii. Educate landowners
    1. Meet with landowners, when necessary, to discuss the GIS findings and ground-truth the information for potential protection
iii. Develop methods to protect sponge areas
    1. Municipal overlay ordinance on subdivision and land development ordinance
    2. Place conservation easements on identified sponge areas
    3. Purchase or acquire critical recharge areas through land trusts or similar groups

Diffuse Recharge

1. Increased Impervious Cover in the Watershed

The soils and underlying geology of the valley floors of the watershed naturally facilitate a large amount of groundwater recharge. However, as development continues in the watershed, groundwater recharge is increasingly bypassed by impervious surfaces and stormwater collection, retention, and discharge. Impervious cover estimates for the watershed have risen from ~5% in 1960 to ~11% in 2000. This number translates into less groundwater recharge to supply drinking water and stream baseflow.

Potential Solutions

i. Encourage use of stormwater recharge BMPs in new developments
    1. Utilize Act 167 ordinance guidelines
    2. Educate developers about the varieties of BMPs available, express the environmental benefits
ii. Offer incentives to reduce impervious cover in new developments
    1. Tax incentives, lower costs, higher densities, etc.
iii. Create municipal ordinances requiring specific percentages of open space in new development
    1. Work with municipalities that already have one to create more: Patton – 50% in RPA; 35% for Gray's Woods
iv. Retrofit existing highly impervious developments

1. Identify specific methods to reduce the impact of impervious cover on development already in existence, such as asphalt removal, shared parking, rain gardens, permeable paving
2. Encourage BMPs to be used in retrofit situations
3. Educate the development community about BMPs
4. Secure funding
5. Streamline municipal application and approval process

2. Groundwater Contamination

There are a number of known groundwater contaminant plumes in Spring Creek Watershed. DEP has been tracking the plumes and is attempting to determine the sources of contamination for cleanup. Some of the springs that supply water directly to Spring Creek (Bathgate, Thornton, and Thompson) are known to be contaminated. A contamination monitoring well network currently exists in the watershed and continues to grow. One of the major obstacles to source identification is time; sites may have been contaminated decades ago.

Potential Solutions

i. Use GIS to map known contamination sites
    1. DEP is examining the contaminations and may have this available
ii. Identify sources of contamination
iii. Cleanup known contamination
iv. Continue to monitor contaminated sites

Natural Discharge

Challenges

Springs

1. Poor Water Quality

In general, the Spring Creek Watershed boasts many high quality streams. However, several springs have been contaminated by chemicals and bacteria. Examples include TCE and PCE contamination that is currently being analyzed, Kepone and Myrex contamination of Thornton Spring, and bacterial contamination of Thompson Spring. The Kepone and Myrex contamination specifically led to Spring Creek's designation as a "no-kill" trout stream.

Potential Solutions

i. Identify all contaminated spring sources
ii. Cleanup contaminated springs
    1. Identification will require historical knowledge of previous industries and the geologic system
iii. Continue monitoring contaminated springs after cleanup
    1. Groundwater monitoring will be necessary to trace the potential flow of contaminants
iv. Establish an alert system for unacceptable changes

Wetlands/Marshes

1. Declining Groundwater Levels

   Wetlands and marshes need water to function; declining groundwater levels put these features in jeopardy.

   Potential Solutions

   i. Encourage groundwater recharge
      1. Beneficial Reuse of treated wastewater
      2. Stormwater management
   ii. Reduce impervious surfaces in new development
   iii. Retrofit existing highly impervious developments

2. Encroachment from Development

   Wetlands are an important piece of the natural ecosystem. Benefits of wetlands include water filtration, flood absorption, and wildlife habitat. The watershed possesses many wetland systems, with Millbrook Marsh as probably the most notable example. Wetlands are supposed to be protected by federal regulation, but every year nationwide, tens of thousands of acres are lost to development. New technologies are available to "create" wetlands, but the natural wetland systems are proving difficult to reproduce.

   Potential Solutions

   i. Identify and prioritize wetland and marsh areas using GIS and on-site analysis
   ii. Place conservation easements on priority wetlands and marshes and buffering properties, where appropriate

Section 3: Water Supply

The issue of water supply links the surface water and groundwater systems with the growing communities of the Spring Creek Watershed. The communities must understand the implications of removing water from the natural system for human consumption and use by ensuring clean and plentiful drinking water, protecting the sources of our wells, effectively treating the water after its use, and safely reintroducing the water into the natural system. Source water issues are divided into constructed wells and natural springs. Wastewater challenges involve the public treatment facilities and the private on-lot and community wastewater treatment alternatives. Beneficial Reuse is a concept that links treatment and consumption in the Spring Creek Watershed by recharging the aquifer.

Source Water

Challenges

Streams

1. Protection of Surface Reservoirs

   There are only a few surface reservoirs in the watershed, and they are used to supply drinking water to a very small portion of the watershed. Shingletown Gap Reservoir (SCBWA) on Roaring Run and McBride Gap Reservoir (Rockview) on Nittany Mountain are the two most notable surface reservoirs. Historically, both of these reservoirs were used more extensively that they are today. However, future use of these sources is still possible and measures should be taken to ensure high quality water is available for use, if needed.

   Potential Solutions

   i. Educate the public about the sources of their drinking water supply
   ii. Complete Source Water Assessments for surface reservoirs
   iii. Monitor surface reservoirs for water quality

Wells

1. Insufficient Wellhead Protection

   Several major well fields supply drinking water for nearly the entire population of the watershed. Each well is more at risk as development increases in the watershed and encroaches on the land surrounding the well fields. The SCBWA is currently performing a Source Water Assessment for their well fields in the Slab Cabin subbasin. More stringent wellhead protection regulations should be adopted to ensure high-quality drinking water in the future.

   Potential Solutions

   i. Identify One-Year Zone of Concentration (ZOC) for all wells
      1. Review County Comprehensive Plan for this information
   ii. Complete Source Water Assessments for all water suppliers and wells
      1. Identify funding sources
      2. Identify potential consultants
   iii. Draft Well Construction ordinances
   iv. Draft Wellhead Protection ordinances
      1. Involve municipalities to ensure political acceptance
   v. Place Conservation Easements on properties within One-Year ZOC
   vi. Purchase Land within One-Year ZOC

2. Unacceptable Water Quality

The quality of water being pumped from our well fields is related directly to the land that influences them. Public water suppliers are required to monitor the water that they pump and treat for public use and consumption. These water suppliers should also be encouraged to look beyond the one-year ZOC of their well fields to determine potential threats to their water supply and possible solutions to alleviate those threats. Beyond the public water area, private wells are used by watershed residents.

Potential Solutions

i. Protect Source Water areas
    1. Complete Source Water Assessments for all public water suppliers
ii. Continually monitor source water areas
    1. Monitor well water quality as required by law (for a very limited set of parameters)
    2. Determine whether additional monitoring is needed; determine protocol
    3. Educate owners of private wells to sample their wells occasionally
iii. Apply Treatment Methods where necessary

3. Insufficient Water Quantity

For years, hydrogeologists in the watershed have stated that there is enough water in the groundwater system to supply the needs of a growing population well into the future. However, a period of drought between 1998 and 2001 focused attention on stream baseflow needs as two streams, Slab Cabin Run and Buffalo Run, went dry. Part of protecting and preserving our water resources is ensuring sufficient baseflow in our streams for aquatic life. An analysis of water quantity should determine the balance between consumptive use and continual stream baseflow.

Potential Solutions

i. Establish a watershed-wide groundwater monitoring network to track water level changes over time
ii. Implement a strong Water Conservation Program in all public water supply areas

4. Difficulty Projecting Future Needs

The Centre Regional Planning Agency (CRPA) has recently completed growth forecasts of land parcels to the year 2030. The Centre County Planning Office (CCPO) has population projections for the next 20 years in the watershed. The watershed's public water suppliers know how much water they are pumping and what the trends have been. In order to truly understand the potential impact that growth and development will have on our water resources, these efforts need to be combined to create a consistent, watershed-wide projected buildout analysis.

Potential Solutions

i. Perform a detailed watershed-wide buildout analysis to project a more accurate water use amount based on population and location
ii. Enforce watershed-wide Regional Growth Boundaries to limit sprawling development and protect natural areas
    1. Stronger municipal ordinances
    2. Diversify zoning

5. Conserving Water

Current estimates of consumptive water use in the watershed are approximately 64 - 66 gallons per day per person (SCBWA and CTWA). Compared to state-wide Pennsylvania rates, this ranks slightly higher than the average of 62 gallons per day. In 2000, the watershed population was ~95,000. Some population estimates show the watershed's population increasing by 20% in the next 20 years. Population increases will lead to increased water needs for homes and businesses. A water conservation program will be needed to ensure that our water withdrawal does not adversely impact our water supplies and our stream baseflow.

Potential Solutions

i. Calculate a water budget for the watershed and compare it to prior water budgets
ii. Educate landowners about water conservation techniques
    1. Develop education materials and distribution system
    2. Offer incentives for water conservation
iii. Implement a Water Conservation Program in the Spring Creek Watershed
    1. Work with water and sewer authorities to create a program that rewards consumers for water conservation

Springs

1. Unacceptable Water Quality

Springs are a major source of baseflow for the streams of the Spring Creek Watershed. In a few cases, these streams feed water supply reservoirs, such as Rockview State Correction Institution or State College Borough Water Authority's Shingletown Gap reservoir. In addition, springs such as the Big Spring in Bellefonte serve the water supply needs of communities. Springs are often influenced by sinkholes, which are quick conduits between the ground and surface water.

Potential Solutions

i. Identify all spring sources, including sinkholes, through GIS, groundwater models, and local knowledge
ii. Continually monitor the water quality at major springs

Wastewater

Challenges

Publicly Owned Treatment Works (POTW)

1. Capacity

Currently, the major wastewater facilities in the watershed are staying under their restricted caps. However, as population and businesses continues to grow, the need to either take on additional capacity or install alternative methods of treatment will surface. The Penn State facility already discharges their treated wastewater through a series of spray irrigation fields, allowing them to have zero direct discharge into a stream. The University Area Joint Authority (UAJA) has also developed alternative discharge strategies through their Beneficial Reuse project.

Potential Solutions

i. Recycle treated wastewater in the Spring Creek Watershed using UAJA's Beneficial Reuse model
    1. Industrial users
    2. Spray irrigation
    3. Supplement stream baseflow
    4. Recharge groundwater
ii. Implement a Water Conservation Program to reduce treatment needs
    1. Discuss volumetric billing
    2. Develop a comprehensive educational effort

2. Impact of Wastewater Discharge on Streams

Wastewater from UAJA, SBWJA, and Bellefonte is discharged directly into Spring Creek or its tributaries. Adding large volumes of wastewater to streams can potentially impact the surface water ecosystem. Each of these wastewater treatment plants are required to monitor stream conditions. Additional monitoring may be needed in the future.

Potential Solutions

i. Evaluate new wastewater treatment methods
    1. Ultraviolet Radiation and Reverse Osmosis
ii. Implement a Water Conservation Program
iii. Protect and Restore Riparian Buffers to reduce thermal pollution

3. Impact of Upstream Influences on POTWs

UAJA, SBWJA and Bellefonte discharge treated wastewater directly into Spring Creek or its tributaries. As NPDES permit holders, and because of Spring Creek's high-quality cold water fishery designation, one of the water quality measures they are responsible for monitoring is temperature. If the water that flows past their discharge points has already been heated as a result of urbanization, their responsibility to reduce the temperature becomes an even greater burden.

Potential Solutions

i. Address Thermal Pollution upstream from POTWs' discharge points
    1. Protect and Restore Riparian Buffers upstream of treatment plants
    2. Work with MS4 municipalities to reduce nonpoint source pollution problems

Private and Community on-lot septic systems

1. Failing Systems

The estimated population of the watershed in 2000 was ~95,000. About 20 % of this population lives outside of a public sewer service area and relies on septic systems for wastewater disposal. Failing septic systems can go undetected for years and lead to surface water and groundwater system problems. Some of the possible hazards associated with malfunctioning septic systems include wastewater seepage into homes, backed up septic systems, and contamination of drinking water supplies.

Potential Solutions

i. Educate on-lot septic system owners
    1. Proper maintenance
    2. How to identify problems on their property
    3. Who to call with specific problems and questions

ii. Perform site inspections
    1. Authorize a circuit rider to inspect areas of known septic problems and potential problem areas as determined by analysis
iii. Require septic tanks to be emptied on a periodic basis
iv. Use known technologies to fix or replace failing systems

2. Insufficient Routine Maintenance

Many citizens are unaware of their responsibility to properly maintaining an on-lot septic system. Routine maintenance can help prevent potential spills or failures and will reduce the chance of groundwater contamination.

Potential Solutions

i. Educate on-lot septic system owners
    1. Proper maintenance
    2. How to identify problems on their property
    3. Who to call with specific problems and questions
ii. Perform site inspections
    1. Authorize a circuit rider to inspect areas of known septic problems and potential problem areas as determined by analysis

3. Placement of Systems in Inappropriate Locations

The success of an on-lot septic system is dependent on its specific location, the specific soils beneath it and depth of soil from surface to bedrock. Based on these factors, certain areas of the watershed are inappropriate for development. Preventing development in such areas will help to protect the groundwater.

Potential Solutions

i. Identify soils appropriate for on-lot septic systems
    1. GIS analysis
    2. Perc tests
ii. Guide growth and development to appropriate soils

NPDES Phases I & II (National Pollution Discharge Elimination System)

1. Industrial Point Source Discharges (Phase I)

In Phase I of the NPDES program, all industrial point source discharges were issued permits (UAJA, PFBC, Corning, Cerro, etc.). Some of these permit levels were not met and caused direct impairment to Spring Creek and Logan Branch (PFBC hatcheries). Stakeholders within the watershed need to work with these permit holders closer to ensure that they are meeting their requirements.

Potential Solutions

i. Ensure that existing and future violators work with DEP
    1. PFBC has already worked with DEP to lower discharge levels of fish effluent
ii. Continue to monitor all point source discharges for potential permit violations
iii. Establish Total Maximum Daily Loads (TMDLs) for the Spring Creek Watershed
    2. Establishing TMDLs will create even more stringent levels of pollutant discharge in the watershed for permit holders
    3. TMDLs can also address sediment, which is not regulated by any industry or NPDES, but is addressed through new construction activities

2. Municipal NPDES Education

With the implementation of NPDES, Phase II, five municipalities of the watershed, Rockview, and Penn State have met the population threshold for MS4 designation and become NPDES, Phase II permits holders. As part of the permitting process, these MS4 permit holders must complete a five-year plan to address urban non-point source pollution. The first few years of the permit emphasize education and public involvement.

Potential Solutions

i. Educate Municipal Engineers about NPDES II and nonpoint source pollution
ii. Encourage Permit Holders to work cooperatively for efficiency and effectiveness
iii. Initiate a nonpoint source public educational program throughout the watershed

Section 4: Land Use and Water Resource Planning

Many of the land use decisions that are made regularly by municipal officials in the Spring Creek Watershed both influence, and are influenced by, our water resources. Land use issues are best discussed from the perspectives of the past and the future. The PMT has identified problems with decisions made in the past that must someday be fixed, given enough time and resources. We have also identified future land use challenges that can be alleviated with proper visioning and planning.

Past Land Use Decisions

Challenges

1. Increases in Impervious Cover

   As development has increased in the watershed, so has the amount of impervious cover. Research indicates an increase in impervious cover in the Spring Creek Watershed from 5% to ~11 or 12% over the past 40 years. Many studies have demonstrated adverse consequences when impervious cover in a watershed reaches 10%. Impervious cover reduces groundwater recharge and exacerbates the thermal pollution of our streams. It also increases the total volume of stormwater runoff and the rate of its flow.

   Potential Solutions

   i. Educate the development community about the importance of reducing impervious cover in new development and increasing open space for groundwater recharge
   ii. Identify existing development areas with excess impervious cover using GIS and site analysis (excessive parking lots, extra roads, etc.)
   iii. Implement stormwater retrofit BMPs in redevelopment opportunities (bioswales, porous pavement, enlarging/creating retention basins, removing excess pavement, etc.)

2. Development in Inappropriate Areas

   Certain areas in the watershed, such as wetlands, floodplains, and steep slopes, are not appropriate for development. These areas are generally protected through regulation. However, there are other areas, such as critical recharge areas, sinkholes, moderately steep slopes, and natural heritage areas that should also be avoided. These natural resources offer benefits to the larger community and pose potential threats if not given due consideration in the development process. Developers and municipalities alike need to be made aware of these areas and the ways that they can protect them.

   Potential Solutions

   i. Identify natural resource areas that are inappropriate for development using GIS and known post-development problem areas
   ii. Educate the development community and municipal decision makers about the importance of protecting these natural areas
   iii. Identify appropriate places for development as better alternatives to accommodate growth
   iv. Protect these areas by any means possible (easement, zoning, purchase)

3. Increases in Stormwater Runoff

Increases in stormwater runoff have caused major flooding problems in many areas of the watershed, most notably in the Thompson Run subbasin. Current and past stormwater management practices have not adequately controlled stormwater flows, in some cases contributing to the adverse flooding conditions in the watershed.

Potential Solutions

i. Encourage stormwater BMPs as outlined in the Act 167 Spring Creek Stormwater Management Plan
ii. Identify problem properties to retrofit with better stormwater management solutions
iii. Secure partners and funding to retrofit problem stormwater basins
iv. Create new stormwater basins on available vacant land to encourage more recharge

4. Impaired Streams

Over sixteen miles of streams in the Spring Creek Watershed were recently characterized as impaired. Development in inappropriate areas in combination with inappropriate stormwater management choices have contributed to these impairments, carrying higher volumes of pollution-laden and heated stormwater and sediment to our streams. Several highly visible flooding patterns in the watershed, such as the flooding of State College Area High School and Route 26 in the area of Your Building Center and Clark Motors, have focused community attention on urban stormwater issues. There are also stream segments that have been impaired due to poor agricultural practices, lack of forested riparian buffers, and point source pollution in rural areas. To save future stretches of stream and fix the current impairments, these non-point stormwater source pollution and rural land use issues must be addressed.

Potential Solutions

i. Determine the specific causes of the impairments by analyzing the effects on the stream
ii. Identify the sources of the impairment (not just stormwater, but *where* it comes from and *how much* of a reduction it would take to see noticeable impact)
iii. Identify reaches of stream in danger of becoming impaired
iv. Prioritize stream reaches for restoration or remediation
v. Create Action Plans to correct impairments by subwatershed and implement the plans

Future Land Use Decisions

<u>Challenges</u>

1. Protection Ability of Current Municipal Ordinances

One of the most influential methods that municipalities have to protect the environment lies in their responsibility for the health, safety and welfare of their citizens. To carry out this responsibility, the Pennsylvania Municipalities Planning Code (MPC) grants to municipalities the power to regulate land use. Municipal ordinances are developed over time to best manage land use issues. However, as land management philosophies have changed, it is necessary to periodically review the current ordinances and modify them as needed to encourage environmentally-sound development in the watershed.

Potential Solutions

i. Perform Codes and Ordinances Worksheet (COW) analysis for municipalities of the watershed to determine strengths and weaknesses of current regulations
    1. This tool is available through the Center for Watershed Protection
ii. Work with municipal managers and staff to identify ways that municipalities can better protect the environment in routine decision-making

2. Protection of Riparian Areas

Effective riparian buffers have proven to play a key role in overall watershed health. Existing, functioning riparian buffers must be protected. The municipalities of the watershed need stronger tools and ordinances to protect these important features.

Potential Solutions

i. Develop a model Riparian Overlay Zoning Ordinance in cooperation with municipal officials
ii. Negotiate Conservation Easements on properties to protect existing riparian areas
iii. Educate riparian landowners about how to better manage their streamside lands

3. Protection of Natural Resource Areas

Natural resource areas include wetlands, floodplains, steep slopes, rare and endangered habitat listed in the Centre County Natural Heritage Inventory, contiguous forest lands, sinkholes, critical recharge areas, first-order streams, and riparian buffers. Each of these resources contributes positively to the overall health of the watershed, both individually and in conjunction with each other as part of the larger ecosystem. Some of these natural resources are protected by regulation, but others are not. Important natural resources should be defined by the community, mapped, and protected by municipal ordinance.

Potential Solutions

i. Develop specific protection criteria to consistently define and identify natural resources for protection
ii. Map these natural resources in GIS through the comprehensive planning process and distribute the information to municipalities
iii. Develop a model natural resource overlay zone in coordination with municipal officials

4. Environmental Education for Municipal Officials

Municipal officials change frequently and are expected to learn about many complex issues in the course of their public service duties. Municipal officials also have various educational and professional backgrounds and interests. Traditionally, environmental planning and decision-making has not been the highest priority at the municipal level given competing needs and limited resources. Therefore, it is vital that the newly elected officials be educated about environmental issues and their economic consequences.

Potential Solutions

i. Work with municipal managers and staff for their expertise and experience and to ensure continuity
ii. Determine environmental education needs of each municipality
iii. Develop concise documents to teach the basics
iv. Determine and develop the most appropriate methods to make the information available to municipal officials

Summary

The Spring Creek Watershed Plan is a project of the Spring Creek Watershed Commission, a group of elected and appointed officials that voluntarily meet bi-monthly to discuss issues of watershed concern. The Watershed Commission is generously supported by the Centre County Board of Commissioners through the Centre County Planning Office. Phase 1 of the Spring Creek Watershed Plan was funded by the Pennsylvania Department of Environmental Protection and facilitated by the ClearWater Conservancy on behalf of the Spring Creek Watershed Commission. A Watershed Planner on the staff of the ClearWater Conservancy worked closely with a Project Management Team composed of a variety of key stakeholder representatives in the community.

Phase 1 of the Spring Creek Watershed Plan was a learning experience for the members of the Project Management Team. Research, analysis, and critical discussions with key watershed stakeholders over the course of the project led to a change in overall watershed planning philosophy and the methods that the community will employ to carry out the next steps of the Spring Creek Watershed Planning and Implementation process.

The Project Management Team determined that creating a watershed plan using a traditional comprehensive planning process and format would not be effective in the Spring Creek Watershed because of the length of time it would take, the amount of funding it would consume, and the level of planning that already exists. The Team therefore focused on completing Phase 1 of the project with a concise statement of the water resource management challenges facing this watershed and the potential solutions that are available for solving these challenges. The Challenge – Solution Matrix and supporting narrative synthesizes and condenses the abundant research and planning for a set of very complex and interrelated issues in the Spring Creek Watershed into a framework for effective future community decision-making and action.

To continue the Watershed Planning and Implementation process in the Spring Creek Watershed, the Project Management Team has outlined several next steps to facilitate in 2004.

1. Project Selection

With the completion of the final report for Phase 1 of the Spring Creek Watershed Plan project, the Project Management Team believes that the watershed has a plan framework with sufficient detail to begin prioritizing and advancing projects that will produce measurable positive environmental results. The Project Management Team recommends that the Spring Creek Watershed Commission, as the client of the Spring Creek Watershed Plan, prioritize and select the projects to advance to completion as Phase 2 of the Watershed Plan.

In addition, several other stakeholders of the Spring Creek Watershed Community—including ClearWater Conservancy, the Centre County Planning Office, the Centre Regional Planning Agency, University Area Joint Authority, the State College Borough Water Authority, the fourteen individual municipalities, the Spring Creek Chapter of Trout Unlimited, the Centre County Conservation District, The Pennsylvania State University, and others—may be able to move forward with specific projects that improve the watershed and help to carry out their individual missions in the community. The project selection process will include the Spring Creek Watershed Community Coordinating Committee in an effort to coordinate actions and foster communication of ideas, issues, and initiatives. A public forum will also be offered to share the Watershed Planning and Implementation project selection process with the wider community and to provide public input back to the Spring Creek Watershed Commission.

2. Implementation

Implementation of a given priority project could involve additional specific research, planning, communication, development of tools or processes, identification of funding sources and project partners, and most critically, the project's implementation in the watershed. The Project Management Team has outlined the prioritization and project selection process, which will take place with the Spring Creek Watershed Commission and the Spring Creek Watershed Community Coordinating Committee in spring 2004.

3. Communication

As the Watershed Planning and Implementation process moves forward to project implementation, communication with key stakeholders remains a critical task of the overall effort. The Project Management Team recommends utilizing the Spring Creek Watershed Community Coordinating Committee as the vehicle to facilitate communication of watershed issues and coordinate watershed-based projects. The Spring Creek Watershed Community initiative is currently staffed and facilitated by the ClearWater Conservancy. The Coordinating Committee will continue to work closely with the Spring Creek Watershed Commission.

Volunteer committees of the Spring Creek Watershed Community are also currently exploring more efficient and effective ways to reach out to watershed stakeholders, evolving from the current *Springs&Sinks* publication and the www.springcreekwatershed.org website. These two communication outlets will be incorporated into the overall Watershed Planning and Implementation process as it moves forward.

4. Recommendation of a sustainable "implementing entity"

From the beginning, key stakeholders in the Spring Creek Watershed have recognized the need for a watershed-wide "implementing entity" to ultimately oversee the Watershed Planning and Implementation process and carry out and coordinate watershed-based projects and initiatives. A critical task of Phase 1 of the Spring Creek Watershed Plan involved research into the types of entities that have been established in other communities and their relevance and potential political acceptance in the Spring Creek Watershed.

In the next phase of Watershed Planning and Implementation in the Spring Creek Watershed, the Project Management Team will further develop and refine information on the range of possible solutions that could most effectively carry out these Watershed Plan implementation functions. Recommendations may be made for both shorter-term, interim solutions and longer-term, ideal solutions. Community consensus will play a critical role in any decisions that are made regarding this issue in the future.

As a stakeholder in the Spring Creek Watershed Planning and Implementation effort, ClearWater Conservancy is currently seeking funding to continue the facilitation of the Spring Creek Watershed Community effort and carry out the next steps of the Spring Creek Watershed Planning and Implementation process. Closely related to these efforts, but funded as separate projects, is the Water Resources Monitoring Project that ClearWater administers on behalf of the Spring Creek Watershed Community and a new proposal to regionally provide several NPDES phase II outreach and public involvement components for the Spring Creek Watershed's MS4 permit holders.

Phase 1 of the Spring Creek Watershed Plan has provided a clear framework and direction for coordinated action by the Spring Creek Watershed Commission and watershed stakeholders involved in the Spring Creek Watershed Community. As the focus of watershed initiatives now shifts to implementation, the Project Management Team, on behalf of the Spring Creek Watershed Commission, would like to thank the Pennsylvania Department of Environmental Protection for its past and continued support of watershed protection and enhancement in the Spring Creek Watershed.

Appendix A. Spring Creek Watershed Plans and Studies

1. **Searchable Bibliographic Database for the Spring Creek Watershed (1999); Spring Creek Watershed Community** – This database is a compilation of approximately 300 documents that specifically study an aspect of the Spring Creek Watershed and/or its tributaries or include the Spring Creek Watershed within a larger study area.

2. **Act 167 Stormwater Management Plan for the Spring Creek Watershed (2002); Sweetland Engineering and Associates, Inc. & Centre County Planning Office** – This plan is the first in the Commonwealth to incorporate the new requirements of NPDES Phase II (effective March 2003 nationwide). The plan offers watershed municipalities new BMPs to treat stormwater and requires stormwater recharge through the new ordinance.

3. **Various Act 537 Plans in the Watershed (2 major in Spring Creek Watershed)** – These sewage facilities planning documents project sewage service needs in the community and recommend best sewage treatment and disposal alternatives for areas and specific sites.

4. **Nittany and Bald Eagle Greenways Plan (2002); Yost, Strodoski and Mears & Centre County Planning Office** – This plan details the "ribbon of green" concept for Spring Creek and its tributaries from the headwaters to Bald Eagle Creek and further downstream to Bald Eagle State Park.

5. **Centre County Comprehensive Plan (1979, Phase I of the current update, 2003); Centre County Planning Office** – As required by the MPC (2000), counties must complete a comprehensive plan that is compatible with other regional and municipal comprehensive plans. This plan develops a vision for Centre County, inventories its natural and community resources, tracks land use changes, and proposes a growth management plan for the future.

6. **Centre Region Comprehensive Plan (2000); Centre Regional Planning Agency** – The overall purpose of this document is to provide a framework for regional coordination of the six Centre Region municipalities in all aspects of comprehensive planning. The primary theme of this plan is the importance of growth management, given the rapid population growth taking place in the Centre Region.

7. **Nittany Valley Joint Comprehensive Plan (currently in development); RothPlan** – The Nittany Valley Joint Planning Commission was formed in 2002 to coordinate planning in five municipalities in the "downstream" portion of the Spring Creek Watershed. This plan will be another positive model for regional planning.

8. **Spring Creek Rivers Conservation Plan (Spring Creek Corridor Study and Spring Creek Study, Phase II) (1994 and 2001); Penn State University Department of Landscape Architecture and ClearWater Conservancy** – These documents form the framework for conservation in the Spring Creek Watershed. Watershed-wide and site specific recommendations for natural and cultural resource protection and enhancement are discussed, illustrated, and prioritized.

9. **Centre County Natural Heritage Inventory (1991, updated 2002); Western Pennsylvania Conservancy, Centre County Planning Commission, ClearWater Conservancy** – These studies seek to document the critical natural areas of the county, from a biological diversity and ecological integrity viewpoint. The Inventory is an important planning tool to identify and rank areas of the county for future protection.

10. **Vision 2020: Living with I-99 Land Use and Sustainability Plan (2001); Community Planning Consultants and ClearWater Conservancy** – This community visioning and planning effort sought to prepare the local area for the land use implications of Interstate 99. Twenty-eight strategies were created to assist municipal officials in implementing the vision: to maintain a balance between a diverse economy, a healthy environment, distinct communities, and an efficient transportation system in the Mid-Bald Eagle Watershed.

11. **Bellefonte Waterfront Master Plan (2002); Land Studies, Inc.** – Currently, a large portion of Bellefonte Borough's Spring Creek stream frontage is either un-used or underutilized. The plan illustrates the mixed use redevelopment potential of the waterfront and identifies opportunities to enhance, protect, and restore the natural resources and environment of the stream corridor.

12. **Protection and Management Plan for the Millbrook Marsh Nature Center (1998); Penn State Cooperative Wetlands Center, ClearWater Conservancy** – The overall goal of this plan is "to protect, restore, and enhance the biotic, abiotic, cultural, and scenic values of the site and to promote public understanding, appreciation, and enjoyment of this heritage…" Millbrook Marsh is one of the most ecologically important areas in the watershed. It is located at the confluence of two impaired stream segments and filters pollutants from those streams.

13. **Local Comprehensive Plans and Zoning Ordinances** – Fourteen municipalities make up the Spring Creek Watershed. Some cooperate on comprehensive planning, but each has their own zoning and other ordinances.

14. **Trout Unlimited Study of Spring Creek (2000); Land Studies, Inc.** – This report identified restoration opportunities along the streams in the Spring Creek Watershed. A few of the projects, the Military Museum in Boalsburg and Spring Creek Park outside of Bellefonte, have already been completed, but many more opportunities for projects still remain.

15. **Spring Creek Water Resources Monitoring Project Annual Reports (1999-2002); Spring Creek Watershed Community** – These reports are produced at the conclusion of each monitoring year. A volunteer water resources monitoring committee developed the monitoring protocol, leads the decision-making and planning for future years, and evaluates potential expansion of the project. The data have been used by watershed stakeholders in academic research and in DEP aquatic investigations. A baseline of data is being established to compare against future changes.

16. **DEP Aquatic Investigations (most recent 2001)** – Over the past 40 years, DEP has conducted several aquatic studies on parts of the Spring Creek Watershed's streams. In many cases, the studies were done at specific sites in response to a pollution event. Since 1997, DEP is systematically assessing the waters of the Commonwealth to determine the lakes and streams not attaining their designated use(s). In 2001, Spring Creek and its tributaries were assessed and found to have a total of 16.2 miles (~20%) impaired due to a variety of causes.

17. **The 1996 International Countryside Stewardship Exchange Report (1996); The Countryside Institute** – The Exchange addressed land conservation, community development, and other related issues by pairing experienced professionals from North America and Europe with the leaders of the local community. Spring Creek Watershed was chosen as one of two exchanges in this year. The team visited the watershed for one week and gave a formal report about the strengths, weaknesses, opportunities, and threats in the watershed. Community momentum led to the creation of the Spring Creek Watershed Community, which continues to guide watershed discussion and planning.

Appendix B. Watershed Plans and Integrated Water Resource Plans from other Watersheds

18. ***Watersheds* – An Integrated Water Resources Management Plan (2002)** – This document is a supplement to the Chester County Comprehensive Plan and was an effort of the County Water Resources Authority. The Plan contains a watershed assessment, with an emphasis on identifying priority areas and implementation strategies for the entire County. This effort is the benchmark for Water Resources Planning in the state and was a research staple in Phase 1.

19. ***Pennridge Water Resources Plan* (2002)** – This plan focused on an eight municipality area in Bucks County that has been experiencing rapid growth. The plan was created to proactively address future growth while focusing on water quality and quantity issues. Specifics included a water quality assessment, utility planning, and water budgets.

20. **Lancaster County Water Resources Plan (1996)** – "The purpose of (this plan) is to protect groundwater resources, improve water supply planning, secure future drinking water supplies, and improve environmental quality. This plan specifically focuses on water supply planning and wellhead protection. It does not encompass all aspects of water resources planning and management…"

21. **Juniata Watershed Management Plan (2000)** – This plan is the Rivers Conservation Plan for the 3,400 square mile Juniata River Watershed. Due to its size and scope, the plan is very general in its findings and recommendations. The recommendations are listed in matrix format and prioritized for implementation. The plan offers some direction for implementation, but like many other planning efforts, specific actions will need to be developed to ensure the success of future programs.

22. **Jacobs Creek Watershed Management Plan (2002)** – The 98 square mile Jacobs Creek Watershed encompasses several rural communities and is located in southwestern PA. Created by students in PSU Center for Watershed Stewardship, this plan is a comprehensive review of the whole watershed. The plan was created for the Jacobs Creek Watershed Association to outline problems faced by the watershed and offer general recommendations for solving them. The plan shies away from political issues, because many of the municipalities are very cautious of municipal cooperation and planning efforts.

23. **Nescopeck Creek Watershed Stewardship Report (2002)** – The Nescopeck Creek Watershed is approximately 215 square miles and is located in northeastern PA. Although mainly rural, the city of Hazleton sits near the center of the watershed. This plan was also a project of the PSU Center for Watershed Stewardship. The three main issues from this plan are outreach and organization development, water quality, and land-use and ecosystem planning. The recommendations are very general and offer few specifics for implementation.

24. **Maiden Creek Watershed Report (2000)** – The 216 square mile Maiden Creek Watershed in southeastern PA is relatively rural. This was the first PSU Center for Watershed Stewardship project. Many of the water resource issues in this area are agricultural, though some minor development pressure is being felt by some medium-sized towns. The recommendations in this Plan are conceptual.

25. **Kettle Creek Watershed Plan (2001)** – Kettle Creek is located in northcentral PA and is a popular destination for trout fisherman. Although 90% of the watershed is forested and many of the streams are designated as Exceptional Value – Cold Water Fishery, several non-point source pollution issues were addressed. The Kettle Creek Watershed group has a strong stake in the watershed, and is working to implement the plan's recommendations.

26. **Sinking Run Watershed Stewardship Plan (2003)** – The Sinking Run Watershed is a smaller watershed (~29.5 square miles) located in northeastern Blair County. 98% of the watershed is covered either by forest or agriculture, with the remainder built in single-family residences. Some of the main threats to this watershed are a lack of riparian buffers, the potential for a large increase in population from urban areas (Altoona, State College), and the lack of organized wastewater treatment.

27. **Schuylkill Watershed Conservation Plan (2001)** – This watershed is almost 2,000 square miles and encompasses seven counties in southeastern PA. The plan was created as a guidebook for municipalities and nonprofits to address the long-term health of the watershed. The plan focuses on three major areas: watershed lands, water quality, and watershed institutions. The recommendations were created to guide discussions and actions but did not offer specific solutions.

28. **Back River Watershed Management Plan (MD) (1998)** – The Back River Watershed is approximately 56 square miles and is located in the northeastern corner of the city of Baltimore and in Baltimore County. At the time of the plan, the watershed was about 70% developed, with impervious cover at ~29%. The focus of this plan was watershed management from a stormwater perspective, identification of specific retrofit opportunities, and estimation of costs associated with these projects at sub-watershed levels. The management recommendations focused not only on flow management but also on levels of phosphorus and nitrogen.

29. **Powhatan Creek Watershed Management Plan (VA) (2001)** – This plan was created by the Center for Watershed Protection, one of the leading agencies in watershed research. The 22 square mile watershed feeds into the James River in eastern VA. The plan recommends actions to be taken by James City and includes costs, a time schedule, and subwatershed management plans. This plan is a good example of the level of detail that should be achieved in Phase 2 of our Spring Creek Watershed Planning and Implementation efforts.

30. **Yarmouth Creek Watershed Management Plan (VA) (2003)** – This plan is very similar in nature and area to the Powhatan Creek Watershed, and was also developed by the Center for Watershed Protection.

31. **Lower Susquehanna River Basin Comprehensive Watershed Management Plan (ongoing)** – The Susquehanna River Basin Commission is performing this study for the 4,000 square mile basin. The study is focusing mainly on water supply and demand issues, with additional emphasis on water quality, stressed stream reaches, water resource infrastructure, and water resource management. The study currently outlines major tasks, which will relate to chapters in the plan. The entire study is expected to be completed by the end of 2005.

32. **Arlington County Watershed Management Plan (VA) (2001)** – Although created at the county level, and at a small scale (~34 square miles), the structure and recommendations of this plan are appropriate for the future direction of watershed planning in the Spring Creek Watershed. The plan breaks the county into 19 subwatersheds and analyzes them for water quality, impervious cover, and stormwater management. It explores both present and future scenarios. The recommendations are specific in location and action and include total costs to accomplish the given goals. The county is ~35% impervious and is trying to reduce the impact of development on the streams. This plan is also a great "what if" example for the Spring Creek Watershed.

33. **Lower Cedar River Basin and Nonpoint Pollution Action Plans (WA) (1996)** – This watershed is about 188 square miles and flows around the city of Seattle in western Washington. The plans were created to alleviate serious flooding problems, to protect and enhance pristine salmon habitat, and to ensure high quality water. The funding and staffing for the creation of these plans came from the county and city governments.

34. **Foster Joseph Sayers Lake Watershed Assessment (2003)** – This plan focuses on methods to improve water quality in the lake at Bald Eagle State Park, by addressing nitrogen and phosphorous pollution. The watershed is 339 square miles and includes the Spring Creek Watershed within its boundaries. The recommendations are conceptual in nature. Data from the Spring Creek Water Resources Monitoring Project were used in this plan.

35. **Lackawanna River Watershed Conservation Plan (2001)** – This approximately 350 square mile watershed covers four counties in northeastern PA. The plan addresses a large number of categories, from water supply to recreation, and looks very similar to our Spring Creek Rivers Conservation Plan (also completed in 2001). The recommendations are meant to guide municipal decisions at the conceptual level. Specific actions are not offered.

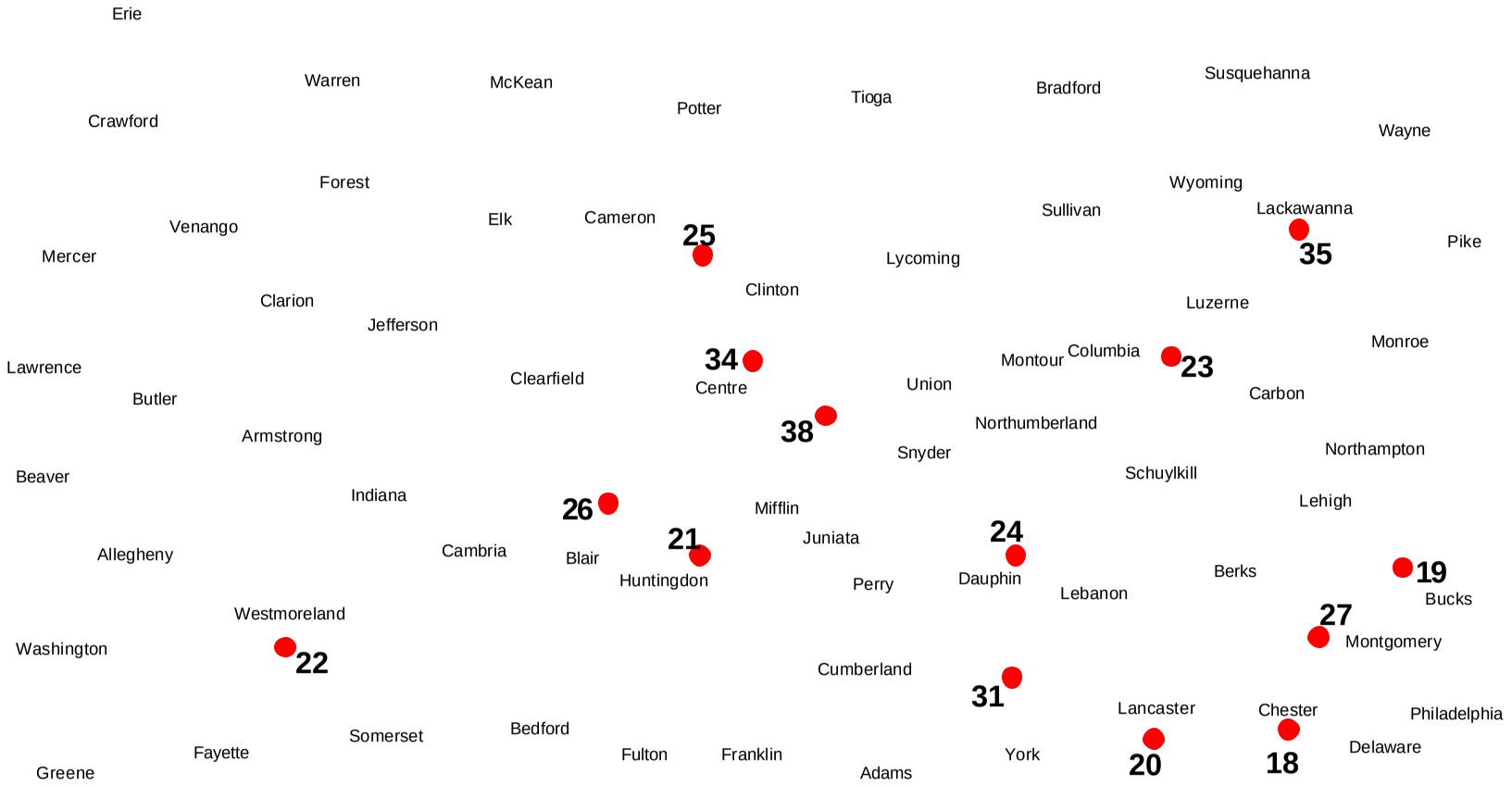
36. **Bowker Creek Watershed Management Plan (BC, Canada) (2002)** – Although the watershed is very small (~6mi^2), some of the concepts and the format could be applicable to Phase 2 of the Spring Creek effort. Each action item for the watershed lists a timeline, resources needed (cost or staff time), sources for the resources, a lead agency, supporting agencies, and a contact person. Little ambiguity has been left in this plan. One of the key actions is the creation of a Master Drainage Plan (MDP) for the watershed, understanding the complete hydrology, both with current development and projected development changes (retrofitting and new development). The challenge in applying this level of detail to our 175mi^2 watershed is one of scale.

37. **Strategic Plan for Managing Oregon's Water Resources 2001-2003 (OR) (2001)** – This is a different sort of plan, created by the Water Resources Commission of Oregon, an administrative and policy arm of the State Water Resources Department. This Plan outlines the new ideas and planned activities for Oregon's water resources from 2001-2003. The activities will be mainly performed by the WRD and include a stewardship and supply initiative to assess surface and groundwater supplies and perform basin assessments, evaluation of water rights and availability for new users, public outreach programs, and funding.

38. **Penns Creek Watershed Assessment (2002)** – The 240 square mile Penns Creek Watershed contains mainly agricultural and forested lands with a scattering of small towns. The watershed has experienced minimal growth, but is beginning to feel the impact of development pressure from the State College area of the Spring Creek Watershed. The plan includes implementation strategies for land use, agriculture, economy, stormwater, volunteerism, and overall watershed restoration. The strategies for implementation are fairly specific, detailing partners, costs and a timeline for completion. A few of the recommendations suggest creating additional plans for specific items, such as development and stormwater.

Location Map of Pennsylvania Plans in Appendix B

(Numbers on map refer to order in Appendix B)



Appendix C. Watershed Related Studies and Resources

39. PA Water Resources Planning Act 220
40. PA DEP Source Water Protection Program (SWAP) description
41. *Water Demand Management Within the Integrated Resource Planning Process*
42. *Integrated Resource Planning and Strategic Planning for Water Utilities*
43. *The Economics of Watershed Protection*
44. *Watershed Assessment Framework* – CWS Keystone Projects
45. PA DCNR Watershed Planning: Rivers Conservation Plan Outline
46. *Putting Together a Watershed Management Plan: A Guide for Watershed Partnerships*
47. A Stream Corridor Protection Strategy for Local Governments
48. *Low Impact Development Offers Some Solutions for Groundwater Issues*
49. Literature Review of the Impervious Cover/Stream Quality Relationship
50. *Watershed Planning in a Developed Urban Area*
51. *Developing an Applied System of Ecological Indicators for Measuring Restoration Progress in an Urban Watershed*
52. Rapid Watershed Planning Handbook
53. Better Site Design: A Handbook for Changing Development Rules in Your Community
54. PA Municipalities Planning Code

Appendix D: USGS Conceptual Model Report

(To be attached as a separate document)

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