FOREWORD

The Chester Creek Conservation Plan is the product of a partnership between the Chester Ridley Crum Watersheds Association (CRC), the Delaware County Planning Department, the Chester County Planning Commission, and the Pennsylvania Environmental Council. This report provides a guidebook for landowners, municipalities, conservation groups, and citizens interested in taking concrete steps to enhance the long-term health of the creek. The Plan builds on the Preliminary Findings Report from May 28, 1999 by offering recommendations to address the issues raised in that report and in public workshops held before and after that report was completed. The results of a survey of municipal and county officials and a private citizens survey sent to over 600 landowners in the watershed are included as an appendix. The Plan's recommendations have been reviewed by the general public and professionals involved in water issues through public workshops and direct solicitation of comments from officials by the project team.

The Chester Creek Conservation Plan was produced with financial assistance from Pennsylvania's Rivers Conservation Program, which awarded a planning grant to the project in 1997. When the Pennsylvania Department of Conservation and Natural Resources (DCNR), which administers the program, approves the conservation plan, the Chester Creek will be submitted for inclusion on the Pennsylvania Rivers Registry. The inclusion of the Chester Creek on the Registry provides the basis for municipalities and conservation groups to apply for DCNR matching funds to implement the recommendations in the report.

The Chester Creek Conservation Plan was developed in tandem with an Act 167 Storm Water Management Plan, which is nearing completion. The Storm Water Management Plan is being coordinated by the Delaware County Planning Department, with assistance from the Chester County Planning Commission. The Act 167 plan is funded by the Pennsylvania Department of Environmental Protection (DEP) and will focus on flood control and water quality issues in the watershed. A consulting engineering firm, Gannett Fleming, Inc., is responsible for assisting the counties in creating the plan. Another related plan in progress is the Chester County *Watersheds* Plan, which is an element of the County's Comprehensive Plan. This plan is sponsored by the Chester County Water Resources Authority and has similar goals and scope as the Chester Creek Conservation Plan, but includes all twenty-one watersheds in Chester County.

Note on Organization

The chapters that follow are organized according to the primary issues that affect the conservation of any Pennsylvania stream. It is important to realize that the issues that affect stream conservation tend to overlap, making their separation into these discrete chapters at times difficult. Rather than repeating similar information, the findings are placed under what seem to be the most fitting section

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Natural Lands Trust, Inc., a private, nonprofit land trust headquartered in Delaware County, prepared the Chester Creek Conservation Plan.

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INTRODUCTION

Location

The 67.2-square-mile Chester Creek "watershed" (the land area that contributes runoff to Chester Creek and all its tributary streams) begins in a number of headwater streams in eastern Chester County and western and central Delaware County. The watershed's northernmost boundary is in West Whiteland Township, on the southern flank of the South Valley Hills. The western boundary closely follows US Route 202, while much of the eastern boundary runs along PA Route 352. The longest stretch of the stream, starting with the East Branch of the Creek in West Whiteland, flows 24.5 miles southeast through Chester and Delaware Counties to its confluence with the Delaware River. Chester Creek enters the Delaware River in the City of Chester just to the east of the park commemorating William Penn's initial landing site (**Figure 1: Watershed Map**).

Setting

The watershed is within the jurisdiction of fourteen townships, five boroughs, and one city. The watershed is a mix of urban, suburban, and rural land (**Figure 2: Land Uses**). The creek passes through practically every kind of land use and neighborhood found in the Philadelphia metropolitan area. The East Branch's major tributary, Goose Creek, begins in West Chester, while the East Branch itself flows through the relatively mature suburbs of East and West Goshen and Westtown before joining with Goose Creek in Thornbury Township (Chester County). The East Branch also feeds the West Chester and Milltown Reservoirs. The West Branch begins with a small stream in western Thornbury Township (Delaware County) and is the source of Brinton Lake. With its major tributaries Green Creek and Webb Creek (also called Concord Run), the West Branch flows through Concord Township to the confluence with the East Branch in Aston Township at Lenni. In this central portion of the watershed, both on the East and the West Branches, are the remaining vestiges of the rural landscape that once dominated the watershed. This central area is also the portion of the watershed that is experiencing the most rapid growth, as its farms and woodlots are converted to housing and commercial areas.

South of US Route 1, which crosses the south central portion of the watershed, land use becomes increasingly dense. Aston and Chester Townships and Brookhaven, Parkside, and Upland Boroughs are almost fully developed with small-lot residential subdivisions, multifamily developments, commercial, and industrial uses. The mouth of the creek in the City of Chester is surrounded by an urban landscape of row houses, schools, playgrounds, and factories.

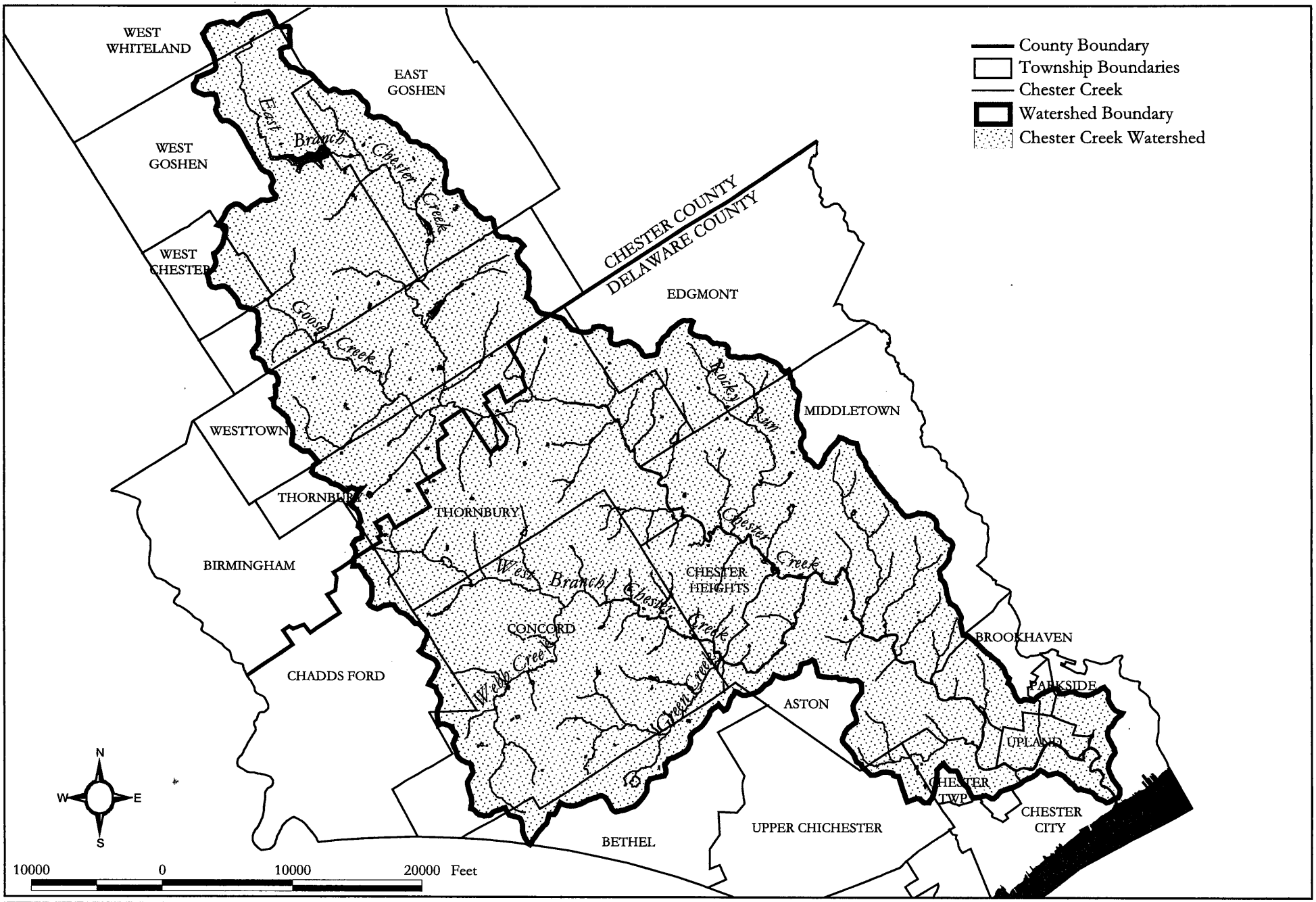
The major issues facing the municipalities of the watershed are diverse. The townships in Chester County and western Delaware County are largely concerned with managing their rapid growth and providing adequate services for increasing numbers of largely affluent citizens. Although they have taken steps to protect their remaining open landscapes and the quality of their streams, adverse impacts to water quality are a growing problem. Chester City, the developed boroughs in southeastern Delaware County, and to lesser extent, West Chester, must contend with aging infrastructure, an eroding tax base, and a loss of population. They are working to retain and attract business, reinvigorate neighborhoods, and improve their existing parks. Renovation of streambanks and stream-side lands can be a part of these initiatives.

The creek valley contains a wealth of parks, cultural institutions, historical buildings, and landscapes worthy of protection. It also is home to many committed citizens and public officials who are working to see that it remains a beautiful and healthy place to live.

Water Quality

The quality of the water flowing through the tributary system of the Chester Creek watershed varies among the "subwatersheds" (the land areas that contribute runoff to specific tributaries). The most direct causes for this variation are the number and size of sewage treatment plants, and the amount of "impervious cover" (land covered with materials that repel water, such as roofs and paving) in each subwatershed. The subwatersheds with less impervious cover and no sewage treatment plants have better water quality. Based on the standards used by the Commonwealth, much of the West Branch system still has moderately good water quality. Rocky Run, in Edgmont and Middletown Townships, has very good water quality. Goose Creek, flowing out of downtown West Chester and receiving discharges from two large treatment plants, has only fair water quality.

Below the confluence of Goose Creek and the East Branch, water quality improves somewhat due to the East Branch's dilution of the Goose Creek outflow. At its mouth on the Delaware River, the water quality is again only fair, having been impacted by the high percentage of impervious cover there.



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 1
Watershed Location

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NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).

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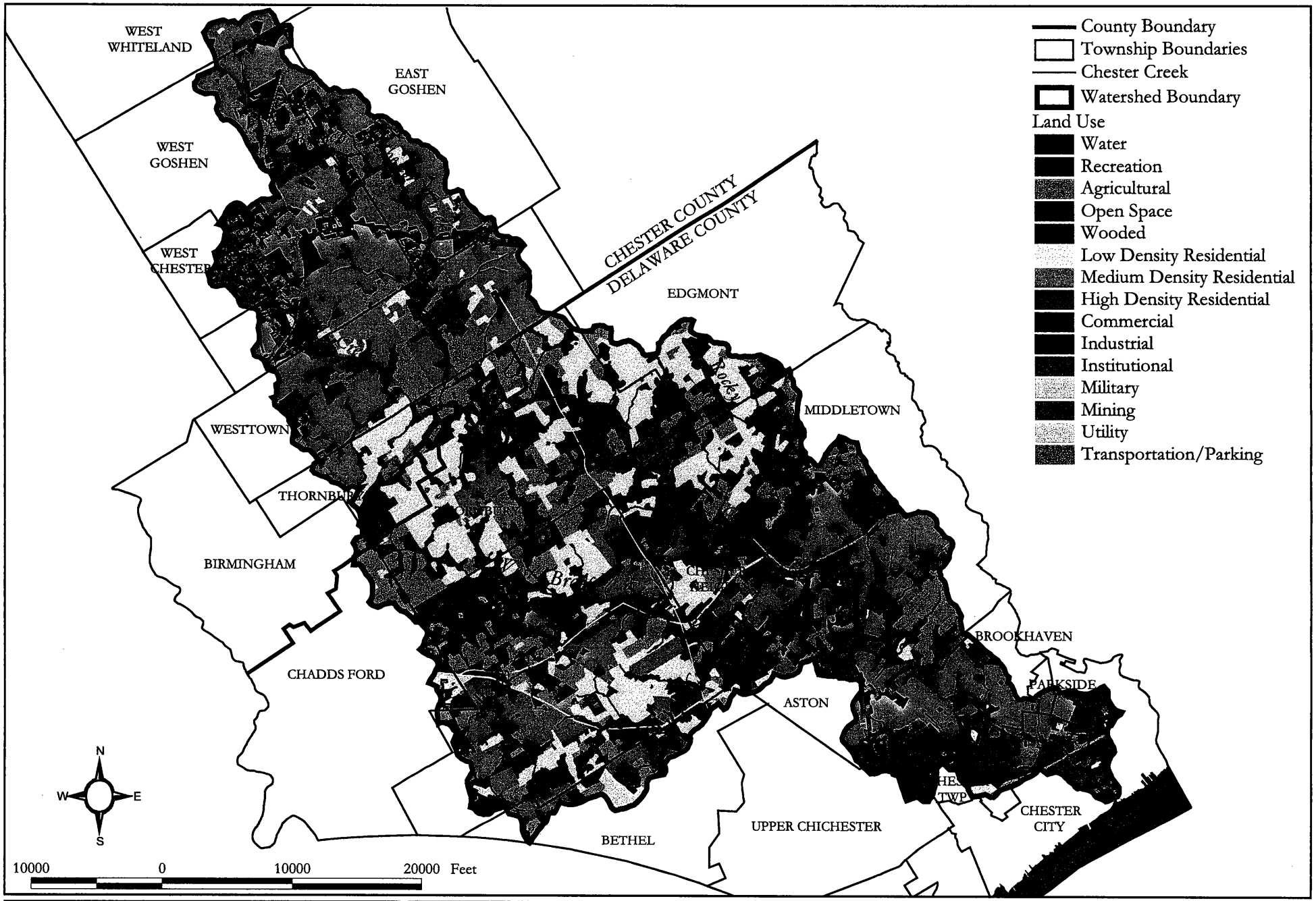

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FIGURE 2

Land Use Generalized

DCR 12/01/99 Rev. 1/23/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Land Use provided by Delaware and Chester Counties.

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1

FLOODING & STORM WATER

Over many thousands of years the recurring flooding of streams produces a series of level terraces along their banks. The terraces, called floodplains, are narrow or wide, depending on the size of the stream and the surrounding topography. Flooding, and floodplains are a natural part of every stream system. Floods reinvigorate soils in floodplains by depositing nutrient –rich silt. Streams tend to meander within the borders of their floodplains, especially when the gradient (slope) of the stream is low. The wide loops of Chester Creek in the City of Chester where it crosses Pennsylvania's narrow Coastal Plain are a good example of this geomorphic process. The floodplains in the Chester Creek watershed are widest near Cheyney (just below the confluence of Goose Creek and the East Branch), on the West Branch at Aston Mills, in the southeast quadrant of West Chester Borough on Goose Creek, and in the tidal section of the main stem at Camp Upland Park (**Figure 3: Floodplains**). Wetlands often occur in floodplains, where they help to absorb and infiltrate floodwater.

The Chester Creek floods regularly. The highest flood on record occurred on August 5, 1843 (US Army Corps of Engineers, Floodplain Information, Chester Creek, April, 1977). Other damaging floods occurred in 1950, 1955, 1960, 1971, 1996, and, most recently, in 1999 by Hurricane Floyd. These floods caused significant damage to properties in the path of floodwaters and resulted in the death of a number of local citizens.

Development in a watershed tends to increase the number and severity of floods. This is due largely to the increase in "impervious surfaces" (roads, parking lots, rooftops, etc.) that accompany land development. Impervious surfaces resist the infiltration of water. Therefore, as the total percentage of impervious surface increases, the amount of water entering streams after a rainstorm increases. The increase in water going into streams during rainstorms is matched by the decrease in water being infiltrated deep enough into the ground to replenish groundwater. Stream flow between storms can therefore decrease after development occurs. **Figure 4:**

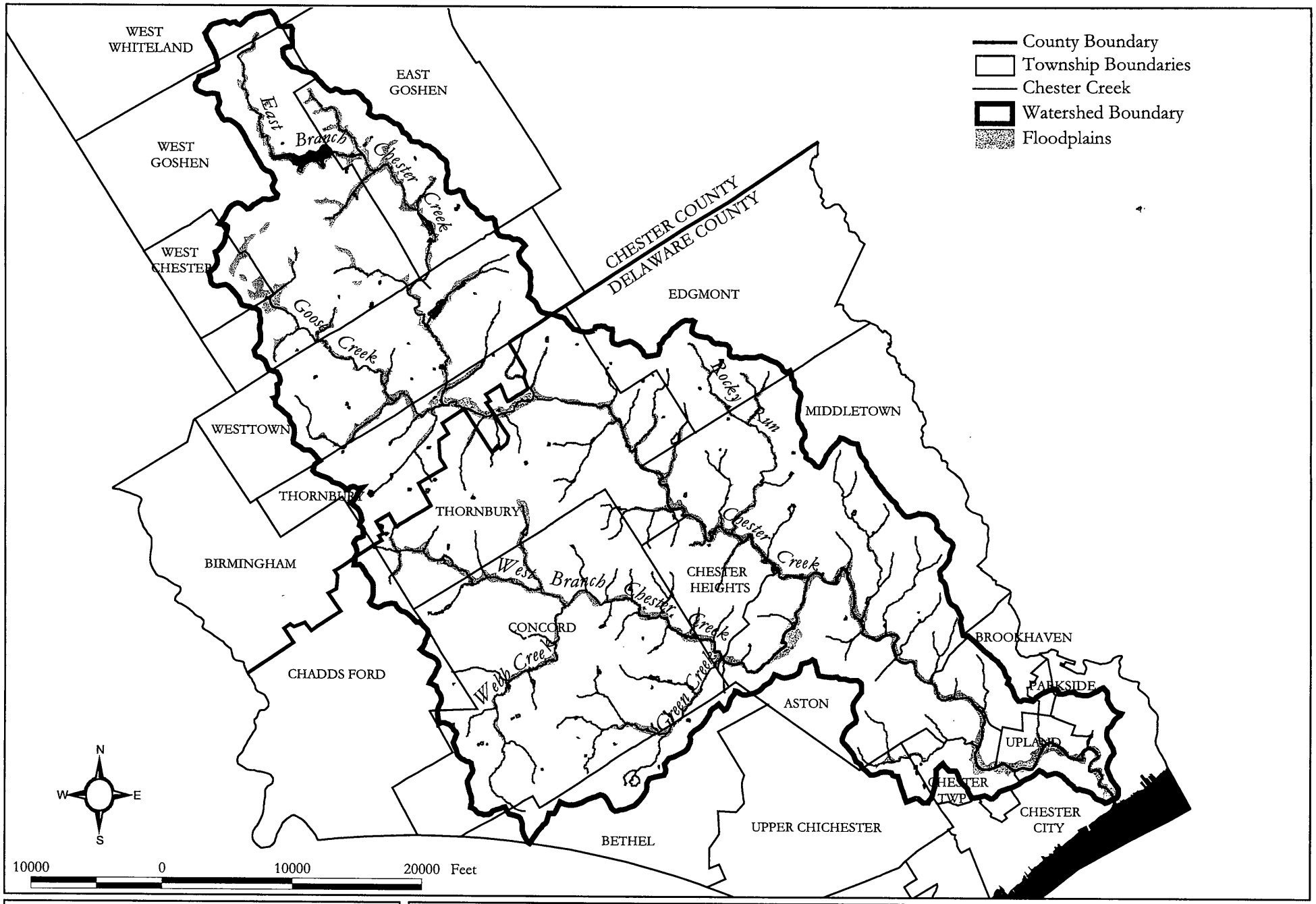
Impervious Cover Percentages, illustrates the percentage of impervious cover for each watershed land use (per the "Chester Creek Act 167 Stormwater Management Plan". See following section). Note that the upper and lower ends of the watershed have the largest concentrations of impervious surfaces.

Greater quantities of floodwater cause a number of changes in streams: the stream channel may deepen, stream banks may erode, and the width of the floodplain for a given storm may increase. All these changes can destabilize streamside property and increase the number of structures exposed to flooding. Furthermore, construction in the floodplain itself diminishes the natural capacity of the floodplain to absorb and dissipate floodwaters.

Floodplain Ordinances

The protection of the floodplain was ranked as "important" or "very important" by nearly all the municipal and citizen respondents to the watershed survey (see Appendix A). Since the passage in 1978 of Act 166, the Pennsylvania Floodplain Management Act, municipalities in the state have been required to pass floodplain ordinances. The ordinances must meet minimum standards in order for residents to be eligible for federal flood insurance and for the municipalities to continue receiving state funding. Every municipality in the watershed has flood-prone areas (as identified in Figure 3) and has passed ordinances that meet these minimum standards. The standards are designed to protect property value and public health. They accomplish this by regulating what can be built in the floodplain and how it is to be built.

A floodplain is divided into at least two zones, which are locally regulated in conformance with state and federal regulations. The zones are depicted on Flood Insurance Rate Maps prepared by the Federal Emergency Management Agency (FEMA). The first is called the floodway. This is the area closest to the stream, where floodwaters move quickly and can cause severe damage to structures (**Figure 5: Floodplain Zoning District**). It is technically defined as the minimum area necessary to pass the waters of the 100-year flood (a flood that has a statistical probability of occurring once every one hundred years). The second zone is called the flood fringe. The fringe will not have the damaging velocities of the floodway, yet it will still be inundated in the 100-year flood. Other regulated areas include the rest of



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 3

Floodplains

DCR 12/01/99 Rev. DCR 1/23/01
NOTES:
1. Streams, floodplains, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).

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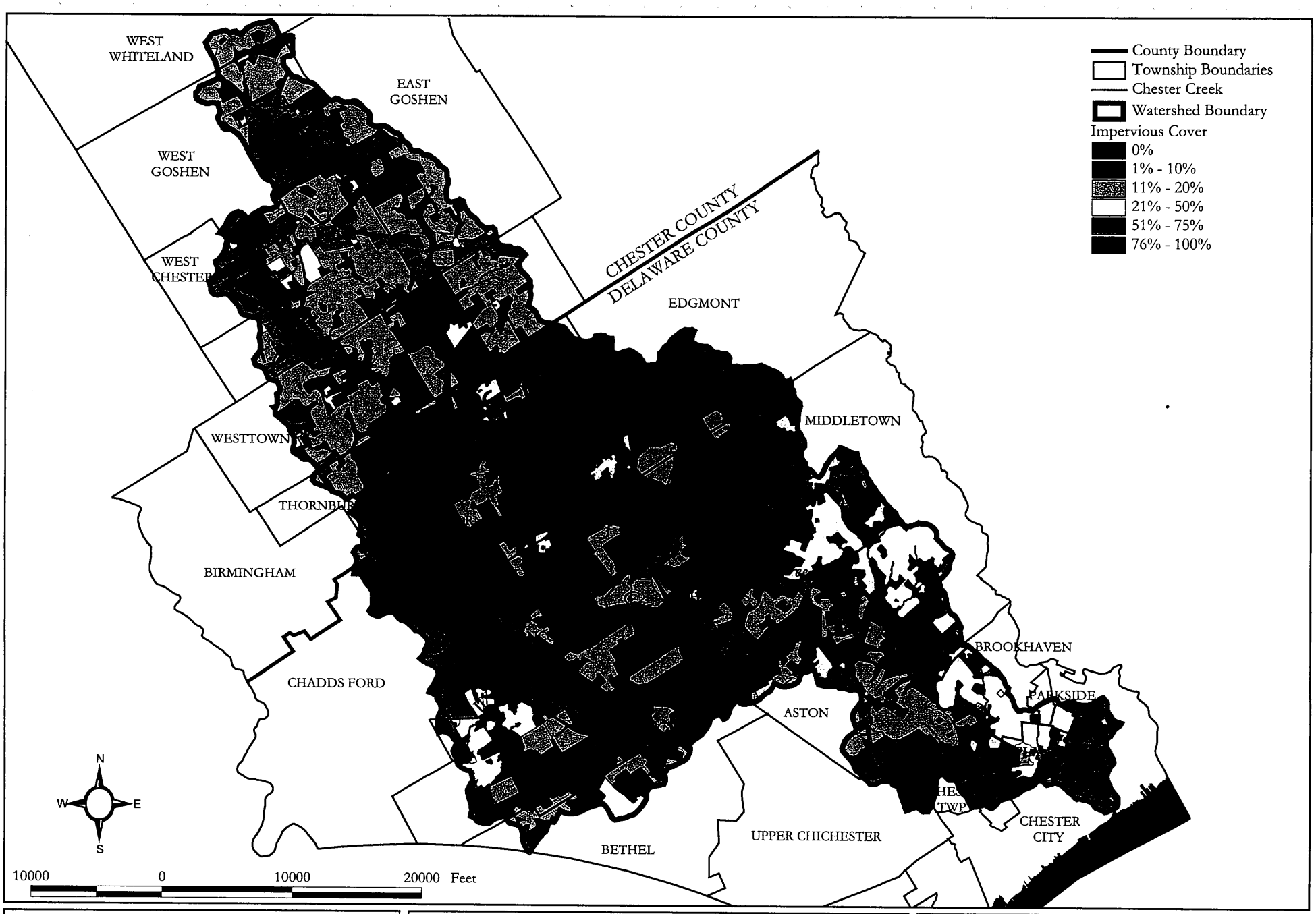

Chester Creek Watershed
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FIGURE 4
Impervious Cover Percentages

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NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Impervious Cover by Land Use from Delaware County, PA.

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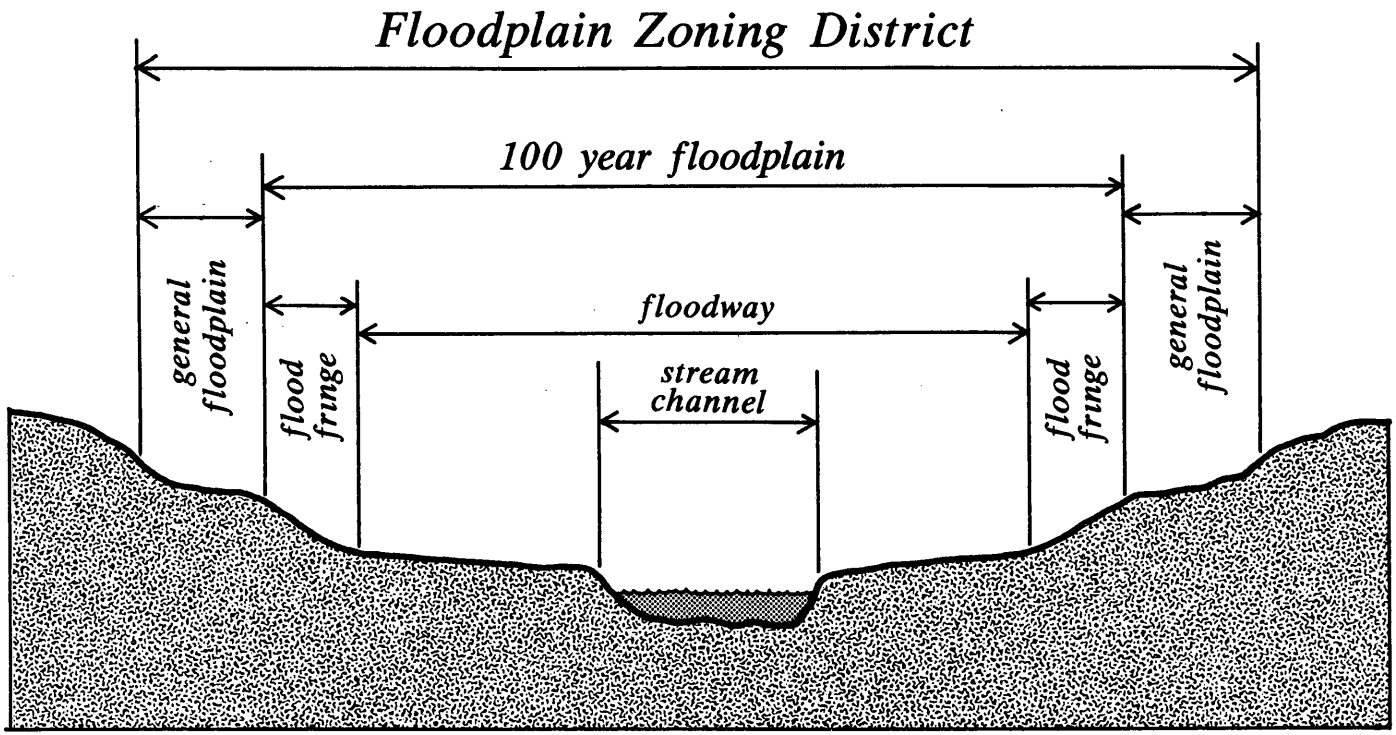
the 100-year flood area from the federal flood maps and, occasionally, the "hydric" (wet) soils identified by the county soil maps.

The floodplain ordinances generally prohibit any uses or construction that would cause an increase in the height of floodwaters. However, new construction that would not increase flood heights is generally permitted if it is properly flood proofed. In broad outline, all of the floodplain ordinances:

- Severely restrict development in the floodway
- Require flood-proofing of building interior space below the flood elevation
- Limit filling that would raise flood elevations
- Limit certain uses such as nursing homes, hospitals, jails, and manufactured homes
- Prohibit the storage of dangerous chemicals in the floodplain

An important unintended consequence results from the federal law. Because the floodplain ordinances meet the minimum standards, residents and business owners are eligible for flood insurance. Conventional development is not thwarted by the unavailability of insurance. Most development can occur with only slight modification, so it quite possible for floodplains to be developed. In a sense, the minimal federal standards encourage development, rather than letting the private insurance market minimize construction in a high-risk area by charging exorbitant rates. The federal government has recognized this and is changing its general approach (as discussed in the recommendations that follow this section).

Unsatisfied with the minimum standards, some municipalities have increased floodplain restrictions. Some do not allow any principal structures in the floodway (Middletown Township), or, better yet, the entire floodplain (East Goshen Township). Some do not allow any construction within 50 feet of any stream (Edgmont Township). Others do not allow clearing of trees or vegetation in the floodway (Middletown and Concord Townships.). These restrictions can further reduce the impact of flooding on property improvements and maintain the health of the floodplain ecosystem. In addition, some of these additional measures can make the townships eligible for reduced flood insurance rates, if they meet the "Community Rating System" goals of FEMA (DVRPC, Bucks County Flood Recovery and Mitigation Strategy, 1998, p. 35).



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 5
Floodplain Zoning District

DCR 07/19/00
NOTES:
1. Floodplain Zoning District taken from Natural Lands Trust graphics files.

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Obviously, many of the buildings along streams in the Chester watershed were built before the passage of Act 166. For these structures, stricter floodplain ordinances are not applicable. FEMA and the Pennsylvania Emergency Management Agency (PEMA) offer programs to assist municipalities in purchasing and removing structures that are persistently and heavily damaged by floods. The resulting floodplain must be permanently set aside as open space. The state program also considers requests for community flood-proofing projects, improved storm drainage and stream bank stabilization. It is important to note that these programs are only activated as the result of flooding that is declared an official disaster by the federal government. In September 1999, PEMA bought 15 homes that were devastated by Hurricane Floyd in the Toby Farms development in Chester Township and in Chester City.

Floodplain Ordinance Recommendations

1. Floodplain ordinances that protect the natural elements of floodplains (woodlands, buffer areas, wet soils, wetlands, etc.), along with ensuring that property improvements (buildings, parking areas, etc.) are not misplaced or poorly constructed, are a critical part of an effective river conservation plan. Ideally, these ordinances should include:
    - Prohibition of new structures or impervious surfaces within the 100-year floodplain. Redevelopment of properties in floodplains should strive to meet this standard, as long as unreasonable economic hardships are not created that would hinder redevelopment efforts.
    - Along smaller streams not having a delineated floodplain, either: 1) the 100-year floodplain line should be determined as part of the building approval process, or 2) a set buffer width of 50′ (per Edgmont Township), to 75′ (US Forest Service recommendation) should be used (whichever is wider). Within this area, new structures or impervious surfaces should be prohibited.
    - Natural vegetation within the floodway should be preserved and/or replanted if missing. Landscaping standards emphasizing use of native floodplain species in newly planted areas should be instituted.
    - Allowance for compatible uses in floodplains, such as: agriculture, forestry, playgrounds, ball fields, and open space.

2. Major elements of the recommendations above may become mandatory with the completion of the Act 167 Stormwater Management Plan described in the next section. If so, the Pennsylvania Department of Environmental Protection offers 75% funding for the creation of ordinances that implement Act 167 plans- so long as they are placed within a stormwater management ordinance. The ordinances could be drafted with the assistance of the county planning agencies or the Delaware County Conservation District and Chester County Conservation Districts (DCCD/CCCD, respectively). Each conservation district now has a watershed coordinator, whose responsibilities include developing such ordinances, if requested, in coordination with the townships (Charlotte "Chotty" Sprenkle, Watershed Coordinator, Chester County Conservation District, pers.comm., 1/ 8/ 01).

3. Of course, ordinances are only effective if they are enforced; and this can happen only if adequate funding and staff resources for enforcement are available. A program to assist municipalities train code enforcement officers in floodplain enforcement should be undertaken by the county planning agencies and /or the conservation districts during the implementation of the Stormwater Management Plan.

4. FEMA and PEMA programs should be better publicized and understood. For example, FEMA has established a Hazard Mitigation Grant Program to pay for projects such as the acquisition and relocation or removal of structures from flood-prone areas. This program is administered by PEMA. Funding for the Hazard Mitigation Grant Program is initiated when the President declares a "Disaster Area". On September 18, 1999, a request for federal disaster assistance was approved for residents and businesses in seven counties, including Chester and Delaware, which were damaged by severe flash flooding from Hurricane Floyd just days before. As previously stated, PEMA bought out 15 homes in Toby Farms and Chester City that were devastated by Floyd. All the disaster money available from this event has been allocated.

5. A similar program is administered by the United States Army Corps of Engineers (USACOE) called the Challenge 21 Initiative. This program focuses on non-structural alternatives to flood protection. Where appropriate, USACOE will provide funding assistance to move families and businesses out of harm's way and return the floodplains of rivers and creeks to a condition where they can naturally moderate floods, as well as provide other benefits to communities and the environment. The Challenge 21 program will have $200 million over the next six years to pay owners 65% of the cost of buying properties in floodplains, relocating the owners, and restoring ecosystems. Using these funds to match funds from the Commonwealth's Community Conservation Partnerships Program or Chester County's Preservation Partnership Program may be an excellent means of restoring floodplains with little additional cost to municipalities. A workshop to disseminate information on the floodplain programs available to municipalities should be conducted in both Chester and Delaware Counties.

Storm Water Management under Pennsylvania Act 167

Storm water runoff planning was given a boost in 1978 by the passage of the Storm Water Management Act (Act 167). Act 167 authorized comprehensive watershed storm water management plans, conducted by counties, funded largely from state funds, and implemented through municipal ordinances. Even before the passage of Act 167, storm water drainage systems in Pennsylvania generally featured means to "detain" (hold for a period) the first portion of large rainstorms on-site. The requirement to do so is based on the rights of municipalities to regulate development, which originates from the Municipalities Planning Code (Act 247).

The maximum rate of runoff from new development is usually limited to the same rate of runoff that occurred before development. Because rooftops and parking lots shed water at a faster rate than fields and forests, engineers have generally designed basins or underground holding tanks to capture and hold ("detain") the extra water. Detention basins are a common sight throughout the Chester Creek watershed. They are present at office parks, shopping centers, and residential subdivisions. Older storm water systems were designed to

rapidly remove storm water from the site to the nearest waterbody. These systems do not feature detention basins.

Once a holding facility fills to its designed capacity, it releases storm water at a rate designed to equal the pre-development rate. It is important to note that it is the ***rate*** that is controlled, not the ***amount***. The increased area of impervious surface inevitable with development causes a proportional increase in the total amount of runoff produced during a storm. When many basins within a single watershed release this increased amount of water at a set rate, they do so only by extending the time it takes for storm water to pass through a watershed. This may not cause the same degree of property damage as the sudden flush of water from a large storm (in the absence of the facilities), but the prolonged, increased flow can nevertheless be damaging to stream banks.

Stream banks in developing watersheds are often destabilized by another kind of storm. Detention basins are designed to control the flow from infrequent, major storms, not smaller, more common rainstorms (storms with the probability of occurring every 1-2 years). Recent research suggests that natural stream channels evolve to carry these smaller storms exclusively, and that larger storms have less influence on the geometry of the stream channel (Ann L. Riley, *Restoring Streams in Cities*, p. 123). The Center for Watershed Protection in Maryland, among others, has extensively documented the results of suburbanization on stream channels in the mid-Atlantic (see T. Schueler, Site Planning for Urban Stream Protection, p. 23). Increases in impervious surfaces lead to increases in volume and velocity of runoff from all storms, including the common ones. A storm that would fill the stream with water every one to two years becomes a storm that spills out of the banks, and even more frequent, smaller storms produce enough runoff to fill the banks. Streams adapt to the new flow pattern through bank erosion and deepening of the stream channel. The Center for Watershed Protection has determined that these changes begin when the percentage of impervious surface in a watershed reaches 10- 15%, which is about the percentage associated with residential neighborhoods with one-acre lots. The subwatersheds in the upper and lower ends of the Chester Creek watershed mostly exceed this percentage, and the central sub-watersheds are being rapidly converted to neighborhoods of this general density.

It is therefore timely that a Storm Water Management Plan under Act 167 has been initiated for Chester Creek. The Act 167 Chester Creek Watershed Plan will produce a watershed-wide comprehensive storm water

management plan by the end of 2001. Gannett Fleming, Inc., the consulting engineering firm assisting Delaware and Chester Counties in developing the plan, has completed a sophisticated computer model of the watershed's flooding behavior. The model incorporates a number of variables affecting flooding, such as: amount of development, obstructions to flow, topography, soils, and vegetation. The model allowed the engineers to test cause and affect scenarios of development and allowed them to determine the effects of various methods of storm water management by manipulating the amount of water leaving each subwatershed. By varying "release rates" in the sub-watersheds (the percentage of the total runoff not held in a detention basin, the lower the number, the greater amount of water held back), Gannett Fleming has determined the least damaging means to pass floodwater through the stream system. The final plan will mandate the release rates for each subwatershed, with a probable range from 50% to 100%, and will provide model ordinances to insure that the release rates are met.

Until recently, Act 167 Plans have focused solely on water quantity management. The Chester Creek plan is one of the first to include both quantity and quality goals in accordance with new DEP guidelines (Karen Holm, Delaware County Planning Department, pers. comm. 11/25/00). The following are the plan's objectives:

- Implement non-point source pollution removal methods (see Chapter 3, Nonpoint Source Pollution for an explanation of the term)
- Maintain groundwater recharge
- Reduce channel erosion
- Manage flood events that spill over stream banks
- Manage extreme flood events.

Once completed and adopted by the two counties, state law requires that the plan recommendations be incorporated into the development ordinances of all the watershed municipalities. Implementation of an Act 167 storm water plan falls to these same municipalities through their municipal engineers and code enforcement officers.

Act 167 does not require the retrofit of existing storm water management facilities when redevelopment occurs. These projects are governed by the requirements of the Pennsylvania Municipalities Planning Code (MPC). In most cases, commercial property owners are not required to install new storm water detention devices if no increase in impervious surface is created

by the redevelopment, which is a typical situation. Municipalities may, however, request the installation of these devices, such as urban best management practices, if other variances or exceptions are necessary for a plan approval (Ann E. Hutchinson, Planning Director, Lower Merion Township, pers comm. 8/29/96).

Storm Water Management Recommendations

1. Due to their comprehensive and well-researched nature, the recommendations of the Act 167 Plan are incorporated, *in toto*, into the Chester Creek Conservation Plan. The incorporation of these recommendations shall be by reference, thereby avoiding repetition of the entire plan within this document. Should the River Conservation Plan be completed and Chester Creek added to the River Conservation Registry before the acceptance of the Chester Creek Storm Water Management Plan by the Department of Environmental Protection (the Commonwealth's agency responsible for the Act 167 plans), then the most current draft of the Act 167 Plan should be considered the source of the relevant recommendations.

2. Municipalities interested in investigating a current example of excellent stormwater management regulations should review the ordinance of London Grove Township, Chester County. The ordinance is based on a township-wide storm water management plan. Among its notable features are:
   - Drainage easements required along all existing watercourses
   - Setbacks provided for improvements from stream and wetlands, including a 75' undisturbed riparian buffer
   - Infiltration (rather than detention) recommended as the primary method of storm water control, including methods to prevent groundwater pollution
   - Equal attention to water quality and quantity

   Possibly the most innovative prescription of the London Grove ordinance requires that, "The volume of groundwater recharge on sites shall be maintained at pre-development levels to assure that there is no reduction in the annual recharge to the groundwater reservoir resulting in a lowering of the base flow of streams, and of water supplied to wells."(Tourbier and Walmsley, Inc., "London Grove Stormwater Management Ordinance", p. 24). This addresses an oversight in the Storm Water Management Act. Act 167 does not

address groundwater levels directly, only the flow of surface water. Increase in impervious surface decreases the volume of water absorbed by soil and thereby entering into "groundwater" (the reservoir of water that lies below the surface and provides the water for wells and the "base flow" of streams).

The second major recommendation of this section is that municipalities in the Chester Creek watershed should consider using the London Grove Stormwater Management Ordinance to improve the storm water management ordinance that they will be required to adopt at the end of the Act 167 planning process. The county planning agencies and/or conservation districts could research the London Grove model and provide technical assistance to townships seeking to adopt some of its features.

Table 1

Summary:

Flooding and Storm Water Recommendations

Recommendation	Participating Parties
Prepare ordinances and revise existing municipal ordinances, per the standards of the Act 167 Stormwater Management Plan and the London Grove Stormwater Management Ordinance (or its equal)	Municipalities, County Planning Agencies, Conservation Districts, Municipal Environmental Advisory Commissions
Provide adequate resources for enforcement of ordinances	Municipalities
Publicize FEMA, PEMA, and USACOE flood plain programs	FEMA, PEMA, Corps of Engineers, County Planning Agencies, Conservation Districts, Municipal Environmental Advisory Commissions

2
WATER QUALITY

The basis for comparing the health of streams is "water quality". The parameters used to measure water quality can be quite complex, but the most used are temperature (lower temperature means better quality), dissolved oxygen (more dissolved oxygen is better), coliform bacteria (a kind of bacteria in sewage and animal feces), and a set of indicator aquatic animals (certain species are present only when water quality is high, others are characteristic of poor water quality). In addition, the quantities of certain metals and nutrients may be measured. Each measure can be related to runoff, e.g., more paving raises the temperature of runoff, and animal yards on farms can raise coliform bacteria levels.

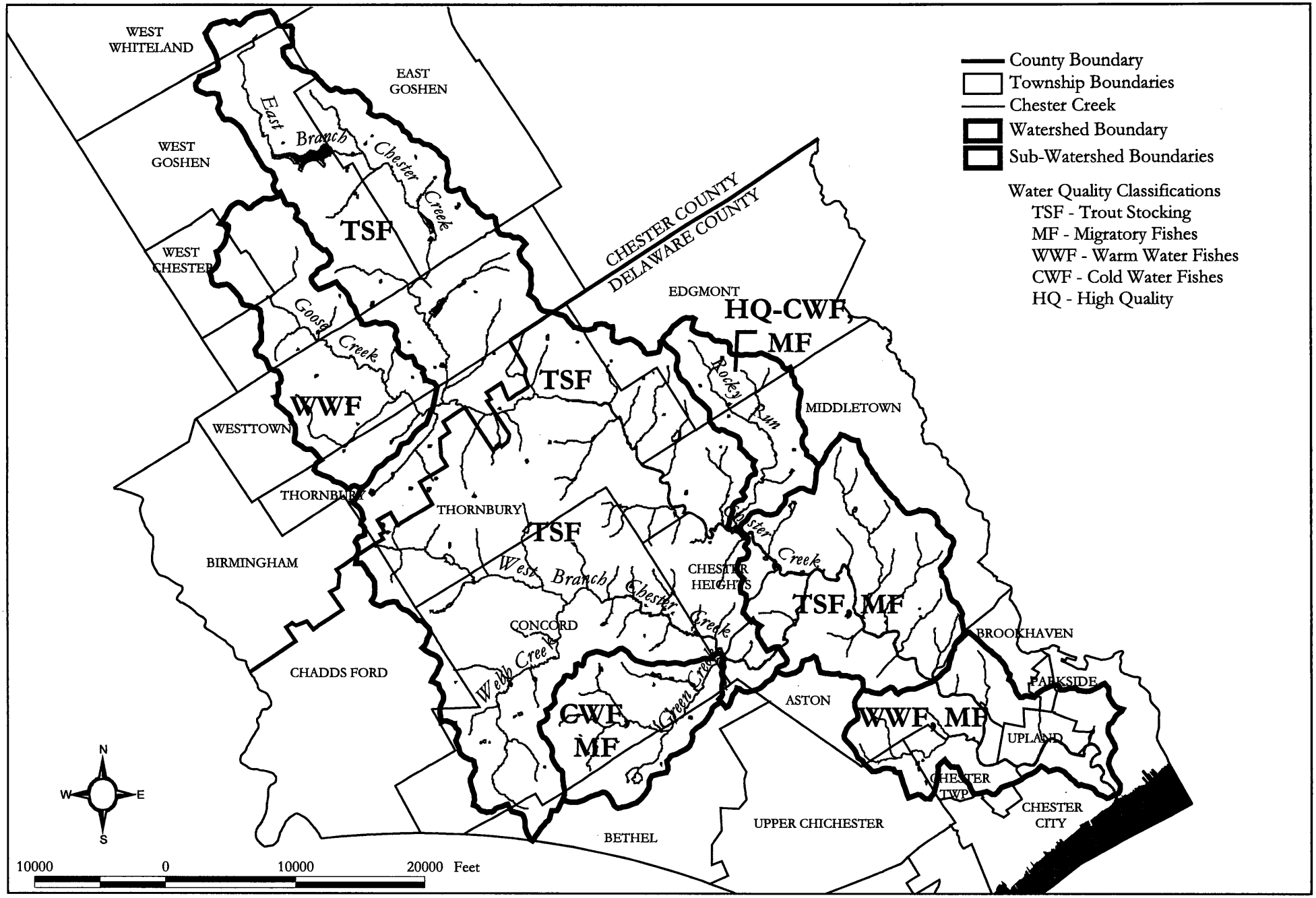
Water Quality Classifications

DEP has established state-wide standards for the level of water quality each stream system should maintain. The entire state is divided into sub-watersheds with assigned water quality designations (**Figure 6: Water Quality Classifications**). In the Chester Creek watershed, most of the streams in the upper and western reaches are classified as "Trout Stocking Fisheries" (TSF), except for Goose Creek, which has been given the lower "Warm Water Fisheries" (WWF) classification (see Figure 7). The TSF designation means that DEP, when reviewing a permit application, will consider the potential impact of any proposed use based on the ability of the waterway to meet chemical and temperature parameters designed to sustain stocked trout. For instance, permitted uses in a TSF stream can not cause the temperature of the receiving water to exceed 74 degrees Fahrenheit during July; and the average dissolved oxygen in the stream must be 6.0 mg/liter from February to July. The WWF classification allows water to reach 87 degrees in July and dissolved oxygen to average 5.0 mg/liter during the entire year (DEP, Chapter 93. Water Quality Standards, pp. 93-95, 1994).

Green Creek, from its sources in south central Concord Township and Bethel Township, to its confluence with the West Branch in northwestern Aston, is classified as a "Cold Water Fisheries, Migratory Fisheries"(CWF-MF), which requires a water temperature of 66 degrees Fahrenheit in July and the same dissolved oxygen as a TSF stream. The MF designation comes from the presence of American eels, a species that spends part of its life cycle in the Atlantic Ocean, and part in freshwater rivers on the east coast. The MF designation is included on all the segments of the stream system below the confluence of Rocky Run. The most rigorous classification in the Chester Creek watershed is given to Rocky Run, a tributary of the East Branch that arises in Edgmont Township, flows through Middletown Township, and enters the Chester Creek near the Wawa Dairies plant on US Route 1. It is a "High Quality, Cold Water Fisheries" (HQ-CWF). Using the same parameters for temperature as a CWF, it must also retain a minimum (not average) of 7.0 mg/liter dissolved oxygen all year as a result of its HQ designation.

Water quality designations are occasionally changed to stricter standards by DEP, but only if a formal request to do so is made by local citizens. DEP then conducts tests to see if the stream warrants a new designation. Green Creek was changed from TSF to CWF-MF in 1995 as a result of a request made by the Chester Ridley Crum Watersheds Association (DEP, "Green Creek Special Protection Evaluation Report", March 1995, page 1).

A recent, relevant federal water quality designation is the "impaired" water definition. This term comes from the 1997 settlement of a dispute between EPA and the Commonwealth regarding enforcement of the Federal Clean Water Act (Gary Walters, DEP, pers. comm., 11/7/98). The Clean Water Act (administered by EPA) requires states to report the status of water resources within their boundaries and to provide a summary of identified non-point source problem areas. Pennsylvania's "Unassessed Waters Program" was created by DEP to meet EPA standards. The program assesses streams through review of the watershed land uses and rapid sampling of stream bottom-dwelling invertebrate organisms. The results are evaluated using biological criteria to distinguish between healthy and impaired conditions. This information is reported in the State's "305(b) list", submitted to EPA every two years.



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 6
Water Quality Classifications

DCR 12/01/99 Rev. DCR 1/23/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Water Quality Classifications from Chapter 93: Water Quality Standards of the Pennsylvania Code.

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Streams that are found to be "impaired" are included on the State's "303(d) list", which is also submitted to the EPA. Several sections of the Chester Creek are on the year 2000 303(d) list, but as medium or low priorities: these impaired segments are not yet targeted for a "total maximum daily load" (TMDL) study, where allowable "loads" (amount) for specific pollutants will be determined and enforcement measures adopted. These impaired segments will have TMDLs determined sometime after 2002, after streams with more severe pollution problems than Chester Creek's have been addressed.

Water Quality Classification Recommendations

1. A watershed assessment of the Chester Creek and its tributaries should be performed to gauge feasibility of upgrading current stream designations. If candidate sub-watersheds are found, every effort should be made to elevate their classification.

2. The 303(d) process should be monitored and priority status for the impaired segments of Chester Creek requested if warranted.

3. London Grove Township's storm water management ordinance (mentioned in Chapter One' s recommendations) also contains provisions to prohibit water temperature increases in streams designated as Exceptional Value, and to allow very little change in temperatures for streams designated as Cold Water Fisheries or Trout Stocking Fisheries. The provisions provide a means to implement Chapter 93 of the State Code pertaining to water quality standards. Among its measures are:
   - Employment of temperature-sensitive "Best Management Practices" (BMPs, see Chapter 3) and storm water conveyance systems. Storage pool areas and supply and outflow channels are to be shaded with shade trees.
   - Requirement for long term maintenance schedules and management plans for BMPs and stream buffers for development sites
   - Establishment of a thermal riparian forest buffer of 75-foot width along streams, ponds, and bodies of water

   Municipalities in the Chester Creek watershed should be encouraged to adopt these or similar standards and practices. A workshop,

including the consultants responsible for the ordinance (Cahill Associates of West Chester), may be the best way to convey the innovative features and implementation history of the ordinance.

Water Quality Monitoring

Chester Creek's water quality monitoring picture might be considered half-finished. This is due to the differences in approaches to water quality between the two counties. Delaware County is typical of most Pennsylvania counties in that it does not administer or conduct any water quality testing program. Chester County, however, probably has the most progressive water testing program in Pennsylvania. This is due in no small part to the historic leadership of Ruth Patrick, Abe Wolman, and Robert Struble, whose commitment to the Brandywine watershed was instrumental in the creation of the Chester County Water Resources Authority (CCWRA) in 1961 (J.L. Bowers, CCWRA, pers. comm. 2/19/99). This is not to imply that Chester County streams do not have water quality problems, it is just that problems are more likely to be identified on a regular basis.

Initially, the CCWRA was created to implement a comprehensive plan to protect the Brandywine Creek from agricultural pollution and flooding. It administered the construction of five of the six flood-control dams that were called for in that plan. In 1969 CCWRA entered into partnership with the U.S. Geological Survey (USGS) to cooperatively measure water resources throughout the County (USGS Fact Sheet 067-98, "US Geological Survey Cooperative Water-Resources Programs in Chester County Pennsylvania", June 1998). Some of the current programs of USGS are measuring groundwater quantity and quality, drought forecasting, and studying the effect of urbanization on stream networks. Since 1970, USGS has regularly monitored chemistry and aquatic species at 40 to 50 sites throughout the county, including five sites on the Chester Creek system. The five sites, moving downstream, are:

- Green Hill Road near Phoenixville Pike
- Reservoir Road above Milltown Reservoir
- Westtown School just below Westtown Lake
- Goose Creek at Cheyney University
- East Branch below confluence with Goose Creek in Thornbury Township (Delaware County)

Twenty years of consistently collected data is a resource few streams in Pennsylvania can claim. Interestingly, one of the trends in the data is toward some improvement of water quality in the creek system as it has converted from an agricultural watershed to a suburban one. This is due to a decrease in pesticides (Drew Reif, USGS, pers. comm. 11/7/98). However, there are still serious problems with the water. Recently, sediment, nutrient and pesticide levels have increased, and the population of sensitive aquatic organisms has decreased. The two large sewage treatment plants on Goose Creek (West Chester and West Goshen), which provide secondary treatment, release water with high nutrient levels. Although the plants are not in violation of their DEP permits, the volume of treated water has negatively impacted the stream. In is worth noting that the standards for nitrate output were reduced in the early 1980's and that phosphate levels have not yet been instituted. The effect of these nutrients continues through the last downstream station monitored by USGS.

CCWRA is developing a comprehensive "Water Resources Management Plan" (partial support is coming from the Rivers Conservation Program of DCNR). The plan, known as *"Watersheds"*, should be available in draft form by mid-2001. It will focus on the sustainability of water for projected growth and the protection of stream valleys. It will use the years of USGS data to back up its conclusions, and make that data understandable to lay readers. It will be an implementation tool of *"Landscapes"*, the County's award-winning comprehensive plan. The plan will incorporate elements of the Chester Creek Conservation Plan and vice versa. The Chester Creek will be studied as two sub-basins. The watershed's potential for non-point source pollution is being assessed (among numerous other watershed management components) and the best measures to correct problems are being developed (J.L. Bowers, CCWRA, pers. comm., 5/1/01). The Plan will recommend the most appropriate BMPs and ordinances. CCWRA will assist the Planning Commission in audits of local ordinances to determine what revisions should be made to implement the Management Plan findings.

DEP has conducted a number of chemical and biological studies of Chester Creek. These have been done to respond to citizen complaints, to determine whether water quality classifications should be changed, to document the effect of spills and, recently, to assess what portions of the stream are "impaired" (see "Water Quality Classifications", above).

The U.S. EPA, through its Office of Water and in association with the Chester Ridley Crum Watersheds Association, has also been supporting an on-going volunteer stream monitoring program that assesses simple chemical and biological indicators of water quality at several stations on Chester Creek. Philadelphia Suburban Water Company (PSW) participates in the monitoring program, primarily as an observer at meetings of the citizen volunteers. PSW believes that the volunteer monitoring program is useful because it provides important data regarding water quality and polices the watershed for possible spills, accidents, or problems (Preston Luitweiler, PSW, pers. comm., 5/2/96). PSW also appreciates the extra people on the Chester Creek because it retains only 2.5 staff persons to monitor water quality in its entire service area. This translates to a half-time position for the combined Chester and Ridley watersheds.

Water Quality Monitoring Recommendations

1. A thorough stream sampling program to supplement, close gaps, and formalize existing data should be implemented. A thorough understanding of existing data is needed first. This program should occur both at the volunteer level (to encourage "ownership" of the streams) as well as at the governmental level (to assure adequacy of protocols and uniformity of data analyses). The analyses would also provide a measure of the effectiveness of the recommendations contained in this plan.

Table 2

Summary: Water Quality Recommendations

Recommendation	Participating Parties
Water Quality Classifications	
Perform watershed assessments (based on existing data) of the Chester Creek and its tributaries to gauge feasibility of upgrading current stream designations	USGS, DEP, County Planning Agencies, EACs, CRC, Trout Unlimited, Delco Anglers
Water Quality Monitoring	
Implement a thorough stream sampling program to supplement, close gaps and formalize existing data	USGS, DEP, County Planning Agencies, EACs, CRC, Trout Unlimited, Delco Anglers

3

POINT SOURCE POLLUTION

This chapter and the one that follows discuss the common sources of pollution in Chester Creek. A "point source" is any pollutant that can be traced to a single source, usually a discharge pipe. It is distinguished from "nonpoint source" pollution, which is ubiquitous, coming from innumerable small discharges, such as eroding fields, fertilized lawns, and dirty roadways. Sewage treatment and industrial discharges are the two point sources of pollution that, due to their potential impact on public health, are closely regulated by state and federal government. Most sewage treatment plants in the watershed process raw sewage from ordinary sources, such as homes and businesses, and release the treated water into streams or rivers. A few plants release the treated water either to an underground leaching field or to an above-ground spray irrigation system. Industrial discharges include those that treat either the regular discharge from a specific industrial operation, or those designed to clean pollution from an inadvertent spill (such as a leaking underground storage tank).

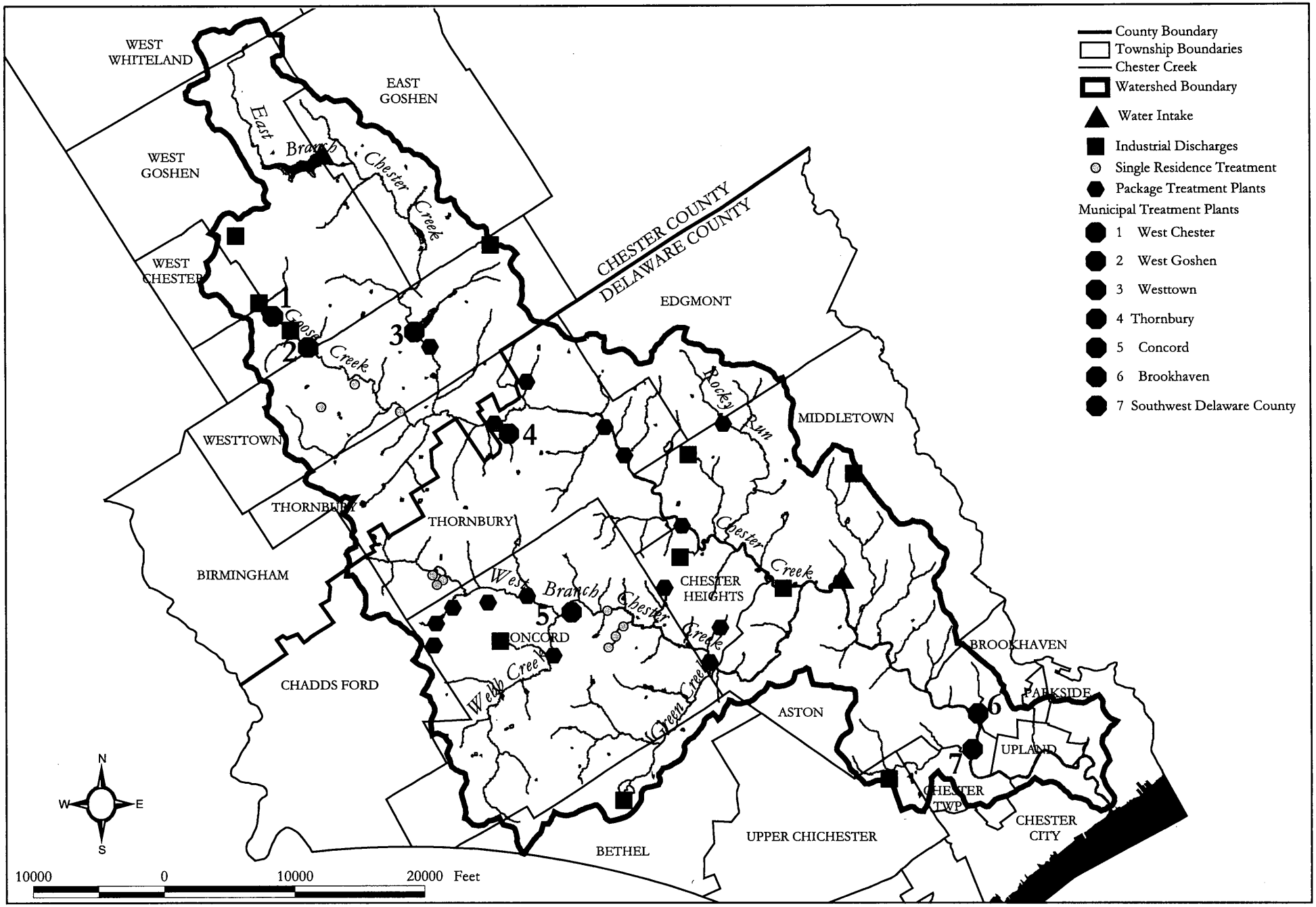
Thanks largely to the Federal Clean Water Act with its attendant "National Pollution Discharge Elimination System" (NPDES), the outflow from sewage treatment plants and industry are more tightly regulated than was the case thirty years ago. While Chester Creek does have seven active industrial discharges, the preponderance of discharges, both in number and volume, comes from non-industrial sewage treatment plants (**Figure 7: Point Source Discharges**). There are six municipal treatment plants, fourteen smaller "package" treatment plants serving single developments, institutions or businesses, and twelve single residence treatment plants (DEP, permit maps, 1999). The US Environmental Protection Agency (EPA) has given the Commonwealth of Pennsylvania jurisdiction over the enforcement of the NPDES program.

Municipal Sewage Treatment Plants

Three municipal sewage treatment plants are located in Chester County just south of West Chester. The West Chester Borough and West Goshen Sewer Authority plants are on Goose Creek within a half-mile of each other. The Westtown Township Sewer Authority's plant (formerly run by a private sewer company) is on the East Branch just upstream from Westtown School. The remaining three plants are located in Delaware County. Concord Township Sewer Authority's plant is located on Webb Creek, but its discharge is into the West Branch below Nathaniel Newlin Park. Brookhaven Borough and the Southwest Delaware County Sewer Authority have plants on the main stem within a half-mile of each other near Bridgewater Road. Delaware County Regional Water Quality Control Authority (DELCORA) services some of the sewered areas in the lower Chester Creek watershed. The outfall from the DELCORA plant is on the Delaware River in Chester City, just below the mouth of the Chester. Due to the river's tides, its effluent could impact the Chester Creek.

The sewage treatment plants submit monthly reports to DEP and are inspected regularly. NPDES permits must be renewed every five years. An additional EPA inspection occurs yearly. DEP does not stipulate when during the course of a month the testing for the monthly report will occur (Richard Breitenstein, DEP, pers. comm., 5/13/99). In order to corroborate the monthly reports, water quality specialists from DEP make announced or unannounced inspections, depending on the judgment of the enforcement officer. Consistent failure to meet permit standards subjects the plant operators to fines.

Maintaining a consistent output from a sewage treatment plant requires skill and experience. The process depends on live organisms (bacteria) for much of the processing. If the processes are upset, it may be weeks before optimal conditions are restored. Flows into the plants vary over the course of a day. Although it is not legal to connect rooftop drainage into sewers, the increases in sewage volume entering the plant after rainstorms are probably caused by such connections (Mark Moffa, West Goshen Sewer Authority, pers. comm. 5/12/99). Adding additional wastes, which occurs at the SWDCA plant, requires careful consideration to prevent overloading plant capacity.



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 7

Point Source Discharges

DCR 12/01/99 Rev. DCR 1/23/01

NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Water Intake, Discharges, and Treatment Plants from Delaware County and PASDA.

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Table 3a

Municipal Sewage Treatment Plants

Plant Operator	Permitted Capacity	Receiving Stream	Notes
West Chester Borough	1.8 mgd	Goose Creek	Designed to accept industrial wastes it no longer has to process
West Goshen Sewer Authority	6.0 mgd	Goose Creek	Recently permitted expansion from 4.5 mil. gal./day to 6.0 mgd
Westtown Township	290,000 gpd	East Branch	In process of expanding to 495,000 gal./day
Thornbury Township (Delaware County)	120,000 gpd	East Branch	Expansion request is being processed by DEP
Concord Township Sewer Authority	1.2 mgd	West Branch	Delaware County Prison uses 140,000 gal/day of plant capacity
Brookhaven Borough	192,000 gpd	Chester Creek	Services just 700 homes in the Borough
Southwest Delaware County Sewer Authority	5.0 mgd	Chester Creek	Accepts residential sewage and industrial wastewater from outside the watershed

In most cases, individual municipalities own the sewer lines that terminate in treatment plants owned by sewer authorities. In many municipalities, records of the location and size of their sewer systems are outdated or inaccurate (Eileen Mulvenna, NDI Engineering Inc., pers. comm., 5/12/99). It can be difficult for the smaller, less financially sound systems to fund regular maintenance of the lines. Without maintenance, pipe cracks or joint failures are likely, potentially resulting in leaks into streams. The accidental release of even small amounts of contaminants can impact aquatic life in long stretches of the stream or require a long recovery period (Preston Luitweiler, PSW, pers. comm., 5/2/96). Concerned citizens report most of the

documented leaks. West Chester Borough has created computer GIS mapping of its sewerage and has a regular program of repairing and replacing older lines (parts of the Borough are still served by the original brick arch construction). Surveillance of the sewer lines is done by "televising". A video camera mounted on a self-propelled cart is lowered into the sewer line and records the condition of the pipe as it rolls down gradient.

Planning for sewage systems (both public sewage systems) and individual septic fields) in Pennsylvania is regulated by DEP under the Pennsylvania Sewage Facilities Act (Act 537) of 1966. Municipalities are required to account for existing and future sewer needs in comprehensive plans commonly referred to as "Act 537 plans". DEP provides matching funds for the plans and sets the conditions for what they include. Municipalities are expected to revise the plans when unanticipated growth or other changes make their original plans obsolete. All the municipalities in the Chester Creek watershed have Act 537 plans, but some are quite old and may benefit from updating. The following chart displays their status:

Table 3b

Act 537 Plan Status

Municipality	Plan Approval Date	Status
Aston Township	97/04/16	Less than 5 years old
Bethel Township	95/03/21	Less than 5 years old
Brookhaven Borough	98/03/17	Less than 5 years old
City of Chester	72/01/01	Almost 30 years old
Chester Heights Borough	97/04/16	Less than 5 years old
Chester Township	91/03/26	More than 10 years old
Concord Township	99/09/15	Less than 5 years old
East Goshen Township	99/03/30	Less than 5 years 0ld
East Whiteland Township	99/04/01	Less than 5 years old
Edgemont Township	81/08/07	Almost 20 years old
Middletown Township	98/09/02	Less than 5 years old

Parkside Borough	72/01/01	Almost 30 years old
Springfield Township	99/12/02	Less than 5 years old
Thornbury Township	95/04/17	Less than 5 years old
Thornbury Township	98/06/30	Less than 5 years old
Upland	72/01/01	Almost 30 years old
Upper Chichester Township	99/04/01	Less than 5 years old
West Chester Borough	96/10/23	Less than 5 years old
West Goshen Township	98/01/20	Less than 5 years old
West Whiteland Township	96/08/12	Less than 5 years old
Westtown Township	94/01/26	More than 7 years old

Municipal Sewage Treatment Plant Recommendations

Municipal sewage treatment plants are complex and expensive utilities that are the focus of regulators from several levels of government. Even though they have a profound effect on the health of a waterway, it may be presumptuous to offer recommendations on improving their operations within the context of a modest River Conservation Plan, simply because adoption of this plan will not deliver sufficient resources to rebuild or modify a plant. However, in the area of citizen education and volunteer monitoring, a River Conservation Plan can offer viable recommendations.

1. A two-part, "point source" monitoring program could be undertaken:
    a. First, in-stream inspections at sewage treatment plant outfalls could be performed by trained volunteers, to look for signs of spills or obvious degradation in streams. Homeowners along the creek could be trained to look for signs of plant failure and leaking lines. A fact sheet describing how to report spills and a map showing sewage lines could be distributed.
    b. Second, the monthly testing reports filed with DEP by plant operators, and the written results of DEP and EPA inspections could be reviewed for adherence to the discharge

limits set by the plant's NPDES permits. In order to accomplish this with volunteers, a training program would be needed. The Delaware Riverkeeper organization, an education and advocacy group with offices in Washington Crossings and St. Peters (see Appendix A), or another organization, may be able to serve as the consultant to create such a program. Support from public agencies, such as EPA, the Chester County Water Resources Authority, and the Delaware Estuary Program, and especially DEP, would be crucial to its continuance and legitimacy. Without the support of DEP, problems uncovered by the volunteers would have no viable avenue for redress.

2. As such a program gains experience, it may be able to undertake special studies, such methods to improve record keeping systems at sewer plants and DEP, and infiltration and inflow (I/I) studies (when leaks or excessive flows are suspected in sewer systems).

3. Act 537 plans greater than five years old should be re-examined and, if appropriate, amended to reflect current conditions, including advances in treatment technology, and the status of groundwater and surface water supply and quality in the municipality.

Package Treatment Plants

Smaller package treatment plants are scattered throughout the watershed and serve institutions (such as Westtown, Sleighton, and Glen Mills Schools and Cheyney University), subdivisions (e.g., Thornbury Hunt), and businesses (e.g., State Farm Insurance and Concord Country Club). The plants, which typically process 20,000- 40,000 gallons/day, use either the older method of discharging directly into a stream, or a newer method of land application of the treated wastewater.

In land application, wastewater is treated in the traditional fashion of filtration, aeration and biological action, and then is either sprayed above ground through an irrigation system, or released underground in a large septic field. Land treatment provides additional cleansing through the action of soil microbes, which can remove much of the nutrients and heavy

metals before the water travels, as groundwater, to the creek system. Because of the benefits of this method, the Chester County Planning Commission has long advocated land application of treated wastewater. This additional treatment can effectively remove excess nitrogen and phosphorus from the wastewater and can help maintain groundwater levels (Chester County Planning Commission, "Utilization of Spray Irrigation in Wastewater Treatment", 1990). There are no land application plants in Delaware County.

Excess nitrogen and phosphorus are common causes of algae blooms and the resultant degradation of aquatic habitats. These nutrients are expensive to remove from wastewater by conventional means. Above-ground land treatment allows terrestrial plants to use these nutrients for growth, thus taking them out of the hydrologic cycle before they reach a stream. However, above-ground land treatment also results in evaporation. Wastewater released in underground septic fields is not as prone to evaporate, which increases groundwater recharge, but it also is not as exposed to plant roots as above-ground land treatment, and therefore increases the flow of nutrients to groundwater. The Applebrook Golf Course at Hershey's Mill is irrigated with wastewater from the homes in Hershey's Mill.

Above-ground land treatment is sensitive to soil type and season and requires a fairly large parcel. Above-ground land treatment has been the preferred technological solution, followed by subsurface disposal, for sewage treatment discharge to the cleanest waterways (DEP, "Special Protection Waters Implementation Handbook", page V-1, 1992). However, there are indications that subsurface systems are becoming equally acceptable. An innovative sub-surface system has been installed in Thornbury Township, Chester County. The system uses "drip" irrigation technology, originally developed in Israel, to replace an above-ground spray field. The drip system uses one-half inch diameter flexible polyethylene tubing placed six to eight inches below grade. The tubing contains emitters every two feet that release water when pressure in the tube reaches a certain set point. The Township's drip system, designed by Yerkes Associates, requires a smaller land area due to lesser buffer requirements. It increases groundwater recharge, is less dependent on dry or warm weather, and lessens maintenance costs (Chester County Planning Commission, Planning Tomorrow Today, Winter 1999, page 8).

The package treatment facilities can have an important maintenance drawback, which many municipalities have recognized and are addressing. Historically, the initial maintenance responsibility has been left with the homeowners association or business served by the plant. When the plant requires expensive repairs or fails, those responsible may be unwilling or unable to pay for the repairs. The municipality then must take it over to protect public health. DEP urges municipalities to be involved in the initial design and to be the permittee. East Goshen and Thornbury (Chester County) Townships now require that they be the permittees for small plants, and that the facilities be designed to Township specifications. Thornbury Township (Delaware County) took this step with the treatment plant built originally for the Thornbury Hunt development, which will soon accept effluent from new, adjacent subdivisions. Chester County has suggested that municipalities avoid this interim step altogether and directly manage all package treatment plants as public facilities from the outset (Chester County Planning Commission, "Utilization of Spray Irrigation in Wastewater Treatment", 1990).

Package Treatment Plant Recommendations

1. Municipalities should be the permittee for any proposed package treatment plants within their jurisdiction and should assume responsibility (if possible) for those already in existence. The regulations used by East Goshen and both Thornbury Townships could be used as models.

2. The volunteer water quality monitoring program proposed for the municipal sewage treatment plants could be extended to include the package treatment plants. It would serve as a supplement to the compliance monitoring conducted by DEP. First, monthly testing reports filed by plant operators with DEP can be reviewed to confirm that discharge limits set by NPDES permits are not exceeded or only exceeded in very isolated instances. Second, visual inspections can be performed by trained volunteers to look for signs of spills or obvious degradation in streams. The same training and support would be required as for the municipal plant program.

Industrial Discharges

Permitted industrial discharges are scattered throughout the watershed. Several are simply separators that remove oil from storm water, such as the Sun Oil fuel dispensary on Route 452 in Aston and the Laurel Pipeline facility in Bethel. Others discharge heated water from an industrial process (e.g., Westlake Plastics in Lenni). A few are the result of an accidental spill, such as a leaking fuel oil tank that required extended cleaning of an underground plume (Ennis Oil Company in Chester Heights).

The industrial discharges into the Chester Creek system do not now have a major impact on water quality (Richard Breitenstein, DEP, pers. comm., 5/13/99 and 10/7/99 and Joann Dolcheck, DEP, pers. comm., 10/7/99).

Industrial Discharge Recommendations

1. Since industrial discharges do not appear to be a problem and implementation resources will be limited, no recommendations are made at this time.

Storm Sewer Systems

Almost all pollution not created by sewage systems and industrial discharges is carried by storm water. Until quite recently, federal law exempted municipal storm sewer systems (MS4's) from the NPDES regulations governing point sources. This is changing, as EPA institutes the "NPDES II" regulations that developed from the re-authorization of the Clean Water Act. Soon, with the exception of Chadds Ford Township, the storm sewer systems of all the municipalities in the Chester Creek watershed will be regulated under this program (Karen Holm, Delaware County Planning Department, pers. comm. 2/25/00). The program includes six control measures:

- Public education and outreach on storm water impacts
- Public involvement and participation

- Illicit discharge detection and elimination (including the development of a storm sewer system map and adoption of enforcement mechanisms)
- Construction site storm water runoff control
- Post-construction storm water management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations

Storm Sewer System Recommendations

1. Acceptance of the water quality Best Management Practices in the Act 167 Chester Creek Stormwater Management Plan (see Chapter 1) will make municipalities eligible for funding from DEP to create ordinances that will not only implement the Stormwater Management Plan, but also the NPDES II standards for storm sewer systems (Karen Holm pers. comm. 11/25/00). Because the NPDES II program will mandate more stringent water quality controls, it is prudent to adopt such standards while funding is available. Such ordinances should be careful to address the six control measures listed above.

2. An educational program for municipalities on effective measures to implement the NPDES II program should be undertaken.

Table 3c

Summary:
Point Source Pollution Recommendations

Recommendation	Potential Participating Parties
Establish volunteer monitoring programs for sewage plants (both public and package treatment plants)	Municipalities, Chester Ridley Crum Watersheds Association, Philadelphia Suburban Water Company, Local Environmental Advisory Commissions, Operators of Treatment Plants, DEP
Enhance the monitoring program through special studies on record keeping systems, and infiltration and inflow (I/I)	Same as above
Assure public agency responsibility for future small packaged treatment plants and for those already in existence	Municipalities
Update Act 537 Plans older than 5 years	Municipalities
Adopt Water Quality Standards from the Act 167 Plan as part of NPDES II adoption	Municipalities

4

NON-POINT SOURCE POLLUTION

Non-point source pollution, which runs off roads, parking lots, lawns, farms, and rooftops in rainwater, is ubiquitous. Its widespread nature makes it difficult to measure and control. At the same time, recent research suggests that non-point sources add six times as much pollution to streams as point sources (Environmental Law Institute, "Using Pollution Control to Protect Threatened and Endangered Species and Reduce Ecological Risk", p. 20. The largest component of non-point source pollution, by volume, is sediment (DEP, "Erosion and Sediment Pollution Control Manual", 1990, p. 1). Other pollutants include fertilizers, pesticides, pet feces, solvents, motor oil, antifreeze, and road salt.

The watershed can be characterized as being quite developed in its eastern headwaters and in its lower reaches. The middle and western portions of the watershed are a mix of rural lands and rapidly developing suburbs. Water quality follows the development pattern closely, being impacted most where developed, and being less impacted where growth is not as dense.

Reducing non-point source pollution requires addressing a wide variety of issues. This chapter is the largest in the Chester Creek Conservation Plan, and, if it seems unwieldy, the reader is asked to remember that the focus is on the sources and remedies for non-point source pollution

Best Management Practices

Almost all non-point source pollution is carried by stormwater. Therefore, measures to reduce runoff and slow it down not only reduce flooding, but also carry the additional benefit of reducing non-point source pollution. Two basic ways to accomplish this are to: 1) slow the velocity of storm water flow and force it to spread out over vegetated ground, providing an opportunity

for water infiltration and for sediment, nutrients, and chemicals to settle; 2) reduce the gross amount of pollution in the storm water, and; 3) reduce the generation of storm water runoff. The body of professional practice that has grown up around these basic concepts has been given the name "Best Management Practices" (see Schueler, Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs, Metropolitan Washington Council of Governments, 1987, for an example of one compendium). Innovations continue to expand the array of BMPs available, including logs made of flocculents and emulsions sprayed to impede erosion of colloidal-clay soils.

The Pennsylvania Association of Conservation Districts (PACD) recently published a comprehensive Best Management Practices Manual that describes the wide variety of techniques available to site designers (PACD, "Pennsylvania Handbook of Best Management Practices for Developing Areas", 1998). Municipal engineers throughout the watershed are becoming familiar with these techniques through workshops and the distribution of the manual by the two county conservation districts. The Chester County Conservation District expects to have information on a self-guided tour of BMPs that have been installed throughout the County available to municipal officials by summer 2001 (PADEP Environmental Protection Update, Dec. 4, 2000).

Adoption of BMPs has been relatively slow in Pennsylvania compared to neighboring states due to a lack of a state-wide mechanism to require their installation. Conservation districts cannot require their installation (except in "HQ" watersheds, which for Chester Creek means only the Rocky Run sub-watershed) because they are considered storm water, not erosion, control devices (Ed Magargee, Delaware County Conservation District, pers. comm., 5/11/99). Local municipalities are free to adopt BMPs as part of their land development ordinances however, and London Grove Township in southwestern Chester County is often cited as a municipality that has developed a good set of BMP ordinances (Dan Grieg, Chester County Conservation District, pers. comm., 4/28/99).

The recent policy initiative of the CCCD to reduce review fees by 25 percent for projects that employ any preferred BMP for erosion control and storm water management is a welcome step toward wider use of BMPs.

Prevention of non-point source pollution using BMPs is easier to accomplish in developing areas than in existing urban areas. The older communities in the watershed, such as West Chester, Brookhaven, Upland and Chester, have storm drainage systems that were constructed before detaining storm water became required. There are few structures available to catch the concentrated road residues, trash, salt and domestic pet feces that flow into streams with every rain. Even in newer developed areas the existing detention basin systems do not slow the flow of the most common (two-year) storms. Any comprehensive program to lessen non-point pollution from urban areas will have to address economical means to retrofit existing systems.

There are other, more site specific, best management practices that were not included in the Pennsylvania BMP Manual. These fall under the category of source protection and prevention. For example, enclosing or placing a roof over certain material storage or handling areas could result in far lower pollution discharge rates from an industrial site than trying to treat the runoff after it has come in contact with production materials. Similarly, modification to processes or material changes can reduce the amount of potential pollutants on-site.

Best Management Practices Recommendations

1. BMPs from the Chester Creek Stormwater Management Plan should be adopted into municipal codes and ordinances. Opportunities to use BMP retrofits should be sought wherever possible in redevelopment projects. The Act 167 Plan will encourage implementation of BMPs and will prepare municipalities for NPDES II regulations.

2. London Grove Township storm water management provisions and the Center for Watershed Protection literature should be reviewed for additional BMPs not included in the Act 167 Plan. In addition to runoff controls, London Grove Township requires that the volume of groundwater recharge be maintained at pre-development levels to assure that there is no net reduction in the annual recharge of groundwater. Where it is not possible or prudent to recharge groundwater, there are mandated reductions in runoff pollution for total phosphorous, total nitrogen, trace metals, and "biological

oxygen demand" (BOD). Municipalities in the Chester Creek watershed should consider adopting similar standards and practices.

3. Delaware County Conservation District and local municipalities should adopt the Chester County Conservation District's fee reduction incentive for projects using preferred BMPs.

4. An accounting system should be developed by municipalities to keep track of BMP retrofits and new installations. Examples may include number of downspouts disconnected, rain gardens installed, etc. Municipalities with active programs should be recognized.

5. A homeowner education program regarding personal practices (i.e. fertilizers and pesticides, automobile fluids, water conservation, etc.) should be implemented. Programs such as the Regional Southeastern Pennsylvania Household Hazardous Waste Program (215-238-9991), which includes both Delaware and Chester Counties, should also be publicized (also see Chapter VI, Environmental Education).

Sedimentation and Erosion Control

Sediment, as has already been mentioned, is the leading pollutant in Pennsylvania streams. Therefore, its control is fundamental to any successful water quality effort for the Chester Creek. Sediment damages streams in two fundamental ways. First, it covers undisturbed gravel stream bottoms with silt. This interferes with the stream ecosystem at all levels in the food chain, from algae to trout (which need gravel beds to lay eggs). Second, sediment carries a variety of pollutants, such as heavy metals and phosphorus, into the water. This may lead to algae blooms and the concentration of toxic metals in aquatic carnivores (such as trout).

Sediment tends to enter streams like the Chester in two basic ways: during land clearing and construction, and from the permanent changes in storm water flows after development is complete. Erosion during construction is obvious and is regulated through the Pennsylvania Clean Streams Law. The second form is subtle and is only indirectly regulated through storm water ordinances. In a developed watershed, increased flow during storms tends to slowly de-stabilize channels and increase bank erosion until the stream

reaches a new equilibrium condition. Additional loads of sediment from new construction delays the equilibrium process by filling and, therefore, reducing the size of the channel, leading to new bank erosion during floods. The increased velocity and frequency of floods, which are the result of development also destabilizes banks. The discussion here is limited to the regulation of erosion during construction. Eroding stream banks are further discussed in Chapter IV - Land Stewardship.

NPDES permits, administered by the conservation district, are required for any earthmoving of more than five acres, or any construction that affects wetlands or encroaches on streams. By 2001, any earthmoving of more than one acre will require an NPDES permit. Site designers prepare erosion control plans as part of the basic package of plans. Depending on the county and the municipality, these plans are either reviewed by the conservation district or the municipal engineer (in Chester County most plans are reviewed by the conservation district; in Delaware County disturbances less than five acres are reviewed by the engineer unless a stream encroachment or wetland is involved). It is up to the local municipality to decide how to regulate erosion control for land clearing of less than five acres. Many have decided to require plans for much smaller disturbances and have additionally required that plans be reviewed by the conservation district.

Conservation district staffs have a large work load of review, inspection, and enforcement. The Delaware County office processed 300 plans and conducted 219 inspections in 1998. The Chester County office reviewed 780 plans and conducted 900 inspections in 1998. Field inspections are mostly in response to complaints. The inspectors find that large contracting firms readily comply with plan and field changes. The record of small contractors is more variable, due often to unfamiliarity with erosion control law (Ed Magargee, Delaware County Conservation District, pers. comm., 12/21/95). At the municipal level reviews are done by the municipal engineers, and inspections by the engineers and the zoning enforcement officers.

The erosion control plans prepared to meet the permit standards are fairly straightforward. The science in the preparation of erosion control plans is well understood by the practitioners. This is not to say that bad designs do not happen. For instance, permanent storm water control basins are often used temporarily during construction to capture silt. The Chester County office has noticed that if these basins have more than one inlet, the storm

water entering from different directions produces such turbulence that the silt does not settle properly.

Besides design, which can be improved during the review process, the other major elements to effective erosion control during construction are proper installation, regular maintenance and prompt enforcement to correct violations. A good design can be ruined by sloppy installation or failure to remove accumulated silt. Enforcement of good installation and maintenance is largely driven by citizens who report problems, since the counties do not have large enough staff to conduct regular inspections of every site.

An element that cannot be controlled is the weather during construction. Erosion control devices are designed for two-year storms (a storm with the statistical probability of occurring once every two years). Should a larger storm occur during construction, even well-installed devices could fail.

Erosion Control Recommendations

1. As with floodplain and storm water management regulations, consistency in erosion and sediment control ordinances across township and county lines would assist regulators and contractors, large and small, to become equally well-versed in erosion and sediment control practices.

2. Municipalities or county conservation districts should hire additional technicians to review erosion and sediment control plans, and inspectors to assure proper installation and maintenance in the field.

3. A volunteer monitoring program such as the Brandywine Valley Association's and the Delaware Nature Society's (DNS) "Soil Watch" programs should be established. This program includes volunteers who monitor the efficacy of erosion and sediment control measures at construction sites and help insure compliance with regulations. DNS has also recognized developers who adhere to certain guidelines as "Soil Stewards". More information is available at their website at www.delawarenaturesociety.org.

Private Septic Systems

Many residences in the central and western portions of the watershed are served by individual septic systems. County health officials in Chester County and municipal health officers in Delaware County follow regulations, promulgated by DEP (Title 25, Chapters 71,72,73) regarding the location of the fields and the suitability of the soils. Even so, the systems do fail occasionally, either through poor siting, lack of maintenance, or age, allowing incompletely treated wastewater to enter the groundwater from surface water. The failure can be undetected for years.

Individual septic systems are not systematically inspected by health officers. Even in the case of residential "package" systems permitted in marginal areas on a case-by-case basis by DEP, a yearly report from the owner is all DEP requires. Township sewage enforcement officers do, however, keep records, and problem areas are identified in "Act 537" plans (state-mandated, but locally completed plans for providing sewage service to municipal citizens).

Unfortunately, the lack of regular oversight may be hiding a large number of failing systems. The nine "Single Residence Sewage Treatment Plants" permitted by DEP in the watershed tend to occur in clusters (such as by Brinton Lake), indicating areas of marginal soils where other systems may be failing without detection.

Private Septic System Recommendations

1. Ordinances regarding septic system registration and maintenance programs should be instituted as needed. Concord Township, for example, requires proof of periodic pumping. A similar ordinance is in effect in East Goshen Township. If need be, fines or other approaches should be used to assure proper maintenance.

2. In order to assist in this program, homeowners should be provided with a fact sheet including signs of failures or other problems as well as summary of the impact their system has on neighbors and the

entire watershed. Fact sheets for municipalities and authorities are available from DEP, including "Understanding Septic Systems" for home owners and "Process for Resolving Complaints about Malfunctioning On-Lot Sewage Disposal Systems".

Impervious Cover

Besides the specific effects of the phenomena listed in the previous subsections, it is also generally true that they combine with all the other attendants of development to produce a generally negative effect on streams. The Center for Watershed Protection (CWP) in Ellicott City, Maryland, has produced, among numerous other excellent publications, a widely recognized guide for managing urbanizing watersheds called Rapid Watershed Planning Handbook (1998). The CWP approach is comprehensive and easily understood by non-professionals because it uses a single parameter to predict the general condition of a watershed. CWP has analyzed data from many mid-Atlantic streams and has found a strong, negative correlation between **impervious cover** in a watershed and **water quality** in the stream. This is especially true in smaller watersheds (up to 6,400 acres). While the Chester Creek watershed is 43,000 acres, many of its subwatersheds fall within the smaller watershed size. Because of the consistency in its data, CWP has developed four general planning categories for streams:

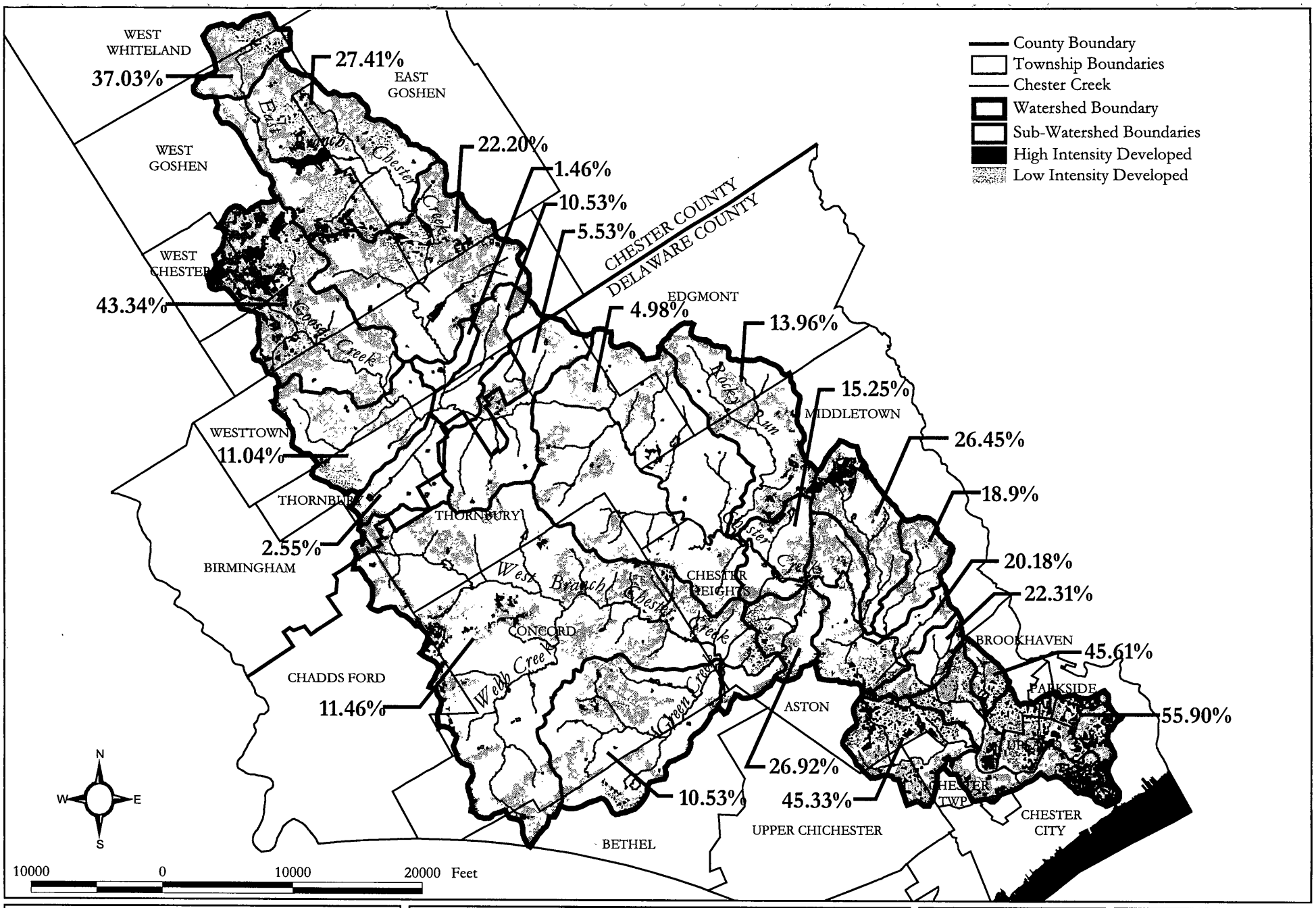
Sensitive stream:	Less than 10% impervious cover
Impacted stream:	Between 10% and 25% impervious cover
Non-supporting stream:	Greater than 25% impervious cover
Restorable stream:	Impacted or Non-supporting, but having a high retrofit or restoration potential

A sensitive stream has high water quality and stable banks (Note: an exception to this simple categorization can occur in agricultural areas without adequate stream buffers. Even though impervious cover is low, runoff from animal yards and fields can lower water quality. This is not a significant factor in the Chester Creek watershed). According to CWP, the planning goal in a sensitive stream watershed is to maintain the existing biodiversity and channel stability. An impacted stream will generally show a decline in physical, biological, or water quality indicators. The goal in an impacted stream is to limit the degradation of habitat quality and maintain

the current biological community. A non-supporting stream is characterized by unstable channels and a poor to fair biological community. The goals in a non-supporting stream are to minimize pollutant loads, alleviate downstream flooding, and improve aesthetic appeal. Finally, a restorable stream that is classified as impacted or non-supporting but has retrofit potential has goals that include shifting of the stream designation to the next higher classification and increasing the economic value of the surrounding neighborhood or watershed.

An analysis of impervious cover was performed for the Chester Creek sub-watersheds (**Figure 8: Approximate Impervious Cover by Sub-watershed**). Please note that the percentages shown in this figure are based on broad assumptions and should be used more for comparing one sub-watershed to another and not for implying absolute values of imperviousness). It is interesting to note where impervious percentages seem to match DEP water quality designations, and where the match is not as strong. The high impervious percentages in West Chester and lower Delaware County match the Warm Water Fisheries designation. But Rocky Run, the sub-watershed with the highest classification, has a percentage in the "Impacted" range and somewhat higher than Green Creek, which has a lower designation. Also note that the low impervious cover of the central sub-watershed between Cheyney and Glen Mills does not define the main stem's group because its classification depends also on the combined imperviousness of all its upstream sub-watersheds, but it would define the classification of the small tributaries that flow into the main stem in that area. Based on this small sample, it seems evident that imperviousness, while important, is not the sole influence on water quality. Other factors, especially point source pollution sources, must also be considered.

In order to look at change over time in impervious cover, population change projections (a stand-in for development) are shown in **Figure 9: Population Change 1990-2020**. A comparison of Figures 8 and 9 indicates that several sensitive streams, as defined above, are in the townships that are projected to have the greatest population increases. Most notable are Thornbury, Edgmont, and Concord Townships and the Borough of Chester Heights, all in Delaware County. Consequently, a further analysis of these municipalities was performed based upon a "maximum build-out" scenario developed by the Delaware County Planning Department. In each case, almost all of the remaining undeveloped land is zoned for mid- or low-



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 8
Approximate Impervious Cover by Sub-Watershed

DCR 12/01/99 Rev. DCR 1/23/01; 5/29/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Low Intensity Developed and High Intensity Developed from EPA Region III Land Cover Data Set.

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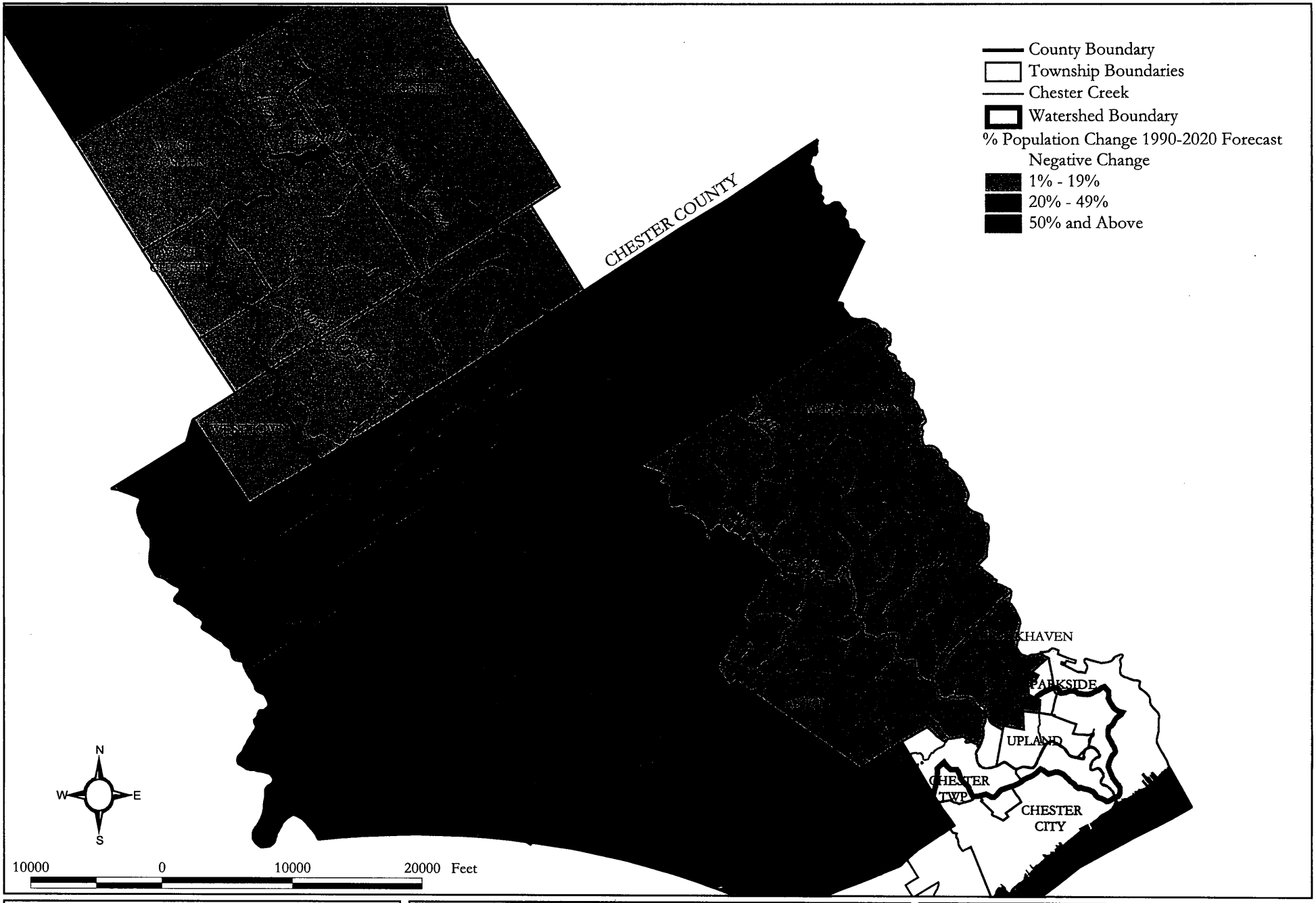

Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 9

Population Change 1990 - 2020

DCR 12/01/99 Rev. DCR 1/23/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Population Change information provided by Delaware County.

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density single family residential housing on lots greater than 30,000 square feet. CWP research indicates this density produces 10% to 20% impervious cover (Center for Watershed Protection, "Rapid Watershed Planning Handbook", October 1998, p. 6.7). This suggests that the remaining sensitive streams will become impacted and the larger streams in the lower watershed will become non-supporting. Note also that population change is a useful indicator only in areas being developed. The impervious cover percentages do not lessen substantially in areas that are not actively growing. Upland, Chester, Brookhaven, and the other older Delaware County communities are largely paved and are likely to remain so.

Impervious Cover Recommendations

1. While open space preservation efforts are important throughout the watershed, they are particular crucial in Thornbury, Edgmont, and Concord Townships and the Borough of Chester Heights in Delaware County. Most of the remaining sensitive streams are found there. Open space preservation efforts should be focused in these four municipalities.

2. The eight-part watershed protection approach developed by the CWP, and summarized in the Rapid Watershed Planning Handbook (Chapter Two, page 2.1 – 2.26), should be adopted by all municipalities in the watershed. Promotion of this approach should be undertaken by local public and private agencies and organizations. Alternatively, or in tandem, the "10 Principles for Comprehensive Stormwater Management", to be included in CCWRA's *Watersheds* plan, should be adopted by municipalities

Table 4

Summary

Nonpoint Source Pollution Recommendations

Recommendation	Potential Participating Parties
Best Management Practices	
Adopt best management practices (BMPs) from the Act 167 Plan that would also meet NPDES II standards	Municipalities, Planning Commissions, EACs
Adopt other BMPs which require infiltration of stormwater and pollution reduction	Municipalities, Planning Commissions, EACs
Develop an accounting system to keep track of installed BMPs and recognize excellent examples and municipal programs	Municipalities, Planning Commissions, EACs, Conservation Districts, U.S. Natural Resources Conservation Service (NRCS)
Institute homeowner education programs re: personal practices (e.g., use of fertilizers and pesticides, automobile fluids, water conservation, etc.)	Municipalities, Planning Commissions, EACs, Conservation Districts, Watershed Organizations, County Planning Agencies, Philadelphia Suburban Water Company, NRCS
Erosion and Sediment Control	
Adopt consistent erosion and sediment control ordinances across township and county lines and assure that regulators and contractors are equally well-versed in erosion and sediment control practices	Planning departments, conservation districts, Municipalities, EACs
Municipalities and county conservation districts should hire additional technicians to review erosion and sediment control plans, and inspectors to assure proper installation and maintenance in the field.	Conservation Districts, Municipalities
Establish/expand a "Soils Watch" volunteer monitoring program to monitor sediment loads	Watershed organizations, EACs, Conservation Districts

Private Septic Systems	
Institute ordinances regarding septic system registration and maintenance	Municipalities, EACs
Homeowners should be provided with a fact sheet including signs of failures or other problems as well as summary of the impact their system has on neighbors and the entire watershed.	Municipalities, EACs, County Health Department
Impervious Cover	
Focus open space preservation efforts in the four municipalities of Thornbury, Edgmont, and Concord Townships and the Borough of Chester Heights in Delaware County.	Municipalities, watershed organizations, nonprofit conservation organizations
Promote and adopt the eight-part watershed protection approach developed by the Center for Watershed Protection, and the 10 Principles of Comprehensive Stormwater Management by CCWRA.	CCWRA, Municipalities, Planning Commissions, EACs, watershed organizations, nonprofit conservation organizations
Encourage homeowners to adopt small-scale measures, such as dry wells for gutter systems, to increase infiltration of stormwater from impervious surfaces	CCWRA, Municipalities, Planning Commissions, EACs, watershed organizations

5
LAND STEWARDSHIP

Land stewardship, which this report defines as the ways in which property owners use and maintain their land, has a powerful influence on the stream system. The strongest response by citizens and municipal officials to the issues listed in the surveys was the importance of protecting and enhancing "natural habitats" along the creek. This included equal concern for protection of special habitats, stabilization of streambanks, and loss of riparian (streamside) forests. This chapter also addresses the care and maintenance of ordinary landscapes, such as lawns, which occupy a significant portion of the watershed.

General Land Stewardship Recommendation

1. One of the best ways to encourage responsible stewardship is to get people actively involved in land and water conservation efforts, if only for a day or two a year. Annual stream cleanups provide the opportunity to connect people to a stream without necessitating a large time commitment. Even better, an entire week set aside for nature walks, historical presentations, and educational seminars, has been developed by CRC. Called "Creek Week" it is held in May and has been expanding its offerings every year. Creek Week should continue to expand according to the imagination of its participants. It could, for example, include stream restoration projects and school field trips.

Natural Areas

The Nature Conservancy, through the Pennsylvania Science Office, has conducted Natural Area Inventories for both Delaware and Chester Counties (available from the County Planning Commissions). These studies document areas in a county where rare, threatened, or endangered plants and animals have been found, or where excellent examples of undisturbed

natural habitats exist. The Chester County Natural Areas Inventory (1994) documents one natural area in the Chester Creek Watershed. The Delaware County Natural Areas Inventory (1992) documents seventeen (**Figure 10: Natural Areas**). Of these eighteen, four contain important rare species. The most important is the "Williamson School Serpentine Barrens" in Middletown, followed by the "Johnsons Corner Quarry/Woods" in Concord, which has subsequently been lost to a housing development. The Hershey's Mill site in Chester County is a serpentine barren like the Williamson School site. The last important site is along the West Branch near Aston Mills and is called "SP589", after the numeric designation of the rare aquatic plant found there. The other fourteen sites are the healthiest examples of typical ecosystems to be found in the watershed. Most are woods and most still exist (Elam Woods in Concord has been developed). The highest ranked of these is the "Edgewood Memorial Park Woods", a mature beech woods located in the northern portion of the cemetery property (and at least partly lost to development).

Table 5a

Natural Areas in the Chester Creek Watershed

ID #	Rank	Site Name	Municipality	Description
	DELAWARE COUNTY Statewide Significance			
1	1	Williamson School Serpentine Barrens	Middletown	Globally imperiled serpentine habitat; fair population of Pennsylvania threatened plant; three additional plant species of special concern
2	2	Naamans Creek Road Site	Concord and Bethel	Five plant species of concern occur at the site; consists of several areas of wet meadow and early success ional woods; site is combined with Johnson Corner Quarry/Woods site
3	5	SP589	Aston and Concord	Poor population of S2S3 aquatic plant grows in West Branch of Chester Creek
4	5	SP513	Concord	Poor population of TU wildflower with Coastal Plain affinity grows along power line cut in Clayton Park

ID #	Rank	Site Name	Municipality	Description
DELAWARE COUNTY Local Significance				
5	High	Edgewood Memorial Woods	Concord	Stand of mature beech on NW slope adjacent to cemetery; non-weedy; provides wildlife habitat and green space; one of the best examples of this forest type left in the county
6	Medium	Garnet Mine Road Woods	Bethel	Mature mixed mesophytic woods dominated by beech and tulip tree; relatively non-weedy; may have good spring wildflowers; provides wildlife habitat, green space, watershed protection
7	Medium	Glenwood School Woods	Middletown	Large tract of moderately mature mixed mesophytic woods along tributary to Chester Creek; provides wildlife habitat, green space, and watershed protection
8	Medium	Brinton Lake Wetland	Thornbury	Large wetland bordering NW edge of Brinton Lake; provides wildlife habitat and open space
9	Medium	Cheyney Wetland	Thornbury (Delaware and Chester County)	Large, undisturbed, non-weedy wetland mosaic along Chester Creek; provides habitat for migratory waterfowl; has educational value; potential habitat for rare insects
10	Low	Crozierville Woods	Aston	Moderately mature forest dominated by tulip tree and red oak with diverse herb layer containing many plants of Christmas fern; provides refuge for flora and fauna
11	Low	Darling Woods	Thornbury and Chester Heights	Broadwing hawk nested here in 1991; protects nearby Chester Creek from excessive sediment load
12	Low	Wawa Woods	Middletown	Mature grove of beech on NW slope above Rocky Run; interesting metamorphic rock outcrops
13	Low	Bethlehem Church Woods	Thornbury	Mature beech-dominated woodlot bordered by low-density housing; potential for a rare plant species

ID #	Rank	Site Name	Municipality	Description
14	Low	Glen Mills School Woods	Thornbury	Moderately mature to mature beech-dominated forest along tributary to Chester Creek; largely lost to golf course construction
15	Low	Markham Woods	Concord	Small mixed hardwood forest recovering from heavy logging several decades ago; relatively non-weedy except in gaps; provides wildlife habitat and open space
16	Low	Elam Woods	Concord	Fragment of mature beech-dominated forest with some large tulip trees; has potential for spring wildflowers; provides wildlife habitat and green space
17	Low	Shavertown Woods	Concord	Mature beech-dominated woodland; potential for a rare species
CHESTER COUNTY Statewide Significance				
18	3	Hershey Mill	East Goshen	Good populations of four plant species of special concern

Regulatory protection for Natural Areas is seldom specified in municipal ordinances. The loss of two areas in Concord is testament to their lack of protected status. Conversely, two other areas were protected as their surroundings were developed. Darling Woods and Crozierville Woods both remain largely intact after the balance of the properties on which they grow were developed for housing.

Other areas are noted for their local importance, although not listed in the Natural Areas Inventories. These include: Bonner and Martin Parks in Thornbury (Delaware County), Westtown Lake and its 25-acre wetland with surrounding woodlands in Westtown, Coopersmith Park and the West Chester Reservoir in West Goshen Township, and the Milltown Reservoir in East Goshen Township. Woodlands bordering the West Chester Reservoir and the reservoir itself provide important wildlife habitat for birds, amphibians, and other wildlife.

Natural Areas Recommendations

1. Natural areas identified in this plan should be acquired or otherwise protected (e.g., through conservation easements).

2. Natural Areas should be shown in the open space preservation component of municipal comprehensive plans and open space plans. Natural Areas so identified should be shown on future preliminary and final subdivision and land development plans. The plans should also specify means by which the open spaces will be preserved (acquisitions, easements, overlay districts, etc.).

3. Municipalities should consider requiring an Environmental Resource Inventory (ERI) with all large development plans. Background on ERIs is available from the Pennsylvania Environmental Council (See Appendix A)

4. Private owners of natural areas should be contacted and informed regarding the assistance available to help them manage the lands. Informational brochures should be developed as needed.

5. Educational programs for homeowners regarding land stewardship (e.g., reducing large expanses of grass, providing riparian buffers, etc.) should be initiated. See Chapter 7 recommendations, as well.

Riparian Buffers

Riparian (or streamside) buffers may contain both wetland and upland areas and may consist of herbaceous, shrub, and tree or mixed plant communities. The riparian forest, with its mixture of plant types, has been shown to be critical to the continued stability and health of waterways (US Forest Service, Riparian Forest Buffers, 1991). These natural sponges have been shown to absorb and bind much of the sediments, nutrients, and some of the pollutants in runoff before it reaches the waterway. The shade provided by the trees and shrubs keep water temperatures low; their leaves and twigs are also the primary source of food for the aquatic food web. Vegetation slows the speed of storm water crossing the buffer, reducing erosion of the small swales and gullies that feed the stream. Research by the Stroud Water Research Laboratory on White Clay Creek has shown that forests along streams also make for wider, cooler streams (Sweeney, "Stream side Forests

and the Physical, Chemical and Trophic Characteristics of Piedmont Streams in Eastern North America", Water Science Technology, Vol. 26, No.12, 1992). The US Forest Service publication cited above, and the 1995 paper by the Montgomery County Planning Commission entitled, "Riparian Corridors, the Benefits of Protection" are both excellent brief descriptions of the many benefits of the riparian forest.

Riparian forest protection is particularly important in the "headwaters" of the watershed. Headwaters are the small streams that feed into one another to create the larger portions of the water system. Most of the length of any stream system in Pennsylvania is found in the headwaters, not the major tributaries. Therefore, there is a greater chance for pollutants to enter the stream in a headwaters area. Also, because headwater streams carry less water, they are more easily damaged by relatively small amounts of pollution. Ironically, it is easier to get DEP permits for some construction activities (such as bridges) along these smaller, more sensitive streams than for larger creeks (Dan Grieg, Chester County Conservation District, pers. comm., 5/4/99).

In order to function well, riparian buffers must receive storm water as sheet flow, i.e., broad, shallow, overland flow, as opposed to runoff concentrated in gullies. Sheet flow is slow enough to allow the interaction between the living portion of the buffer and the storm water to remove much of the nitrogen and sediment. Gullies and storm drain outlets at the stream bank short circuit the buffer. A riparian buffer cut by gullies will still serve as important habitat and as a source of food for the stream, but it will not cleanse storm water nearly as well (Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed, Chesapeake Bay Program, 1995, pg. 17).

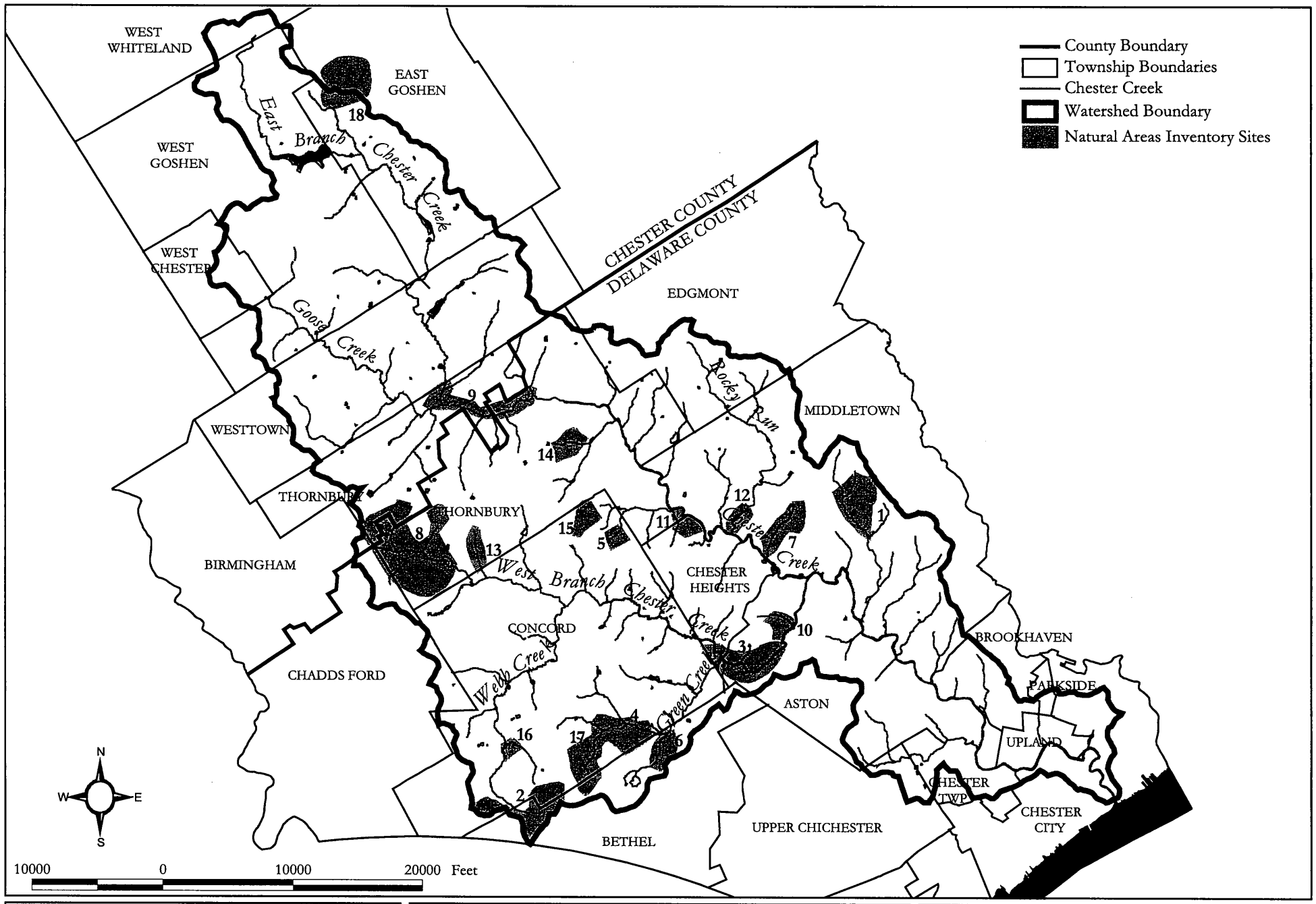
Riparian buffers are present on many of the larger rural properties of the watershed, and in public parklands and private common open spaces throughout the watershed. Certain large institutions, such as Westtown School and Williamson Trade School also have done a good job of maintaining woodland along the creek. But in many areas developed for housing and recreation in the tributary system, riparian woods are conspicuously absent.

Lawns, unfortunately, do not have the absorptive or food- and shade-providing qualities of riparian woods. In the upper watershed and throughout the tributary system open land down to the banks are quite common. It is likely that landowners maintain their properties in this fashion with the best of intentions, not realizing that their actions degrade water quality.

Although many stream corridors in the watershed currently are at least partially wooded, there are few regulations that prevent logging, or that require reforestation of stream corridors. Some municipalities do address the issue indirectly through floodplain and tree protection ordinances (e.g., Middletown and Concord Townships). A model zoning ordinance has been prepared by Montgomery County Planning Commission, based on the work of the US Forest Service, to establish a riparian corridor overlay district (*"Riparian Corridor Conservation District"*, 1995) Like the Forest Service model, it uses 75′ from the bank as the minimum width of a functional riparian buffer. The Buffer is divided into two zones: the first 25′ next to the stream is an undisturbed forest (or replanted forest). The next 50′ is also wooded, but may contain storm water detention devices and may be logged. The Forest Service recommends the logging as a way to remove accumulated nutrients (incorporated into the wood) from the buffer. In the case of steep slopes abutting the stream, the undisturbed zone is carried to the top of slopes greater then 25% (but not more than 75′). The storm water management ordinance of London Grove Township, mentioned in previous sections, prohibits storm water devices in the entire buffer area along Exceptional Value and Cold Water Fisheries streams (London Grove Stormwater Ordinance, p. 36).

Riparian Buffer Recommendations

1. CRC should continue its efforts on an educational guide for landowners adjacent to streams, including literature describing the importance of riparian buffers, types of plantings that are most effective, and maintenance instructions.
2. The Heritage Conservancy has conducted an in-depth study of riparian lands along the Chester Creek. One exercise was a calibrated videotape of their flight over the Chester Creek in a helicopter at 35 mph and 200 feet altitude. Using this videotape and ground verification, the conservancy determined which areas have or lack forest and/or shrub buffers. The findings were mapped in digital form using a "Geographic Information System" (GIS). The Heritage



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 10
Natural Areas Inventory

DCR 12/01/99 Rev: DCR 1/23/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Natural Areas Inventory Sites coverage created by DCR with on-screen digitizing using USGS quadrangles to locate information from Chester County (1994) and Delaware County (1992 rev. 1998) Natural Area Inventories, December 1999.

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Conservancy report "Riparian Buffer Assessment of Southeastern Pennsylvania" should form the base information for municipal riparian buffer planting programs and ordinances.

3. CRC should work with the U.S. Natural Resource Conservation Service and the Conservation Districts to expand staff and funding committed to stream bank restoration and riparian buffer planting programs. Municipal partners should be sought as well. Demonstration projects along Goose Creek in Thornbury Township (Chester County) are excellent examples of restoration and are visible to the public.
4. Generally consistent riparian buffer ordinances across township and county lines are desirable for protection of stream habitats and to ease the approval process. The model riparian buffer ordinance available from the Montgomery County Planning Commission, and/or the Stormwater Management Ordinance of London Grove Township should be incorporated into local zoning ordinances where appropriate. This would work best where streamside lands will eventually be developed.
5. In already developed commercial and industrial areas, buffers could be established incrementally by incentives in the land development ordinances, which could allow reduced parking areas or increased building floor area in return for restored buffers. In situations only requiring planting, municipalities or conservation groups could also offer to do the restoration work for the landowner at a subsidized rate. This may appeal to landowners desiring to "cleanup" the back end of their parking area or unused lot.
6. Existing municipal weed ordinances should be modified to allow meadows to develop in riparian areas. An even stronger measure would prohibit mowing more than twice a year in riparian land areas.
7. CRC should also increase the number of water quality monitors, who, as part of their volunteer efforts, conduct a visual assessment of the riparian zone at monitoring sites.

Management of Public Lands

Management techniques in existing parklands vary according to the use of the land. Woodlands and meadows are found in the passive open spaces of many of the parks: Middletown's Darlington Tract, Goose Creek Park in

Thornbury (Chester County), Bonner and Martin Parks in Thornbury (Delaware County), Eagle Field in Aston and Woodburn Park in Westtown being examples. Speaking strictly from a water quality and wildlife perspective, these are excellent approaches to management of streamside lands. They require little labor to maintain and provide the assets described in the previous Riparian Buffer section. Large expanses of mowed grass such as found in Camp Upland Park (and in some of the common open spaces managed by homeowners' associations), by contrast, require regular maintenance and do not provide the same buffering and habitat qualities as wooded buffers and, to a lesser extent, meadows.

Thornbury Township (Chester County) has recently undertaken an initiative to restore its degraded stream banks. The first project was completed at the Township's new Goose Creek Park in the spring of 1998. The project was accomplished with design and installation assistance from the US Natural Resources Conservation Service (NRCS) and the Conservation District, and funding help from Chester County. The combination of professional land grading and planting by volunteers was found to be efficient and cost-effective. The Township hopes to use the same formula to tackle other eroded banks (Mahlon Rossiter, Thornbury Township pers. comm. 4/26/99). Progress will be largely dependent on the ability of NRCS personnel to devote time to the project (Tim Smail, NRCS, pers. comm., 4/28/99). The DEP Bureau of Waterway Engineering also can provide professional expertise for stream bank and in-stream improvements (Tom Dillingham, DEP, pers. comm., 11/16/00). Combining stream bank restoration with riparian buffer planting is an excellent means to gain funding from the DEP's "Growing Greener" Program for riparian work and the Delaware County Conservation District's Mini-Grant Program.

Management of Public Land Recommendations

1. The science and practice of riparian buffer creation and stream bank restoration have made tremendous strides in the past decade. The literature available to assist land managers is growing as well. One good resource is the "Stream Corridor Restoration" book, published by The Federal Interagency Stream Restoration Working Group (October 1998), and available through the EPA's Office of Water (www.epa.gov/owow). The Delaware Riverkeeper organization also is a resource for publications and technical assistance (Joy Lawrence, Delaware Riverkeeper, pers. comm., 11/16/00)

2. Public land managers should work with NRCS and DEP professionals to develop streamside improvement projects, utilizing public funding available from state and federal programs.

Conservation Easements

Conservation easements are voluntary restrictions placed on a property to protect selected resource areas. The easement is either donated or sold to another party, usually a conservation organization or government agency. The owner retains all rights in the property except that which is specifically conveyed. For instance, the owner may give away to the right to subdivide the property, the right to log along a stream, and the right to exceed a certain percentage of paved area on the property. The owner retains all rights not given away, such as the right to live on the property and to sell it to someone else. The conservation organization has the right and the obligation to enforce the terms of the easement in perpetuity. If the easement is donated, its value may be considered a charitable contribution under the federal tax code.

Easements are an important tool in the protection of stream corridors because they offer the ability to protect the natural features of a property without causing the owner to lose all rights to enjoy it. An effective estate-planning tool, they can lower the value of a property and its estate taxes, making it easier to pass to a younger generation. Easements can, but do not have to, grant to the public a right-of-entry. That decision is up to the landowner. When the public is given the right to enter, it is often along a clearly defined corridor such as a ridgeline or stream. In some instances, local governments have purchased trail easements, which grant the right to construct and maintain a trail through a specific area.

As a conservation and tax-planning tool, easements have not been particularly well known to landowners. Municipal open space plans dutifully mention them as an inexpensive preservation tool, but landowner education needed to actually establish the easements is often not carried out. This has probably been because municipal officials do not have the long experience with easements that land conservancies do, and do not have the resources to market them effectively. With the recent passage of a number of open space bonds in the Philadelphia suburbs, some municipalities have established vigorous landowner contact and easement purchase programs. Both Buckingham and Solebury Townships in Bucks County have protected

a significant percentage of their acreage through easement purchases. Pennsbury Township, in Chester County, sponsored a number of landowner meetings in private home s to discuss the utility of conservation easement to protect its rural landscape. A number of communities have set up land conservancies to hold the easements. West Pikeland and Kennett Townships in Chester County, Lower Merion Township in Montgomery County, and Tinicum and Bedminster Townships in Bucks County are examples.

Easements have not been used extensively in the Chester Creek watershed. The two largest easement holders in southeastern Pennsylvania, Natural Lands Trust and the Brandywine Conservancy, hold few easements in the watershed. Both organizations have had the most success with easement programs in rural areas that are recognized as a distinctive area by their residents, and who have local leaders committed to conservation (Willistown and Unionville in Chester County are good examples). The central area of the Chester Creek watershed remains an area where an easement program could have some success if undertaken very soon.

In the lower watershed, a private easement program would probably have less success due to the smaller size and lower assessed value of the properties. Private conservancies shy away from small easements in developed areas due to their higher administrative cost and lower resource value. Less value also translates into less tax benefits for donated easements. However, a public easement program could be very useful to municipalities as a way to acquire trail access along a stream, as a means to ensure proper management of common open space, or as a means to protect an historic building (called a "facade easement").

Any public or private easement program would be enhanced by the recognition of residents that they form a coherent area worthy of protection. Broadly defined, a "Conservation Neighborhood" is a geographically connected group of homeowners or landowners that recognize that connectedness. Conservation neighborhoods, with local leadership, can undertake any sort of cooperative project to serve their common good. It may be an easement program, a stream cleanup, a riparian planting, or whatever might protect the natural and human characteristics of the neighborhood. Such efforts can also help residents understand that what they do on their property makes a difference in the larger watershed.

Conservation Easement Recommendations

1. A watershed-wide easement program of mailings and small meetings should be developed to educate landowners and municipalities. For landowners, the emphasis might be on protecting a defined neighborhood. Municipal officials should be briefed and provided with concise materials on easements with examples of their use by municipalities in the Philadelphia metropolitan area. One or more landowners should be found who would be willing to donate conservation easements and serve as a case study for other potential donors.

2. Since the cost of negotiating, drafting, and documenting conservation easements can put them out of reach of many landowners, funding should be sought to set up a sliding scale payment system. This would greatly improve the chances of the program's success.

3. Municipalities should work with Counties and School Districts to create a process allow lowered real estate taxes (either through lowered assessment or special millage rate) on properties encumbered by permanent conservation easements.

Preferential Taxation

Pennsylvania has encouraged landowners to refrain from selling property for development through the Act 319 and Act 515 differential taxation programs. Both programs grant significant reductions in property taxes in return for a contractual obligation to limit subdivision and/or maintain rural land uses over the contract period. Act 319 is commonly referred to as the "Clean and Green" program and is the preferred program in Chester County. Both programs require properties to be least ten acres in size before they are eligible. The differences between the two programs are beyond the scope of this report, but one major difference is that Act 319 allows some subdivision, but Act 515 does not. Both program penalize an owner who breaks the contractual agreement by requiring payment of the back taxes plus interest.

Preferential Taxation Recommendation

Eligible properties not currently under one of these programs should be identified and a directed mailing sent to their owners.

Unnamed Tributaries

The Pennsylvania DEP Stream Directory lists approximately 100 tributaries of the Chester Creek, but nearly two thirds of these are unnamed. A stream-naming project may emphasize the importance of smaller streams, as these are the streams more likely to be unnamed (see Appendix A to contact CRC for its brochure with more details). A naming project also provides an opportunity to accentuate historic names in the public consciousness.

Unnamed Tributaries Recommendations

1. A stream-naming committee should be formed. The responsibilities of the committee would include 1) coordinating work with municipalities, 2) researching the history, physical properties, and biology of the streams, 3) determining names, and 4) preparing and submitting requests. A successful stream-naming project would not only heighten awareness of watershed attributes but would also serve as an excellent stewardship exercise as well.

2. The official naming body for streams in the United States is the United States Board of Geographic Names in Virginia. Formal requests should be sent to:

Executive Secretary
United States Board on Geographic Names
US Geological Survey
523 National Center
Reston, VA 20192-0523
703-648-4544

Table 5b

Summary:
Land Stewardship Recommendations

Recommendation	Potential Participating Parties
General Land Stewardship	
Designate a week of activities towards the Chester Creek including activities such as nature walks, historical presentations, and educational presentations	Watershed organizations, School Districts, Municipalities
Natural Areas	
Acquire or otherwise protect Natural Areas through conservation easements, particularly the "bridges" between currently protected lands	Municipalities, Counties watershed organizations, land trusts
Show Natural Areas in municipal comprehensive development and open space plans, require their protection during the development process.	Municipalities, EACs
Contact private owners of natural lands and inform them regarding the assistance available to help them manage their land	Watershed organizations, EACs, Municipalities
Riparian Buffers	
Create an educational guide for landowners adjacent to streams	Watershed organizations, EACs, NRCS
Use the Heritage Conservancy riparian study to form the base information for municipal riparian buffer planting programs and ordinances.	Municipalities
Develop consistent riparian buffer ordinances based on Montgomery County and London Grove models	EACs, county planning departments, municipalities
In already developed commercial and industrial areas, establish buffer incentives in zoning and land development codes, and buffer planting programs	Municipalities, EACs, county planning departments,

Seek funding and professional support to expand stream bank restoration and riparian planting programs, including invasive plant control	CRC, Municipalities, Conservation Districts, NRCS
Modify existing municipal weed ordinances to allow meadows to develop in riparian areas.	Municipalities
Increase the number of water quality monitors, who, as part of their volunteer efforts, would conduct visual assessments of riparian zones.	CRC
Public Lands	
Public land managers should undertake streamside improvement projects to establish buffers, restore banks and remove invasive plants	Municipalities, EACs, watershed organizations
Conservation Easements	
Develop a watershed-wide easement program of mailings and small meetings to educate landowners and municipalities.	Watershed organizations, land conservancies, municipalities
Develop a differential tax program that allows owners of eased lands (or otherwise protected natural areas) to apply for and receive lowered property assessments	Counties, Municipalities
Seek funding to cover the cost of negotiating, drafting, and documenting conservation easements for those in need	Watershed organizations, land conservancies, municipalities
Preferential Taxation	
Identify and contact owners of properties eligible for preferential taxation programs	Watershed organizations, land conservancies, municipalities
Unnamed Tributaries	
Form a stream-naming committee	EACs, historical societies, watershed organizations

6

LAND DEVELOPMENT & REDEVELOPMENT

Regulating development is probably the most important and time-consuming task of local officials. Chester County was the tenth fastest growing county in the nation between 1980 and 1990. The growth of the Delaware County townships in the middle of the watershed has been no less rapid. Concord Township, Thornbury Township, and Chester Heights Borough were three out of the five fastest growing municipalities in the County from 1970 to 1990 (Delaware County Planning Department, Delaware County Open Space Project Report, February 1996, page 36). **Figure 12: Undeveloped Land**, displays the lands that are not fully developed, and clearly shows the concentration of these lands in the central portion of the watershed.

Municipal development laws are usually contained in two major documents; the "Zoning Ordinance" (which regulates the location, type, size and density of development), and the "Subdivision and Land Development Ordinance" (which stipulates the layout and construction materials of streets, sewers, storm drainage and other improvements). The appearances of our communities are profoundly affected by the rules contained in these ordinances. New subdivisions, shopping areas, and office parks are built following their prescriptions. Conversely, natural systems, such as woodlands and stream networks, are just as profoundly affected by the prescriptions contained in these ordinances, often simply by being left out of the regulations. The amount of non-point source pollution, described in Chapter 3, is influenced by development ordinances. The recommendations to ameliorate those effects, therefore, use development regulations as a crucial part of the solution.

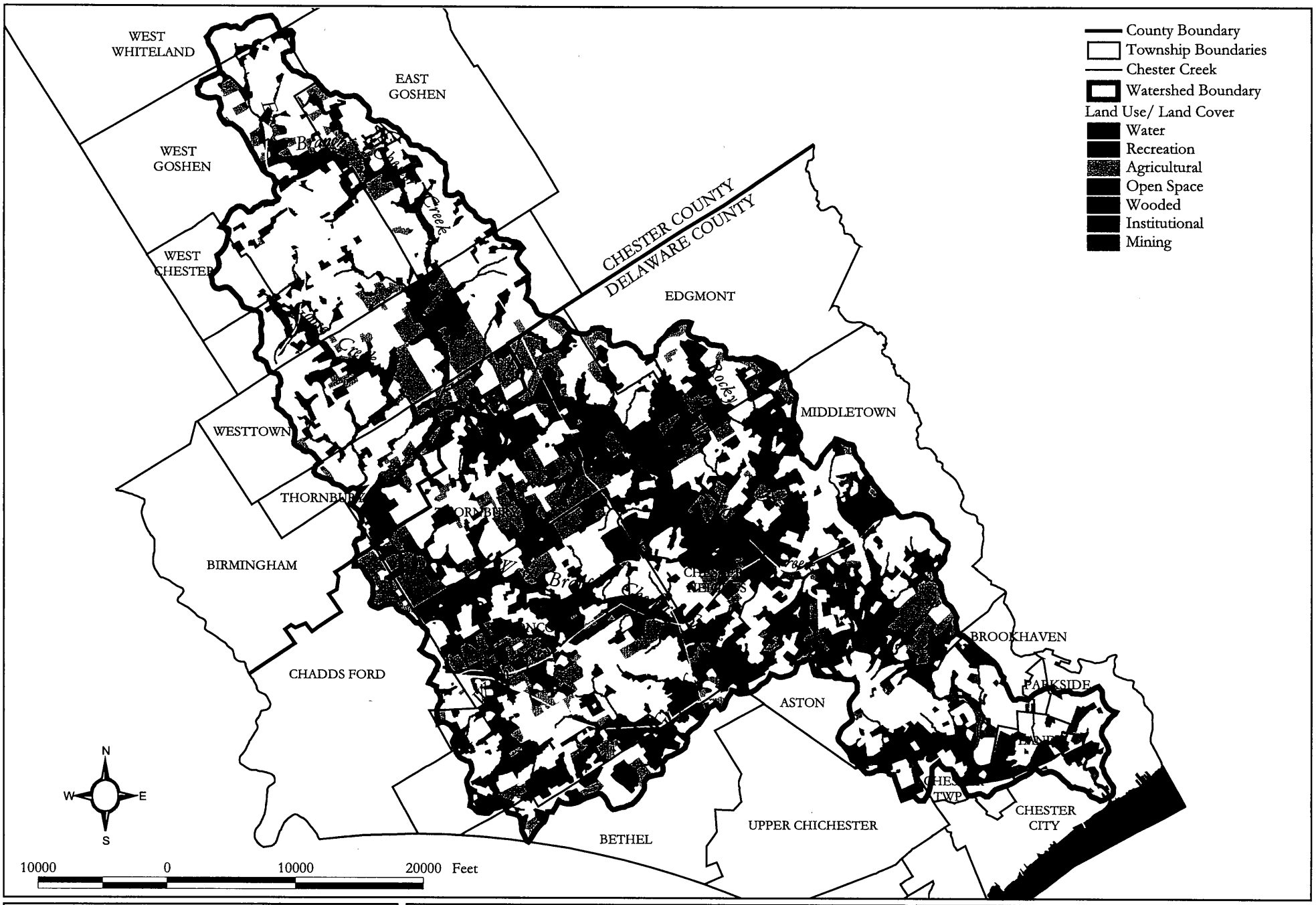
Local ordinances cannot be created from scratch. Municipalities in Pennsylvania must follow the "Municipalities Planning Code" (MPC), a state-mandated set of rules governing the scope and limits of municipal authority to regulate growth. For instance, Pennsylvania municipalities have

to provide for all types of growth (industry, mobile homes, apartments, shopping centers, cell towers, adult entertainment, as well as single family homes), regardless of the possible desire of local officials to prevent certain kinds of development. At its root, this mandate is anti-discriminatory and beneficial to private property rights, although in practice it has forced officials to accept poorly conceived development proposals. The MPC was thoroughly revised in 1999. One of the most important features of the 1999 MPC is its allowance for spreading various land uses among adjoining municipalities, if they conduct joint land planning.

Although the full spectrum of land uses are allowed in each community, the municipal zoning districts in the watershed tend to allow for smaller lot sizes and more commercial and industrial uses in the municipalities closer to the Delaware River and around West Chester. The central portion of the watershed is mostly large-lot residential zoning (approximately one acre or larger) due to requirements for on-lot wells and septic systems, although this is changing rapidly with the recent construction of public sewage treatment plants. Some municipal zoning ordinances contain "lot averaging" and "cluster" provisions that allow development to be concentrated on part of a site, if the site is of a certain minimum size and if the remaining undeveloped land is set aside as permanent open space.

Some ordinances create districts that "overlay" the underlying districts. Overlay districts are used where environmental restrictions are present, or where certain kinds of growth are encouraged. For instance, Chester City has an overlay district for the waterfront that allows for mixed uses in an otherwise industrial zone to encourage increased access to the Delaware River (William Payne, Chester City, pers. comm. 5/4/99). Steep slope districts and floodplain districts are two of the more common environmental overlay districts.

Another very important influence on development is the availability of "infrastructure"; publicly-owned improvements such as roads, water systems, and central sewers. The availability of infrastructure can be influenced by municipalities, but not completely controlled. DEP, the Department of Transportation (PennDOT), and the Pennsylvania Utilities Commission all have important influence on where infrastructure is constructed. This is well demonstrated by Concord Township. Construction of a new sewer system, financed by developers, was begun in 1996. While



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 11
Undeveloped Land

DCR 7/28/00 Rev: DCR 1/23/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Land Use/Land Cover from Delaware County and Chester County.

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the township averaged two to three dozen housing building permits a year through the early 1990's, approximately 300 per year were issued in 1997, 1998, and 1999. Concord Township tried to keep sewers out of its borders for many years, in order to prevent the rapid development it has seen in the last three years, but the developer-financed system removed its ability to base its low-growth stance on soils unsuited for septic fields (Philadelphia Inquirer, 12/5/99).

Compact Development

The municipal zoning district codes described here often include provisions for concentrating development in part of a property, and leaving the remainder in a form of open space (either public parkland or common land owned by a homeowners' association). "Compact Development" (also called conservation subdivision or cluster development) has been permitted in modern zoning codes for several decades, because smaller lots generally require less roadway and utility lines to service the homes, meaning less municipal maintenance. This type of development preserves open space, a public amenity. Inclusion of riparian forests and floodplains in the preserved open space is easily accomplished and facilitates protection of stream corridors.

To protect municipal taxpayers from the public costs of poorly conceived designs, compact development ordinances lay out a number of standards that the developments must meet. They generally include:

- Either common water or public sewers, or both (because the lots are too small to contain individual wells and septic tanks)
- Minimum tract size, usually at least twenty acres (to prevent the creation of small, unusable pieces of open space)
- A minimum percentage of open space, typically 50 percent
- The percentage of open space usable for active recreation (so that the open space is not all floodplain, wetlands, and steep slope)
- A mechanism to establish the number of units that can be built on the site
- Density bonuses for developers who exceed the minimum standards of the ordinance (to reward good design).

Numerous examples of compact development exist throughout the middle and upper portions of the watershed. The best examples from a conservation standpoint are those that do not increase overall density (number of housing units), and that concentrate the open space into one or two large blocks, instead of creating numerous small strips between blocks of housing. Darlington Woods in Chester Heights, and Crozierville Woods in Aston are two good examples of this. Another advantageous design principle is creating an interconnected network of open spaces from many different developments. One example is in Concord Township, where the open spaces of three separate developments abut, creating a large block of protected land along Webb Creek. Other examples are found in East Goshen above the Milltown Reservoir and in Middletown on Mount Alverno Road. Thornbury Township (Delaware County) has even created a unified open space plan for connecting new developments' open spaces to its park system

It is unfortunate that a minimum tract size is used to limit compact development, especially in the more developed areas, because the limitation removes many small developable properties from this subdivision option. Even small open spaces can further the protection of aquatic habitats and connect other, larger, open spaces together. Compact development ordinances can also be very complex, with much greater detail required for the plan documents, making the approval process more costly and time-consuming than a standard subdivision.

The Pennsylvania Department of Conservation and Natural Resources (DCNR) sponsors a statewide program to encourage municipalities to adopt flexible compact development ordinances. The program is called "Growing Greener" (it should not be confused with the DEP program of the same name). Natural Lands Trust is the lead agency for this initiative. The Growing Greener program provides significant subsidies to municipalities that participate in its two-stage process. First, an "audit" or brief review, of the municipalities zoning code is conducted to determine how it might be changed to comply with the program's standards. Second, if the municipality chooses to move forward, revised ordinances are crafted, either by Natural Lands Trust, or with its assistance. One of the most innovative features of the Growing Greener approach is making compact development the "By-Right" form of development (without increasing allowed density), and conventional development a "Special Exception" or "Conditional Use".

This reverses the typical zoning code structure for compact development review, speeding the approval process for compact designs.

Compact Development Recommendations

1. Zoning revisions that improve the protection of important natural features should be adopted wherever practical. Components of these ordinances should include:
    a. Overlay districts for steep slopes, wetlands and floodplains, stream corridors and large woodlands.
    b. Compact development ordinances that follow the Growing Greener model for flexibility and review procedures and are based on an interconnected open space plan similar to the East Goshen and Thornbury (Delaware County) plans.
    c. For areas with water and sewer systems, eligibility of smaller lots (> 5 acres) for compact development, similar to the "Open Space Conservation District" of Lower Merion Township, Montgomery County.

Redevelopment of Urban Sites

The more developed townships of the lower watershed can make scant use of clustering, but they can increase their ability to improve existing conditions when properties are reviewed for redevelopment. They also can tighten the environmental provisions of their ordinances so that, when the few remaining properties able to be developed are planned, streamside riparian buffers are set aside. "Redevelopment", as defined here, means renovating existing structures or demolishing old structures and rebuilding new facilities. Subdivision would not typically be a part of this process. Generally speaking, the Subdivision and Land Development Ordinance (SLDO) will control vehicular circulation, grading and storm drainage; the Zoning Ordinance will control the building setback, buffer requirements, and required number of parking spaces. These two documents can work together to provide incentives to reduce the amount of pavement and to create a continuous band of vegetation along creeks. Chester City, as it re-writes its zoning ordinance, is considering the creation of a preservation

district along Chester Creek in order to accomplish these objectives (William Payne, Chester City, pers. comm. 5/4/99).

In order to meet the challenge of redeveloping potentially contaminated sites, Governor Ridge signed the Land Recycling Program into law in 1995. This program encourages the recycling and redevelopment of old industrial sites (sometimes called "brownfields"). It sets standards, by law for the first time, that are protective of human health and the environment, but which also consider future use. It provides potential developers with clear cleanup standards based on proposed use of the site. Prior to the Land Recycling Law, cleanup standards were the result of a negotiated agreement, which could vary widely, depending on the legal acumen of the applicants and regulators. The law also provides protection from liability for the developer when that cleanup standard is achieved.

Pennsylvania's Land Recycling Program actually includes three bills: Acts 2, 3, and 4. Act 2 created a framework for setting cleanup standards, provided special incentives for developing abandoned sites, released responsible parties from liability once cleanup standards are met, set deadlines for DEP actions, and provided funding for environmental studies and cleanups. Act 3 limited the environmental liability of those involved in redeveloping and financing a recycled industrial site. Act 4 provided up to $2 million for environmental assessments in certain communities and for cleanups in certain cities through the Pennsylvania Department of Commerce (DOC). Act 4 also allowed DOC to make grants to municipalities, municipal or local authorities, nonprofit economic development agencies, and similar agencies. The grants are to conduct environmental assessments of industrial sites located in municipalities designated as "Distressed Communities" by DOC. Certain cities are eligible for grants to conduct environmental assessments and remediation activities.

Redevelopment of Urban Sites Recommendations

1. Municipalities and potential developers should work together to cleanup and otherwise explore redevelopment options for known and suspected brownfield sites. Developers should be encouraged to explore assistance through the Land Recycling Program.

2. Model redevelopment ordinances that balance the need for environmental improvements with the need for redevelopment should be developed and adopted by the older, denser communities in the watershed.

Table 6

Summary: Land Development & Redevelopment Recommendations

Recommendation	Potential Participating Parties
Adopt conservation-based subdivision and land development ordinances	County planning departments, municipalities, DCNR
Clean-up and otherwise explore redevelopment options for suspected brownfield sites	Counties, Municipalities, Developers, DOC
Develop model redevelopment ordinances	Municipalities, Counties

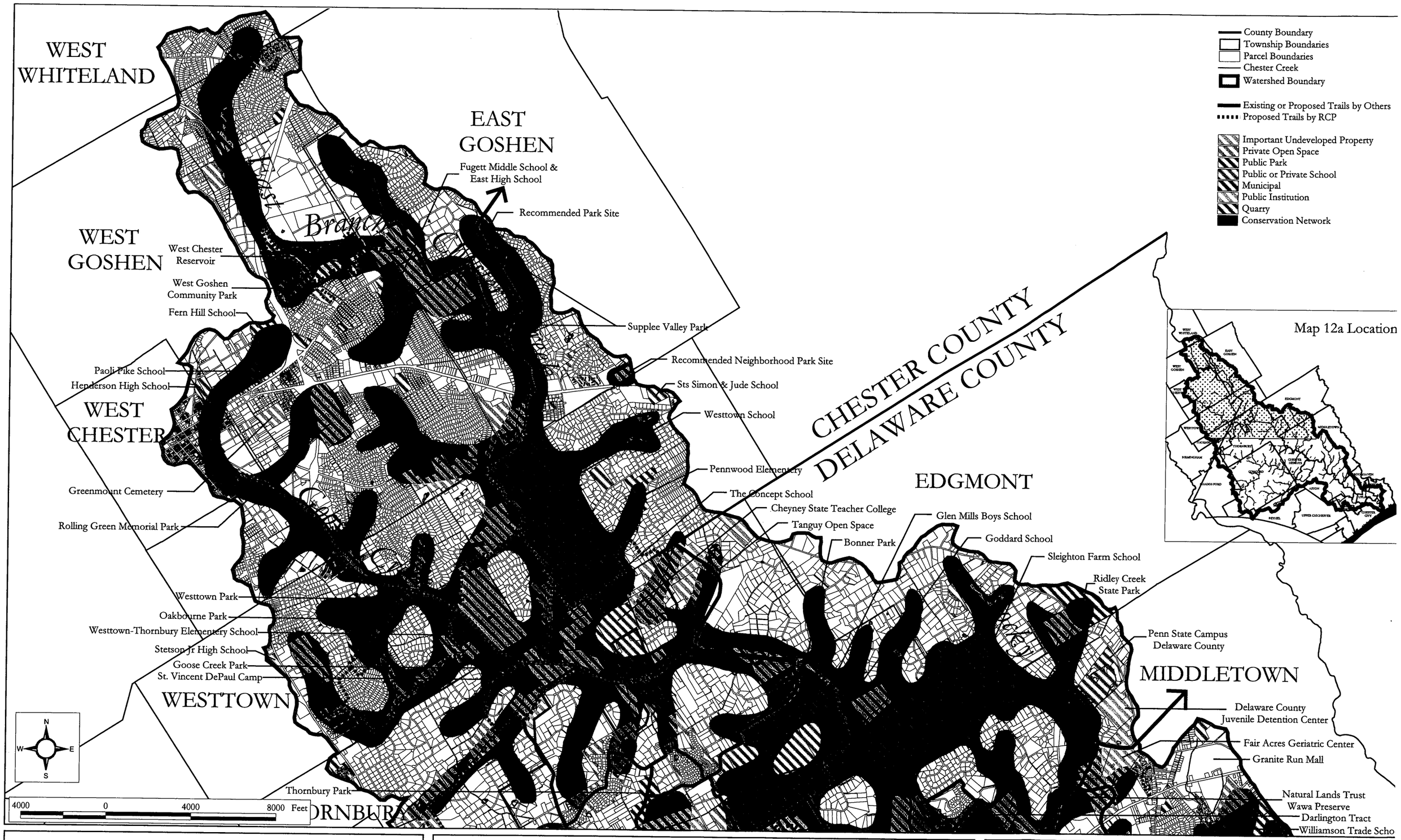
7

OPEN SPACE

The Conservation Network

At the heart of the open space recommendations in this plan is the concept of a "Conservation Network". The term is used to describe the interconnected properties, centered on the stream system, that contain the natural resources most important to protect or improve. The Conservation Network includes properties that are already protected from further development in some way, and properties that are not. Therefore, it includes large undeveloped properties, natural areas identified in the County Natural Area Inventories, public and quasi-public lands, as well as developed areas adjacent to the stream system (**Figure 12a: Conservation Network-- Northern Section & Figure 12b: Conservation Network-- Southern Section**). The primary goal of the open space recommendations is to connect the existing open spaces together along the stream corridors, by enlarging the acreage of permanently protected land, and by improving land stewardship where permanent protection cannot occur.

Areas within the Conservation Network should be given priority for the land protection activities proposed in this plan. For example, permanent protection activities, such as land acquisition for public parkland and nature preserves, conservation easement programs, common open spaces set aside in conservation subdivisions, and buffers created in redevelopment projects, should focus on the Conservation Network. Portions of the Conservation Network are within lands already developed as residential neighborhoods or commercial areas. For these areas, efforts that don't require land purchases, such as streambank restoration projects, riparian buffer planting programs, stream cleanups, and citizen education programs, should be instituted. Sponsors for these activities could be municipalities, watershed associations, conservation districts, or neighborhood associations.



Chester Creek Watershed

Chester & Delaware Counties, PA

FIGURE 12a

Conservation Network - Northern Section

DCR 1/23/01 Revised 05/30/01

NOTES:

1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Parcel Boundaries from Chester and Delaware Counties.

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MIDDLETOWN

Delaware County Juvenile Detention Center

Fair Acres Geriatric Center

Granite Run Mall

Natural Lands Trust

Wawa Preserve

Darlington Tract

Williamson Trade School

Martin Park

Franklin Mint

Darlington Woods

Lenni Park

Indian Orchard Park

Hidden Hollow

Linvilla Orchards

Knight Road Park

Richardson Tract

The Christian Academy

BROOKHAVEN

Delaware County Field & Stream

Coebourn Elementary School

The Christian Academy

PARKSIDE

Thornbury Park

THORNBURY

Penn Oaks Golf Course

Palmer Park

Camp Sunshine

Delaware County Prison

Cherry Farm

Brinton Lake

Craig Farm

Concord Country Club

Edgewood Memorial Park

Newlin Mill Park

CHADDS FORD

Map 12b Location

Sisters of St Francis

Neumann College

ASTON

Aston Township Community Center

Delaware County Vo-Tech School

Imperial Nursery

St Thomas School

Pennell Elementary School

Clayton Park

Sun Valley High School & Northly Middle School

CHESTER TWP

Toby Farms School

Camp Upland Park

Main Street Elementary School

Our Lady of Charity School & Trust

Crozier Park

Chester Crozier Medical Center

Columbus School & Chester High School

Chester Rural Cemetery

Deshong Memorial Park

Widener Colle

CHESTER CITY

Garnet Valley High School

Garnet Valley Middle School

BETHEL

UPPER CHICHESTER

County Boundary

Township Boundaries

Parcel Boundaries

Chester Creek

Watershed Boundary

Existing or Proposed Trails by Others

Proposed Trails by RCP

Important Undeveloped Property

Private Open Space

Public Park

Public or Private School

Municipal

Public Institution

Quarry

Conservation Network

N

W

E

S

4000 0 4000 8000 Feet

Chester Creek Watershed

Chester & Delaware Counties, PA

FIGURE 12b

Conservation Network - Southern Section

DCR 1/23/01 Revised 05/30/01

NOTES:

1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Parcel Boundaries from Chester and Delaware Counties.

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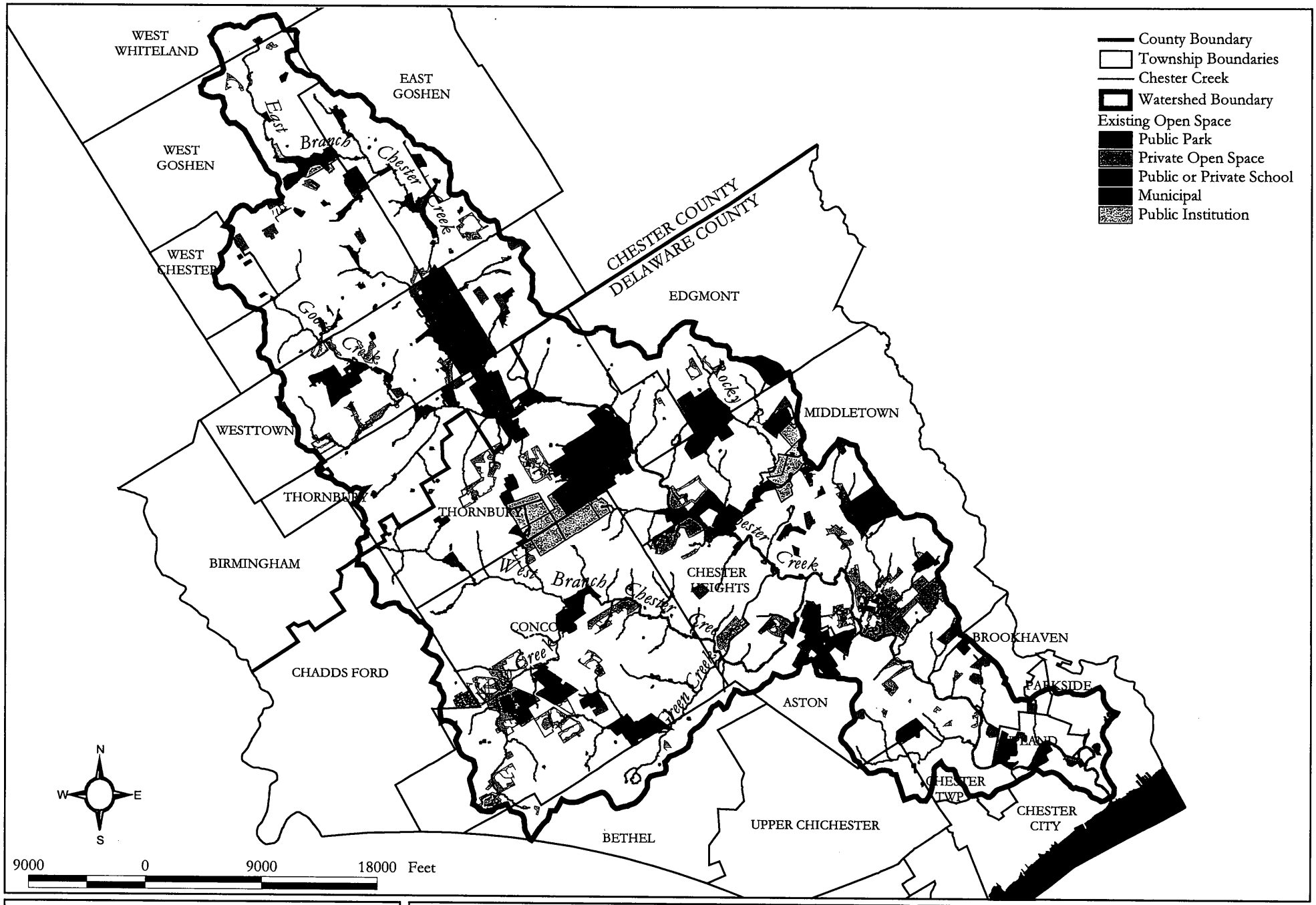
The Conservation Network varies in breadth throughout the watershed. There are a number of important "nodes" with important aggregations of undeveloped land (see Figures 12 a & 12b). These areas are extremely important to protect as regional resources. These areas are listed below, starting in Chester County, with names relating to local features:

1. **West Chester Reservoir-** West Goshen Township has a major park on the reservoir. East Goshen Township recommends the protection of a large property east of the reservoir at Ellis Lane and Paoli Pike as an addition to the East High School/Fugett Middle School complex. A trail system could be developed around the reservoir to connect the West Goshen Park with East High School and the East Goshen trail system, via various undeveloped commercial properties.
2. **Westtown School-** Largely the school property itself, with a large undeveloped property to the west.
3. **Glen Mills-** The largest node in the Conservation Network, it stretches from Bonner Park to the Darlington Tract, and includes Glen Mills School, the eastern portion of the Delaware County Prison property, Glen Mills Quarry, and Sleighton School. The terminus of the proposed Chester Creek Rail Trail is at its southern end. A number of existing and proposed municipal trails could be connected by a trail link across the Darlington Woods open space and one additional property.
4. **Brinton Lake-** Upstream are two large undeveloped farms, which, if and when developed, should preserve wide stream-side buffers to prevent further sedimentation of the historic lake. The entire node is a County Natural Area.
5. **Wawa Road-** Between Route 1 and Valley Brook Road are a number of large residential properties and a Camp Meeting, which may be suitable for a conservation easement program.
6. **Williamson School-** Contains the largest contiguous woods in the lower watershed, a top priority County Natural Area, and the headwaters of Chrome Run.
7. **Newlin Mill to Green Creek Confluence-** Includes Newlin Mill Park, the Willcox Property (potential subject of an agricultural easement) and several important linking properties on Valley Brook Road. The Proposed Concord Loop Trail passes through these properties.



Chester Creek Watershed
Chester & Delaware Counties, PA

FIGURE 13
Existing Open Space

DCR 7/28/00 Rev: DCR 1/23/01
NOTES:
1. Streams, watershed boundaries, township boundaries, and county boundaries from Pennsylvania Spatial Data Access (PASDA).
2. Chester County information from Protected Open Space CD provided by Chester County Planning Commission.
3. Delaware County information derived from driving tour of the watershed and parcel data from Delaware County.

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www.natlands.org

8. **Clayton Park-** Includes the headwaters of Green Creek and a County Natural Area.
9. **Newman College-** One of the largest properties in the lower watershed, it controls scenic high meadows around its central core of buildings.
10. **Linvilla Farms-** The largest node in the lower watershed, it includes Linvilla Farms, the Delaware County Field and Stream property, the Chester Water Authority lands on Route 352, and several private properties on Mount Alverno Road. The proposed Chester Creek Rail Trail passes through this area and should ultimately connect with the Linvilla Farms trail system of Middletown Township.
11. **Chester City-** A smaller node than the others, but included due to its dense, urban location. Includes underutilized Crozier Park, the Chester-Crozier Hospital Arboretum, Chester High School, the YWCA property, and Deshong Park.

Public Parks and Open Spaces

Public parks are the most recognizable element of any open space system. **Figure 13: Existing Open Space Network** shows the distribution of parks and other open spaces throughout the watershed. The park network is modest, with no parks large enough to be considered of regional size. The largest concentration of parkland is in the vicinity of Glen Mills, where Middletown, Thornbury and Chester Heights all have parks and open spaces. Delaware County owns and manages Clayton Park on Route 322 in Concord Township and Camp Upland in Upland. The remaining parks are municipal. The acres preserved as private open space in residential developments are probably equal to the acreage of public parkland.

Recent assessments of the adequacy of existing parkland to meet regional standards find the amount of parkland in the watershed to be insufficient. Delaware County itself, as opposed to its constituent municipalities, possesses only 15% of the parkland it should for its population. The standards used in these assessments were adapted from national standards by the Delaware Valley Regional Planning Commission and are widely used throughout the Philadelphia metropolitan area. The Chester County municipalities conducted their assessments as part of their "Open Space, Recreation and Environmental Resources Plans," which were done under

the County open space program. The Delaware County Planning Department conducted an assessment of the entire County in 1995 called the "Delaware County Open Space Project, Recommended Strategy." Assessments such as these are an inexact science, but regardless of their shortcomings, the findings demonstrate the simple need for acquisition of additional parkland.

Municipalities have long recognized the need for protecting land as they have developed. Land in the watershed is quite expensive, and Townships have needed to consider carefully every purchase in order to maintain local support for the expenditures. Most of the municipalities in the watershed own parkland and some have recently purchased additional property. West Goshen Township has a new 35-acre park near the West Chester reservoir. Concord Township added two tracts, totaling 68 acres, to its open space system (John Cornell, Concord Township, pers. comm. 4/29/99). Thornbury Township (Chester County) recently purchased and improved the 28-acre Goose Creek Park. Thornbury Township (Delaware County) has made several strategic purchases to expand its park system and to link it to more public roads (Scott Cannon, Thornbury Township Planning Commission, pers. comm., 12/14/00). Another method of parkland acquisition is exemplified by East Goshen Township, which has built an extensive park system by taking title to the open space areas created by residential subdivisions. Several other townships, notably Westtown and Middletown, have accepted the opens spaces from subdivisions as well.

The Commonwealth has offered matching funds for public parkland acquisition under a variety of programs over the past several decades. The current program is called the "Community Conservation Partnerships Program" and is administered by DCNR. The Program offers matching funds to municipalities, authorities, counties, and non-profits that wish to acquire public parkland or develop trails. Applications are accepted yearly, recently in the early fall. While there is no statutory limit on the amount of money awarded, in the recent past $250,000 to $300,000 has been the largest amount awarded to municipalities, and about twice that amount to non-profits. It is important to note that acquisition projects listed in River Conservation Plans such as this receive additional points when applications are ranked. In Chester County, additional funds are available through the County's Heritage Park and Open Space Municipal Grant Program (for municipalities) and Preservation Partnership Program (for non-profits).

They are also a matching programs. The tidal section of the Chester Creek watershed falls within the jurisdiction of the Federal Coastal Zone Management Act (CZM). The CZM program offers grants to municipalities for a variety of improvement projects.

Municipalities may also use bonds, special use taxes and their general funds to purchase open space. Recent years have seen a great increase in local spending, most notably in Bucks County, where twenty municipalities have passed bonds or local income tax referenda, totaling more than $100 million for open space acquisition. Often these initiatives have been taken with the encouragement of local school districts, which must educate the children moving into new residential subdivisions. Solebury Township, Bucks County, analyzed the costs for its school district associated with new development and concluded it was cheaper to buy undeveloped land, keeping its school-age population growing slowly, than to allow all its farmland to be converted to neighborhoods. The rise in tax revenues with development would not have equaled the rise in the costs for the school district (Jeff Baumann, Solebury Township Land Protection Committee, per. comm. 7/28/00). As a result, the Township has aggressively pursued a conservation easement program, with the assistance of the Brandywine Conservancy and funded by municipal bonds, which has purchased development rights on thousands of acres of the Township's historic farms.

Other Open Spaces

A great deal of the "open space" in the watershed is not publicly owned. Rather, it is private parcels managed by homeowners' associations. Most often these properties are created during the development process and surround the house lots, or occupy the least buildable land. The open space is restricted from further development by homeowners' association by-laws, deed restrictions, and/or development approval requirements. The open space in the Tanguy Homesteads is under additional protection through a conservation easement to the Brandywine Conservancy (as is Bonner Park, also in Thornbury, Delaware County). Examples of private open spaces include Thornbury Hunt (Thornbury Township, Delaware County), Fox Hill Farms (Concord Township), and Darlington Woods (Chester Heights Borough). These areas are usually not open to the public; however, some

townships require that a public trail right-of-way be included within the open space.

Other forms of open space include private parks, cemeteries, schools, and other institutional property. These lands are more or less protected by the various missions of the organizations that own them. The largest private park area in the watershed is the Nathaniel Newlin Foundation's park at the confluence of Webb Creek and the West Branch (US Route 1 and Cheyney Road). Natural Lands Trust owns several properties near the Wawa dairy facility, both on Rocky Run and a small tributary of Chester Creek. Both these organizations have land preservation as part of their mission, and, therefore, the properties are protected. While public school properties are often important links in the open space networks and trail systems recommended in the following section, the changing demographics of school districts can dramatically change the way school properties are used. Other educational institutions, such as Glen Mills School, Williamson School, Westtown School and Cheyney University are shown on Figure 12 because they are among the largest undeveloped landholdings in the watershed. Both Cheyney and Williamson also hold important Natural Areas noted in the County Natural Areas Inventories (see Chapter 5). Glen Mills School converted a significant portion of its property into a golf course. Sleighton School recently announced a sale of its property. The other private institutions could develop or sell their lands if warranted by their internal needs.

Cemeteries, while a long-term use of land, are not inviolate, especially when only a portion of the ground is used for burials. Edgewood Memorial Cemetery, on Route 1 in Concord, sold a portion of its rear (a County Natural Areas Inventory Site) for a residential development. Conservation easements would insure that cemeteries (and institutional and recreational properties) are not converted to other uses. Golf courses are another form of open space that can be converted to other uses.

Public Trails

In certain situations public walking trails are good uses for floodplains. Floodplains tend to be wooded and unsuitable for building, and they connect together to form a natural means to go places. Middletown Township has developed an excellent trail system along Rocky Run and in

the Linvilla Farms area, which connects various municipal, private and institutional properties. Thornbury (Delaware County), East Goshen, and Westtown Townships are among the municipalities working on interconnected trail systems.

Another important trail initiative is underway in the lower watershed. The Friends of the Chester Branch, a former subsidiary of the Chester Ridley Crum Watersheds Association, has received a Federal Intermodal Surface Transportation Enhancement grant (ISTEA) to study the feasibility of creating a 6.7-mile trail on an old railroad bed. The trail, which is still in the study phase, would run from the old Wawa train station in Middletown, to the Caleb Pusey House in Chester Township. It is envisioned as a multi-purpose trail that would allow citizens to bike, horseback ride or walk.

Proposals for development of public trails often causes contentious debate among trail advocates and private property owners adjacent to the proposed trail. Private property owners fear increased litter, vandalism and loss of privacy. The experiences of other communities throughout the country (National Park Service, "Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors", 1992) have consistently shown that:

- A majority of trail users live in adjacent neighborhoods.
- Well-used trails are generally self-policing.
- Well-used trails are those that have a logical beginning and end, that actually provide a desired route for pedestrians.
- The initial fears of property owners of increased crime are not borne out.
- Unsupervised pets and litter are the two most widely reported problems.
- Limiting access from parking areas decreases disorderly conduct.
- Dead ends have a greater tendency to become a nuisance.

The public trails shown on Figure 12 are of three types: already existing trails, trails proposed by municipalities in open space plans, and trails proposed by the authors of this report. The new trails proposed in this report were limited to those that meet the standards outlined by the National Park Service (no dead ends, desirable destinations, etc.). An effective technique for instituting trails is to construct them in segments, starting with the least contentious, to gradually build public trust in their usage and maintenance.

Public Use of Private Land/Liability Issues

When a private landowner considers opening the property to some form of public use (such as a trail), concern regarding liability for the personal injuries of the users is paramount. Unfortunately, this concern can prevent a well-intentioned landowner from providing a public service that, thanks to Pennsylvania state law, carries very little liability. The Recreation Use of Land and Water Act (1966) was passed to encourage landowners to make land and water areas available to the public by limiting their liability to tort claims. The act states that a landowner has no "duty of care to keep the premises safe for entry or use by others for recreational purposes, or to give any warning of a dangerous condition, use, structure, or activity..." Allowing entry does not give the user status as an invitee or licensee, nor does it imply that the property is safe. The only requirements for the landowner are that no fee for use of the land is charged, and that known dangerous conditions are not hidden willfully or maliciously. Willfulness has been defined in case law as voluntarily, intentionally or knowingly hiding a condition that is not obvious to someone entering the premises ("Pennsylvania Land Conservation Handbook", Allegheny Land Trust, 1996, page VI-3). This same protection has been extended to local governments on their recreational lands. The Pennsylvania Rails-to-Trails Act provides the same protection for private landowners who provide free trails for the public.

The clear protection these laws provide may not prevent an injured person from pursuing a claim against a property owner. Protecting innocent property owners from the cost of defending such suits should be seen as a challenge by local governments to support their citizen's charitable public service. There are no easy solutions to this problem in a litigious society. However, a municipality may be able to provide a free risk assessment of a property through its insurance carrier. Such a service may consist of a site inspection and a review of owner's current insurance to ensure its adequacy.

Table 7

Summary:
Open Space Recommendations

Recommendation	Potential Participating Parties
Acquire, or otherwise protect through conservation easements or subdivision approvals, undeveloped parcels within the Conservation Network as noted on Figure 11.	Municipalities, Counties, Land Conservancies
Institute comprehensive neighborhood stream protection and restoration programs in developed sections of the Conservation Network.	Municipalities, Watershed Associations, Counties, Conservation Districts, EACs, Civic Groups, Homeowners' Associations
Work with large institutional and recreational landowners to determine possibility of protecting portions of these lands.	Municipalities, EACs, Watershed Associations, Land Conservancies
Construct Public Trails, such as the Chester Creek Rail Trail, shown or recommended in this report in a phased program	Municipalities, Trail Groups, Counties
Provide a free risk assessment of a property to help protect property owners who allow access to their land	Municipalities (through their insurance carrier)

8

ENVIRONMENTAL EDUCATION

Development of an environmentally literate citizenry depends to a large extent on sound, balanced environmental education that begins when we are young, and that continues through life. Age-appropriate study of the stream system should be a part of the environmental education of students at all levels within area schools. By learning more about nearby freshwater ecosystems, students are equipped to understand more complex ecological relationships. Such study can also serve as a baseline of environmental health, against which future classes can measure environmental improvements or degradation at their study sites. Students confronted with local environmental issues and asked to consider means to solve local environmental problems are more likely to understand the results of their own actions, and to be more motivated to create a healthier environment. As students grow into voting citizens and municipal officials they may then understand and act on environmental issues more readily.

In the Chester Creek the mingling of natural processes and cultural influences provides an ideal focus for environmental education. The number and kinds of animals that use its woodlands and live in its water are indicators of ecological health that can be measured by school students. Watching the stream downstream of a forest and then a construction site, especially after a rainstorm, is a clear demonstration of the effect of land clearing. The differences in geomorphology of the channel in a pasture and in a forest tell a story of the effect of agriculture on streams. The impact of human activities on the Chester Creek also can be seen through trips to water or sewage treatment facilities, mapping and labeling storm drainage systems, or comparing different land uses. There are also opportunities for interested school groups, scouts, and other service organizations to develop or participate in restoration or clean-up projects as a community service and learning experience.

These are just a few examples of the topics that can be explored in school curriculums, programs for municipal officials and citizen programs. The challenge is to develop an integrated program that does not rely on the interest of only a few individuals, but rather is incorporated into the day-to-day activities of school systems, municipalities, and conservation organizations.

School Curriculum

There are numerous public, private and parochial elementary schools, middle schools, and high schools in the watershed. The public schools are subject to state requirements to include environmental education in their curriculums. The Chester County portion of the watershed is entirely within the West Chester Area School District. The Delaware County portion falls within the Chester-Upland, Chichester, Garnet Valley, Penn-Delco, and Rose Tree-Media School Districts. Cheyney University, West Chester University, Pennsylvania State University's Delaware County Campus, Neumann College, and Williamson School also fall within the watershed.

Examples of creative approaches to the study of freshwater ecosystems at elementary, middle, and high school levels are presented in this section. This is in no way intended to be a comprehensive summary of the numerous endeavors led by fine educators, institutions and organizations in our region. However, it is hoped that these examples may inspire such environmental education.

Conestoga High School's Advanced Research Biology students studied Chester Creek in detail in the 1997-1998 school year, under the direction of Norman E. Marriner. Through this investigation the students gained a better understanding of the scientific process, report production, and limnology. Their study of Chester Creek and its associated report could be used as a model by high schools within the watershed. Although not as extensive a study, the environmental education of ninth graders at Great Valley High School (during their spring field trip to Pickering Creek) was enhanced by the teaching of Drew Rief of the USGS. Both hydrology and aquatic biota were studied. Part of Great Valley High School's self-designed

environmental education program includes comparative stream study up- and downstream of a sewage treatment plant.

Radnor Middle School, located within the Darby Creek Watershed in Delaware County, has an excellent program on "Watersheds" which constitutes the entire curriculum for the students during seventh grade. It was developed by Ed Silcox and Mark Springer and is now taught by Mark Springer and John Savich. Social studies, science, mathematics, and the other subject areas are studied through the concept of watershed.

In the West Chester Area School District, the "Woods and Water" class offered by Dr. Kip McKnight through the gifted program for the elementary grades includes the study of Oakbourne Pond. Both physical and biological data are recorded, and students learn to compare pond and stream ecosystems. The Brandywine Valley Association's watersheds curriculum ("Brandywine Flows"), is part of the twelfth grade curriculum at Henderson High School.

On the collegiate level, Dr. John F. Davis, Associate Professor in the Department of Civil Engineering at Widener University, currently has senior civil engineering students working on independent projects using GIS mapping, with the goal of eventually setting up a water quality model. These initiatives are not only dependent upon student interests and involvement but monitoring resources as well. Funding to procure monitoring equipment and analytical work would further promote these efforts.

School Curriculum Recommendations

1. Funding should be sought to:
    a. perform a comprehensive survey of educational capabilities and opportunities in the watershed
    b. facilitate connections between schools and resources
    c. encourage partnering with schools in various parts of the watershed.

2. Resources can also be obtained through websites such as the Pennsylvania Center for Environmental Education at www.pcee.state.pa.us and the Pennsylvania Fish and Boat Commission education website at www.state.pa.us/fish.

3. Attention should be paid by the school districts to ways to infuse the existing curriculum (mathematics, history, literature, etc.) with material that deepens environmental understanding.

4. Schools should be encouraged to get involved in "Envirothon", a state program run by the counties. Offered to first through twelfth graders in Chester County and to ninth through twelfth graders in Delaware County, Envirothon is a challenging and fun way for students to test their environmental literacy in areas of soils, aquatic science, wildlife, forestry and environmental issues. Winning teams go to state and even national competitions. Last year's finale, which focused on wetlands, was held in Nova Scotia. Penncrest's team participated and won the national title--against 47 states and eight Canadian provinces!

Municipal Officials

In 1973, the Pennsylvania General Assembly passed Act 148 authorizing any municipality or group of municipalities to establish, by ordinance, "Environmental Advisory Councils" (EACs). EACs advise the local planning commission, park and recreation board, and elected officials on environmental matters. Their purview deals with: the protection, conservation, management, promotion and use of natural resources located within the municipality. Act 148 also allowed for joint EACs shared by groups of municipalities. Currently, only three municipalities in the Chester Creek watershed have EACs: Chester City, Thornbury Township (Delaware County), and East Goshen Township (through the East Goshen Conservancy Board).

EACs could identify projects where their local municipality could partner with local high schools, scouting groups, or other service organizations. CRC's stream cleanup day in May is a terrific opportunity for such partnering. Such collaborations, as between Thornbury Township (Chester County) and the Henderson High School Environmental Club (guided by teacher Daniel Lammey) to bring about stream restoration at Goose Creek Park, greatly benefit all parties involved. EACs could also play an

educational and outreach role in meeting new regulatory requirements, such as NDPES II (see Chapter 4).

Municipal Official Recommendations

1. Efforts should be made to initiate EACs. The Pennsylvania Environmental Council (PEC) is planning to conduct watershed-based EAC organizing in the Chester Creek watershed that will include reviewing watershed activity, assessing EAC activity in the watershed, connecting EACs to the watershed effort, promoting EACs to municipal officials, and encouraging multi-municipal projects (e.g., an Environmental Resource Inventory).

Citizen Education

Although it may seem difficult to relate to your watershed from the vantage point of your home and yard, a homeowner can take steps that benefit rivers and streams. Many opportunities are available to practice good environmental stewardship and to participate in local initiatives. Homeowners' actions can demonstrate to neighbors simple practices that are easily accomplished. Homeowners can also support local watershed organizations and other conservation groups. One person' s actions may not result in dramatic stream improvements, but when a larger number of homeowners start practicing the following stewardship principles and expressing their concern for the watershed, significant improvements can be made.

Practice good lawn maintenance

Surveys indicate that as many as 80% of homeowners in the United States use fertilizers and 60% use pesticides. If not applied properly, these fertilizers and pesticides enter our ground and surface waters during storms. Larger lawns tend to contribute greater amounts of fertilizers and pesticides. Pet wastes that are not cleaned up can exacerbate pollution.

Properly maintain septic systems
Many owners of septic tanks do not think about their systems until a problem occurs and, even then, the systems are often ignored. Evidence of problems may include extra-lush lawn around the septic area, wastewater above the ground, or detection of excessive bacteria or chemicals in nearby wells. Once problems such as these occur, it is often too late to perform simple maintenance, and, worse, the groundwater and surface waters may have already been polluted.

Properly dispose of used motor oil and household wastes
Americans dispose of approximately 180 million gallons of used motor oil a year. This is sixteen times as much as was spilled by the Exxon Valdez in Alaska. Most municipalities prohibit dumping of automobile fluids down storm drains or in anywhere else.

Reduce fresh water demand
The average American uses between 50 and 100 gallons of water a day. This is not surprising considering that a normal faucet runs at the rate of 3 to 5 gallons a minute, an older toilet's flush requires 5 to 7 gallons of water, and an unrestricted shower head runs at 5 to 10 gallons a minute.

Increase the infiltration of storm water
Creating dry wells, disconnecting drain spouts from curb outlets, encouraging sheet flow on lawns, and other residential BMPs can greatly reduce stormwater flows to streams.

Join a watershed, land conservation, or similar nonprofit group
Local citizens can become empowered by joining groups such as Chester Ridley Creek Watershed Association, the Brandywine Valley Association, Brandywine Conservancy, Delaware County Environmental Network, or Natural Lands Trust, which all offer a broad spectrum of programs and projects to improve the environment.

Citizen Education Recommendations

1. There are a number of things a homeowner can do to minimize adverse environmental impacts. In general, the use of Integrated Pest Management (IPM) techniques is encouraged. IPM is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimal impact on human health, the environment, and non-target organisms. Preferred pest management techniques include encouraging naturally occurring biological control, using alternate plant species or varieties that resist pests, selecting pesticides with lower toxicity to humans or non-target organisms; adoption of cultivating, pruning, fertilizing, or irrigation practices that reduce pest problems; and changing the habitat to make it incompatible with pest development.

2. Causes of malfunctioning septic systems can include: poor installation and/or maintenance, disposal of household chemicals (e.g., paint thinners) into the system, overloading the system with a garbage disposal unit, use of septic tank cleaning additives, and too many septic systems in a limited area. Prevention of these problems can be accomplished by assuring that systems are installed correctly. They should also be inspected and cleaned every two to four years, or annually, if garbage disposal units are used. Household chemicals should not be disposed of in the system and hazardous cleaning additives should not be used. Finally, septic systems can be eliminated if hookups to public sewers are possible.

3. Municipalities should be contacted for instructions on disposal of used motor oils. Having services performed at a garage is another way of ensuring that fluids are disposed of properly. Disposal information is available from DEP at www.dep.state.pa.us (choose recycling works logo) or the Regional Southeastern Household Hazardous Waste Program at 215-238-9991. The American Petroleum Institute also has numerous tips on used motor oil recycling on its web page at http://www.api.org/pasp/recycleoil.

4. Many communities enacted stenciling programs where messages such as "Do Not Dump" are placed on catch basins. Usually sponsored by municipalities, volunteer groups often do the stenciling. The Partnership for the Delaware Estuary, the Stroud

Water Research Center, and the county conservation districts have the best information on how to stencil stormdrains.

5. High potable water usage rates can be reduced through the use of low-flow toilets (current standard is 1.6 gallons/flush) and shower heads, and the use of aerators on faucets. Dishwashers and washing machines should be run only when full. Leaky toilets and faucets can be repaired. Front-loading washing machines save significant amounts of water. The use of lawn sprinklers and/or irrigation can also be minimized

6. EPA's Office of Water (www.epa.gov/ow) lists many projects and guidance documents from groups such as the Natural Resources Defense Council. General Internet searches can provide procedures used and lessons learned from government agencies and watershed associations throughout the country.

7. Programs to educate homeowners should be developed and should include each of these components. Care should be taken to consider the best format which to deliver the specific information: workshops, seminars, demonstrations, and field training are all potential techniques.

Table 8

Summary: Environmental Education Recommendations

Recommendation	Potential Participating Parties
Seek funding for a.) Performing a comprehensive survey of educational capabilities and opportunities in the watershed, b.) Facilitating connections between schools and resources, and c.) Encouraging partnering with schools in various parts of the watershed	School districts, watershed organizations, conservation organizations, Conservation Districts, NRCS
Encourage watershed education through involvement in programs such as "Envirothon"	Conservation districts, watershed organizations, school districts, Conservation Districts, Scouts, 4-H Clubs
Initiate efforts to form new Environmental Advisory Committees or to strengthen those already in existence	PEC, watershed organizations, Municipalities
Enact stenciling programs on catch basins	Municipalities, CRC, Conservation District
Develop home owner education programs for a.) Integrated Pest Management (IPM), b.) Hazardous waste disposal information, c.) Water use reduction, d.) Composting	EACs, watershed organizations, Philadelphia Suburban Water Company, Conservation Districts, NRCS

9

HISTORIC PRESERVATION

The Chester Creek watershed is well endowed with historic structures and landscapes dating from the Colonial Period to the twentieth century. There are old mill complexes and ruins along the Creek in the middle and lower watershed; farmhouses and estates are scattered throughout the upper watershed. There are also old commercial and government buildings in West Chester and Chester, as well as the Nathaniel Newlin Grist Mill Museum.

Historic structures are often beautiful and they provide us a means to imagine the lifestyle and landscapes known to previous generations. The physical remains of the past are instructional in many ways. For instance, in the Chester watershed the old mills and millraces demonstrate the importance of waterpower to early settlements and the beginnings of the industrial revolution. Barns and farmhouses show the sensitivity to topography and climate that informed the settlers' placement of farm structures, and all historic structures show the constantly changing styles of architectural design.

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

The Commonwealth of Pennsylvania, through its Historic and Museum Commission (PHMC), administers the National Register program within the state. Pennsylvania Act 167 allows local governments to set up historic

districts where demolition, new construction, alteration and renovation can be regulated to conserve the historic character of the district. Proposals for changes within a Historic District are reviewed by a local Historic Architectural Review Board (HARB), which advises the local governing body. Applications for Act 167 Districts and for the National Register must be approved by PHMC. Other options to promote preservation include municipal ordinances that can protect historic sites whether they form a district or are scattered.

Overall, there are approximately 875 historic "resources" located in the Chester Creek watershed (Stephanie Barber, Delaware County Planning Department, pers. comm., 1/15/99). "Resources" are defined as any artifact; it may be a home, a dam, a bridge, a ruin, a mill, or a public building. Approximately 150 of these are located within flood plains. Of these, nearly 50 are either listed on the National Register or are eligible for National Register listing. Those resources not listed on the National Register are of local historic significance and may simply have not yet been documented for a listing application.

The importance of historic preservation has been long recognized in this part of Pennsylvania. Both counties have had historical societies for many years. There are active historical societies in both Chester and Delaware Counties as well as in many of the municipalities. Technical assistance to municipalities in Delaware County is provided by the Preservation Planning Division of the Delaware County Planning Department. This assistance includes preservation planning sessions, comprehensive plan components, historic legislation and ordinances, setting up historic commissions, historic survey guidance, and design guidelines.

A number of the municipalities in the watershed have taken steps to preserve their historic heritage. Typically the preservation effort has been a combination of private and public effort, where local citizens interested in preservation make application for National Register status for a building or district, and municipal officials determine the preservation measures most useful to their community. An initial step should be a survey of the municipality to determine the structures and areas worthy of preservation. Edgmont Township, for example, completed just such a survey in 1994, with the assistance of the Delaware County Planning Department.

The Chester Creek watershed has never been the organizing unit for a comprehensive survey of historic structures. Creeks and rivers, however, are actually natural organizing elements for historic interpretation. They demonstrate the interactions between history and natural determinants. They provide food, power and travel routes, and form natural political boundaries.

Historic Preservation Recommendations

1. A comprehensive survey of historic structures and landscapes in the Chester Creek watershed should be developed based upon the existing work by the municipalities and new research. The survey should include themes that tie the existing structures together and that explain the reasons for existing patterns of settlement in the watershed. Recommendations for new or expanded municipal historic districts, and all structures eligible for the National Register should also be included.

2. With the comprehensive survey as a basis, a thematic approach to interpreting the Chester Creek watershed's historic resources should be developed. Emphasis should be on the view from public right-of-way. A signage system should be designed to complement existing PHMC signage. It could be combined with natural resource information in a curriculum package for local school districts.

3. Local historic societies, or other interested parties should work with interested owners to make additional applications for inclusion on the National Register of Historic Places.

4. Municipalities should create or expand historic districts, under Act 167, where appropriate. Preservation tools, historic resources, and funding programs for historic preservation should become better known to municipalities. Most notable are those of the Pennsylvania Historic Museum Commission, Community Development Block Grants, and federal and state tax incentives.

5. Municipal ordinances should include a demolition permit process requiring HARB review in Historic Districts and National Register properties. The process should include a period to allow the

municipality an opportunity to acquire the property to avert demolition. Procedures and policies should be created to address instances where Native American artifacts are uncovered during construction or rehabilitation work. Thornbury (Delaware County) is developing an ordinance which provides incentives for owners to retain historic structures (Lawrence Barrett, pers, comm. 3/1/01).

6. In order to be successful these efforts need the cooperation of the owners of the historic structures, because there is little a municipality can do, short of condemnation, if an owner is determined to demolish a historic structure. Preliminary survey work should therefore include a survey of owner attitudes. Appropriate educational materials that emphasize the positive aspects of historic preservation should also be available. Residential owners in Historic Districts often feel that they are being unfairly regulated when they have to appear before a HARB to receive approval for, as examples, exterior paint color, or new windows. The review process can delay their plans, or even worse for them, the HARB can recommend that their plans be denied. To avoid bad feelings, an illustrated brochure of design guidelines to explain what the HARB looks for in proposals and why, would greatly improve the processing of applications.

Table 9

Summary: Historic Preservation Recommendations

Recommendation	Potential Participating Parties
Develop a comprehensive survey of historic structures and landscapes in the Chester Creek watershed	Counties, Historical Societies, Municipalities
Develop a thematic approach to interpreting the Chester Creek watershed's historic resources	Counties, Historical Societies, Municipalities
Create brochures, slide shows, museum displays, etc. to explain the findings of the comprehensive survey, using the thematic approach	Counties, Historical Societies, Municipalities
Make additional applications to the National Register of Historic Places	Municipalities, Historical Societies
Create or expand Act 167 historic districts. Become familiar with preservation tools, historic resources, and funding programs for historic preservation.	Municipalities, Historical Societies, Counties
Develop a demolition permit process requiring HARB review in Historic Districts and National Register properties	Municipalities, Historical Societies
Create illustrated brochures of design guidelines to explain the policies of HARBs	Municipalities, Historical Societies
Create procedures and policies for when Native American artifacts are uncovered during construction or rehabilitation work	Municipalities, PHMC, Delaware County Institute of Science

10
IMPLEMENTATION

A practical means to carry the Conservation Plan from a series of recommendations into actual implementation is tremendously important to its ultimate usefulness. The Rivers Conservation Program, under which this plan was developed, encourages municipalities to apply for the matching funds available for implementing these projects. Only municipalities that have passed the plan by a resolution of the governing body will be eligible for the funding (see Appendix D for a sample resolution). River-related non-profits can also apply for these matching funds.

The form that municipal and non-profit support can, or should, take is the topic of this chapter. There are probably four general institutional methods, which are discussed in the following sections. Each has unique strengths and weaknesses, and further study may find a hybrid form that would best suit the Chester Creek watershed.

Individual Municipalities

The first administrative model is simply the initiative of individual municipalities taking advantage of whatever aspects of the Conservation Plan that suit their particular priorities. In this method a local government body, either the Planning Commission, Park and Recreation Board, or Environmental Advisory Commission would be responsible for implementing the plan. Due to the nature of the Township and Borough system, there is sure to be a measure of this form of implementation regardless of whatever other forms occur. The greatest advantage to this implementation model is its simplicity. There is no need for intermunicipal cooperation or new institutions. The Chester Creek Conservation Plan simply becomes another planning tool to be used when the municipality has a need the River Conservation Program can help address.

However, individual municipal action has the drawback of being uncoordinated with the needs of the entire watershed. Intermunicipal cooperation is usually given higher ratings than individual municipal actions by grant-making agencies because the former can address issues that cross jurisdictions. Individual action is also dependent on interested individuals within each municipality to advance the conservation plan. Over time individuals on Boards and Commissions change and institutional memory can be lost. But for certain items, for instance the acquisition of public open space, the development of a streamside trail, construction of an observation platform, or other site specific improvements, individual municipal action seems to be the most logical form of implementation.

Intermunicipal Committee

A second model for implementation is an intermunicipal body. Such a body could be a simple coordinating committee of appointed representatives of each municipality (and possibly Philadelphia Suburban Water Company, Chester Ridley Crum Watersheds Association, the Conservation Districts, the Chester County Water Resources Authority, and the two County Planning Commissions). It would be charged with developing an implementation agenda to address issues that cross jurisdictions and that would balance the needs of the various municipalities. This could be particularly important if several municipalities would be interested in receiving funding in a single cycle. In such cases the committee could package the requests under a single project submission to avoid competition within the Chester Creek watershed. It could develop proposals for intermunicipal joint projects. The committee would be responsible for amending the Conservation Plan recommendations as new project priorities develop, ensuring that state funding could continue to be put to work on the Chester. It could have regular meetings chaired by rotating representatives, or meetings timed to funding cycles called simply to discuss the projects for which funding would be sought. The Lancaster Intermunicipal Committee is an example of such a cooperative venture in southeastern Pennsylvania (see Appendix B for contact name and phone number).

Pennsylvania State Law actually provides for such a committee through Act 148 (1973), which established the right of municipalities to set up Environmental

Advisory Boards (EAC), also authorized them to set up multi-municipal EACs.Recent changes to the Municipalities Planning Code also encourage intermunicipal planning.

An intermunicipal committee is well-suited to address watershed-wide issues, such as a non-point source pollution management program (which might include a riparian buffer planting program, educational outreach to homeowners, commercial and institutional properties on reducing nutrient and pesticide use, and model ordinances for buffers, erosion control, and other environmental protection). It could be particularly useful for efforts to influence state and federal actions in the watershed. It could make sure that state and federal officials are aware of the findings and recommendations of the Conservation Plan and incorporate the recommendations into their permitting decisions. For instance, reviews of water quality designations, permitting for new sewage treatment facilities, NPDES non-point source programs, road and bridge improvements, and Coastal Zone Management projects all could benefit from the support (or opposition, as the case may be) from an intermunicipal committee.

The intermunicipal committee would benefit from the official sponsorship of Chester and Delaware Counties. The County Planning Commissions would be ideal organizations to provide the administrative support necessary for calling the meetings and preparing minutes, agendas, grant requests, annual reports, etc. Central coordination by the Counties is quite important because more immediate, local, and competing demands for time and resources tend to divert local governments' attention. The greatest limitation on a committee is likely to be the amount of existing County and local government staff time and funding that can be diverted from other programs, or new funding that can be found to devote to the Chester Creek watershed.

The Department of Conservation and Natural Resources could encourage the creation of an implementation program for its Rivers Conservation Plan on the Chester Creek by assisting the pursuit of state and federal sources of funding to underwrite the beginning years of the committee's work. The financial contributions from member municipalities could be based on a flat rate, or could be based on some formula using land area within the watershed, population, and total assessments.

Chester Creek Watershed Authority

Another type of intermunicipal cooperation could be a municipal authority charged with implementing the Conservation Plan. While municipal authorities are more commonly used for expensive infrastructure projects such as water and sewer systems, the Pennsylvania Municipal Authorities Act allows their creation for both flood control and park and recreation facilities (*"Municipal Authorities in Pennsylvania"*, Department of Community Affairs, page 1). Just such an Authority was created for the LeTort Spring Run watershed in Cumberland County in the wake of flooding by Hurricane Agnes (see Appendix B for contact name and phone number). Authorities are a familiar and efficient means to manage projects in the public interest that naturally cross municipal boundaries. The Chester County Water Resources Authority is an obvious local example of an authority focused on water issues, albeit over an entire county rather than a single watershed.

Municipalities create authorities and appoint members to their boards, but authorities are not part of municipal government. They are charged with a specific mission and are given the responsibility to finance the mission through bonds, special assessments on property in the service area, user fees, or by contributions from member municipalities.

A Chester Creek Watershed Authority could be given the mission of making long-range plans for the corridor, owning streamside lands (either fee simple or easement), educating officials and citizens in watershed protection, managing the watershed public lands, and assisting municipalities in applying and administering grants.

An authority could be an attractive holder of common open spaces that it either purchased outright or that were produced by cluster developments. It could also hold conservation easements on common open spaces to ensure that homeowners associations do not neglect their management responsibilities.

As a long-range planner, grant administrator, and educator the Authority could function in the same capacity as the intermunicipal committee described above. Its by-laws should be written to insure that municipalities have a strong voice in plans that would affect lands in their jurisdiction.

Chester County Planning Commission Government Services Center 601 Westtown Road, Suite 270 West Chester, PA 19382 (610-344-6285) www.chesco.org/planning.html	Chester County Water Resources Authority 601 Westtown Road Suite 270 West Chester, PA 19382- (610-344-5400) www.chesco.org/water.html
Chester Ridley Crum Watersheds Association 210 Moylan Ave. Wallingford, PA 19086 (610-566-1627) www.ctic.purdue.edu/CRC/home.html	Delaware Cnty Board of Assessment Appeals Government Center 201 W. Front Street, Ground Floor Media, PA 19063 (610-891-4879)
Delaware County Conservation District Rose Tree Hunt Club 1521 N. Providence Road Media, PA 19063 (610-892-9484)	Delaware County Historical Society Malin & James Road Broomall, PA 19 (610-359-1148)
Delaware County Institute of Science 11 Veterans Square Media, PA 19063 (610-566-5126)	Delaware County Park & Recreation Government Center 201 W. Front Street, 2nd Floor Media, PA 19063 (610-891-4663)
Delaware County Planning Department Toal Building 2nd & Orange Streets Media, PA 19063 (610-891-5200)	Delaware Estuary Program www.delep.org Delaware Nature Society www.delawarenaturesociety.org
Delaware River Basin Commission P.O. Box 7360 West Trenton, NJ 08628-0360 (609-883-9500) www.state.nj.us/drbc/drbc.htm	Delaware Riverkeeper Network P.O. Box 326 Washington Crossing, PA 18977 (215-369-1188) www.delawareriverkeeper.org
Delaware Valley Regional Planning Commission The Bourse Building 111 S. Independence Mall East, 8th Floor Philadelphia, PA 19106 (215-592-1800) www.dvrpc.org	Federal Emergency Management Agency Region III One Independence Mall, 6th Floor 615 Chestnut Street Philadelphia, PA 19106-4404 (215-931-5614) www.fema.gov

Friends of Chester Branch P.O. Box 2313 Aston, PA 19014 (610-558-1262?) members.tripod.com/~ctrail	Heritage Conservancy 85 Old Dublin Pike Doylestown, PA 18901-2489 (215-345-7020) www.heritageconservancy.org
Lancaster Inter-Municipal Committee P.O. Box 8347 Lancaster, PA 17604-8347 (717-397-7313)	League of Women Voters 226 Forster Street Harrisburg, PA 17102-3220 (717-234-1576) www.lwv.org
LeTort Regional Authority *(watershed-based)* 415 Franklin Street Carlisle, PA 17013-1859 (717-245-0508)	Lower Merion Township Planning Department 75 Ardmore Avenue Ardmore, PA 19003 (610-645-6115)
Montgomery County Planning Commission Montgomery County Courthouse P.O. Box 311 Norristown, PA 19404 (610-278-3722)	National Oceanic and Atmospheric Adm. 227 W. Beaver Ave., Suite 402 State College, PA 16801-4821 (814-234-9412) www.noaa.gov
Natural Lands Trust Hildacy Farm 1031 Palmers Mill Road Media, PA 19063 (610-353-5587) www.natlands.org	The Nature Conservancy of Pennsylvania 1100 E. Hector Street Suite 470 Conshohocken, PA 19428 (800-628-6860) www.tnc.org
Pennsylvania Audubon Society 100 Wildwood Way Harrisburg, PA 17110 (717-213-6880) www.audubon.org/chapter/pa	Pennsylvania Center for Environmental Education Slippery Rock University Slippery Rock, PA 16057 (724-738-4555) www.pcee.state.pa.us
Pennsylvania Department of Community and Economic Development Commonwealth Keystone Building 400 North Street, 4th Floor Harrisburg, PA 17120-0225 (717-787-3003) www.dced.state.pa.us	PA Dept. of Conservation and Natural Resources Bureau of Recreation and Conservation, 7th Floor, Rachel Carson State Office Building P.O. Box 8475 (P.O.Box 8767--general) Harrisburg, PA 17105-8475 (717-772-3321) (general phone #: 717-787-2869) www.dcnr.state.pa.us

PA Dept. of Environmental Protection Southeast Regional Office 555 North Lane Conshohocken, PA (610-832-6000) www.dep.state.pa.us	PA Emergency Management Agency 2605 Interstate Drive Harrisburg, PA 17110-9364 (717-651-2009) www.pema.state.pa.us
Pennsylvania Environmental Council 1211 Chestnut Street Suite 900 Philadelphia, PA 19107 (215-563-0250) www.libertynet.org/pecphila	Pennsylvania Fish & Boat Commission P.O. Box 67000 1601 Emerton Ave. Harrisburg, PA 17106-7000 (717-705-7800) www.state.pa.us/fish
Pennsylvania Game Commission 2001 Elmerton Ave. Harrisburg, PA 17110 (717-787-7015) www.pgc.state.pa.us	PA Historical and Museum Commission Box 1026 Harrisburg, PA 17108 (717-787-3913 or -3034) www.state.pa.us/PA_Exec/Historical_Museum
Pennsylvania Resources Council Environmental Living Center 3606 Providence Road Newtown Square, PA 19073 (610-353-1555) www.prc.org	
Pennsylvania Science Office 208 Airport Drive Middletown, PA 17057 (717-948-3962)	Philadelphia Suburban Water Company 762 West Lancaster Ave. Bryn Mawr, PA 19010-3489 (610-525-1400)
Stroud Water Research Center Academy of Natural Sciences 970 Spencer Road Avondale, PA 19311 (610-268-2153) www.stroudcenter.org	Trout Unlimited 1500 Wilson Blvd. Suite 310 Arlington, VA 22209-2404 (703-522-0200) www.tu.org Delco Anglers (610-649-3442)

U.S. Army Corps of Engineers Philadelphia District Wanamaker Building, Rm. 600 100 Penn Square East Philadelphia, PA 19107-3390 (215-656-6516) www.nap.usace.army.mil	U.S. Dept. of Agriculture, Natural Resources and Conservation Service 601 Westtown Rd. West Chester, PA 19382 (610-696-0398) www.nrcs.usda.gov
U.S. Dept. of the Interior Fish and Wildlife Service Region 5 300 Westgate Center Drive Hadley, MA 01035 (413-253-8300) www.fws.gov	U.S. Dept. of the Interior, Geological Survey 111 Great Valley Drive Malvern, PA 19355 (610-647-9008) www.usgs.gov
U.S. Dept. of the Interior National Park Service Valley Forge National Historical Park P.O. Box 953 Valley Forge, PA 19482-0953 (610-640-9681 or 610-783-1000) www.nps.gov	U.S. Environmental Protection Agency Region III 841 Chestnut Building Philadelphia, PA 19107 (800-438-2474) www.epa.gov
Wallace Township Planning Commission 451 Fairview Road P.O. Box 670 Glenmoore, PA 19343 (610-942-2880) www.wallacetwp.org	Wissahickon Valley Watershed Association 12 Morris Road Ambler, PA 19002 (215-646-8866) www.wvwa.org

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C

PROJECT TIMELINE

1997	Rivers Conservation grant awarded
Feb.-June, 1998	Work plan developed, site visits made, municipal survey distributed
Sept. 28, 1998	Initial Public Meeting to determine local interest and needs
October, 1998	Municipal surveys collected and reviewed
Dec. 2, 1998	Act 167 Plan/River Conservation Management Plan Coordinating Meeting
Jan.-Mar., 1999	Survey distributed to over 600 landowners in the watershed and municipalities interviewed
April 21, 1999	Chester Creek Preliminary Findings Report distributed for comment
May 28, 1999	Revised Chester Creek Preliminary Findings Report released
June 30, 1999	Public Workshop on Preliminary Findings Report held
March 31, 2000	Draft Rivers Conservation Plan for Chester Creek prepared
July, 2000	Zoning/Buildout Scenarios complete
Feb. 1, 2001	Draft Plan to Project Review Committee

Feb. 15 to May 1	Responses received from Project Review Committee
March 1, 2001	Public Meeting held on the draft Chester Creek Conservation Plan, Middletown Township Building
June 15, 2001	Final Rivers Conservation Plan distributed for public review, comment, and municipal endorsement
July-Sept., 2001	Municipal letters/resolutions of support solicited
July 17, 2001	Public Hearing on the Final Plan
November, 2001	Municipalities and other groups become eligible to apply for matching funds from DCNR to implement plan recommendations
By early Dec., 2001	Submittal of the Final Plan and Municipal Endorsements to DCNR, and request to DCNR that Chester Creek be included on the Pennsylvania Rivers Conservation Registry
By late Dec., 2001	DCNR approval of the final Rivers Conservation Plan (projected)

Chester Creek Watershed
LANDOWNER SURVEY

RESULTS

Do you have a waterbody or wet area on your property?

12 pond
15 wetland
10 small stream (< 2' wide)
24 mid-sized stream (2' - 4' wide)
10 large stream (> 4' wide)
15 Chester Creek itself

Living beside water can have benefits. Do you consider any of the following water-related advantages to be a benefit for you?

39 Scenery
40 Wildlife
20 Play area for children
3 Public Parks
15 Fishing
19 Increased Property Value
25 Walking

Other: asset to the environment
landscape conservation
sound of the water

Living beside a stream can have drawbacks. Have any of the following issues caused you problems?

13 Flooding
24 Eroding banks
4 Meandering Channel
14 Water pollution
14 Trespassers/Liability
20 Trash in stream
8 Sewer lines/outfalls

Other: none
runoff from upstream development
possible loss of driveway bridge from erosion
limitations of use due to State regulations
unappreciative people
muddy water from upstream
need a bridge to access property
fishermen

Recently scientists have learned that the presence of a band of natural vegetation along a waterbody (called a "buffer") can absorb stormwater and pollutants and decrease erosion. Do you have a water related buffer? (grass alone doesn't count)

33 Yes **11 No**

How wide is it?

4 less than 5 feet 11 5-10 feet 1 10-20 feet 13 over 20 feet
[3 varies]

Local municipalities are responsible for most of the regulations that can help protect their creeks and their waterbodies. In your opinion are your municipality's ordinances:

3 Adequately protective
19 Not protective enough
2 Too restrictive
20 Don't Know
2 No opinion

Would you favor having the all the municipalities work together with landowners and the Chester Ridley Cum Watersheds Association to improve the quality of the Chester Creek and its tributaries?

45 Yes 2 No [1 Don't Know]

What would be the most important recommendation(s) to include in a plan for conserving Chester Creek?

- include surrounding landowners in conservation subdivision planning
- restrict development aroun waterbodies
- clean out obstructions, make a small reservoir for water needs, stop WAWA from dumping into Rocky Run
- better water retention at industrial sites above Brinton Lake
- improve the sewage discharge from the Thornbury Hunt sewage treatment plant
- monitor sewer outfalls into creeks
- control non-point source pollution
- intermunicipal planning and implementation
- reduce erosion
- control developers who damage streams
- stop over development, let streams return to their former clean state
- assist local governments that confront professional developers
- stormwater management
- educate citizens in stream care
- control sprawl through legislation
- less residential development
- publicize volunteer tasks
- protect headwater streams
- enforce soil conservation regulations
- require sewer discharges rto meet their permit requirements
- educate communities about local history and the creek's importance
- establish an intermunicipal plan or ordinance protecting sensitive lands along the creek
- acquire properties or easements along the creek
- provide safe access via a rail trail
- maintain flood control ditches dug by USACOE

OPTIONAL

How long have you lived at (or owned) your property?

24 years	average
90 years	most
1 year	least

2 respondents entered 200+ years, indicating multi-generational ownership

Would you like more information on:

24 Managing your streamside land for wildlife and water quality
20 Stabilizing stream banks
26 Local government regulations on the Chester Creek
25 Land preservation techniques with potential tax advantages to landowners

Would you like to become involved with protecting the Chester Creek?

18 As a creek monitor
10 As a liaison with your local government
7 In public education
9 In stream cleanup

Have you done something to protect the Chester Creek and/or its watershed and do you have expertise or acquired knowledge that you would share?

- replaced defective septic system
- planted native species
- purchased 23 acres to preserve floodplain
- leader in local citizens group fighting developmet on Tanguy Run
- clean up creek on property 3-4 times/year
- have tested water quality for 20 years
- don't use pesticides, never log property
- sold development rights to County
- argued for preservation in front of Township
- applied to DEP for "Exceptional Value" water quality status for tributary
- monitor water quality
- member of Chester Ridley Crum Watersheds Association
- allowed a natural buffer to grow
- have knowledge of erosion control

Additional Comments:

- large fish kills in my pond from local farm use of pesticides, etc.
- member of local Planning Commission
- pleased to know plan is being done
- need better institutional and social mechanisms to conserve land
- US Army Corps of Engineers has been unresponsive to complaints regarding ditch maintenance
- 440-unit Thornbury Township development will increase flow in Tanguy Run
- need to practice prevention instead of repairing damage done by development

Name: 37 names provided
Address:

Phone:
email: