4 The Baseline: Portraits of the Watershed

Degraded watersheds are like sick people. They have to be observed and undergo tests before adverse conditions are relieved, and most ills are cured. In short, an information baseline is necessary before strategies and projects for fixing and improving the creek can be done.

The baseline for Paxton Creek watershed provides a broad range of topical information that is the foundation for a meaningful Rivers Conservation Plan. Information on the watershed's natural resources, its history and culture, and its problems and prospects are summarized in this chapter.

Stakeholders Speak on Watershed Issues!

Building upon the watershed visioning exercises, further efforts at taking the general stakeholders' pulse involved four planning workshops, two written surveys, and other vehicles. Issues important to watershed stakeholders are evident:

- ☑Water resources (floods, stormwater, groundwater, and water quality)
- ☑Sprawl with preservation of farmland and open space
- ☑Natural resource losses (habitat, natural vegetation, soils, wildlife) in urbanizing Paxton Creek watershed.

Educational Gathering

Insights were gained also through data inspections, interviews with resource professionals and municipal officials, and numerous discussions at meetings, conferences, and river festivals (Table 4.0). These opinions reinforced those of the general stakeholders, and pointed out additional watershed concerns and opportunities:

- ☑Culture and development (recreation, urban redevelopment)
- ☑Education and outreach (watershed awareness and creek-based education).

Table 4.0 Watershed Issues and Problems

Category	Issue or Problem	Issue or Problem
Water	Excessive Runoff	Frequent Floods
	Insufficient Groundwater Recharge and Inter-basin Water Transfers	Water Quality Decline
Land	Degraded Uplands Impervious Cover Excess Sparse Open Space	Degraded Creek Channels Severe Erosion Diminishing Wildlife Habitat
Culture and Development	Additional Creek-based Recreation	Lagging Urban Redevelopment
Education (and Outreach)	Lack of Watershed Awareness	Insufficient Creek-based Education

"Paxton Creek: Among the biggest sediment producers...of the* nation's most endangered river *(American Rivers, Kober 2005)"

In written surveys stakeholders including land owners indicated support for various future land uses (woodlands, open space), and specific rehabilitation approaches (tree buffers, low impact development). They show only moderate to low support for improvements featuring trail/path systems, greenways for economic development, floodwaters storage, protected areas for beauty and history, and additional recreation sites. The watershed landowners value very highly their residences, views of wildlife/nature, and leisure walks near the creek. They do not care much for all terrain vehicle or snowmobile recreation.

Trail Link

In terms of revenue-and non-revenue generating activities, respondents have very low support for light industrial facilities, and additional commercial and residential development. Substantial support exists for modest tax increases to pay for watershed improvements, and the use of private lands for creek projects, but opinions differ on amounts and responsibilities. This situation underscores a big problem: revenue generating land uses (industry and commerce) are not favored. This places greater financial responsibility on existing property owners, and the need for alternative financing of watershed improvement projects.

Another way of looking at concerns and issues is the collective perspectives of different groups of stakeholders such as residents, government officials, conservationists/environmental professionals, and water/wastewater managers They have additional insights which include concerns for future growth, revenues, aging water infrastructure, and protection of water supply resources.

Growth: Population, Developed Land and Impervious Cover

Prior to development, the watershed was nearly all forested. During the 1700s and 1800s, many trees on flat or rolling terrain were logged for lumber, farming, and related purposes. The population boomed in Harrisburg and Penbrook bringing with it a heavy concentration of roads, residences, businesses, government, commerce, and industry that continues today, as shown in a current land cover and land use map for the watershed (Figure 4.0).

After World War II, the watershed underwent a growth spurt. New development shifted to the suburbs, beginning in Susquehanna Township in the 1950s and 1960s and continuing most notably, today, in Lower Paxton Township. As the population in Harrisburg decreased by half in the last half century, the Lower Paxton population increased ten fold!

Population projections for watershed municipalities to 2020 show a further loss in Harrisburg, a small increase in Penbrook, and roughly 15% increases in the two townships. (Park, 2003) More roads, homes, stores, businesses, schools, churches, and utilities typically accompany increased growth.

Vacant developable land in the watershed is projected to diminish by 90% in the next 20 years. Almost half of an estimated additional 15,500 dwelling units are projected for Lower Paxton Township, and about a quarter each for Susquehanna Township and the City of Harrisburg. Penbrook's projected increase is miniscule (<1%). A comparison of 1949 and 2003 aerial photographs shows marked changes from rural to urban landscape in Upper Paxton Creek North subwatershed, and illustrates what has happened throughout Paxton Creek. (Figure 4.1)

Figure 4.0

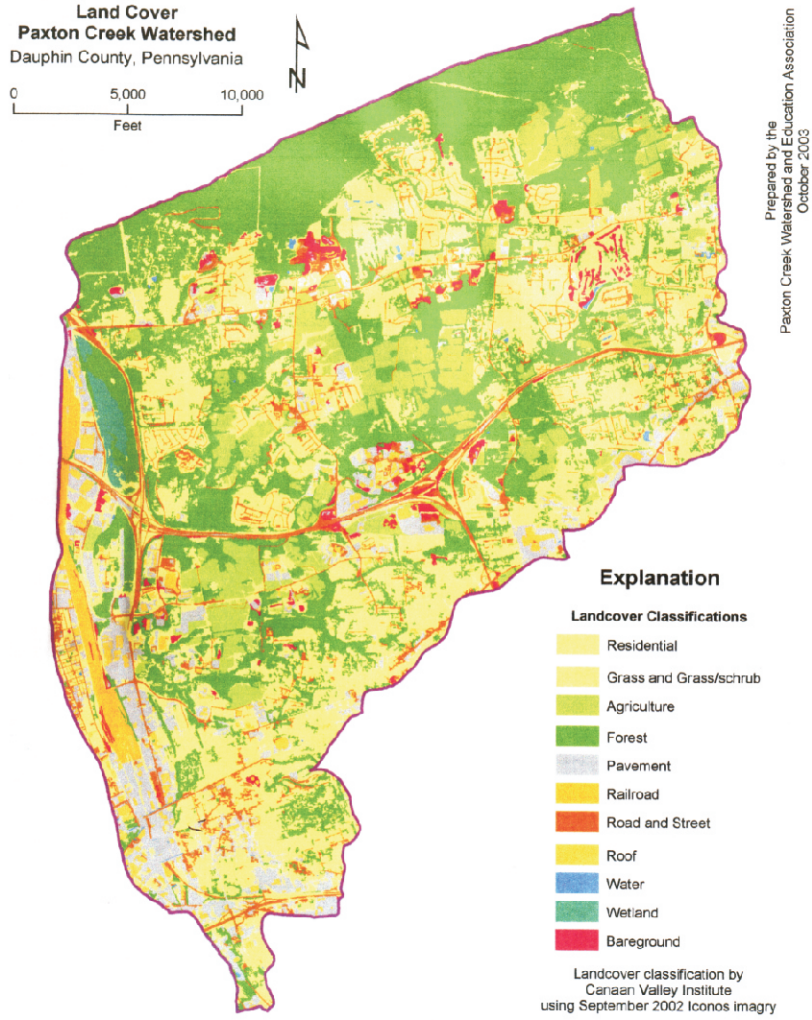
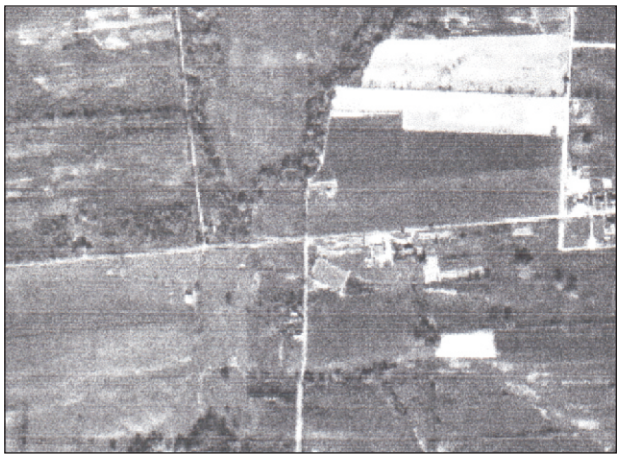
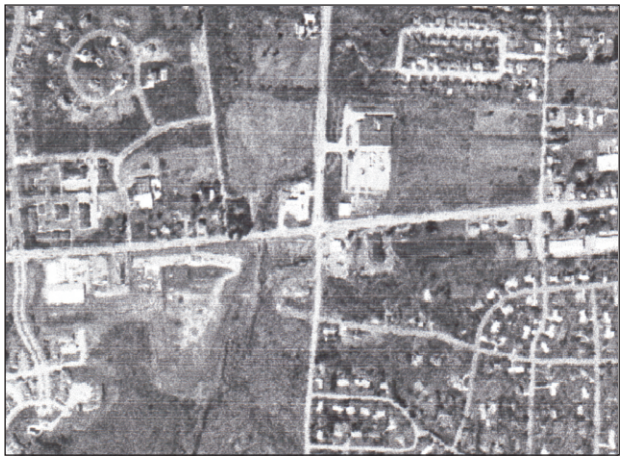


Figure 4.1 A Half Century of Sprawl: Landscape at the junction of Linglestown Road (Route 39) and Colonial Road



1949



2003

Table 4.1 Impervious Cover Estimates

Subwatershed	Total Area		Impervious Cover (%)		
			Current	Future Estimate*	
	(ac)	(mi^2)		(low)	(high)
Asylum Run	2411.5	3.8	30	44	50
Black Run	2234.1	3.5	21	30	42
Devonshire	861.6	1.3	37	46	56
Linglestown	1960.7	3.1	25	26	42
Lucknow	281.2	0.4	10	25	40
Mountaindale (Fox Run)	734.6	1.1	21	23	38
Paxton Creek (low main stem)	2964.8	4.6	56	58	63
Paxton Creek North (Upper & Lower)	4709.9	7.4	18	30	42
Paxtonia	853.8	1.3	36	39	52
Wildwood Lake	522.1	0.8	38	36	41
Watershed Total	**17,534.3**	**27.4**	**30**	**37**	**48**

* High future impervious cover levels are estimated from maximum impervious acreage allowed by zoning in 2003 and continuation; low estimates are based on average impervious cover coefficients determined for land uses.

The impervious surface associated with watershed development is extensive (30% overall), and is estimated to grow another 12 to 18% by year 2020 (Table 4.1), with the projected changes shown on a map. (Figure 4.2)

Land ownership is mixed in the watershed. Most lands have private tenure, but lands owned by local, state, and federal agencies exist in various locations in the subwatersheds. Most public lands are in the City of Harrisburg and Susquehanna Township.

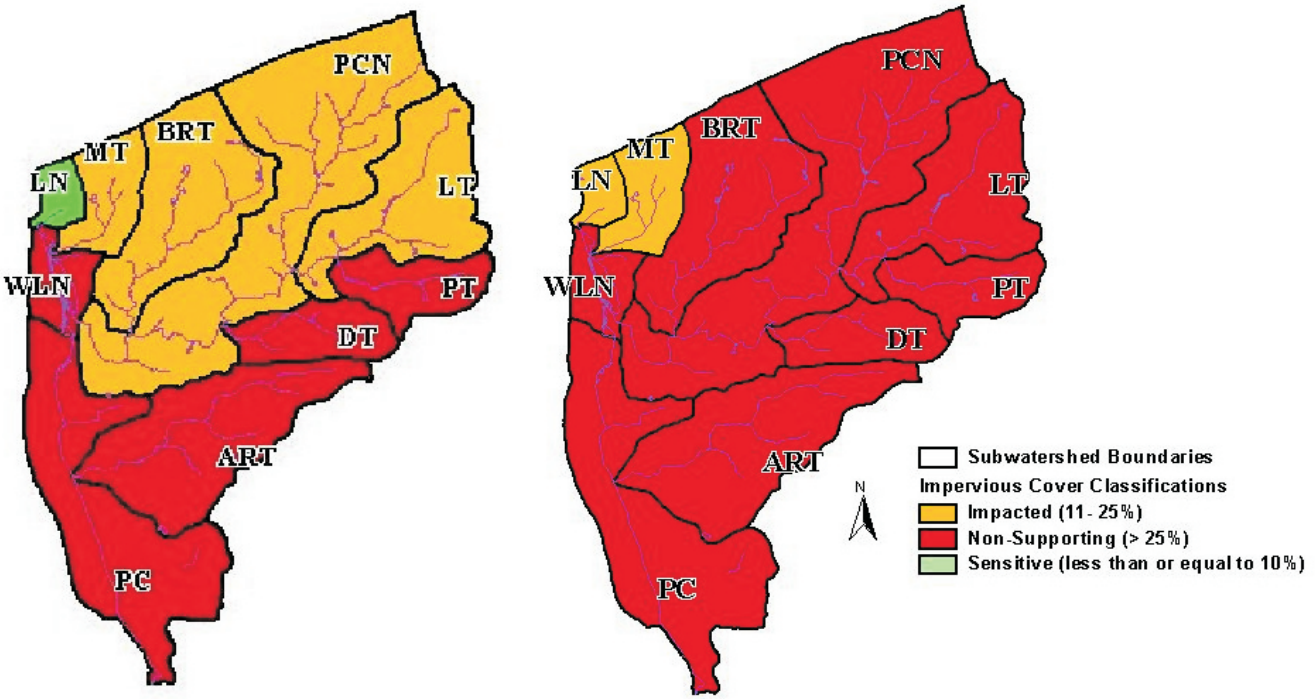


Figure 4.2 Current and Future Impervious Cover

The Baseline: Portraits of the Watershed

What Are the Paxton Creek People Like?

Paxton Creek people are a hardy and diverse lot. They include descendents of *The Paxton Boys* (Scotch-Irish settlers who survived devastating Indian raids); canal men, wagon and motor vehicle drivers; river boatmen and railroad workers; politicians and government employees; European immigrant families who worked the farms, iron works, and neighboring coal mines; returnees from World War II who fueled the second great watershed transformation; Asian refugees from a civil war; and persons displaced by hurricanes and floods. Successful rehabilitation and enhancement of the watershed will require extensive cooperation, participation, and vigor by these persons and others through public-private partnerships over the coming decades. Other characteristics of the area's population in race, income, employment, housing, and education vary among the subwatershed residents. (Table 4.2) Most statistics are for parts of communities that are in the watershed, not the whole municipalities.

Parking Lot Impervious Cover

Table 4.2 Municipality and County Demographic Statistics

Description	Watershed Area				
	Paxton Creek	City of Harrisburg	Penbrook	Susquehanna Township	Lower Paxton
Land Area (square miles)	27.1	5.3	0.2	10.2	11.4
Population per Square Mile	2,214	4,969	8,370	1,477	1,462
Population 2000 Census (no.)	59,774	26,338	1,674	15,071	16.671
Population Cohorts (no.)					
Support Ages (1-21)	18,566	9,693	530	3,806	4,537
Productive Ages (22-49)	23,696	10,606	757	6,525	6,808
Mature Ages (50-64)	9,178	3,462	206	2,608	2,902
Race (no.)	59,775	26,339	1,676	15,062	16,670
Caucasian	33,371	6,571	1,237	10,753	14,820
Afro-American	20,527	15,795	281	3,486	965
Asian	1,592	719	38	319	515
Hispanic	4,449	3,687	85	330	345
Housing Units (no.)	26,536	12,093	780	6,549	7,117
Owner Occupied	14,477	4,735	382	4,564	4,779
Renter Occupied	9,355	5,287	347	1,689	2,031
Vacant	3,708	2,054	51	295	307

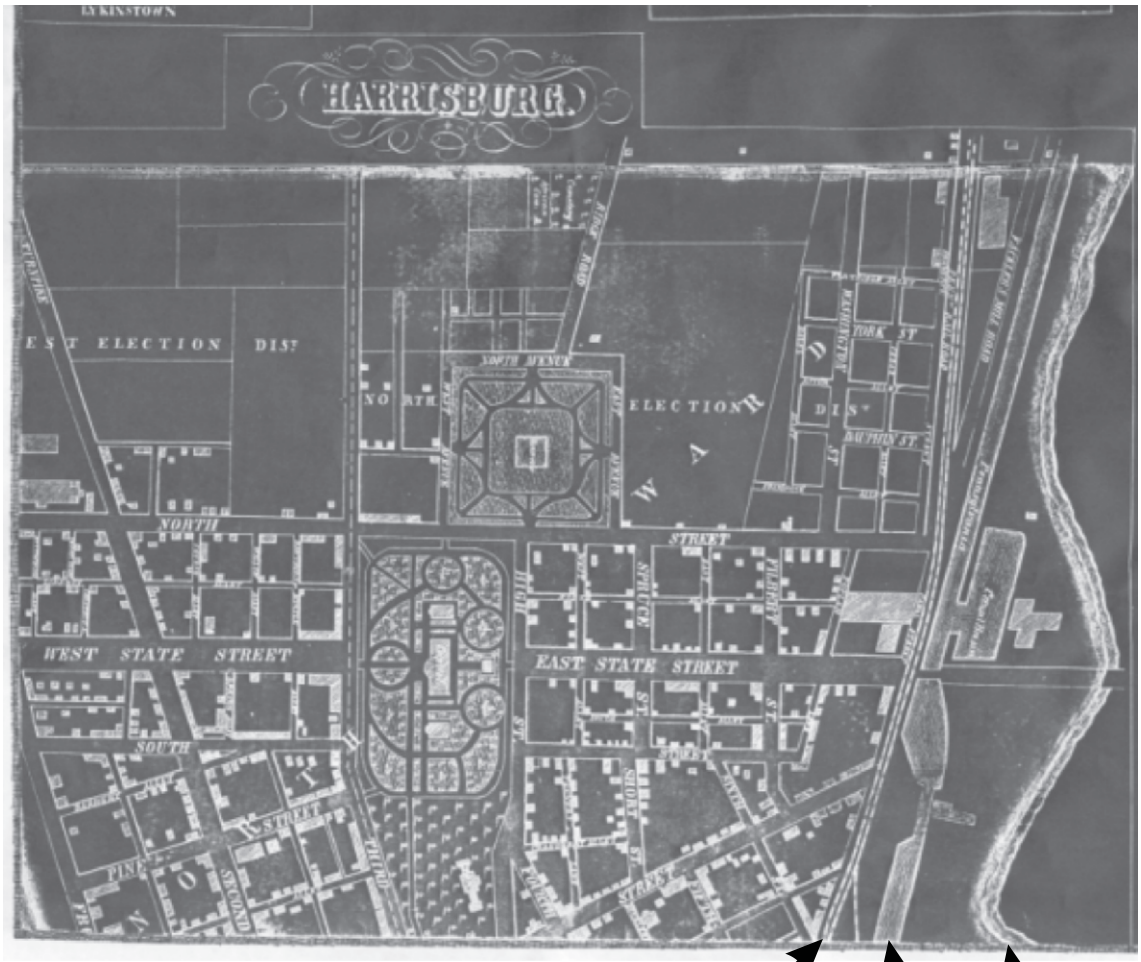
Source: US Census 2000; compiled from subwatershed proportions of Census tracts, block groups, and blocks; omits minor totals (<25 total persons) for Middle Paxton and Swatara Townships *statistics represent county or total municipal populations rather than watershed portions.

The Baseline: Portraits of a Watershed

Rich History and Culture

Paxton Creek watershed has been a crossroads for thousands of years. Its topography includes a nearby great water gap, a section of Blue Mountain carved open by the force of melting glaciers that created the Susquehanna River. The natural terrain provided land and water routes going east to west and north to south. Three centuries ago foot paths began giving way to roads, highways, a canal, trolleys, and railroads as humans settled and transformed the watershed.

Paxton Creek history is rich. The watershed is the site of a grand state capitol built with watershed materials, a place that experienced real terrorism during its settlement (Indian raids), contributed to the success of the American Revolution, and served as a mustering point for 300,000 Union soldiers during the Civil War. The Paxton Creek area was a pioneer in the nation's early Industrial Age, underwent significant community development during its City Beautiful Movement a century ago, and experienced a subsequent decline in watershed health. Today, Paxton Creek sits on the brink of watershed recovery and enhancement.



Harrisburg in 1855

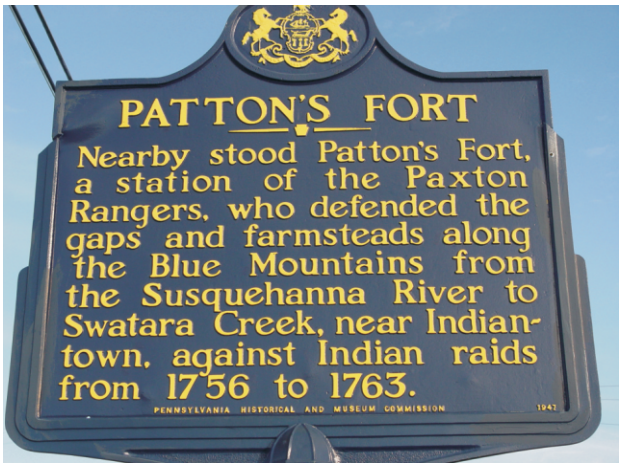
Three hundred years of settlement activities have taken their toll on watershed history, inadvertently destroying historical sites, and changing landscapes with artifacts. The following significant historical and cultural resources have been tallied (Figure 4.3):

- ☑ 8 Historic markers
- ☑ 4 Listed archeological sites (unmapped for protection)
- ☑ 11 Historical cultural features
- ☑ 12 Historic structures on registers
- ☑ 3 Museums, special facilities
- ☑ 5 Historic districts
- ☑ 3 Trails and CA Greenbelt
- ☑ 24 Local unlisted historical sites
- ☑ 2 State forests and game lands

Other historical and cultural landmarks are on the watershed periphery (Susquehanna River Water Gap, Fort Hunter, State Archives, Susquehanna River Water Trail, Paxtang Parkway, Pennsylvania State Museum).

Currently a shortage of creek-based recreation land exists in watershed municipalities. Guided by recommended standards of the National Parks and Recreation Association, the Tri-County Regional Planning Commission estimates an additional 665 acres are needed for municipal parks in Dauphin County by 2020 (Park, 2003), of which nearly a quarter of the acreage (24%) should be located in the watershed (as per projected residential populations).

Figure 4.3 Historical Marker



Watershed Wildlife and Habitats -- Some Surprises

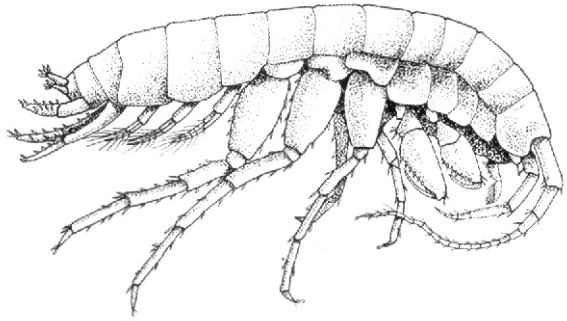
By many measures, Paxton Creek watershed has greater biological resources than habitat conditions suggest. In regional studies done by both the EPA and the USGS, overall watershed conditions for wildlife were found to be poor, because of adverse situations such as small and fragmented natural cover, poor quality of riparian vegetation, development on steep slopes, roads located close to creeks, and absence of interior forest. “A legacy of habitat disturbance” is how one report labeled Paxton Creek's condition (Gap, 1999).

Wetland Habitat

Despite these disturbances, the watershed has small but significant biological resources:

- ☑**Terrestrial (land) and aquatic (water) vegetation:** More than 331 species in major types of plant communities (forest, grassland including wet meadow, and wetland); 33 species of upland plants rarely found in PA; and 3 species on a list of biota with threatened or endangered status maintained by the Pennsylvania Natural Heritage Program (PNHP, formerly the PNDI).
- ☑**Terrestrial and aquatic fauna:** 288 animal species (amphibians, reptiles, turtles, mammals, birds, fish, and macroinvertebrates - commonly known as water bugs) observed or listed in assessment reports; RCP studies found for the first time a rare animal species (creek-bottom dwelling, blind water bug called *Stygobromus* sp.) in Wildwood Lake Sanctuary also listed on the PNHP. (Figure 4.4)

Figure 4.4 Rare Water Bug *Stygobromus* sp.



☑**Five important places with habitat suitable for biota in and near the watershed:** 1) linear forest remnants along the creek provide habitat and create travel corridors for species that use forest edges for access to food and cover; 2) fields and meadows provide significant habitat for butterfly and bird species; 3) Blue Mountain (designated Important Bird Area 51) where updrafts and habitat are used by 150 migratory bird species across the Northeast and Middle Atlantic states; 4) Wildwood Lake Sanctuary containing a superb 90 acre wetland that supports plant and animal species, provides a resource for residential wildlife, and serves as a stopover place for birds in-transit along Blue Mountain; and 5) river islands/surroundings near the creek's mouths having unique biota that temporarily might reside in or visit the watershed.

Top of the Watershed

The challenge is to protect the abundance and diversity of remaining biota, and to increase the habitat's capacity to support higher numbers of plants and animals.

Wildlife diversity in Paxton Creek generally declines from upstream to downstream and from north to south in the watershed. In 2004, wildlife health was better than expected in certain subwatersheds (Paxton Creek) and worse than expected in others (Asylum Run).

Mixed Bag of Headwaters (First Order Tribs)

Paxton Creek has a mixed bag of headwaters, the uppermost channels of drainage areas. Headwaters are small streams (also called first order tributaries or *tribs*) that begin in two ways. They can start as very small flows from the natural landscape. These headwaters have functional floodplains and are often the least degraded parts of watersheds. At the same time, headwaters can be vulnerable to water withdrawals and pollutants. Headwaters can also start as flows from impervious surfaces in built environments. Streams with these origins typically have faster and larger flows, and tend to erode lands more quickly and more severely. They may carry greater amounts of pollutants and create sediment deposits in pools and slow-moving reaches.

In Paxton Creek watershed, only 24% of its headwaters (6.5 miles) are those originating from natural landscapes. The majority begin as runoff from urban lands. Asylum Run, for instance, starts as runoff from the Colonial Park Mall. Urban runoff also contributes significant flow to Linglestown, Devonshire, Paxtonia, Paxton Creek, and Wildwood Lake subwatersheds. These headwaters typically need rehabilitation, whereas headwaters based on natural flow–those starting on Blue Mountain (Lucknow, Martindale, Paxton Creek North, and Black Run subwatersheds)–need protection from conventional development.

Stormwater - The Bane of Paxton Creek Watershed

Paxton Creek's accelerated stormwater runoff creates three major problems for the watershed: 1) more frequent and intense flooding, 2) greater transport of pollutants, and 3) accelerated erosion and sedimentation.

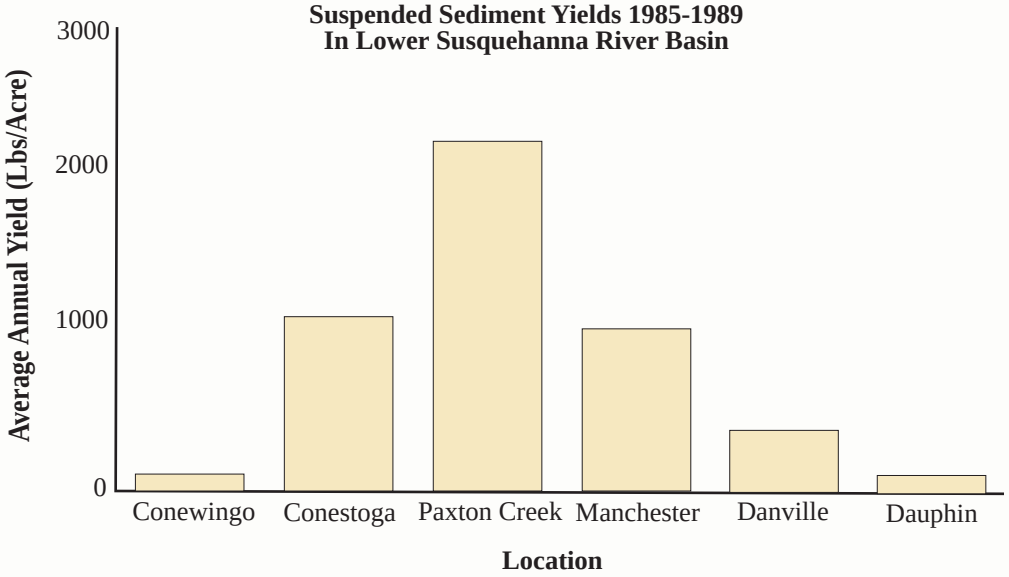
The soil erosion and sedimentation has been so severe that forested deltas have formed in Wildwood Lake, nearly cutting the lake into parts and vastly reducing the lake's water depth. The process has made Wildwood a superb wetland, replacing its value as a fully functioning lake (boating, swimming, storing stormwater).

The amount of sediment carried by Paxton Creek waters varies, but it can be huge. The average annual suspended sediment concentration recorded for Paxton Creek is among the highest (2,300 pounds/acre) in the Susquehanna River basin, an amount 2 to 22 times greater than runoff from places such as Dauphin, Danville, and Conestoga. (Figure 4.5) Paxton Creek is among the worst sediment producers of the Susquehanna River, the nation's most endangered river among thousands nominated for the annual America's Most Endangered Rivers Report. (Kober, 2005)

Lower Creek Flooding

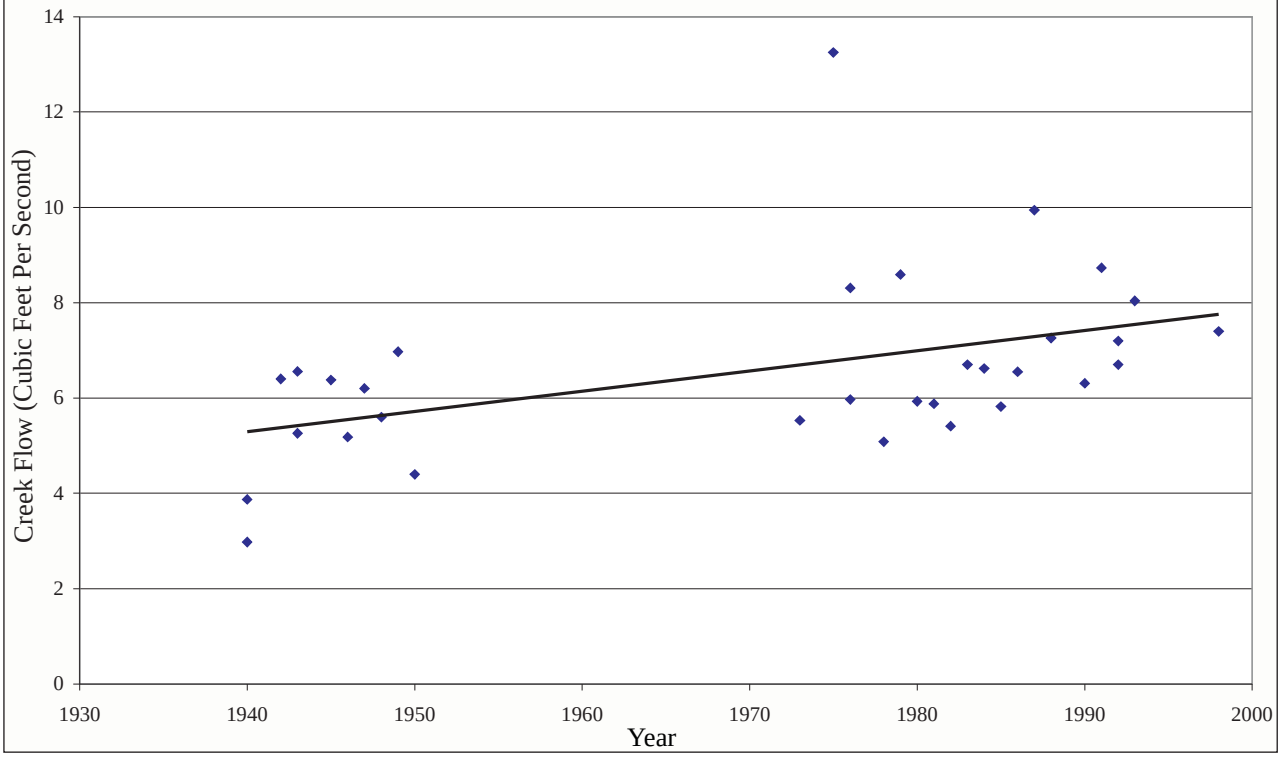
Increased impervious cover in watersheds causes higher and more frequent peak flows of stormwater runoff. (Figure 4.6) This appears to be happening in places along Paxton Creek, such as the Farm Show grounds on Cameron Street. Here the creek's hydraulic gradient is low (bottom is nearly level in the creek channel), causing the creek waters to become sluggish, spill over their banks, and back up into drains on Cameron and Maclay Streets. The situation is made worse by the confluence of high water flows from Asylum Run joining the main stem Paxton Creek only a block downstream from the Farm Show.

Figure 4.5



Data Source: Ott, 1991

Figure 4.6 Rising Trend in Peak Discharge



Data Source: http://nwis.waterdata.usgs.gov/nwis

Paxton Creek is often blamed for additional flooding that is actually caused by the Susquehanna River. During flood stage, the river can rise and back up into Paxton Creek, inundating the Shipoke neighborhood, Shanois and Cameron Streets in south Harrisburg, and other places depending upon the height of the river.

Pollutants wash off the landscape into Paxton Creek during storms. This occurs especially during the beginning of a storm, known as the first flush. The substances carried by stormwater include sediment, nutrients, metals, and coliform bacteria (bacteria associated with animal feces). Although the general origin of sediment and other pollutants in Paxton Creek are evident, analysts do not know the amounts, or loads, carried by stormwater in different parts of the watershed. This information is needed for better watershed planning, projects design, and resource commitment.

Headwaters Flooding

How Clean Are Paxton Creek Waters?

As a result of rapid urbanization, land development practices, and aging infrastructure, Paxton Creek's streams, ponds, and lakes have fair to poor water quality.

Besides sediment, the main water quality problems in Paxton Creek are plant nutrients, dissolved oxygen, coliform bacteria, and, to a limited extent, certain metals. Pesticides and toxic substances have been detected in assessments at only a few sites, but many known toxic waste sites exist. However, no comprehensive watershed study has been conducted of toxic materials.

The PA Department of Environmental Protection (DEP) and the US Environmental Protection Agency (EPA) are aware of the watershed degradation. Segments of the creek have been added to the DEP 303(d) list of impaired water bodies in the Commonwealth. The impairment parameters include high nutrient concentrations, organic enrichment, low dissolved oxygen, high suspended solids, high biological oxygen demand, and excessive silt.

Paxton Creek is in EPA Ecoregion IX, a classification based on soil types, land cover, and other factors. Regarding nutrient criteria developed for this region, Paxton Creek has high nitrogen and phosphorus loads–2.5 times the total nitrogen, and 10 times the total phosphorus recommended limits.

A summary integration of a dozen research reports on surface waters gives a picture of the Paxton Creek water quality:

☑Overall, surface water quality declines from the upper (Blue Mountain) to lower creek reaches for major categories of parameters–chemistry, macroinvertebrates, bacteria, and habitat.

☑Macroinvertebrate populations are generally richer where the creek is in cool, forested areas. The diversity decreases from upstream to downstream; populations of clean water species markedly decline from the mid-to-downstream subwatersheds.

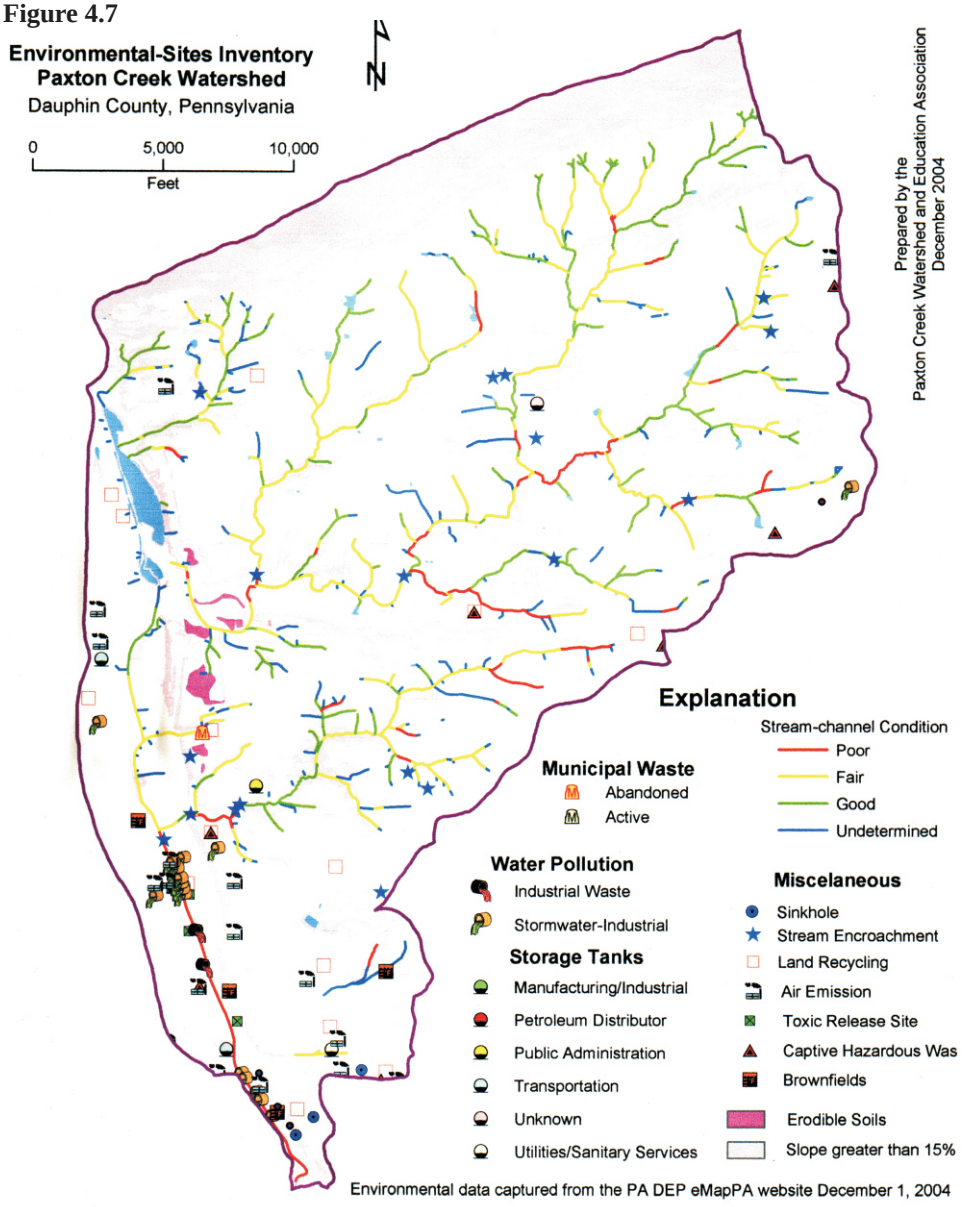
☑Parameters often testing high include sediment, nutrients (nitrogen and phosphorus), metals (zinc, copper, lead–the latter exceeding drinking water standards), and coliform bacteria near points of septic waste contamination or illegal discharges.

Water Bug and Chemistry Assessment

☑Parameters that are adequate most of the time are pH (acidity) and dissolved oxygen (DO). The pH is usually slightly above 7, possibly due to carbonate rock buffering. The DO is generally 6 or more parts per million (ppm), which is adequate for most aquatic creatures, but occasionally extreme levels occur (<4 ppm).

☑The low DO levels, high coliform bacteria counts (animal feces), increased conductivity, and high ammonia, phosphorus, and lead concentrations are common in the channelized segment of Paxton Creek in Harrisburg from the Industrial Road crossing (renamed Wildwood Drive) by the Farm Show, southward toward the creek mouth. Along these channelized creek reaches hundreds of outfalls (pipes) exist, including combined sewer overflow outlets (CSOs). Although more wildlife has been seen in the channelized areas in recent years, these reaches are less healthy than the rest of the watershed. Habitat and macroinvertebrate indices for the bottom-dwelling bugs at these sites are typically one third to one half of those for the upstream watershed.

Figure 4.7



Ins and Outs of Domestic Water and Wastewater

Much of the water consumed or used in the watershed is not Paxton Creek water! Drinking waters come into the watershed, and wastewaters are discharged outside the watershed in what professionals call inter-basin water transfers. Most domestic water used in homes, businesses, and institutions comes from surface water sources, specifically the Susquehanna River and Dehart Dam Reservoir on Clark Creek located north of Blue Mountain. These waters are pumped and treated when necessary to watershed municipalities served by the City of Harrisburg and United Water Company.

These sources currently provide an average 23 million gallons per day (mgd), and can meet a projected, combined water demand of 35 mgd. Concerns exist, however, over the delivery infrastructure (deteriorating pipes, equipment replacement), limited supply from groundwater or other surface water sources (a single pipe 6 miles long connects Dehart Reservoir and Harrisburg.), and additional protection of water supply

sources from incompatible land uses and other threats. In the event of a major disruption groundwater supply would be inadequate. Because much stormwater runs off and does not soak into the ground, aquifer recharge is poor (rough estimate of 9 mgd for a typical moderate storm), vastly limiting groundwater as a source of supply.

Paxton Creek wastewater is handled mainly by sewers carrying sanitary waste, and sometimes stormwater. Wastewater interceptor sewers run in many of the creek corridors. In older, urban areas like Harrisburg, combined sewer systems were built to collect rainwater runoff and wastewater. They are conveyed together in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant using interceptor sewer pipes. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess storm and wastewater directly to nearby streams, rivers, or other waterways. What was considered a sound approach to rid cities of mixed wastewater and stormwater a century ago is now a major source of water contaminants. Pennsylvania leads the nation in the number of combined sewer outfalls (CSOs) along the creek. A study of Harrisburg's 31 permitted CSOs is scheduled for completion this year, followed by addressing the problems within 10 years.

Private septic systems are required for areas not served by municipal sewers. However, septic systems need adequate space and the right soils to function properly. As development occurs the need increases for additional municipal sewers and wastewater treatment facilities.

The public waste disposal systems are operated by various municipal authorities. They supervise, maintain, and finance the conveyance and disposal of wastewater, sharing the fees with water providers. Two plants treat Paxton Creek wastewater–the Advanced Wastewater Treatment Facility of the City of Harrisburg and the Swatara Treatment Plant. Both plants remove phosphorous. Average current wastewater processed by both facilities are 25 mgd, with 44 mgd permitted capacity (almost 50% reserve).

Combined Sewer Outlet

The Watershed– a Recovering Economic Engine

For various reasons (flooding, changed economy, aging infrastructure), economic prosperity has lagged downstream of Wildwood Lake, in other urban neighborhoods, and in semi-rural areas. Prior to World War II Paxton Creek watershed along Cameron Street was the economic workhorse for the area, from the Phoenix Iron Works near the creek mouth to 4 miles upstream at the Lucknow rail yards. This area has been moribund for decades. Only recently have economic stirrings begun (Farm show expansions, hotels proposed to serve the Farm Show area, rail yard upgrade, major commercial redevelopment planned for a large Herr-State Streets parcel. Active upstream economic expansions are also occurring at highway nodes (N. Progress Avenue and I-81), business centers (Interstate Drive, Valley Road), and major connector roads (Routes 22 and 39, Mountain Road). Work-related opportunities still lag, however, as in the enterprise zones.

All this is being done without explicit creek-based alternatives such as miniparks and trails that can assist economic redevelopment.

This RCP is only one effort addressing Paxton Creek's problems. Other initiatives underway in 2005 include an update of the Act 167 stormwater plan for the watershed, the planning and implementation of studies by municipalities dealing with nonpoint source pollution called Municipal Separate Sanitary and Storm Sewer Systems (MS4s), the formation of specific Total Maximum Daily Loads (TMDLs) for Paxton Creek pollutants, a large EPA Targeted Watershed Grant proposal, construction of demonstration stormwater BMPs by the Dauphin County Conservation District, and technical stormwater and low impact development educational programs conducted by various organizations.

Many Persons Don't Know Much About Paxton Creek

The public perceives Paxton Creek watershed mainly as a stormwater drain. As many as one half to three quarters of local stakeholders are neither aware of, nor appreciative of the creek's many functions and benefits. Many persons consider Paxton Creek a non-issue…until floods or droughts occur, land washes away, neighboring open space undergoes development, a major spill occurs, or people get hurt.

The watershed is vastly underused in both formal and non-formal education. Public schools generally fall short in using Paxton Creek watershed in classroom curriculums, and as an outdoor learning environment. Transport cost, liability concerns associated with field trips, and curriculum designs are among the reasons given for under-using this local resource. Although PCWEA has been particularly active in community education, averaging 1.2 educational activities each month for three years, watershed awareness and creek-based education still languish. Options for enhanced educational awareness, creek-based curriculum (even a teaching database on the PCWEA website), mentoring, and skill training are available through activities sponsored by PCWEA and its partners. The informational brochure created during plan preparation *Are You Loving Paxton Creek To Death?* is an RCP Attachment.

Creek Trash Removal

Problems and Opportunities

Based on what is known about Paxton Creek's history, culture, and natural resources, as well as past and projected development, problems and opportunities become evident. They might be considered flip sides of the same coin. For instance, fragmented riparian forests and sparse creek-based recreation are also opportunities to build greenways with educational programs, and miniparks that have economic spinoffs.

The wide array of problems and opportunities that exist in Paxton Creek watershed are diverse and extensive. (Table 4.3) These problems are also depicted on a map. (Figure 4.7) These numbers will change in the future as nine additional subwatersheds are assessed, more projects are inventoried, and rehabilitation progresses. Keep in mind that Paxton Creek subwatersheds vary in characteristics and channel conditions (Table 4.4).

Table 4.3 Problems and Opportunites

Problems or Places of Concern (and Promise)	Additional Opportunities*
Impervious Surface, 8.2 sq. miles	Impervious Surface Retrofit Sites, 58; Phase 1, 20
Impaired Tributaries on 303(d) List, 14.3 miles	Land Recycling Areas, 11
Riparian Reaches Assessed with High Degradation, 10 miles; Intermediate, 27 miles; Low, 25 miles	Potential Greenways and Trails, 30 miles; Phase 1, 0.3 mile.
Vulnerable Headwater Reaches, 6.5 miles	Stream (Channel) Rehabilitation Sites; Phases 1 and 2, 20
Creek Channel Hotspots (Debris Jams, Unstable Slumps), over 17	Upland Reforestation Sites, Phase 1, 4
Channelized Creek, 3.6 miles	Forested Buffer Reaches, 6.5 miles
Abandoned Dump and Municipal Waste Sites, 3	Pollution Source Control Sites; Phase 1, 6
Brownfield Sites, 4	Riparian Areas Needing Vegetation, 68; Phase 1, 10
Toxic Release Sites, 4	Areas Needing Floodplain Modification, 24
Known Contaminated Groundwater Sites, 3	Outfall Protection Sites, 28
Air Emission Sites, 16	Discharge Prevention; Phase 1, 5+ (probable).
Industrial Waste Sites, 4	Piped Sites, 171; Potential Day Lighting Projects, Phase 1, 2
Stormwater-Industrial Sites, 10	Ground Water Recharge Areas: Total, 18.8 sq miles; Priority 1, 8 sq miles.
Steep Slopes, 9-15%, 3.1 sq miles	Additional Watershed Historic Sites, Phase 1, 25
Wetland Areas, 195 acres	Miniparks, Phase 1, 4
Stormwater Facililites (Detention Ponds), 76	Water Facility Recreation Sites, Phase 1, 3
Outfall Protection, 28	Economic Development Related Sites, Phase 1, 3
Creek Crossings, 419	Environmental Hazard Locations, 70
Large Groundwater Withdrawal Sites, 4	Floodplain Reinstatement Areas 24, Phase 1, 8.
Mapped Stream Encroachments, 14	Minor Channel Enhancement Sites (Dozens), Phase 1, 2
Frequent Flooding Areas, 6	Off-creek Stormwater Management (Dozens), Phase 1, 3
Combined Sewer Outfalls, 31	
Sinkholes, 3	

*Phase I pertains to the initial decade of the RCP