Water Resources Plan
Shaping Our Future

A Comprehensive Plan for Montgomery County

MONTGOMERY COUNTY PENNSYLVANIA

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2005

MONTGOMERY COUNTY PLANNING COMMISSION

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Introduction

If one could follow a drop of rain that falls in Montgomery County, it would become obvious that water uses are connected. Rainfall that recharges groundwater or augments stream flow is then withdrawn for human consumption or industrial processes. After it is used, it is treated and discharged to surface waters, where it serves as habitat for fish and other wildlife, and is an important open space and recreation amenity. Eventually, it is withdrawn again to support the residents or commercial/industrial uses in the county. Viewed in this way, the importance of water is obvious. The way that we plan for and manage our water resources has critical implications, not only for the environment, but also for the economy and overall welfare of the county.

Water, sewer, and stormwater systems are a very important part of the infrastructure that supports a community. As necessary as this is, it must be provided carefully, as it has a strong influence over growth, land use, and the environment. Events in the recent past show how comprehensive plan policies can be undermined by haphazard extensions of sewer and water systems. Furthermore, past planning has regarded community facilities as individual elements, with little effort made to recognize the significant connected nature of water, stormwater, and sewage facilities. As a result, the impact development has on water resources has largely been ignored. The effects of impervious surfaces on stormwater runoff and groundwater recharge are two sides of the same coin, but are not always considered in land use or water supply decisions. Other issues in water resource planning, such as balancing recreation or aquatic habitat needs against water supply demand, have only recently begun to be addressed.

Water supply, sewage facilities, and stormwater management have the common denominator of hydrology; that is, they are part of or directly affect the hydrologic cycle. Land uses, from open space to high-density development, all affect the water cycle and have a significant impact on water resources. These areas often are considered separately to address the unique issues related to each of these topics. But as much as possible, the hydrologic context and the link among these areas must be recognized in making planning decisions.

Keeping a safe and clean water supply is essential for human health, recreation, and aquatic wildlife habitat.

Montgomery County receives between 30 and 60 inches of precipitation per year, averaging 42 inches annually. Most of this falls as rain in the spring and summer (50% to 60%), but a significant amount can be received as snow and ice in the winter (20% to 30%).

The Hydrologic Context

The hydrologic cycle moves water throughout the environment in various pathways. While the overall amount of water within the cycle remains relatively constant, its distribution can be altered by natural causes and human activity. Water evaporates from surface sources and condenses in the sky, eventually falling in some form of precipitation such as rain. In an undeveloped area, rainfall moves along three pathways when it reaches the ground:

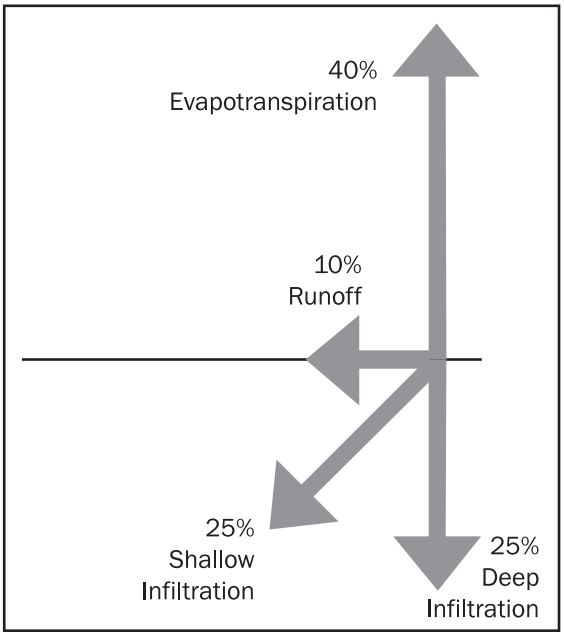
- Evaporation into the atmosphere - this will provide future precipitation.
- Runoff along the surface, eventually flowing into a stream or pond - this maintains water-based ecosystems, and refills reservoirs used for water supply.
- Infiltration (soaking into the ground) - here it can be absorbed by plants or is held as soil moisture. Plants rely on soil moisture between storms. Infiltrated water can also travel down below the roots of plants, eventually recharging groundwater. Groundwater resources supply water to residential, commercial and industrial uses, and sustain natural environments such as streams.

Like its surface counterpart, groundwater flows from place to place, although it moves more slowly. As it flows, it eventually comes back to the surface through springs or seeps, or it can flow up through streambeds or into ponds. In this way, it contributes to surface water flow. During dry periods such as between rains or during droughts, the groundwater to surface water movement is critical to maintaining stream flow and aquatic environments, and to diluting discharges from treatment plants and other sources.

Impervious surfaces and grading in development can change these pathways:

- Grading changes drainage patterns.
- Runoff is increased, concentrated and accelerated towards a discharge point.
- The ground is compacted and smoothed during grading, and infiltration of stormwater is greatly reduced.

Site Hydrology Before Development



- Impervious surfaces such as rooftops and parking lots also reduce infiltration.

Water and sewer service infrastructure also has an impact, depending on how they are provided:

- Numerous wells on individual lots can cause well interference.
- Private wells and public sewers result in groundwater 'mining,' when groundwater is withdrawn, used, and sent to a treatment plant downstream.

The result of compacted soil and impervious surfaces becomes obvious when it rains. The natural flow of water into the ground is disrupted, and the additional runoff can result in flooding and eroded streambanks. The long-term impacts are less obvious. As infiltration is reduced, groundwater recharge is minimized. Yet the groundwater continues to flow to surface water, and water suppliers and private wells continue to withdraw groundwater for supply. This results in groundwater depletion, eventually leading to failed wells, stressed water supplies, degraded streams, impaired wetlands, and disappearing headwater streams.

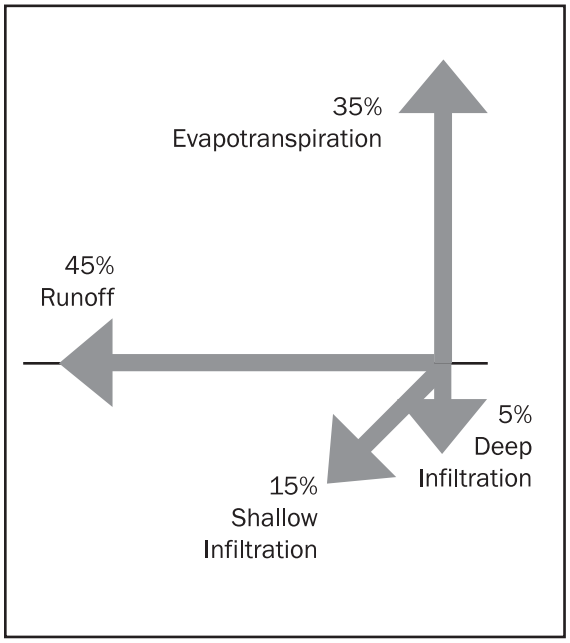
This plan, *Water Resources – Shaping Our Future: A Comprehensive Plan for Montgomery County,* is intended to guide water resource decisions to the year 2025. In particular, this plan lists specific policies that will reduce the negative impact of water on people by reducing the negative impact of people on the hydrologic cycle.

This *Water Resources Plan* proposes, in a series of chapters, to:

- Provide an adequate supply of water,
- Improve water quality and reduce water pollution,
- Limit the impact of flooding, and
- Promote better stormwater management practices.

Overall, this *Water Resources Plan*, if fully implemented, will create a more harmonious relationship between county residents and businesses and the natural water cycle that affects everyone.

Site Hydrology After Development



Impervious surfaces, like roads and rooftops, disrupt stormwater infiltration into the ground.

Chapter 1
Water Resources Goals and Actions

This chapter lists specific goals that, when implemented, will reduce the impact of flooding, protect water supply, and improve water quality. Each goal is followed by a list of actions that will help achieve the goal.

Water is a complex resource that transcends municipal, county, or even state boundaries. All of these various levels of government, as well as developers, businesses, farmers, other landowners, and conservation and environmental organizations, must be a part of any water resources solution.

The goals listed below are taken from the *Vision Plan – Shaping Our Future: A Comprehensive Plan for Montgomery County.* The numbering of the four goals below corresponds to the numbering in this *Vision Plan.*

With continuing droughts and water emergencies, maintaining an adequate supply of water will become both more important and more difficult.

Goal 31.
Provide an Adequate Supply of Water for Both Consumption and Natural Habitats

This goal will be achieved through the following actions:

- Encouraging water systems to use a variety of water sources, including wells and surface water.
- Encouraging conservation of water.
- Using community water systems instead of individual wells where development is dense enough to support these systems.
- Providing safe water service alternatives to areas with contaminated groundwater while simultaneously cleaning up any contamination.
- Interconnecting water supply systems to create a consistent and safe supply for both daily use and emergency situations.
- Increasing the amount of stormwater that recharges as groundwater.
- Educating consumers about water conservation.

Increasing the amount of stormwater recharge, as is done with this infiltration pit, can help ensure an adequate supply of water.

Goal 32.
Protect Water Quality

This goal will be achieved through the following actions:

- Improving the quality of water discharged from

Water that is safe and clean will protect the natural environment and the health of county residents.

Restoring eroded streambanks, like here along the Pennypack, can assist in protecting water quality.

stormwater facilities by requiring the use of best management practices.

- Restoring and protecting streambanks to limit erosion.
- Encouraging as much groundwater recharge and infiltration as possible through the use of pervious paving, seepage beds, bioretention areas, swales, and other best management practices.
- Supporting efforts to develop and enforce more stringent maximum stream discharge limits.
- Adopting ordinances and programs to protect stream corridors and enhance existing and new riparian woodlands.
- Adopting ordinances to protect wetlands, steep slopes, and woodlands.
- Maintaining the existing natural drainage and water cycle on a site during and after the development process.
- Adopting water-supply well protection ordinances.
- Enforcing conservation plans for farms and erosion and sediment control plans for developments.

Controlling flooding will save lives and properties.

Houses within the floodplain, such as this home in Collegeville, should be floodproofed to prevent potential future damage.

Goal 33.
Effectively Manage Flooding

This goal will be achieved through the following actions:

- Completing and implementing stormwater management plans for all of the county watersheds to determine the most appropriate rate of discharge from basins and how these basins can best improve water quality.
- Encouraging redeveloping properties to address previously unaddressed stormwater control.
- Removing buildings from the floodplain that are not floodproofed, where feasible.
- Controlling stormwater on individual properties through the use of rain gardens, rain barrels, natural landscaping, individual detention basins, seepage beds, and other techniques.
- Removing existing impervious coverage and replacing with landscaping or other pervious materials, where feasible.

- Widening or otherwise improving existing drainageways to eliminate artificial constrictions that cause flooding, where feasible.
- Prohibiting new development in floodplains, except for the development of elevated and flood-proofed buildings on brownfield sites in redevelopment areas encouraging economic revitalization.
- Maintaining the natural drainage and water cycle on a site during and after the development process.
- Substantially increasing the awareness of flood hazard risk so that the public takes steps to reduce the impact of floods.
- Preserving floodplain as open space, where feasible.
- Coordinating flood hazard response with local municipalities, state agencies, and federal agencies.
- Providing various types of flood prevention and rescue training.

Goal 34.
Create Attractive Stormwater Facilities that Control Flooding, Recharge Groundwater, and Improve Water Quality

This goal will be achieved through the following actions:

- Retaining stormwater on-site for a longer period to allow for groundwater recharge and sedimentation of pollutants.
- Improving the appearance and function of stormwater basins by creating naturalized basins, requiring curvilinear basins, minimizing side slopes, planting basins with water-tolerant trees, shrubs, and perennials, and eliminating low flow concrete channels.
- Reducing the amount of impervious surfaces in new development through a variety of techniques, such as minimizing road widths, using common driveways, and reducing the amount of parking.
- Maintaining the natural drainage and water cycle on a site during and after the development process.

Attractive and effective stormwater control facilities improve neighborhoods and communities.

Stormwater management facilities, like this bioretention area at Upper Dublin Township's building, can improve water quality as well as provide attractive sites for plants and wildlife.

Chapter Two
Water Supply

A reliable supply of clean water is among a list of essential human needs. In many ways people have had a detrimental impact upon the health of the natural systems that generate clean, abundant water. The proper management of water resources by all levels of government, businesses, and residents is necessary for all of us to have clean supplies of water.

Water policies must consider the recreational, supply, and natural resource protection issues inherent to water resource management. The following actions will improve water resources in the county:

- Encouraging water systems to use a variety of water sources, including wells and surface water,
- Educating consumers and suppliers about water conservation,
- Providing safe water service alternatives in areas with contaminated groundwater while simultaneously cleaning up any contamination,
- Interconnecting water supply systems to create a consistent and safe supply for both daily use and emergency situations,
- Increasing the amount of stormwater that recharges as groundwater, and
- Amending zoning ordinances to both accommodate development appropriate to the water resource capacity of an area and safeguard wellhead protection zones, wetlands, and riparian habitats.

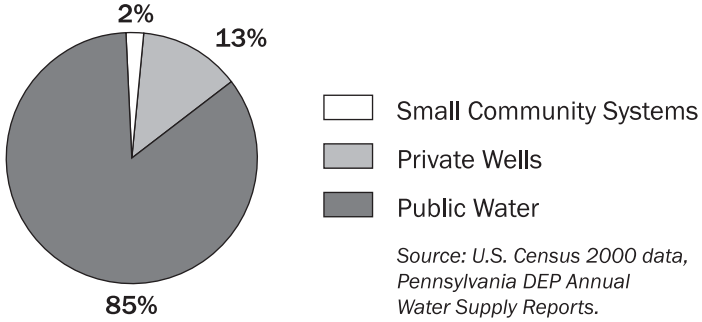
The first part of this chapter outlines existing conditions of public and private water supplies with respect to the resource capacity of a given area. The second part proposes a water resource plan covering water conservation issues, land use and zoning recommendations, and regulatory oversight.

Existing Conditions

Public Water Systems, Small Community Systems, and Private Wells

Public water purveyors served an estimated 652,000 people living in Montgomery County in 2000. Seventeen water suppliers served approximately 635,000 or 97.4% of the total public water custom-

RESIDENTIAL WATER USE IN MONTGOMERY COUNTY - 2000

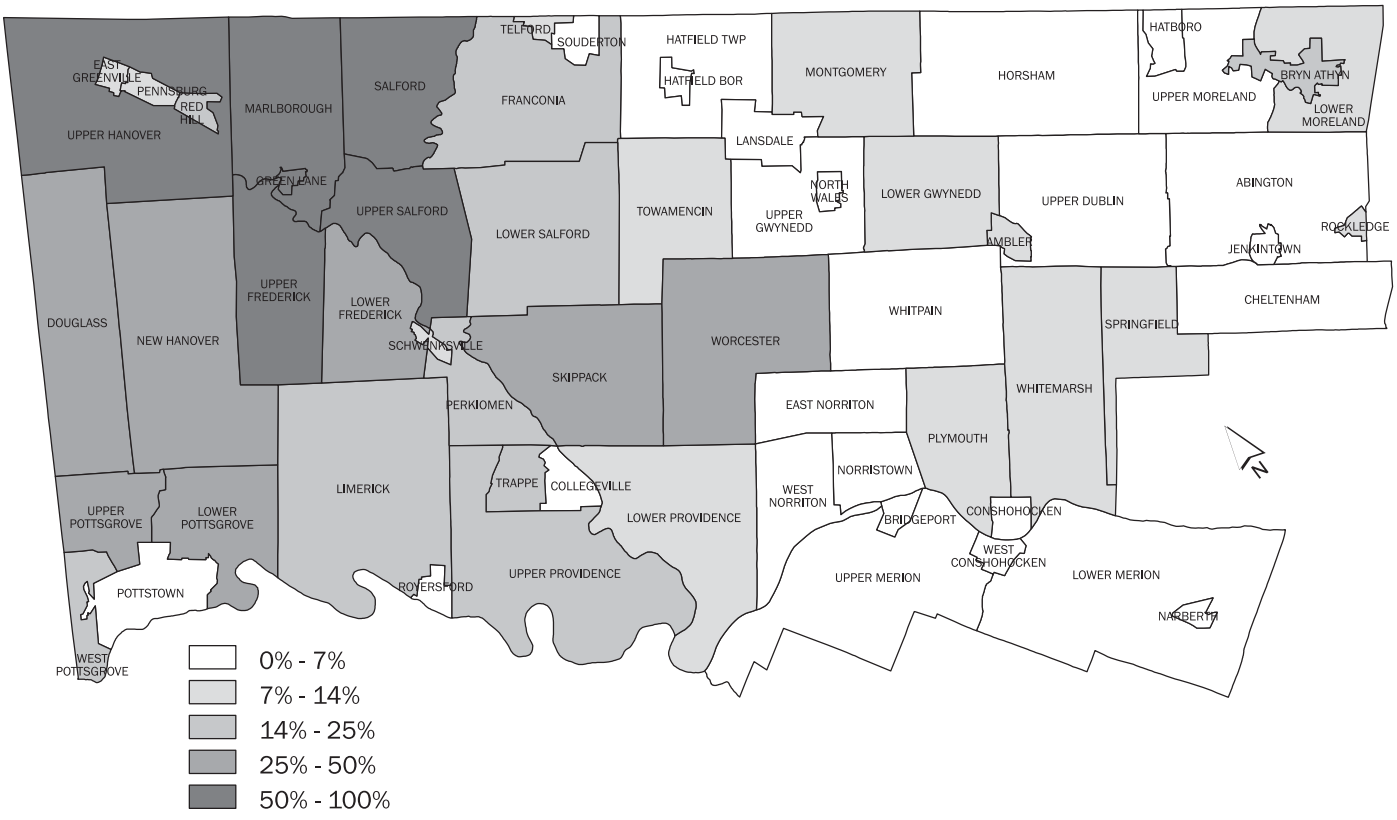


Source: U.S. Census 2000 data, Pennsylvania DEP Annual Water Supply Reports.

Most of Montgomery County's residents get their water from public water systems.

ers. The other 17,000 people using public water were served by small community systems operating in mobile home parks, group living quarters, and several homeowners associations. The remaining 98,000 Montgomery County residents received their water from private wells. Citizens using private wells were concentrated in the western and central portions of the county that are not serviced by public water suppliers (see Figure 1).

Figure 1
2000 Montgomery County Private Well Demand
Proportion of People Using Wells by Municipality



Source: U.S. Census 2000 data, Pennsylvania DEP Annual Water Supply Reports.

Public water systems served almost 141,000 acres in the county (45.2% of the whole) in 2000. Included in this estimate of land area are the many businesses, industries, and private homes that have public water available to them.

Estimates of the numbers of people using individual water supply wells were derived from subtracting the number of people using public water in a municipality from the total population of the municipality. Results are shown in Figure 2.

Figure 2
Estimated Population Using Public Water and Private Wells by Municipality - 2000

Municipality	Total	Private Wells	Public Water	Municipality	Total	Private Wells	Public Water	Municipality	Total	Private Wells	Public Water
Abington	56,103	450	55,653	Lower Merion	59,850	1,451	58,399	Souderton	6,730	174	6,556
Ambler	6,426	558	5,868	Lower Moreland	11,281	880	10,401	Springfield	19,533	1,629	17,904
Bridgeport	4,371	109	4,262	Lower Pottsgrove	11,213	5,062	6,151	Telford	2,469	338	2,131
Bryn Athyn	1,351	322	1,029	Lower Providence	22,390	2,530	19,860	Towamencin	17,597	1,759	15,838
Cheltenham	36,875	1,449	35,426	Lower Salford	12,893	4,186	8,707	Trappe	3,210	578	2,632
Collegeville	4,628	355	4,273	Marlborough	3,104	2,819	285	Upper Dublin	25,878	1,518	24,360
Conshohocken	7,589	290	7,299	Montgomery	22,025	2,142	19,883	Upper Frederick	3,141	2,694	447
Douglass	9,104	4,322	4,782	Narberth	4,233	249	3,984	Upper Gwynedd	14,243	1,057	13,186
East Greenville	3,103	354	2,749	New Hanover	7,369	5,942	1,427	Upper Hanover	4,885	4,096	789
East Norriton	13,211	711	12,500	Norristown	31,282	252	31,030	Upper Merion	26,863	1,634	25,229
Franconia	11,523	4,673	6,850	North Wales	3,342	55	3,287	Upper Moreland	24,993	593	24,400
Green Lane	584	584	0	Pennsburg	2,732	333	2,399	Upper Pottsgrove	4,102	3,017	1,085
Hatboro	7,393	284	7,109	Perkiomen	7,093	2,111	4,982	Upper Providence	15,398	4,628	10,770
Hatfield Bor.	2,605	172	2,433	Plymouth	16,045	1,076	14,969	Upper Salford	3,024	3,024	0
Hatfield Twp.	16,712	913	15,799	Pottstown	21,859	507	21,352	W. Conshohocken	1,446	23	1,423
Horsham	24,232	1,785	22,447	Red Hill	2,196	332	1,864	West Norriton	14,901	869	14,032
Jenkintown	4,478	10	4,468	Rockledge	2,577	271	2,306	West Pottsgrove	3,815	669	3,146
Lansdale	16,071	825	15,246	Royersford	4,246	147	4,099	Whitemarsh	16,702	1,785	14,917
Limerick	13,534	5,747	7,787	Salford	2,363	2,363	0	Whitpain	18,562	1,162	17,400
Lower Frederick	4,795	2,125	2,670	Schwenksville	1,693	213	1,480	Worcester	7,789	4,402	3,387
Lower Gwynedd	10,422	934	9,488	Skippack	9,920	2,426	7,494				

Source: U.S. Census 2000 data, Pennsylvania DEP Annual Water Supply Reports.

Understanding Water Supply Sources: Public Water

Do you know where the water in your house comes from? For a little over one in eight Montgomery County residents the answer is relatively simple- a well located somewhere on their property. For the majority of people, however, the answer is as complex as the large public systems delivering their water. The largest purveyor of water in the four suburban counties surrounding Philadelphia is Philadelphia Suburban Water Company (recently renamed Aqua America.) Aqua America's system withdraws and delivers water to customers in Delaware, Chester, Bucks and Montgomery Counties. With their expansive distribution systems, companies like Aqua America, Pennsylvania American Water Company, and North Penn Water Authority are able to take advantage of distant and disparate water sources. Not only is water transferred a long distance through some systems, but water companies also take advantage of interconnecting with contiguous water utilities. The following example illustrates one possible scenario. North Penn Water Authority and North Wales Water Authority withdraw water from the Delaware River in Bucks County, transport it to Montgomery County, sell it to Aqua America who delivers it back to customers in Bucks County. Given the limitations of the data, it is

Figure 3
Residents Using Private Wells: Top Twenty Municipalities

Rank	Municipality	Total Population	Private Well	Percent
1	Green Lane	584	584	100.0%
2	Salford	2,363	2,363	100.0%
3	Upper Salford	3,024	3,024	100.0%
4	Marlborough	3,104	2,950	95.0%
5	Upper Frederick	3,141	2,760	87.9%
6	Upper Hanover	4,885	4,096	83.8%
7	New Hanover	7,369	5,942	80.6%
8	Upper Pottsgrove	4,102	3,017	73.5%
9	Skippack	9,920	5,930	59.8%
10	Worcester	7,789	4,402	56.5%
11	Douglass	9,104	4,372	48.0%
12	Lower Pottsgrove	11,213	5,062	45.1%
13	Lower Frederick	4,795	2,125	44.3%
14	Limerick	13,534	5,747	42.5%
15	Franconia	11,523	4,673	40.6%
16	Lower Salford	12,893	4,186	32.5%
17	Upper Providence	15,398	4,628	30.1%
18	Perkiomen	7,093	2,111	29.8%
19	Bryn Athyn	1,351	322	23.8%
20	Trappe	3,210	578	18.0%

Source: U.S. Census 2000 data, Pennsylvania DEP Annual Water Supply Reports.

most likely impossible to determine to what extent the over 300,000 Montgomery County Aqua America customers are reliant upon water withdrawn from sources within as opposed to outside Montgomery County. The geography of public water supply transcends county boundaries.

A detailed analysis of public water supply in Chapter Three of the *Community Facilities Plan,* concludes that only three of the seventeen major companies could experience a water supply deficiency without expanding their existing dependable water supply before 2025. These systems are Upper Hanover Township Water Authority, Schwenksville Borough Water Authority, and the portion of Aqua America's service territory in Perkiomen Township. Nevertheless, none of the 17 water purveyors will have a significant water supply deficit based upon the 2025 population that could not be easily satisfied by the development of just one additional water supply source, or purchase of water from an adjoining water company.

Figure 4
Montgomery County Estimates of New Population Using Private Wells
(Municipalites adding population to Rural Resource Areas only)

Municipality	New Development 2000-2025 in Rural Resource Areas That Will Likely Be On Wells	
	New Housing Units	New Population
Lower Frederick	603	1,622
Upper Salford	555	1,543
Upper Frederick	302	818
Franconia	186	489
Lower Salford	121	340
Salford	116	329
Upper Providence	86	231
Marlborough	88	225
New Hanover	79	223
Limerick	80	205
Worcester	54	143
Douglass	51	140
Whitpain	48	124
Upper Hanover	32	88
Upper Pottsgrove	23	65
Whitemarsh	19	48

Source: U.S. Census 2000 data, Pennsylvania DEP Annual Water Supply Reports.

Understanding Water Supply Sources: Private Wells

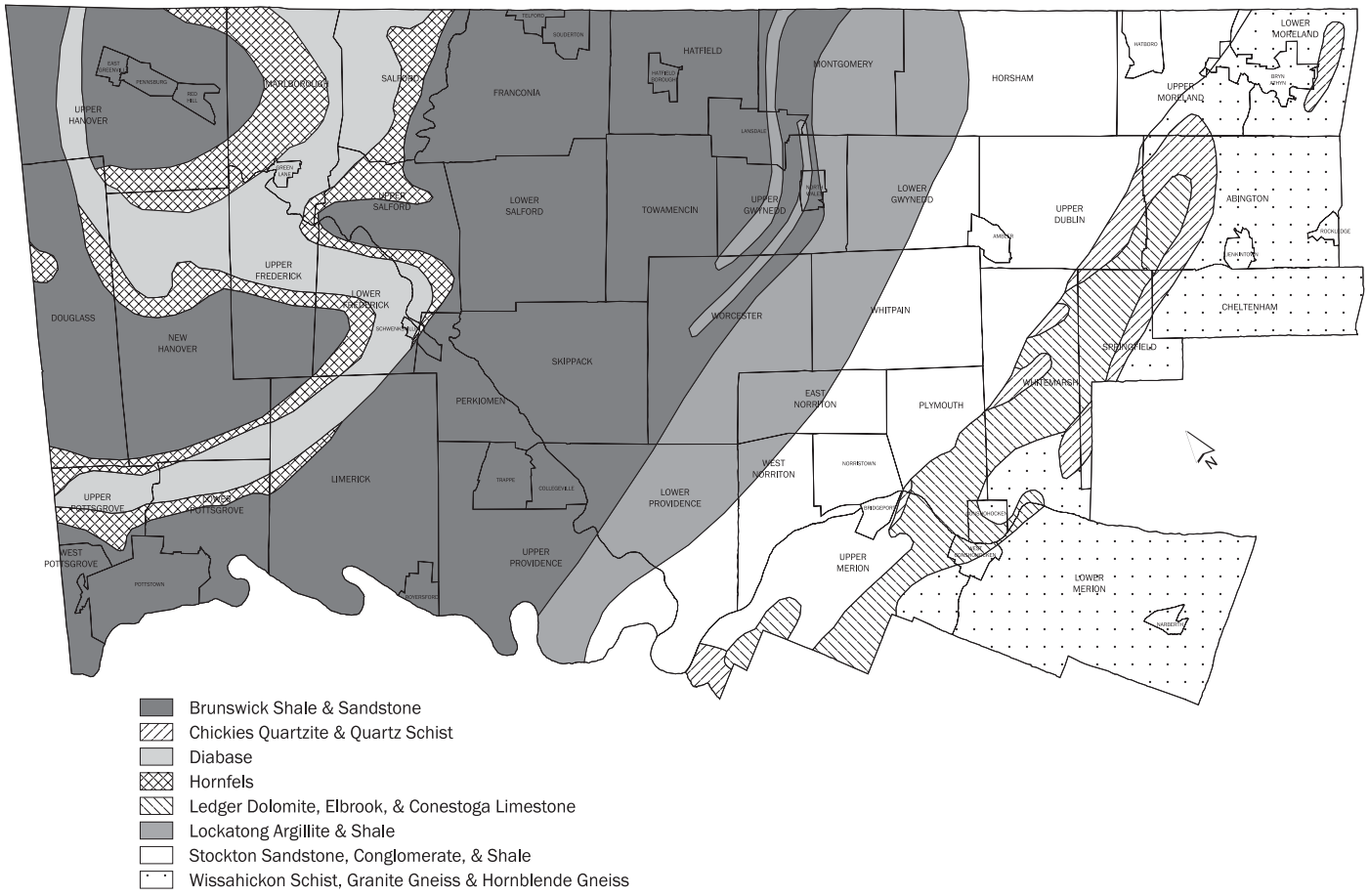
Protecting groundwater resources is important in every municipality in the county; however, residents living in areas that lack public water are most dependent upon a reliable supply of groundwater. Figure 3 lists the top 20 municipalities in the county with residents using private wells. Demand for groundwater is likely to increase in these municipalities since many expect to add residents in rural resource areas by 2025. Figure 4 depicts the municipalities in Montgomery County and the projected number of additional people using private wells by the year 2025.

Groundwater and Generalized Geology of Montgomery County

Studying local geology is helpful for determining the water resource carrying capacity of subbasins and the likelihood of failure under water demand scenarios. While it is useful to consider the differences between the various geologic formations within Montgomery County, the actual yields of particular wells will heavily rely upon site characteristics including depth to water table, elevation, and proximity to streams or other water users. The United States Geologic Survey reports

six different general geologic formations within Montgomery County, each with different characteristics in terms of the potential yield of groundwater. Figure 5 depicts the geologic formations found within Montgomery County.

Figure 5
GENERALIZED GEOLOGY IN MONTGOMERY COUNTY



Source: Surface Geology for Montgomery County, PA, Environmental Resources Research Institute, 1994.

Triassic Lowlands

- **Brunswick Formation:** consists of consolidated reddish-brown shale and sandstone. Most of the groundwater is found in secondary openings, faults and joints of the rocks since pore spaces are very small. Yields are highly variable but generally always adequate for domestic purposes. Deeper wells can be sufficient for commercial and industrial uses.

- **Lockatong Formation:** lies immediately under the Brunswick formation, sometimes interbedding with it. Lockatong consists of thick-bedded argillite, which is resistant to erosion and forms low ridges. Pore spaces are small with most water moving through joints and fractures that tend to be narrower and more widely spaced than in the Brunswick. Consequently yields tend to be lower and only adequate for domestic purposes. About 10 percent of the wells in this formation fail.
- **Stockton Formation:** underlies the Lockatong formation and is divided into three main members: (a) a lower member consisting mostly of sandstone and conglomerate, (b) a middle member of sandstone, (c) and an upper member of mostly red shale. Water can be found in pore spaces and secondary openings however yields are highest in the middle member. Wells are always adequate for domestic use; however higher yields are dependent upon penetrating the productive middle member.
- **Diabase:** consists of younger, igneous rocks, intruded into the Brunswick formation as dikes and sills. Water is found only in fractures which are narrow, widely spaced and do not extend to great depths. Only small yields can be expected and drilling past 200 feet is not advisable in most cases. Many wells located on the tops of ridges and hills fail even under normal domestic demand.

Piedmont Uplands

- **Carbonate Rocks:** underlies the formations found in the eastern portion of the county, but are exposed in eastern Montgomery County. They consist of limestone, dolomite and sediments that in some area have been compressed into very hard, erosion-resistant rock. The beds have been extensively folded and faulted. Groundwater yields are highly variable, depending upon the number and size of fractures penetrated. Wells are generally adequate for domestic usage.
- **Crystalline Rocks:** consists of mostly older, Precambrian, igneous, coarse-grained, granitic rock outcrops found in the southern portion of the county as well as some areas of metamor-

phic gneiss and schist. Water is found only in fractures that tend to be narrow and widely spaced. Yields are normally very small but domestic supplies can be obtained.

- **Unconsolidated:** interspersed among the carbonate rocks in the southern portion of Montgomery County are unconsolidated layers of Paleozoic rocks. Saturated by water and eroded by solution channels, some of the best producing wells, suitable for heavy industry, can be found in these areas although yields remain highly variable.

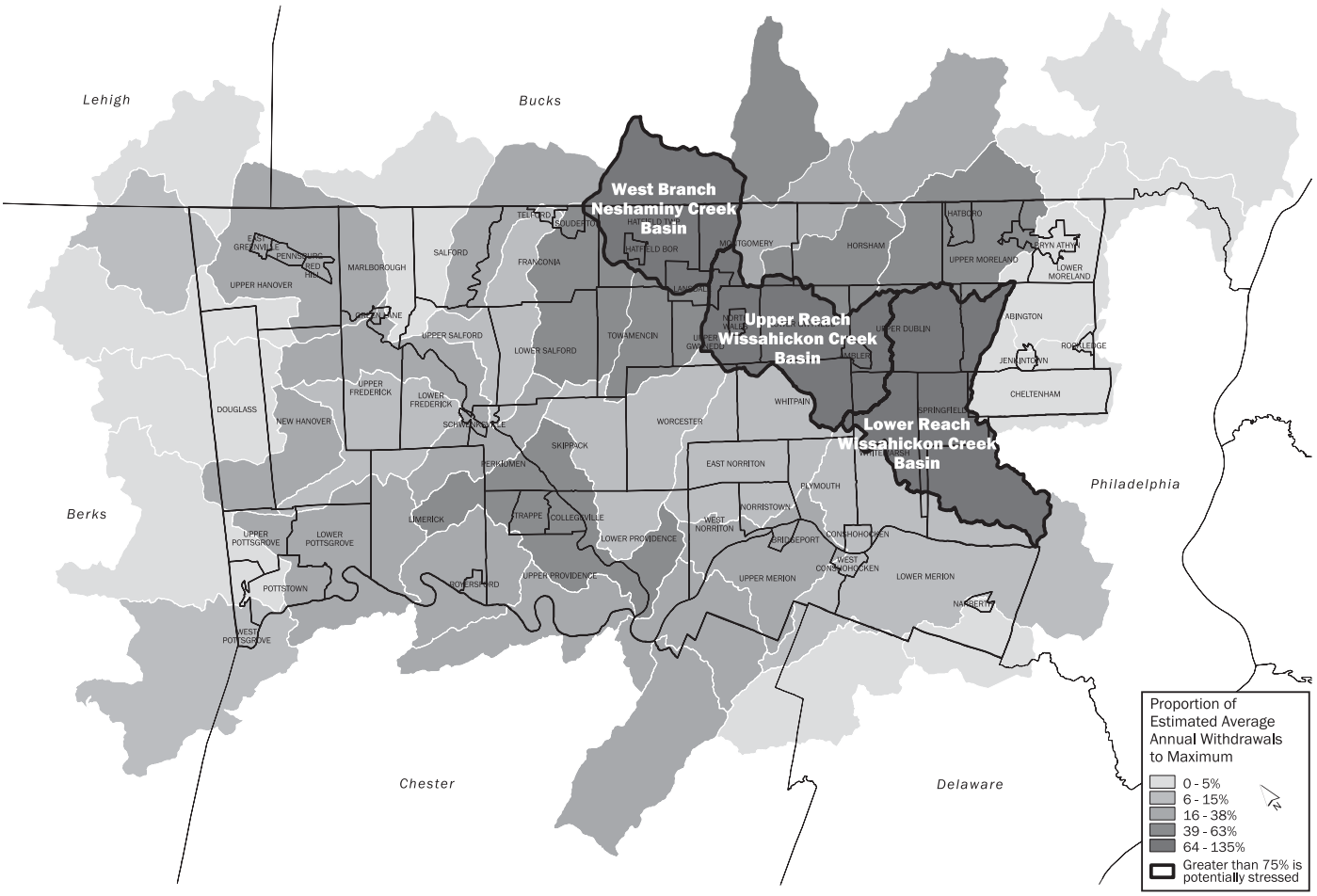
Regulating Major Water Withdrawals: The DRBC and DEP

The Delaware River Basin Commission regulates large water withdrawals in Montgomery County. Any proposed surface or groundwater withdrawal in the basin exceeding 100,000 GPD (gallons per day) is subject to review by the DRBC Board. In 1980 the DRBC responded to concerns about potential overuse of groundwater in and around Montgomery County and established the Southeastern Pennsylvania Groundwater Protected Area (GWPA). Since then all proposed groundwater withdrawals that exceed 10,000 GPD are subject to review as well. In 1998 the regulations were amended to include maximum withdrawal limits for each sub-basin within the GWPA, as well as provisions for mitigation programs when a new proposed withdrawal forces the total for the sub-basin to exceed 75 percent of the maximum. Of the 39 sub-basins in Montgomery County only three are currently classified as "potentially stressed." They are the Upper and Lower reaches of the Wissahickon Creek and the Warminster sub-basin of the Little Neshaminy Creek. (See Figure 6)

In addition, the Water Resources Planning Act of 2002 requires that all water users in Pennsylvania that exceed 10,000 GPD (computed on a 30-day annual average) register with the Pennsylvania Department of Environmental Protection (DEP) and report annual water usage amounts. This information will be part of a new program of statewide water resources planning initiated by the Act. Included in the Act are requirements to update the State Water Plan every five years, identify critical water planning areas, and develop critical area resource plans.

The Delaware River Basin Commission created the Southeastern Pennsylvania Groundwater Protection Area in response to concerns of water overuse.

Figure 6
MONTGOMERY COUNTY SUB-BASINS



Source: U.S. Geological Survey and the Delaware River Basin Commission.

Regulating Individual Water Supply Systems: The Montgomery County Health Department (MCHD)

Chapter 17 of the Montgomery County Health Code concerns the issuance of permits for the construction or modification of individual water supply permits in the county. Applying for a permit to drill a well is a two-step process. The applicant must first obtain a permit to construct and then a permit to operate. To obtain a permit to construct, applicants must demonstrate that the following criteria have been met.

- Individual water supply wells must be constructed by a Pennsylvania Department of

Conservation and Natural Resources licensed well driller.

- No permits for new construction are issued until the sewage facilities planning module is approved by DEP, or a waiver is granted by MCHD.
- Minimum isolation distances from the uses outlined in the Appendix must be met.

The one exception to the requirements for a permit to construct is in emergency situations. In these cases, the MCHD will issue a verbal permit that expires in 24 hours unless drilling commences or a complete Individual Water Supply Well Application is received.

Once a permit to construct is obtained the applicant proceeds to the operating permit application process. This involves conducting a pump test that determines the following.

- Depth of well, pump intake, and static water level (undisturbed for twenty-four hours).
- The measured water level after pumping the well at four gallons per minute for two hours.
- Water quality test results from a DEP certified laboratory for all required parameters (see Appendix).

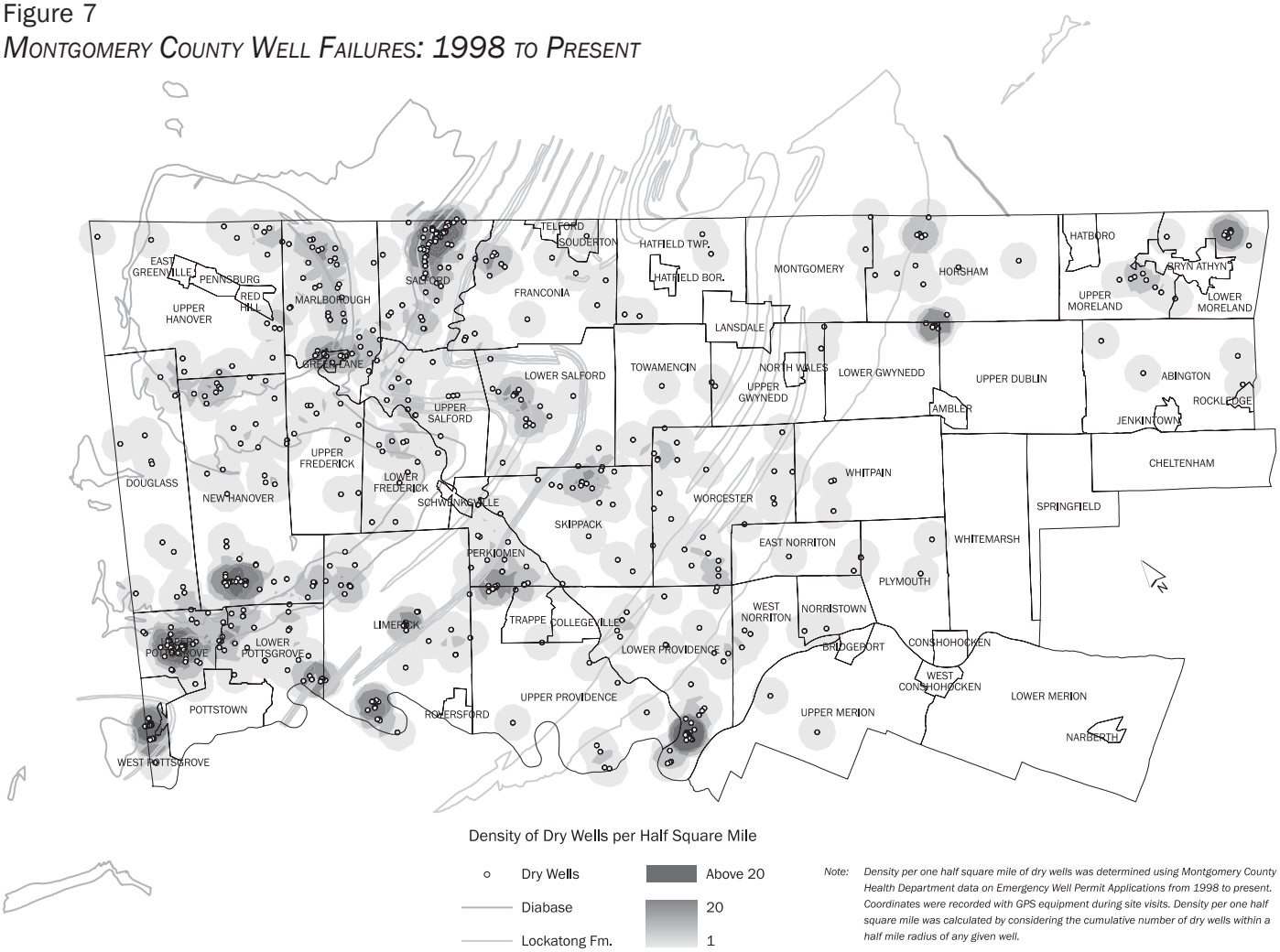
Once permits are issued it is the responsibility of the applicant to conduct ongoing monitoring of the well. The MCHD has compiled a database of well information gathered since the adoption of Chapter 17 on February 7, 1997. Information on contaminated wells and wells that run dry is included in this database. This information gives an accurate picture of where individual water supply issues have arisen.

Groundwater Supply Problems: Emergency Well Permits and Contamination

Emergency Well Permits

When a homeowner's well runs dry, the well permit application process is expedited. Verbal permission to install an emergency well within 24 hours is granted upon request. Once installed, these wells are registered and tested like any other new well. Documenting the location of these failures gives a clear picture of areas with individual water

Figure 7
Montgomery County Well Failures: 1998 to Present



Source: Montgomery County Health Department and U.S. Geological Survey.

supply problems. A total of 582 of these emergency well permits were mapped. This analysis points out areas like Tylersport in Salford Township, portions of Upper Pottsgrove Township, and Lower Providence Township where significant well failure has occurred. Figure 7 depicts areas in Montgomery County that have experienced well failure. Remedies for these situations include designating the Tylersport area as a growth area so that public water can be extended. In other areas, the possibility of community systems should be explored.

While well failure is generally related to diminishing supplies of groundwater associated with droughts, or neighboring users, some of the particular instances are related to out-of-date well design. Wells that are generally shallow in depth are more subject to failure. The map reflects in part the

geography of water supply shortages, and the geography of insufficient well design standards.

It should come as no surprise that well failure is concentrated in areas of the county with high well usage. What is most revealing in this analysis is the extent to which well failure follows local geology. Areas within lower yielding diabase and Lockatong formations experienced a higher rate of well failure than neighboring areas in more productive formations like the Brunswick. This analysis reinforces the theory that local development patterns must be congruent with local natural features.

Contaminated Wells

Wells that test positive for one of the required parameters outlined in the Montgomery County Health Code (see Appendix) must be corrected before an operating permit can be issued. In most cases, the easiest way to correct the problem is to install individual filters on home systems. Where contamination levels are excessive or large clusters of contaminated wells exist, connecting to public water should be considered. In cases where contaminated wells are clustered in areas too distant from existing public water, or levels are too excessive to be corrected by individual filter systems, community water systems should be considered. In these cases, the costs of filtration technologies can be spread over a number of users. Regular water quality testing is essential to detecting these problems. The data presented likely understates the degree of individual well contamination in the county.

Water Supply Plan

Ensuring the long-term sustainability of water resource quality and quantity is dependent upon integrating water use regulation, water conservation practice, and land use decisions. The *Vision Plan* designates undeveloped areas of the county as open space, rural resource areas, and designated growth areas. Generally the open space and rural resource areas contain most of the diabase geology, which in terms of water-carrying capacity is suitable for only low-density development. Local zoning in these areas could be based on natural feature performance measures. This would help ensure that areas proposed for on-lot wells have sufficient water. In designated growth areas, development is being encouraged at densities sufficient to support the extension of public water service.

Water conservation is another major component of the water supply plan. With even modest conservation measures, aggregate water demand can be maintained or lessened even as the county grows in population. Minimizing human demand represents the most cost effective way to manage water resource allocation.

The third main component of the water supply plan is effective water use regulation. This requires a range of perspectives from state and regional agencies to local municipal government. Each level is properly suited to a different aspect of water resource management. Regional agencies can regulate major withdrawals and track water resource allocation. Accurate, up-to-date information will reinforce policy as conditions change and Montgomery County grows. Local government can implement zoning that dictates development density appropriate to the water resource capacity of an area. Municipalities can also protect certain areas like wetlands, riparian areas, and wellhead protection zones to augment water quality. Each level of government is necessary yet none alone are sufficient to accomplish effective water resource management.

Conservation Measures

As summer droughts and water use restrictions become more common in Southeastern Pennsylvania, water conservation techniques will become the norm. Even so, water conservation should be a year-round consideration, as county residents and businesses will always be in need of water. Conservation will be encouraged through the following practices:

- **Requiring new development to maintain existing groundwater infiltration levels on their sites:** The heavy machinery needed to build new developments can compact the soil on a site, drastically reducing the amount of groundwater that seeps into the soil. By limiting heavy machinery to selected portions of a site, this impact is minimized. Additionally, developers can take steps to include natural features, such as vegetated swales or bioretention cells, which can hold stormwater on-site to allow for infiltration. These practices are detailed in Chapter 5: Stormwater Control Facilities.

New construction can increase local stormwater runoff—using naturalized stormwater management techniques can help maintain predevelopment groundwater infiltration.

- **Adjusting pricing to manage demand:** The true costs of supplying water should be taken into account when planning for conservation. This includes the cost of maintaining current and building new water supply facilities. Water authorities and municipalities should also take future total supply capacity into consideration, which can be modified to reflect the effects of water conservation.
- **Educating the public about various conservation practices they can use at home and work:** Possible ways of supplying information to the public include having an understandable and informative water bill, holding educational workshops at schools or government offices, or creating local advisory committees.
- **Changing use habits of customers:** Localities can offer financial incentives to their residents—such as rebates for the purchase of low flow water fixtures. Localities can also promote and model new technology by requiring its use in government-owned buildings. Municipal water use regulations and careful enforcement can also aid in conservation efforts.
- **Requiring conservation measures for all new developments:** New developments can be required to implement standards with regard to low flow fixtures, landscaping, drainage, or irrigation. Private water authorities or developers may lack the ability to institute this type of measure.

  To address the need for sustainable building and development guidelines, the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) Program was created. It outlines the conservation measures that can be taken to attain their "green" building certification. In Pennsylvania, these efforts are coordinated through the Governor's Green Government Council. Water efficiency measures that would count towards certification include using water efficient landscaping, installing innovative wastewater treatment technologies, and reducing water use. Local examples of green buildings can be found in the state's Department of Environmental Protection Southeast Regional office in Norristown and when it is finished being renovated, Bryn Mawr College's Roberts Road Student Village.

Local residents can replace fixtures with low-flow models to save water (and money).

Water companies can encourage their customers to save water by using low flow fixtures and toilets.

- **Retrofitting old fixtures with new, low flow fixtures:** The much more intractable problem of updating wasteful plumbing fixtures in existing homes and businesses could be solved by requiring old fixtures to be replaced when properties transfer title. Replacing older fixtures not only saves water, but can save energy and money too. For example, showers account for about 17 percent of indoor water use. Older showerheads may use between 4 and 5 gallons of water per minute; new showerheads use between 1.5 and 2.5 gallons of water per minute but increase the force of the shower spray. Other low flow accessories include faucet aerators, low flow toilets, and high efficiency washing machines and dishwashers. Front loading washing machines, for example, can save between 15-30 gallons of water per load. Not all water saving tips involve expensive retrofits—placing a weighted half gallon jug in a toilet will displace and save water each time it's flushed.
- **Encouraging efficient landscaping and lawn maintenance practices:** Xeriscaping is a landscape design principle typical of the arid regions of the United States; however it can be employed in our region as well. Xeriscaping involves the use of water efficient, or drought tolerant, landscaping. While Montgomery County may not have the water supply limits like those found in the western United States, it makes practical sense to use plants that are best suited for this local environment. Subdivision and land development ordinances can require sensitive landscape design by limiting lawn size and requiring the use of drought tolerant native plants. A subdivision and land development ordinance can also require drip irrigation systems where practical.
- **Improving loss detection on water lines and fixing leaks:** Water providers are required to submit evidence to DEP of adequate leak detection systems. Public policy at the state level should add incentives for water companies to be more mindful of water delivery efficiency, rather than tapping a source to make up the difference in lost water. Total water lost in the Pennsylva-

nia Delaware Valley Regional Planning Commission region (Bucks, Chester, Delaware, Montgomery and Philadelphia Counties) is estimated to be more than 80 million gallons a day. Homeowners can also help by contacting their water provider when they suspect they have an underground water leak or their water pressure is too high or low.

- **Reuse of water from various sources:** Stormwater and sewage treatment plant effluent represent two sources of water available for reuse. Too often, stormwater and treated effluent are merely discharged to streams and the opportunity for their further use is lost. Both can be collected and reused as irrigation water on golf courses, nurseries, or office parks. This reduces the amount of potable water used for such purposes. Currently, Butter Valley Golf Port in Upper Hanover Township has proposed to use treated effluent from the Bally Borough sewage treatment plant as irrigation water. Rainwater can also be collected from rooftops and reused. The state Department of Environmental Protection Southeast Regional office in Norristown collects rainwater from its roof and stores it for nonpotable use in the building.

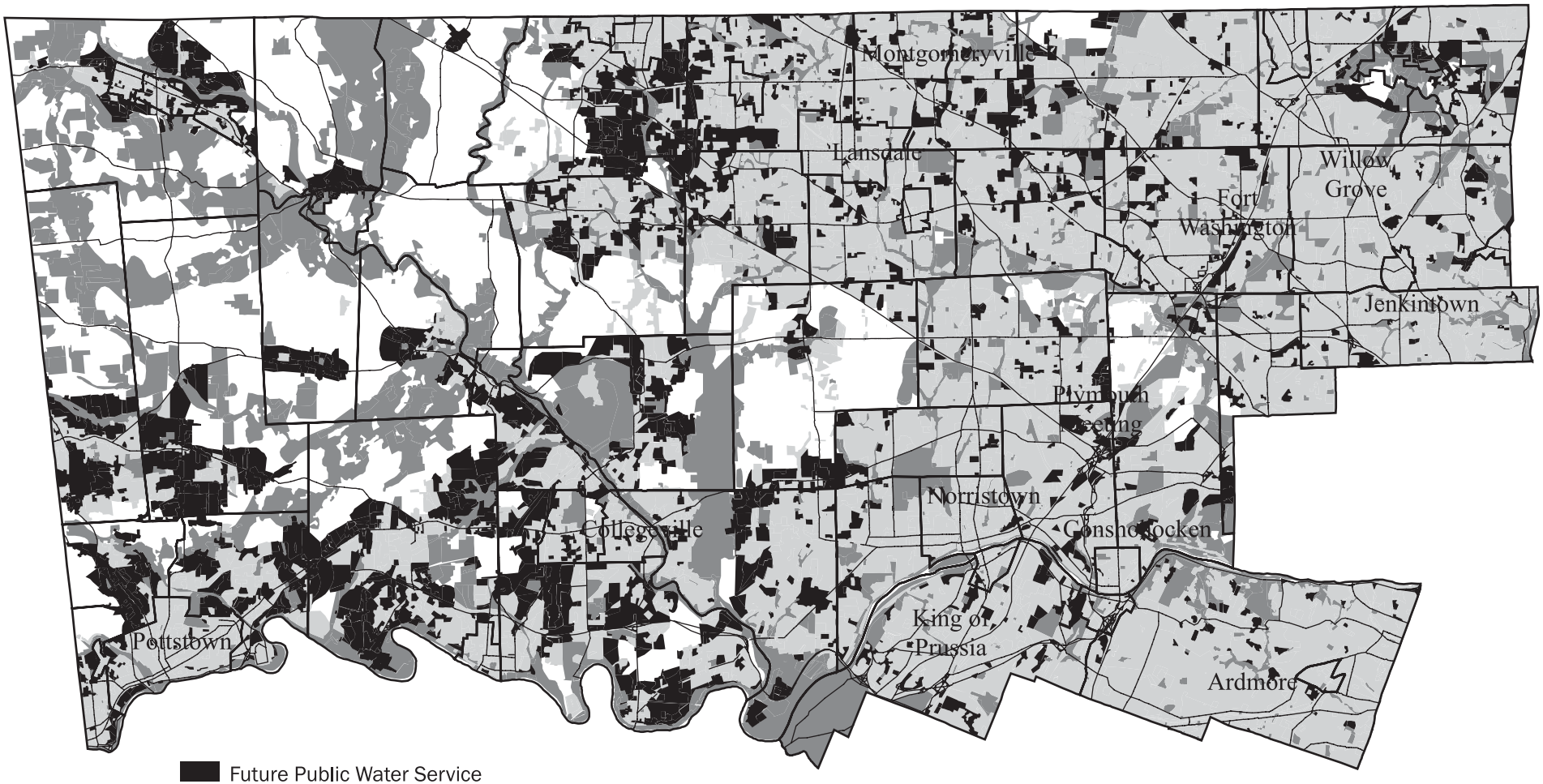
Public Water Supply

As outlined in the *Community Facilities Plan*, of the seventeen major public water suppliers in the county, only three may experience a water supply deficiency without expanding their existing dependable water supply. None of the 17 water purveyors, however, will have a significant water supply deficit based upon the 2025 population that could not be easily satisfied by the development of just one additional source. The sources used for public water supply should be a mixture of ground and surface water sources as well as interconnections with other purveyors. A diverse base of water resources will ensure against the threat of diminished supplies during droughts and contamination of any one source. Figure 8 shows proposed future water service areas.

Individual Well Water Supply

Guaranteeing a reliable source of groundwater

Figure 8
EXISTING AND FUTURE PUBLIC WATER SERVICE AREAS



Note: Mapping based upon 2000 Land Use information.

for county residents using private wells involves balancing supply and demand. While the DRBC concluded that only three of the 39 sub-basins in Montgomery County were under potential water demand stress, the reality is that many property owners' wells have run dry even in sub-basins where total water demand is relatively low. The need for careful planning accompanying development dependent upon individual well water systems is greatest in these areas.

We began by identifying areas in the county most reliant upon individual wells by calculating the sum of an estimate of people using private wells in 2000 by municipality and an estimate of new residents in rural resource areas in those municipalities by 2025. One of the recommendations of the *Housing Plan* is that only 5% of all units added to the county, or 2,450 units by the year 2025, should be in rural resource areas. The distribution of these units is not equal across the county. Figure 4 demonstrates the number of housing units added to every municipality that is projected to add at least one housing unit in rural resource areas before 2025. These numbers were then multiplied by average household size to estimate future populations in rural resource areas. By measuring the growth in population in rural resource areas we can reasonably anticipate future individual well water demand. Our analysis revealed that growth in individual well water demand would occur in areas underlain by geologic formations with low water yields—the Diabase and Lockatong formations.

Strong evidence supports the need for municipalities listed in Figure 4 to pursue water resource planning in order to protect the health and safety of their citizenry. The following actions by state, county, and local agencies will help achieve these goals.

Recommendations

Montgomery County residents using public and individual water supply systems benefit alike from the protection of natural resources. When water quantity or quality problems arise, however, residents using private wells are more heavily burdened. Managing water resources so that large public systems and individual private systems can coexist

requires a balance of regional and local perspectives. The regional perspective is important to measure the cumulative impact of water withdrawals and inter-basin transfers over a large area, while the local perspective can identify and protect areas most appropriate for on-lot systems. The following recommendations address water resource management needs in the county.

- **Continue regional regulation:** The DRBC offers the best vehicle to execute resource-based policy and monitor water withdrawals at a regional level. Current withdrawal information needs to be forwarded to the DRBC by DEP. New requirements for water system reporting, required under Act 220, will augment the supply of water withdrawal information.
- **Eliminate water regulation exemptions:** Mining and agricultural operations are not required to submit applications for water withdrawals to DRBC even if they exceed minimum thresholds for regulation. Industries should be fairly assessed for the water they use in their day-to-day operations.
- **Focus water improvements in designated growth areas:** Municipal zoning can be amended to allow for more than one dwelling unit per acre in designated growth areas. Public sewer and water systems should service these areas. On-lot water withdrawal and septic disposal in these areas would likely create a public health hazard.
- **Restrict extension of public water into rural resource areas:** Public water expansion into rural resource areas should be restricted except when cluster development takes place with greater than 60% open space and a gross density of less than one dwelling unit per acre, and extension of an existing public water system does not extend greater than a half mile outside the designated growth area.
- **Withhold funding to projects that intrude into rural resource areas:** State grants and loans should be withheld for water projects that intrude into rural resource areas. Exceptions

Restricting the expansion of water lines into rural resource areas can slow growth outside of core designated growth areas.

can be made if the county's water service map shows extensions into these areas.

- **Provide concurrence between public water and sewer facilities:** Public water and public sewer need to be installed concurrently in designated growth areas.
- **Expand opportunities by developing new sources:** In order to increase water system reliability; particularly in emergency situations, water purveyors should continue to develop alternative water supplies. This will help ensure against water supply problems.
- **Develop more conjunctive use of water resources:** Reusing wastewater in order to limit withdrawal of fresh water is a practical water conservation technique. An example is the use of treated sewage to water a golf course.
- **Protect water quality via source water protection plans, including wellhead protection:** Wellhead protection is often done through the use of zoning ordinances that limit the types of uses that can be developed within the area contributing to the well. Source water protection plans can also include monitoring systems to provide early warning or a contamination problem and public education regarding proper land use within a wellhead protection area.
- **Encourage developments in rural resource areas of greater than 15 units and more than a half mile from existing public water facilities to install community water systems:** The *Housing Plan* recommends that a very small portion of new housing be built in rural resource areas. To protect public health and welfare in these areas, we recommend small community systems for housing developments of greater than 15 units. Requiring community systems will ensure that the water system is regulated by the DEP for compliance with water quality standards. Assuming a household size of 2.75 people and per capita water use of 120 gallons per day, developments of greater than 30 housing units in Montgomery County will need to comply with DRBC regulations. This would ensure annual reporting and

monitoring of the resource withdrawal. In addition, residents would have some recourse for action if their supply well fails in a community system. In a system of dispersed, individual water supply wells, homeowners have no recourse but to incur the expense of drilling another deeper well.

- **Encourage owners of individual water supply systems to use an on-lot septic system for wastewater disposal:** Using on-lot septic systems for wastewater disposal reduces the consumptive use of water tenfold by facilitating groundwater recharge.
- **Amend the County Health Department Code:** Presently, operating permits are issued on a case-by-case basis. There is no method for understanding the cumulative impact of several wells operating at once in close proximity to one another, as in a development in an area without public water. Wells, when undergoing quality and quantity tests, should be examined in a way that takes other area wells into consideration.

Monitoring wells are an important part of groundwater protection.

- **Improve and maintain the county's well monitoring network:** Continue ongoing work to establish a network of observation wells throughout Montgomery County designed to monitor groundwater.
- **Revise applicable municipal zoning codes:** Section 503, Part 10 of the Municipalities Planning Code authorizes municipalities to regulate subdivision and land development activity so that "Provisions and standards for insuring that new developments incorporate adequate provisions for a reliable, safe and adequate water supply to support intended uses within the capacity of available resources" are present. Consequently, municipalities can identify areas that are most appropriate for on-lot systems or public water systems. Growth can be channeled at increased densities into designated growth areas to take advantage of existing or easily expanded public water supply systems. Development outside of these areas should be limited and tailored to the resource carrying capacity of the particular site.

Municipalities that expect to add significant numbers of residents on individual water supply systems need to undertake water resources impact studies. The Montgomery County Planning Commission has drafted a model ordinance requiring water resource impact studies as part of the subdivision and land development process.

In addition, municipalities could introduce performance based zoning measures, like in Marlborough Township, that would factor the natural attributes of a parcel before assigning an appropriate housing density. In Marlborough Township, density adjustment factors are derived from soil types, presence of diabase, waterbodies, watercourses, floodplains, wetlands, and slope analysis.

Preserving areas vital to water resource protection and directing growth into designated areas is particularly well suited to a transfer of development rights (TDR) program. Although these programs require a great deal of up-front work, they can create a system of land development and preservation funded entirely by private market forces.

Conclusion

While water is relatively abundant in Montgomery County, recent droughts have demonstrated how precious this resource can become. Water resource planning must balance human demands with those of natural systems. Proper stewardship of water resources requires an integrated approach that addresses land use policy, water withdrawal regulation, and conservation strategies. The best way to begin this process is to continue educating children and adults about proper water resource protection. Ignoring the cumulative impact of human choices has profoundly increased the demands placed upon natural systems creating the water resource issues we struggle with now.

Many government agencies, in one way or another, have an impact on water resources as well. At the regional level, the DRBC will continue to provide the oversight necessary to manage water withdrawals across a vast area. In addition,

Pennsylvania's Act 220 requires the DEP to update the State Water Plan every five years, and calls for new, lower thresholds for water withdrawal reporting. This information must be gathered, stored, and shared so that up-to-date analysis can reinforce policy. Communication and cooperation are essential to the efficient regulation of water resources.

The protection of water resources requires the involvement of many levels of government, businesses and individuals. All these entities must address water resources through an integrated perspective that balances present and future water needs with other ecological water requirements. The integrated approach considers and follows fundamentally integrated aspects of water resources including: water quality and quantity; surface and groundwater sources; demand and supply management; and environmental, social, economic and legal dimensions. The recommendations in this chapter are developed out of this integrated approach.

Chapter 3
Water Quality

If asked where water comes from, most people would probably answer with something along the lines of "my faucet" – which highlights the fact that for most people in Montgomery County, it's pretty easy to get clean water for drinking, bathing, or even washing the car. But despite its seemingly limitless supply, local water can easily become contaminated.

Since the Clean Water Act was passed in 1972, much has changed in the world of clean water. This act, and its later amendments, regulates discharges into major waterways as well as quality levels for the pollutants that may remain behind. Since the Clean Water Act was enacted, streams once polluted with wastewater have become sources of high quality drinking water. Uncontrolled dumping is widely a thing of the past. The eradication of highly toxic chemicals allows once-threatened birds and animals to flourish. Locally, it wasn't that long ago that the Schuylkill River was choked with pollution from coal operations upstream. Now it is a major source of drinking water and recreational opportunities for much of the county. As industry continues to clean up its act, better water quality rests with the everyday decisions that county residents make. Even something like lawn fertilizer - when multiplied across all the lawns in the county - impacts local water quality. Improved water quality is important not only for local recreational opportunities and drinking water – but for wildlife habitat and quality of life as well.

The Schuylkill River, once a polluted waterway, now flourishes with active recreation activities and aquatic wildlife.

Maintaining local water quality is a very important part of planning for the county's future and anticipated growth. This chapter will look at the state of water quality today, as well as make recommendations for tools and implementation strategies that will help improve water quality in the future.

Existing Conditions

Local water quality, in large part, is tied to the land use decisions that go on every day in Montgomery County. Anything from agricultural practices to new home construction can have a marked effect on increasing amounts of impervious surfaces, stormwater runoff and infiltration, and groundwater recharge. The sediment pollution that can result from land use changes is the most significant water quality impairment that the county faces.

Trash and debris can negatively impact local water quality, as is the case for this stream.

In general, the impacts of new development on water quality include:

- Increased nutrient loads, leading to excessive algal growth,
- Bacteria contamination during both dry and wet weather,
- Higher concentrations of metals, hydrocarbons, and other toxic pollutants, and
- Frequent trash and debris that jam sewers and local waterways.

Although Montgomery County's water supply is generally of high quality, there are some problem spots in the county's groundwater and surface water supply. What follows is a summary of current water quality issues in the county.

Surface Water Quality

Streams

Water quality standards are established for each stream in the county based on, in part, aquatic life habitat, human health requirements, and recreation use. Threshold chemical and biological characteristics and other stream conditions are required to be maintained for each water quality designation. The state has an ongoing process to assess water quality by identifying streams that do not meet these standards as "impaired." Figure 9 lists impaired streams on the state's 303(d) list – streams that are somewhat compromised by pollution but do not yet require a formal remediation strategy.

Protected use categories for streams include aquatic life, water supply, recreation, and special protection. The criteria for water quality under each category vary; streams are designated in one of several subcategories. Streams with a designation of WWF (Warm Water Fishes) are able to support fish species, flora, and fauna that are indigenous to a warm-water habitat. Similarly, streams designated CWF (Cold Water Fishes) support life found in and around a cold-water habitat. Streams that are designated TSF (Trout Stocking Fishes) are higher quality streams that support stocked trout, as well as other wildlife and plant life that are indigenous to a cold-water habitat. Migratory fish (MF) streams are protected for the passage and propagation of fish that ascend to flowing waters to complete their life cycle. Streams designated as special protection waters with an EV (Exceptional Value) or an HQ (High Quality) designation are of the best quality.

These designations are given to a stream or watershed that constitutes an outstanding national, state, regional, or local resource. Valley Creek is the county's only exceptional value stream; Unami Creek has been named a high quality waterway. An HQ stream's mandated water quality levels can be lowered only if 1) discharge is from necessary social or economic development, 2) all water quality criteria are met, and 3) all existing uses of the stream are protected. EV waters are to be protected at their existing high quality; water quality levels cannot be lowered.

Unfortunately, not all streams in Montgomery County are in pristine condition. Several county streams have final or draft Total Maximum Daily Load (TMDL) restrictions, including (but not limited to) Neshaminy Creek and Glanraffan Creek. In accordance with the federal Clean Water Act, TMDL restrictions are imposed on waterways that do not meet water quality standards. A TMDL establishes the maximum amount of a pollutant that a body of water can assimilate and still meet water quality standards - as well as distributes the pollutant load among contributors.

The state also has fish consumption advisories that it places on waterways throughout the state, so that residents do not eat too much fish that may be contaminated with pollutants. In Montgomery County, the only body of water with consumption advisories for 2004 is the Schuylkill River (this data changes annually). Additionally, in 2001, the state issued a general advisory that no more than one meal (or one-half pound) per week of sport-caught fish should be eaten from the state's waterways – this is to protect against eating fish that may not have been tested for contaminants or fish that may contain unidentified contaminants. For more information, contact the Pennsylvania Fish and Boat Commission.

Figure 9
STREAMS IMPAIRED BY POLLUTION
(but do not require a TMDL)

East Branch Perkiomen Creek
Mill Creek
Skippack Creek
Swamp Creek
Towamencin Creek
Unami Creek
West Branch Skippack Creek
Diamond Run
Gulley Run
Gulph Creek
Indian Creek
Mill Creek
Plymouth Creek
Schuylkill River
Sawmill Run
Stony Creek
Trout Creek
Many of these waterways are listed because of urban and suburban runoff, flow variations, removal of vegetation, or storm sewer problems. Only portions of these streams have water quality problems, and were assessed for their ability to support aquatic life.

Source: Pennsylvania Code, Title 25, Chapter 93.
Data from the Pennsylvania DEP 303(d) list.

Rivers

Montgomery County is an active participant in the Pennsylvania Rivers Conservation Program. The Rivers Conservation Program was developed to conserve and enhance river resources through the preparation and accomplishment of locally initiated plans. The program provides technical and financial assistance to municipalities and river support groups to carry out planning, implementation, acquisition and development activities. An established registry recognizes local river conservation efforts.

Source Water Assessments and Water Quality Reports

The 1996 Safe Drinking Water Act reauthorization requires states to develop a Source Water Assessment and Protection (SWAP) program. The SWAP program assesses drinking water sources serving public water systems for their susceptibility to pollution – in Pennsylvania, about 14,000 permanent drinking water sources were assessed in the two year review period ending in June 2003. In addition, water providers release annual Consumer Confidence Reports that summarize water quality testing results for the previous year. These two sources of information provide a good summary on local water quality issues.

There are several common contaminants found in the drinking water, composed of both surface and groundwater, in major metropolitan areas, including:

- Coliform bacteria: These are microorganisms whose presence may indicate that disease-causing organisms are in the water; fecal coliform and E.coli are a subset of this category,
- Arsenic: a known human carcinogen,
- Lead: can cause permanent brain or kidney damage, as well as developmental problems in children – it enters the water supply through corroding pipes or faucets, and
- Haloacetic acids and trihalomethanes: both are by-products of chlorine disinfection and are possible cancer-causing agents.

Green Lane Reservoir, in Upper Hanover Township, supplies drinking water to the Philadelphia Suburban Water Company.

There are several watershed conservation plans specific to Montgomery County that follow up on initial river planning efforts. The Wissahickon Creek Watershed Conservation Plan covers the entire Wissahickon Creek, including Sandy Run Creek. This plan, sponsored by the Fairmount Park Commission and MCPC, focuses primarily upon the integration of best management practices for stormwater control. The Tookany Creek Watershed Conservation Plan is another DCNR watershed conservation plan, covering Abington and Cheltenham Townships and Jenkintown Borough in Montgomery County. The plan is being administered by Cheltenham Township. Other conservation plans are underway for the Lower Perkiomen Watershed, the Upper Perkiomen Watershed, and the Unami Creek. In addition, several rivers in the county (and their associated watersheds) are part of the Pennsylvania Department of Conservation and Natural Resources' River Conservation Planning Program. The Neshaminy and Wissahickon Creeks are part of this program.

Lakes and Ponds

Lakes and ponds are an important part of Montgomery County life. They provide recreation areas for swimming and fishing, drinking water for local residents, as well as water for various industrial and agricultural operations around the county.

Green Lane Reservoir is in the northwestern part of Montgomery County and covers 818 acres; it also supplies water to the Philadelphia Suburban Water Company. Major land uses in the watershed surrounding the lake are a mix of agriculture and forest. The reservoir is severely eutrophic – meaning that high concentrations of nutrients in the water cause frequent blue-green algal blooms. Algal blooms tend to cause low dissolved oxygen concentrations in the bottom waters in the summer and early fall. This significantly impacts the lake's recreational uses, such as fishing or boating. These algal blooms also create an unpleasant odor, making these recreational uses unappealing. Green Lane Reservoir currently has a TMDL; it dates back to 1996, with the goal of reducing total phosphorus loadings so that chlorophyll-a levels stay at or below 20 micrograms/liter (ug/l) as a seasonal average.

Deep Creek Lake comprises 38 acres and is just south of Green Lane Reservoir. The land in the watershed surrounding the lake is primarily forested. Historically, Deep Creek Lake has had problems

with excessive macrophyte (aquatic plant) growth. It also suffers from excessive sedimentation, causing the lake to become shallower and less amenable for fish. In turn, this creates more habitats suitable for aquatic plant life. To tackle this issue, the county dredged Deep Creek Lake in 1996 and extracted 70,860 cubic yards of sediment. Deep Creek Lake also has had problems with high fecal coliform bacteria levels due to large populations of Canada geese and other watershed activities, and as a result, the lake permanently closed to swimming in 2000.

The *Green Lane Reservoir and Deep Creek Lake: Water Quality Management Study,* prepared in 1998, goes into more detail on these lakes' water quality and pollution problems.

Knight Lake, located between Deep Creek Lake and Green Lane Reservoir, suffers from many of the same water quality problems.

Ponds are also an important part of the county's water supply. In addition to adding to the aesthetic qualities of the area, ponds provide watering areas for livestock and habitat for migrating birds. Smaller ponds frequently get filled in for the sake of new development – preserving ponds for future use and enjoyment should remain among the county's water quality priorities.

Deep Creek Lake has, in recent years, been closed to swimmers due to high levels of fecal coliform bacteria.

Groundwater Quality

Montgomery County's groundwater not only supplies residents with drinking water, but also supplies county-wide industrial uses and makes up a large part of the flow of above ground streams. In fact, groundwater supplies nearly 70 percent of the state's water resources. In rural areas, most residents depend entirely upon groundwater for their water needs. Groundwater, to be more precise, is the water that isn't absorbed by plant roots that settles into the spaces between soil particles and rocks. Groundwater supply is recharged when precipitation is able to infiltrate through the top layers of soil into these cracks and spaces – but the rate of infiltration and the amount of water that seeps into the ground depends upon what covers the soil's surface, soil composition, local vegetation, the soil's moisture content, and the time of year.

Groundwater contamination usually can be traced back to human activities above ground. While a pollutant may infiltrate groundwater supplies at a single location, contaminated water may spread underground in a plume, affecting numerous uses over a larger geographic area. And although some

natural processes like soil filtration or dilution in an aquifer can lessen the effects of groundwater contamination, serious problems will warrant engineered cleanups.

Two current high-profile groundwater quality problems affecting Montgomery County are contamination by TCE or MTBE. TCE, or trichloroethylene, is commonly used as a metal degreaser and can be found in metal-refinishing plants or garages. It can cause health problems when ingested or inhaled, and has been linked with liver, kidney, and lung cancer with prolonged exposure. Several locations throughout the county have some levels of TCE contamination. In addition, the majority of Superfund sites in the county have TCE groundwater contamination. A list of local Superfund sites is in Appendix B.

MTBE, or methyl tertiary-butyl ether, is a chemical compound that is almost exclusively used as an additive in gasoline. MTBE has been used since the late 1970s in place of lead as an octane enhancer – it helps prevent the engine from "knocking." MTBE can leak into groundwater sources whenever fuel is transported or wherever gasoline is stored. For example, in early 2004 a leak at a gas station in Hatfield spilled 1,200 gallons of gas from an underground storage tank. The North Penn Water Authority measured elevated levels of MTBE in one of its nearby wells, but none of the readings were above the health threshold of 5 parts per billion.

Neighboring Counties

Montgomery County's neighbors have been busy protecting their own water resources. This should be of importance to any county resident since the region's water resources and water quality are interconnected. What happens upstream of Montgomery County – good and bad – can eventually find its way here. Chester County, for example, published a comprehensive water resources planning guide called *Watersheds* in 2002. It outlines priorities for Chester County and serves as its Rivers Conservation Plan under the Keystone Rivers Conservation Program. It covers water quality issues as well as implementation strategies for the county and its municipalities. The Philadelphia Water Department (PWD) has also been increasingly involved in the region's water quality work. Since Philadelphia lies at the mouth of the Schuylkill River, the effects of urbanization as well as water

quality of the entire watershed impacts Philadelphia's drinking water supply. The PWD has recently completed source water assessment studies for intake points along the Schuylkill River – this process identifies potential or existing sources of contamination, evaluates the potential impact on the water supply, and then determines priorities for protecting the water supply. Source water protection issues for the PWD include pathogens, algal blooms and excess nutrients, pesticides/herbicides, and high levels of chloride or sodium.

Causes of Water Contamination

Water contamination can generally be broken into two categories: point source pollution and nonpoint source pollution. Nonpoint source pollution comes from many diffuse sources, making its exact origin difficult to determine. Typically, this pollution is caused by rain or melting snow moving over or through the ground. This runoff carries with it the pollutants that settle on roadways or in the soil, with our local streams, wetlands, or lakes as its final destination. On the other hand, point source pollution can be traced to a definite starting place, such as municipal and industrial facilities, bypasses and overflows from municipal sewage systems, or illegal dischargers. And while not all runoff is polluted, the runoff that is polluted is a major source of water contamination. Below are some of the more common causes of water contamination in Montgomery County:

- **Point Discharge from Sewers and Industrial Sources:** While most point discharge from sewers and local industries is controlled through state permitting and treated before release, some amount of discharge does slip through the cracks. Untreated or poorly treated discharge can contaminate local waterways as well as impair the health of local aquatic life. Even wastewater treated under permit conditions does add nutrients and other dangerous wastes to the receiving stream. Smaller retailers, like dry cleaners or gas stations, can also contribute to local pollution problems if their waste is improperly handled.

- **Point Runoff from Land Disturbances:** Construction sites are the major source of sediment pollution. As dirt gets moved around and trees are removed for new development,

Construction sites, if not managed well, can be major contributors to polluted stormwater runoff.

severe sediment erosion can occur. Runoff from construction sites also carries other chemical pollutants from the heavy machinery used on-site. As many areas of Montgomery County inch toward being built out, properties with steep slopes, floodplains, and other environmentally sensitive areas are more frequently affected by construction activities.

- **Nonpoint Runoff from Impervious Surfaces:** Roads, parking lots, and other impervious paved surfaces are major contributors to local water pollution. Approximately 65 percent of runoff from impervious surfaces comes from transportation related sources; the other 35 percent comes from structures like houses, office buildings, or patios. Water quality degradation begins to be a problem for local waterways when the surrounding environment approaches 10 to 20 percent imperviousness – a figure that most suburban areas easily reach.

  Contaminants from vehicles or local highway construction are deposited on the pavement and wash off these surfaces whenever it rains or snows. As this water drains away, dirt, rubber and metal deposits from tires, antifreeze, engine oil, and litter are carried into local waterways. Highway road salt can also harm local water quality, from both storage areas near aquifers and from applications on local roadways.

- **Nonpoint Runoff from Agricultural Operations:** While farming is an important part of Montgomery County's economy, poorly managed agricultural activities can adversely affect local water quality. Nonpoint runoff from farming is one of the top sources of contamination to rivers, lakes, and groundwater supply. Activities that can cause nonpoint pollution include grazing, plowing, pesticide application, fertilizing, and confined animal facilities with large amounts of manure. The 1997 Agricultural Census reported a total of 462 farms and 41,552 acres of agricultural land in the county – and the potential for a lot of runoff.

- **Nonpoint Runoff from Golf Courses, Lawns, and Playing Fields:** Similar pollution problems occur from the runoff that comes off of golf courses and other grassy areas. Fertilizers and pesticides meant for residential use may be

The large amounts of fertilizer used to keep the county's golf courses green can also lead to local water pollution problems.

applied incorrectly or at the wrong time of year. Any excess from any of these uses can easily wash off into local waterways or infiltrate into groundwater supplies. Montgomery County currently has at least 56 golf courses.

- **Nonpoint Runoff from Wild and Domesticated Animals:** Deep Creek Lake's swimming area in Green Lane Park was closed as a result of elevated fecal coliform levels caused by migratory waterfowl. Pets that are not picked up after or huge flocks of geese can also increase nutrient loads (especially nitrogen) in local waterways, compromising the health of aquatic life.

- **Nonpoint Runoff from Malfunctioning On-Lot Sewage Systems:** Failing on-lot sewage systems can contaminate local groundwater supplies. The Pennsylvania Department of Environmental Protection estimates that 35 percent of on-lot sewage systems malfunction and pollute nearby groundwater – the result of mistakes during installation or improper maintenance. The *Community Facilities Plan* addresses failing septic systems in more detail.

- **Seepage From Old Dumps and Landfills:** The federal government enacted the Resource Conservation and Recovery Act in the mid-1970s, which required that new landfills be lined when built and capped when full. But older landfills and dumps prior to that time operated without those safeguards. Illegal dumping is also of concern, since its hidden nature makes it difficult to effectively monitor and prevent.

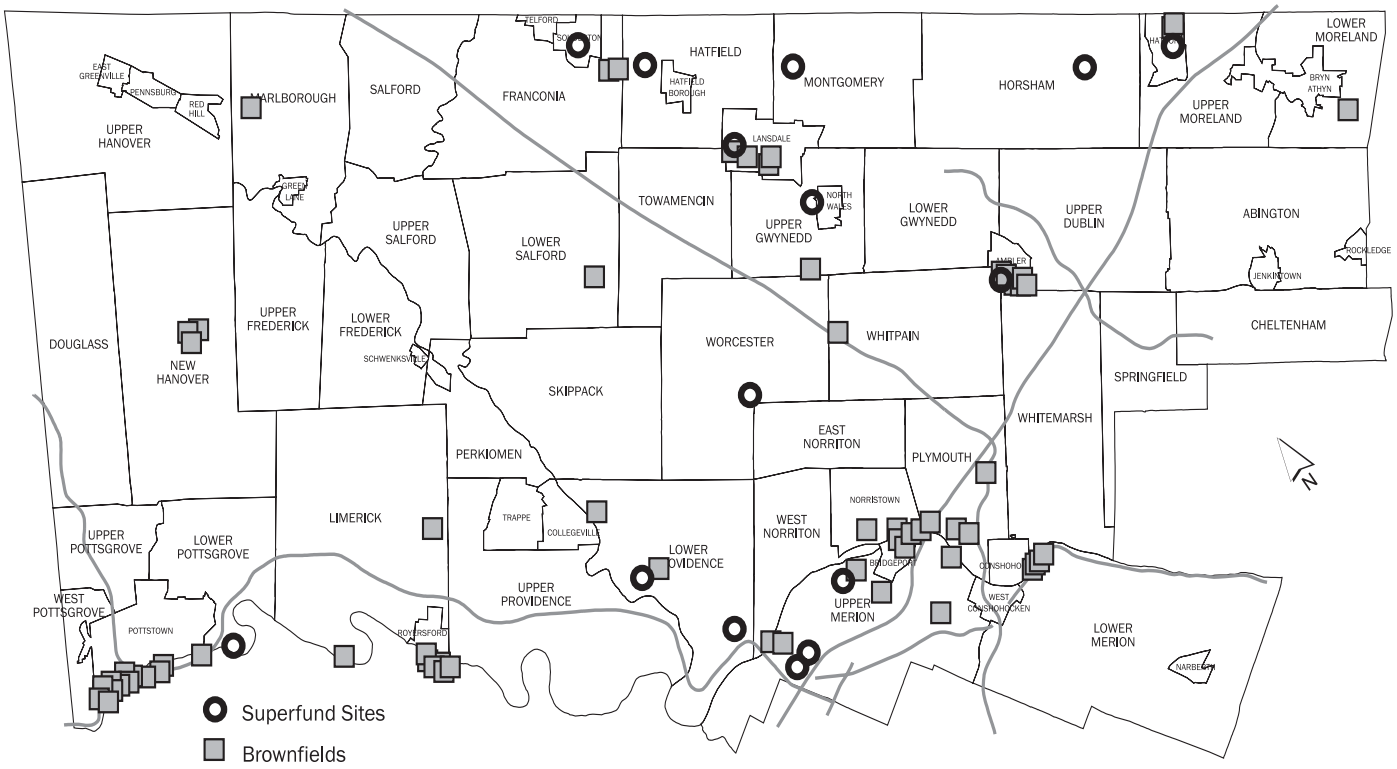
- **Erosion of Streambanks:** When streambanks are lost to erosion, it can have several negative effects on the local ecosystem. Deposition of soil downstream causes problems on productive land as well as sedimentation in reservoirs. Due to high sediment loads, local waterways will have decreased water quality as well as a loss of native aquatic habitats.

- **Superfund Sites and Brownfields:** Superfund was started in 1980 with the passage of the Comprehensive Environmental Response, Compensation, and Liability Act. The sites that fall under this law rank among the nation's worst polluted, and are placed on a "priority list" by the

Large flocks of waterfowl can increase nutrient loads in local waterways.

United States Environmental Protection Agency to be cleaned up. Brownfields cover a much larger category of sites that are abandoned, idle or under-used industrial, commercial or residential facilities where use, expansion, or redevelop-

Figure 10
Superfund and Major Brownfield Sites



Sources: Montgomery County Brownfields Inventory and U.S. E.P.A.

ment is complicated or prevented by real or perceived environmental contamination. These sites, if not properly remediated, can contaminate local groundwater supplies. Montgomery County currently has 15 sites on the Superfund list, as shown in Figure 10.

Figure 11
Reported Leaky Underground Storage Tanks - Montgomery County

Number of Incidents	Year
31	2004 *(Jan. - June)*
48	2003
45	2002
36	2001

Montgomery County has a number of leaking underground tank incidents every year, frequently at gas stations.

Source: Pennsylvania DEP.

- USTs: USTs are "underground storage tanks" – and are more problematic when they are LUSTs, or "leaky underground storage tanks." Montgomery County has 669 underground tanks that are tracked by the Pennsylvania Department of Environmental Protection. Leaking tanks can potentially contaminate local soils and drinking water supplies. USTs leak for a variety of reasons: some are made of steel and rust over time, and others are installed or maintained improperly. Potential contaminants from leaking tanks include hydrocarbons, solvents, and other organic chemicals. State and federal laws

require that leaking tank sites must be cleaned up to restore groundwater quality and create a safe environment for people who live or work around these sites. Leaks and spills can certainly occur in other ways; for example, spills from fuel tanker trucks, other trucks transporting goods through the county, or transmission pipelines may also leak pollutants into the groundwater supply.

Water Quality Plan

Since Montgomery County will continue to experience population growth and development pressure, it will be important to consider the demands that will also be placed on local water quality.

Point Source Pollution

Point source pollution, for the most part, comes from the millions of gallons of wastewater discharged from the pipes of industrial facilities and municipal sewage treatment plants into local waterways. Wastewater sources include domestic wastewater inflow and infiltration—where stormwater and groundwater get into the wastewater collection system—commercial operations such as restaurants, food processing facilities such as meat processors, agricultural operations, and industrial facilities.

Most new large-scale residential and nonresidential developments connect to public sewers or use centralized sewage treatment facilities to dispose of sewage. Therefore, providing adequate public sewage service in areas designated for growth can direct growth away from environmentally sensitive areas. At the same time, extending sewer service to rural or low-density areas may encourage unwanted or haphazard growth. In addition, recent developments in individual sewage systems have made soil constraints less significant. While cost is still a limiting factor, technologically almost any site can be provided with some type of sewage treatment facility. Nevertheless, the availability of sewage capacity continues to play an important role in determining the type, pace, and intensity of development.

To get a better sense of the impact of future growth in this county, the existing and future sewage capacity was determined in each of the county's 12 regions. Only one area – the Central

Sand mounds are just one of many kinds of alternative methods for sewage disposal in the county.

Perkiomen Valley Region – does not currently have the capacity to meet the projected sewer demand for 2025. However, the Lower Perkiomen Valley Regional Sewer Authority and the Montgomery County Sewer Authority have begun planning a plant extension that should meet projected capacity to 2020. While public sewer systems are under control, on-lot septic systems are still an issue in the county. There are approximately 50 areas in the county that have problems with on-lot septic systems. These problem areas increase the potential for point source pollution.

There are alternatives for sewage treatment for standard residential or nonresidential developments taking place in rural or low-density areas. These include, in priority order:

- On-lot systems with subsurface disposal,
- Individual Residential Spray Irrigation Systems (IRSIS),
- Community lagoons,
- Community sand mound,
- Mechanical treatment systems, and
- Individual low flow treatment systems with stream discharge.

Additional discharges from areas that are experiencing growth will have to be carefully monitored. New discharge locations should be carefully chosen so as not to overload streams that carry high amounts of other discharge or suffer from low-flow problems. Additionally, new discharges should be routed away from environmentally sensitive areas.

During large storm events, treatment plants can be overwhelmed with the amount of water needing treatment, and may have to allow for overflows of untreated effluent (also known as combined sewer overflows). Lansdale, Norristown, and Bridgeport all have combined sewer systems that are subject to the U.S. Environmental Protection Agency's CSO Control Policy. Sewage carries excess nutrients such as nitrogen and phosphorus to streams, which can lead to increased nutrient levels, total solids, and water temperature.

Activities that take place at industrial facilities, such as material handling and storage, may have by-products that are exposed to stormwater. The runoff from these activities discharges industrial pollutants into nearby storm sewer systems and water bodies.

Even when faced with tightened water quality regulations and growth pressures, there are a number of best management practices that can be implemented in treatment plants or by local municipalities:

- Keep a watchful eye on septic tank failures. Some signs of failing septic tanks include sewage odors in the house or yard, household drains that back up or run too slowly, wet soil in the disposal field area, or well water that tests positive for coliform bacteria or high levels of nitrates.
- Work to eliminate combined sewer overflows (CSOs). CSOs typically are from older systems and convey sanitary sewage and stormwater at the same time. In the long term, areas that experience overflows should consider implementing low impact development techniques that would control stormwater pollution, as well as potentially separating the sewer lines or expanding treatment facilities.
- Coordinate efforts to achieve compliance with stream discharge limits and TMDLs.

More information on the county's sewage treatment facilities can be found in Chapter Two of the *Community Facilities Plan* as well as the *Montgomery County Sewage Facilities Plan of 1972.*

Nonpoint Source Pollution

Since nonpoint source pollution comes from many diffuse sources, its exact origin can be difficult to determine. Typical sources of nonpoint source pollution have been identified, making it possible for municipalities to work towards decreasing the levels of nonpoint source pollutants that enter local waterways. What follows are some ways municipalities can tackle this issue.

Using Stormwater Best Management Practices

Municipalities should use best management practices (BMPs) to control stormwater runoff – these techniques are covered in more detail in Chapter 5 – Stormwater Management.

Limiting The Effects of Land Disturbance

Municipalities should work with local nonprofit organizations, other nearby municipalities, and developers to provide education and demonstration

Reducing the amount of time that construction sites are cleared can cut back on soil erosion and sedimentation.

sites on erosion control practices for construction sites and urbanized areas.

- Reduce the area and length of time that a site is cleared and graded. Potential erosion can be reduced by designing the site layout to preserve as much undisturbed open space as possible and by phasing construction. This is especially important during later stages of construction when sediment runoff potential is greatest.
- Incorporate erosion and sediment control tools into local regulations; sediment inspectors can visit sites on a regular basis to ensure that any control plans are being followed.
- Restrict the amount of vegetation that can be cleared for construction, while protecting existing trees and landscaping.
- Install berms and buffer strips to slow sedimentation. Installing a grass or mulch cover on cleared or graded areas can reduce suspended sediment levels downstream by six-fold.
- Support landowners who plant vegetative buffer strips along streams, lakes, private ditches, and around surface tile intakes. This can be done on a lot-by-lot basis.
- Encourage wetland restoration and preservation.

Native ground cover can be a low-maintenance and drought tolerant way to replace lawns.

Cutting Down on Runoff

For areas without existing stormwater control facilities, BMPs can go a long way towards improving water quality. Especially effective are backyard BMPs, which can be used on small lots by individual homeowners or renters. Individuals can:

- Limit the amount of impervious surface around homes. Permeable paving materials, like bricks in sand or concrete lattice, will allow for groundwater recharge. Runoff can easily be redirected from drain pipes to rain gardens, rain barrels, and vegetated swales.
- Allow vegetated buffers to grow alongside local streams to filter out pollutants and slow any runoff. Many municipalities in Montgomery County have regulations that require this.
- Consider replacing lawns with native ground cover. Trees, shrubs, and other groundcover absorb up to fourteen times more rainwater than a grass lawn.

- Use natural alternatives to chemical fertilizers and pesticides. If you must use them, test your soil to determine the appropriate amount.
- Control the amount and location of fertilizer, herbicide and pesticide applications.

Keeping Golf Courses and Playing Fields Green

Golf courses and other recreation areas, while providing excellent leisure opportunities and preserving significant amounts of open space in the county, create potential environmental problems as well. Maintaining these green spaces requires the application of fertilizers, pesticides, and herbicides, as well as a huge amount of water. In order to minimize these potential effects, the following practices are suggested:

- Some environmentally restrictive areas, such as wetlands, sensitive waterways, and areas with threatened or endangered species, may need to be removed from lists of potential areas to develop. Buffer areas should be kept around high quality or sensitive waterways.
- Effluent irrigation should be considered if economically and environmentally feasible.
- For areas of golf courses that are not in play, native and/or naturalized vegetation should be used. Areas that are in play should be planted with suitable turf grasses.
- Stormwater retention areas and water reuse strategies should be incorporated into the site's design.
- Strategies that control sediment or topsoil loss, minimize disruption to local wildlife, and lessen any effects on water resources should be implemented during construction.

Stormwater retention areas and other management techniques can be incorporated into the design of new grassy recreational areas.

Protecting Riparian Corridors

Eroded streambanks should be stabilized. Priorities for streambank restoration should be based on soil erodibility, vegetative cover, and amount of urbanization in the watershed. The Montgomery County Conservation District should continue to implement the state's program on erosion and sediment control.

Riparian corridors play an important role in reducing streambank erosion and preserving water

Riparian corridor protection and enhancement are important parts of improved water quality in the county.

quality – these corridors generally consist of the vegetation that grows alongside a river, stream, or some other body of water. But this vegetation can easily disappear if development takes place too close to a streambank or if farm fields overstep their proper boundaries. Riparian corridors provide important benefits to stream corridors; they:

- Provide wildlife habitat and woody debris to the stream ecosystem,
- Protect the streambank from erosion,
- Filter sediment, and therefore pollutants, from runoff entering the stream,
- Provide a storage area for floodwaters,
- Preserve open space and aesthetic surroundings, and
- Shade and cool local waterways.

Although some municipalities in the county have riparian corridor ordinances that limit the development that can take place along local waterways, more municipalities could do the same. The buffers that these ordinances require may range from 25 to 300 feet. In order to maximize the benefits of riparian corridor protection, the following principles should be adhered to:

- Forested riparian corridors should be maintained, and reforestation should be encouraged where there are no wooded buffers. This is important for removing nutrients from the soil, stabilizing the soil, modifying water temperature, and providing food for aquatic life.
- The riparian corridor should be uninterrupted. This helps reduce concentrated flow from entering the stream and provide continuous habitat for the passage of animals.
- Riparian corridors should extend at least 75 feet from the edge of the stream for optimal performance. The 75 feet should include several distinct zones that perform specific functions. Ideally, the first zone should consist of undisturbed forest to provide shade for the stream. The second zone should consist of managed woodland that allows for infiltration of runoff, filtration of sediments and nutrients, and nutrient uptake by plants. Finally, flow into the buffer should be transformed from concentrated flow into sheet flow to maximize ground contact with runoff.

- Recreation within the riparian corridor should be balanced with the impact it may have upon existing natural features. For example, physical invasion of a riparian corridor may be limited when it contains plant or animal species of concern or steep slopes that significantly impact adjacent landowners.
- Development within the riparian corridor should be limited to structural facilities that are absolutely necessary. Agricultural activities should be permitted within the riparian corridor provided they are conducted in conformance with recognized soil conservation practices. When construction activities occur within the riparian corridor, specific mitigation measures should be taken in the form of riparian corridor improvements.
- Generally, the riparian corridor should remain in its natural state. However, some maintenance is periodically necessary, such as minor landscaping to minimize concentrated flow and removal of exotic plant species.

The Montgomery County Planning Commission's *1996 Guidebook for Riparian Corridor Preservation,* along with the more recent *Stream Corridor Restoration Guidebook,* go into greater detail on the principles and practices of riparian corridor management. This model ordinance will likely be updated in the next couple of years.

Keeping Agricultural Runoff Under Control

Since agriculture is still a significant part of county life, conservation strategies should continue to be utilized on local farms. Major agricultural nonpoint source pollutants include nutrients (like nitrogen or phosphorous), salts, sediment, animal wastes, and pesticides. Certain farming activities result in soil erosion, which can pollute local waterways with agricultural chemicals as well as lead to threatened fish habitat or wetlands. There are many soil conservation practices that can be used in local rural or agricultural areas. These include:

- **Control sedimentation:** Municipalities can encourage farmers to enroll in farmland set aside programs that take erodible farmland out of production. Farmers can reduce erosion and sedimentation by between 20 and 90 percent by controlling the volume and flow of runoff water, keeping soil in place, and reducing soil transport.

Livestock, if not properly managed, can overgraze and contribute to increased erosion and compromised water quality.

- **Limit the use of pesticides:** Farmers can utilize Integrated Pest Management (IPM) techniques based on the specific soils, climate, or crop for a particular field – rather than blanket entire areas with a general pesticide or herbicide.
- **Promote improved grazing techniques:** Overgrazing livestock can lead to overexposed soils, increased erosion, non-native plant invasions, and compromised water quality. Farmers can limit grazing intensity, keep livestock out of sensitive areas, provide other sources of water or shade, and replant bare pastureland.
- **Support the expansion of organic farming activities:** Local residents and businesses can shop at local farmers markets or join a community supported farm, just two ways of supporting organic farms.
- **Contain confined animal facilities:** Although confining animals to lots is an efficient way of feeding or maintaining livestock, these areas can become problematic sources of animal waste (and local resident complaints) if not managed properly. Discharge can be limited by storing and managing wastewater and runoff with an appropriate waste management system.

Natural Features Protection Ordinances

Natural features protection ordinances preserve environmentally sensitive land that exists around local waterways, helping to preserve the quality of the county's streams and lakes. Many communities in Montgomery County have adopted a variety of these ordinances as part of their overall zoning. A few are described below.

- *Wetland ordinances* protect designated wetlands by prohibiting any disturbance for residential, commercial or industrial development. Some ordinances may require new wetlands to be constructed if protected wetlands are adversely affected. For example, Skippack Township's zoning ordinance requires a buffer of 25 feet from the edge of any wetland or floodplain. If the land around the wetlands has steep slopes, the size of the buffer is increased accordingly.
- *Steep slope ordinances* control new development as well as protect against serious erosion in areas with "steep" slopes. The definition of

steep varies by municipality; Upper Salford Township's ordinance defines "steep" as any gradient over 15 percent. Perkiomen Township's zoning ordinance, for example, differentiates between slopes from 15 – 25 percent and slopes over 25 percent. On slopes of 25% or more, only limited outdoor uses are permitted, such as wildlife or woodland preserves, game farms, and outdoor plant nurseries. On slopes of 15% to 25%, limited development is allowed as a conditional use.

- *Floodplain ordinances* typically prohibit any new development within a floodplain and may require existing structures to be elevated above a theoretical flood's impact if they are improved. Marlborough Township's Flood Plain Conservation District allows limited uses by right, such as sealed sewers, sealed public water supply wells, or pasture land, as long as they do not raise the 100-year flood level.
- *Woodland ordinances* aim to protect mature trees from being cut down during new development. Lower Salford Township's subdivision ordinance requires replacement of specimen trees and replacement of trees over 8 inches in width if more than 25% of these trees are removed from a site.

More information on natural features protection ordinances can be found in the county's *Land Use Plan* and *Open Space, Natural Features, and Cultural Resources Plan.*

Groundwater

Groundwater protection is needed in order to enhance the quality of life in Montgomery County. Contaminated groundwater may lead to public health concerns about possible toxins or pathogens that could be ingested by people. Contaminated groundwater can also result in increases in the infrastructure costs associated with piping and transporting supplies of clean water to affected communities. Montgomery County's natural resources could be affected by contaminated groundwater as well. Pollution discharge into wetland and aquatic environments could eventually lead to groundwater contamination as pollutants seep through the ground. A thoughtless act could easily destroy water quality and supplies for hundreds or thousands of people.

Protecting the land around wellheads helps to increase water quality in the county.

Wellhead Protection

Wellhead protection is another activity that aims to safeguard groundwater quality. The Pennsylvania Department of Environmental Protection has adopted wellhead protection regulations for new community systems or older wells that are expanding. A water supplier is obligated to show that it owns or controls all of the land immediately surrounding a well before a permit is issued. This allows activities that could adversely impact water quality to be prohibited in the vicinity of community wells; these regulations are implemented on a local level by the Montgomery County Health Department. Since wellhead areas do not necessarily follow jurisdictional boundaries, it is important for all parties involved to cooperate in setting up protected zones.

It is equally important to provide oversight to individual wells to control their location, construction, preservation, and repair. Individuals should test private well water supplies once a year for elevated nitrate and fecal coliform bacteria levels. If a problem is suspected, testing should occur more frequently, and could include testing for contaminants like radon or pesticides. Although some problems can be handled easily, more persistent contamination issues may require a new deeper well or a new source of potable water.

Steps can be taken to protect private well water supplies from contamination. For households that rely upon wells, contaminants should be kept away from sinkholes as well as the actual well. Additional steps include:

- Inspect exposed parts of the well for problems like cracked or corroded well casings, missing or broken well caps, or the settling and cracking of surface seals,
- Slope the area around the well to drain runoff away from the well,
- Avoid mixing or using pesticides, herbicides, fuels, and other pollutants around the well,
- Keep accurate records of any well maintenance,
- Do not dispose of wastes in a dry or abandoned well, and
- Pump and inspect septic systems as often as local authorities recommend.

Land Acquisition

The acquisition of land or development rights can protect groundwater recharge areas by protecting environmentally sensitive areas from future development. TDR programs allow landowners to sell their right to develop to developers who are building in a different part of the community. Developers buy the right to put up more homes than they would have been allowed otherwise. Landowners get money for and can keep the land, although they are no longer allowed to develop the land and must deed restrict it. Although TDRs are not being used in Montgomery County, they have successfully been used in Bucks, Chester, and Lancaster Counties. TDRs and other similar land preservation tools are explained in more detail in Chapter 5 of the *Land Use Plan.*

Conclusion

Although Montgomery County has an abundant supply of clean surface and groundwater, it will continue to be important for the county to monitor and protect its water sources. Water conservation, source protection, and pollution prevention should remain priorities for the county.

Chapter 4
Flooding

Floods are the most common natural hazards in Montgomery County. Flooding happens primarily along the Schuylkill River and the several major streams that run through the county.

Different weather patterns bring with them different types of flooding conditions. Quick, heavy summer storms may cause flash floods in small streams. Rainstorms covering a larger area that cause flooding in local rivers may take up to 24 hours after the storm event to crest. Regardless, as many as 2,500 homes, businesses, and other structures presently are located within the floodplain – and potentially within harm's way. The county is developing a natural hazard mitigation plan that evaluates floodplain management strategies and is used as a basis for this chapter.

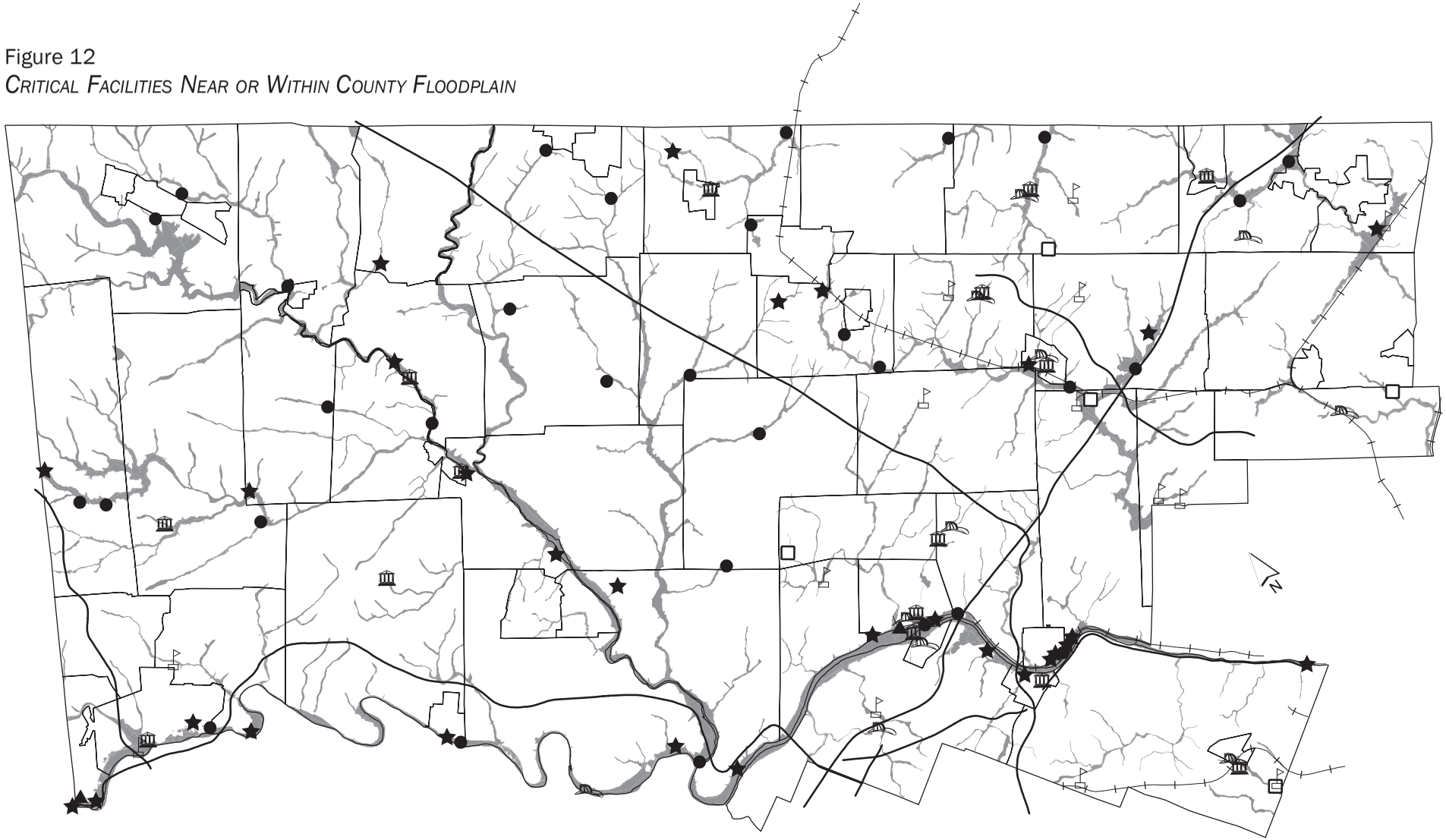
This chapter identifies the existing conditions in the county's flood prone areas and establishes a specific flood protection plan. The chapter begins with a look at these flood prone areas and the watersheds in which they are located.

Flooding is the most common emergency event in Montgomery County.

Existing Conditions

A flood is defined as a general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland waters or the unusual and rapid accumulation or runoff of surface waters from any source. A watercourse can overflow after a heavy rainfall because of the excess stormwater runoff created as a result of dense construction, impervious surfaces, overloaded stormwater management facilities, or water channel constrictions from debris and ice. When a river, creek, or stream overflows its banks, the area of surrounding low-lying land that is inundated with water is referred to as the floodplain. During flooded conditions, developments within the floodplain usually sustain some type of water damage unless they are flood proofed or elevated to a specified height. As is illustrated in Figure 12, some buildings within the floodplain, such as schools and hospitals, are considered critical facilities and could experience flood damage resulting in adverse conditions for any of the county's 62 communities. These facilities either have a particularly vulnerable population or provide

Figure 12
Critical Facilities Near or Within County Floodplain



Source: Montgomery County Public Information Map.

essential services that need to operate continuously. It is important to identify these critical facilities and establish protective measures against potential flooding.

There will always be some flooding in the county but the volume, velocity, and severity of damage from a flood can be reduced with preventive measures, regulations, and practices. Nearly all of the municipalities in the county have adopted a floodplain ordinance to control or prohibit development within the floodplain. The floodplain ordinance should conform to the Federal Emergency Management Agency (FEMA) specifications that allow homeowners in these municipalities to be eligible for federal flood insurance. Telford and Red Hill Boroughs have not adopted a floodplain ordinance because they contain no designated floodplains. Although floodplain ordinances can limit or prevent development, they do not solve the problem of preexisting development within a floodplain. Additionally, floodplain ordinances differ in each municipality. Some communities, such as West Norriton or Whitemarsh, allow flood proofed or elevated buildings and dwellings to be built in the flood fringe while others prohibit dwellings entirely. Most other communities allow some types of public and/or private recreational and utility uses, such as canoe liveries or boat launches in the floodplain. Remediation measures such as open space preservation, natural resource protection, stormwater management, drainage system maintenance, property acquisition (for vulnerable properties), structural projects and public information workshops can help to reduce property losses resulting from floods.

To get a better sense of which municipalities have a bigger flood risk, the total area of each watershed and the area of floodplain in each were calculated as shown in Figure 13. Approximately 7% of the county's total acreage lies within the floodplain. The Schuylkill River Basin watershed has the largest area of floodplain in the county, totaling 5,276 acres. That being said, the Schuylkill River is also the largest flowing waterway in Montgomery County, draining about 83% of the land area in the county. Municipalities along the Schuylkill River floodplain usually experience more damage than municipalities along the other floodplains due to the size, length, volume and velocity of the river during severe storms.

Figure 13
Montgomery County Watersheds

Watershed	Total Acres	Floodplain Acres	Floodway Acres
Swamp Creek	26,172	1,655	712
Manatawny Creek	3,459	204	100
Upper Perkiomen Creek	31,508	2,933	833
Ridge Valley Creek	7,494	405	141
East Branch Perkiomen Creek	14,628	989	496
Skippack Creek	35,639	1,688	453
Perkiomen Creek	23,950	1,859	792
Schuylkill River	52,489	5,276	2,201
Lower Merion Drainage Area	12,976	586	286
Cobbs Creek	2,644	144	0
Stony Creek	16,224	674	113
Neshaminy Creek	8,488	393	161
Little Neshaminy Creek	12,406	692	143
Wissahickon Creek	25,853	1,802	524
Sandy Run	8,014	733	277
Pennypack Creek	20,185	1,341	601
Tookany Creek	9,041	384	84
Poquessing Creek	541	7	0
	311,711	**21,765**	**7,917**

Source: FEMA designated floodplains.

Figure 14
A 30-Year Overview of Major Montgomery County Flooding

September 1971	Severe Regional Storm
June 1972	Hurricane Agnes
July 1973	Severe Regional Storm
December 1973	Severe Regional Storm
January 1979	Severe Regional Storm
June 1996	Summer Storm
September 1999	Hurricane Floyd
June 2001	Tropical Storm Allison
August 2001	Summer Storm
August 2004	Summer Storm
September 2004	Tropical Depression Ivan

Source: Pennsylvania Emergency Declarations Involving Montgomery County.

While some parts of the county flood more than others, all municipalities have been affected by flooding at some point over the last 30 years. Certain areas are still at risk for floods today whereas others may have taken preventive measures to minimize potential impacts. Figure 14 presents an abbreviated thirty-year history of flood related state disaster declarations affecting Montgomery County. Of course, smaller flooding events that caused significant localized damage have taken place between these years. The eastern portion of the county has the majority of the county's older undersized stormwater drainage systems, undersized culverts, and narrow railroad embankments that form constriction points along streams – and problems with any of these could and do lead to flooding. An example of this is in Whitemarsh Township. SEPTA's R-5 regional rail line crosses over a tributary of the Sandy Run Creek that until recently, formed a constriction point due to the undersized culvert. To alleviate this problem, the culvert was enlarged when the original bridge was damaged in a flood. Since the

new bridge is larger, the bridge causes less water backup, resulting in less flooding upstream.

Regular maintenance such as stream cleanups, stormwater drainage inlet maintenance, and frequent street cleaning and trash removal are all measures that can prevent constriction points and minimize flooding.

Flood Protection Plan

Shielding the county and its residents from future flooding is a priority in this *Water Resources Plan*. Even a fleeting summer storm can bring with it thousands of dollars in flooding damage. Although floods are unavoidable, planning ahead for flooding can lessen the effects of both hazardous situations and potential damage.

Emergency Services

Emergency response systems are crucial to having a comprehensive plan of action in the event of a flood emergency. Montgomery County is in the process of developing a wide-ranging emergency response plan; flooding will be an important component since it is the most common emergency event in this region.

A flood warning system consists of converting flood forecasts issued by the National Weather Service into timely flood warning and evacuation notices prior to the actual flooding event. Components of this system include emergency communications, flood stage forecast mapping, flood warnings, and emergency plans. The primary responsibility of flood warning and evacuation lies with the state, county, and local offices of emergency management. Emergency managers maintain an emergency communications network and work with the tools available to them for flood response. Flood stage forecast mapping, floodplain structure reviews and evacuation plans, in addition to the education of community officials, are needed to improve flood warning and evacuation efficiency. News reports from radio and television provide a valuable communication link in this work. The National Weather Service and the U.S. Army Corps of Engineers provide assistance to communities to develop flood warning systems and response plans.

The Delaware River Basin Commission (DRBC) is working with the U.S. Geological Survey (USGS) and the National Weather Service (NWS) to

upgrade the flood warning system within the Delaware River Basin, which includes all of Montgomery County. DRBC's Flood Advisory Committee recently identified two categories of flood warning deficiencies within the basin. The first category focuses on immediate equipment deficiencies. The second category includes general needs related to monitoring, modernized technology, and improved public outreach. The goals of a flood warning program will be to upgrade the precipitation and stream gauging network, complete flood stage forecast mapping, and increase public understanding of flood preparedness.

The flood warning network is effective in predicting flooding within larger streams and rivers where the flood peaks take longer to develop. For most of the smaller creeks in the county, flood warning is difficult since the streams are subject to flash floods that can occur in minutes with little advance warning.

The county should continue to work with the USGS, NWS, and the DRBC in the development and deployment of a more effective flood warning system. The county should participate in meetings and training sessions of the DRBC's Flood Advisory Committee. The county emergency management officials and local emergency personnel should continue training in flood monitoring. If funding becomes available, the county should consider reestablishing a flow monitoring station along the Pennypack Creek.

Preventative Activities

Taking a proactive stance on flooding is perhaps one of the best things a municipality can do to prevent major future damage from taking place. Even something as simple as clearing trash away from sewer outlets can make a big difference. What follows are some tools that municipalities can use to their advantage when preparing for floods down the road.

Building Code Development and Enforcement

Each municipality in the county has adopted some form of the Building Officials and Code Administrators International, Inc. (BOCA) Basic National Building Code. Under Act 45, the Uniform Construction Code, municipalities will have to either adopt and implement state building code standards or have building codes in place that are at least as stringent as the International Building Code of 2000. Municipal code staff should continue to enforce adopted building codes to ensure that new

construction does not take place in the floodplain, except for flood-proofed buildings in redeveloping areas. Code officers should uniformly enforce requirements that buildings substantially destroyed by floods or other occurrences are rebuilt in accordance with flood proofing standards.

Drainage System Maintenance

Local storm drains should be maintained periodically. The removal of debris from inlets, storm sewers, bridge culverts, and drainage channels is important to ensure sufficient capacity in stormwater systems. Outlet structures in impoundment basins should periodically be inspected and cleaned. During recent storms in the county, some flooding incidents were directly attributed to clogged inlet structures. In addition, keeping storm drains clear of trash will assist municipal governments in complying with the Phase II NPDES requirements to maintain water quality in their stormwater drainage system.

Storm drains should be maintained periodically to ensure proper functioning - clogged drains have been attributed to flood events in the past.

Stormwater Management

Stormwater management involves the control of runoff as close as possible to its point of origin. Act 167, the Pennsylvania Stormwater Management Act, was passed in 1978 and requires the county to prepare stormwater management plans for the county's 17 designated watersheds. Stormwater management techniques are covered in more detail in Chapter 5 of this *Water Resources Plan*.

Redeveloping Areas

Many parts of the county developed before stormwater management controls became a mandatory part of new construction. As a result, some of the older areas of the county have more frequent flood events. Municipalities should require areas that are being redeveloped to add proper stormwater management devices for pre-existing development. This can be done through a freestanding ordinance outside of municipal zoning and subdivision ordinances. Upper Merion, for example, has developed this type of ordinance.

Constriction Points

Similarly, constriction points at older railroad and automobile bridges can lead to localized flooding; problem spots should be considered as areas for rebuilding or rerouting if feasible. In Fort Washington, a bridge constriction point made for frequent localized flooding; reconstructing this bridge has alleviated this problem.

Constriction points created by older railroad or automobile bridges can cause local flooding.

Property Protection

Both private property owners and municipalities should strive to protect their holdings as much as possible from flood damage. The strategies that follow can help municipalities working with property owners to prevent future flood damage.

Acquisition and Relocation

The purchase and removal of property is often times the only way to eliminate a flood hazard in developed watersheds. In the past, municipalities have obtained funds to purchase homes from homeowners willing to relocate. The homes are demolished and the ground is restored as a natural floodplain. In some cases, this land is used as public open space. The land may also be used to develop some type of flood control structure. Though at times very expensive, this approach is often the only way to completely eliminate an existing floodplain hazard.

Retrofitting

Structures can be retrofitted and flood proofed to reduce flood damage in the future. The most commonly used flood proofing technique is to raise a structure one foot above the 100-year flood elevation. While this can work in urbanized areas along watercourses with reliable flood elevation data, elevating is no guarantee against future flood loss. Changes in watershed characteristics or imprecise flood elevation estimates can result in flooded elevated structures. This occurred during Tropical Storm Allison to an elevated home at Old York and Warminster Roads in Upper Moreland Township. In addition, residential property owners with elevated structures still are vulnerable to property damage resulting from flooded vehicles and damage to various accessory structures in their yard. During floods, people in elevated structures may require evacuation. Other forms of flood proofing, such as sealing off openings, can be effective in protecting historic structures that can't be moved or structures that need to be located along waterways, such as recreation facilities.

Floodplain Management

The Pennsylvania Flood Plain Management Act, adopted in 1978 as Act 166, encourages proper management of floodplains throughout Pennsylvania. Every municipality with flood prone areas is required to participate in the Na-

tional Flood Insurance Program (NFIP). Municipalities do this by enacting floodplain management regulations that, at their very least, comply with minimum standards adopted by the Pennsylvania Department of Community and Economic Development (DCED). Currently all 60 municipalities in the county eligible under the National Flood Insurance Program have adopted the minimum floodplain management standards. Under Act 166, municipalities can adopt more restrictive floodplain management requirements.

Municipalities should strive to prohibit new development in floodplains, except for the development of elevated flood proofed buildings on brownfields sites in redevelopment areas that are part of economic revitalization initiatives. Municipalities should enforce provisions of their floodplain ordinances that address the rebuilding of substantially damaged structures within the floodplain.

Flood Insurance

Flood insurance does not prevent flood losses; instead, it changes how flood losses are reimbursed. The Federal Emergency Management Agency (FEMA), through private insurance companies and state assistance, operates the National Flood Insurance Program (NFIP). Through this program, any property owner, even those living outside of the 100-year floodplain, may purchase flood insurance on their structure and personal property. As mentioned earlier, an individual's community must first adopt a floodplain ordinance that conforms to FEMA specifications in order to be eligible.

More than 3,300 properties in the county have flood insurance policies in effect for a total of more than $475,800,000. Since 1978, over 2,500 insurance claims have been made for more than $48,500,000 in property losses. The largest total claims come from Lower Merion Township, West Norriton Township, Lower Moreland Township, Whitemarsh Township, and Bridgeport Borough.

The NFIP supports itself on the premiums paid by the policyholders. For owners of property within a 100-year floodplain, the NFIP is the only way they may purchase flood insurance. Property owners that have federal loans for buildings within the floodplain are generally required to carry floodplain insurance.

Over the years, FEMA has incorporated incentives for better floodplain management into the flood insurance program. For example, the Commu-

On average, only about 1 in 5 properties within the 100-year floodplains in Pennsylvania are covered by flood insurance.

nity Rating System offers discounts of up to 50% on flood insurance premiums if communities undertake a proactive flood loss reduction program. Actions include adopting stringent floodplain management regulations and developing floodplain management controls. No municipalities in Montgomery County qualify for a reduced rating.

Even with all of these incentives, on average only about 20% of the properties within the 100-year floodplains in Pennsylvania are covered by flood insurance. Properties within some of the most notoriously flooded areas of the county are without insurance coverage.

The county and municipalities should focus on urging the purchase and relocation of flood prone structures. Funding for relocation projects should be pursued vigorously from various federal and state emergency management funds. The county should also consider amendments to the Consolidated Plan (Housing and Community Development 5-year plan) to allow the use of Community Development Block Grant funding for floodplain housing relocation projects. Elevation and flood proofing should only be used for structures that need to be located in the floodplain for various reasons or involve the revitalization of brownfield sites in older communities. All existing properties in floodplains should be covered by flood insurance.

Flood Control Structures

The purpose of a flood control structure is to physically constrain or to convey floodwaters. Flood control structures include dams, levees, lined stream channels, and storm sewers. Dams and levees have been used for centuries to open floodplains to agriculture and settlement, and in the case of dams, to detain floodwaters for gradual release or for use for water supply, recreation, and the generation of hydroelectric-power. Dams and levees are highly effective in flood loss reduction.

Though effective, two drawbacks to the use of dams and levees are that they are very expensive and often require substantial land area. Additionally, local cost sharing requirements and environmental issues have slowed construction of new facilities in recent years. Flood control dams and levees are unnecessary where there is no floodplain development.

State or county sponsors generally maintain structures funded by the Natural Resources Con-

Dams have been used for centuries for irrigation and flood control.

servation Service (NRCS). In the early 1960s, Montgomery County participated in several NRCS (formerly SCS) projects in the Neshaminy, Wissahickon, and Perkiomen watersheds. The only project to be implemented in part was the Neshaminy basin project. Through that project, eight flood control basins were developed in central Bucks County. Two other basins, one in Bucks and the other in Montgomery County, were never developed.

No large flood control structures are proposed in the county at this time. Municipalities are encouraged to work with the US Army Corps of Engineers and the Pennsylvania Department of Environmental Protection to develop and fund future stream channel improvement projects throughout the county.

Natural Resources Protection

Various natural resources associated with aquatic systems, such as riparian corridors and wetlands, should be protected. Measures to protect these resources include various best management practices, erosion and sediment control regulations, land use controls, and riparian corridor protection standards. The county planning commission has developed a model guidebook and ordinance for riparian corridor protection. Additionally, the county conservation district performs erosion and sediment control reviews.

Protecting riparian corridors not only preserves the aesthetics of local waterways, but promotes improved water quality as well.

Because of the multiple objectives for stream corridors, including tourism and recreational business, there are several sources of money that may be available for floodplain acquisition. These include funding for parklands and open space, as well as money from the Federal Emergency Management Agency's Hazard Mitigation Grants Program. Over the past several decades, several small stream corridor improvement projects have been undertaken in the eastern portion of the county. These projects have been implemented through partnerships between the municipalities and both the Pennsylvania Department of Environmental Protection (DEP) and the US Army Corps of Engineers.

The planning commission should continue to promote their model riparian corridor protection measures. The Montgomery County Conservation District should consider flood impacts in developing natural resources protection measures. River conservation plans and other resource based water-

shed scale plans should be considered in key county watersheds to address a variety of issues including floodplain protection.

Public Information Programs

A broad-based public understanding of natural hazards is needed to reduce flood risks. Often, poor choices made by the public during floods create situations where lives and property are placed at risk. Much of this occurs among motorists who drive into floodwaters or homeowners who fail to heed evacuation warnings. Also, some homeowners place fences, sheds, automobiles and outdoor equipment in flood prone areas of their property. These structures get swept away in the floodwaters and occasionally clog up bridge openings and culverts – further elevating floodwaters. A number of public awareness initiatives have been successfully employed in other flood prone areas of the country including: street signage, maps and displays, library projects, direct mailings such as fliers, youth environmental education, real estate disclosure, and commuter awareness. The Montgomery County Conservation District assisted the American Red Cross in the preparation and dissemination of a flood awareness brochure in the Sandy Run area.

Partnerships should be established between the county, municipalities, the American Red Cross, and local civic associations to promote flood awareness. The Montgomery County Roads and Bridges Department, PennDOT, and local municipalities should evaluate the need for road signage in low-lying areas to warn motorists of potential flood hazard. The county, its 62 municipalities, and other organizations should develop flood awareness public information material for dissemination to residents of flood prone areas. Focused business owner and employee flood awareness training sessions should be developed and hosted by the county, key local business groups, and local chambers of commerce.

Conclusion

Even though flooding is a common occurrence in Montgomery County, steps can be taken to protect residents and their property from being in harm's way. With some preventative measures, floods don't have to become disasters.

Chapter Five
Stormwater Management

The costs associated with stormwater management, and the loss of life, property, and services that often accompanies floods, have made most people view stormwater as a nuisance or threat. In the past, stormwater management has focused on conveying flows off a site and quickly out of a municipality. With new construction, little thought is usually given to changes in local hydrology or impacts to downstream properties. Heavy machinery that aids in clearing, grading, and construction compacts a site's soil. Trees that soak up rainfall are frequently removed and not always replaced. Driveways and streets typically create impervious surfaces that water cannot pass through. Pipes and gutters lead stormwater away from a site. With all of these changes, the amount of precipitation that infiltrates into the ground typically decreases. This newly created excess water becomes stormwater runoff and discharges to downstream lakes, streams, and rivers. If not managed properly, runoff can quickly become a problem. However, with proper management stormwater can easily become a resource.

The first part of this chapter of the *Water Resources Plan* discusses the existing conditions of stormwater, including stormwater problems and the county's planning efforts to date. The second half of the chapter addresses stormwater best management practices (BMPs), the use and function of storm basins, priorities for watershed stormwater planning, and the National Pollutant Discharge Elimination System Phase II program.

> ***In a year, a one-acre parking lot can produce 16 times more stormwater runoff than a one-acre meadow.***

Existing Conditions

The Stormwater Management System

When it comes to stormwater management in Montgomery County, detention basins are the typical solution and are comprised of several components:

- **Collection:** usually a series of pipes, downspouts and site grading that gather runoff from impervious surfaces.
- **Conveyance:** most often a series of drains, pipes, culverts, and channels that direct runoff to a management facility.
- **Management:** a structure designed to retain, recharge, or filter stormwater.

Stormwater management systems are frequently designed for economic and practical purposes, leaving aesthetic and environmental concerns out of the equation.

- **Discharge**: a riser pipe discharges the outflow from the management structure.

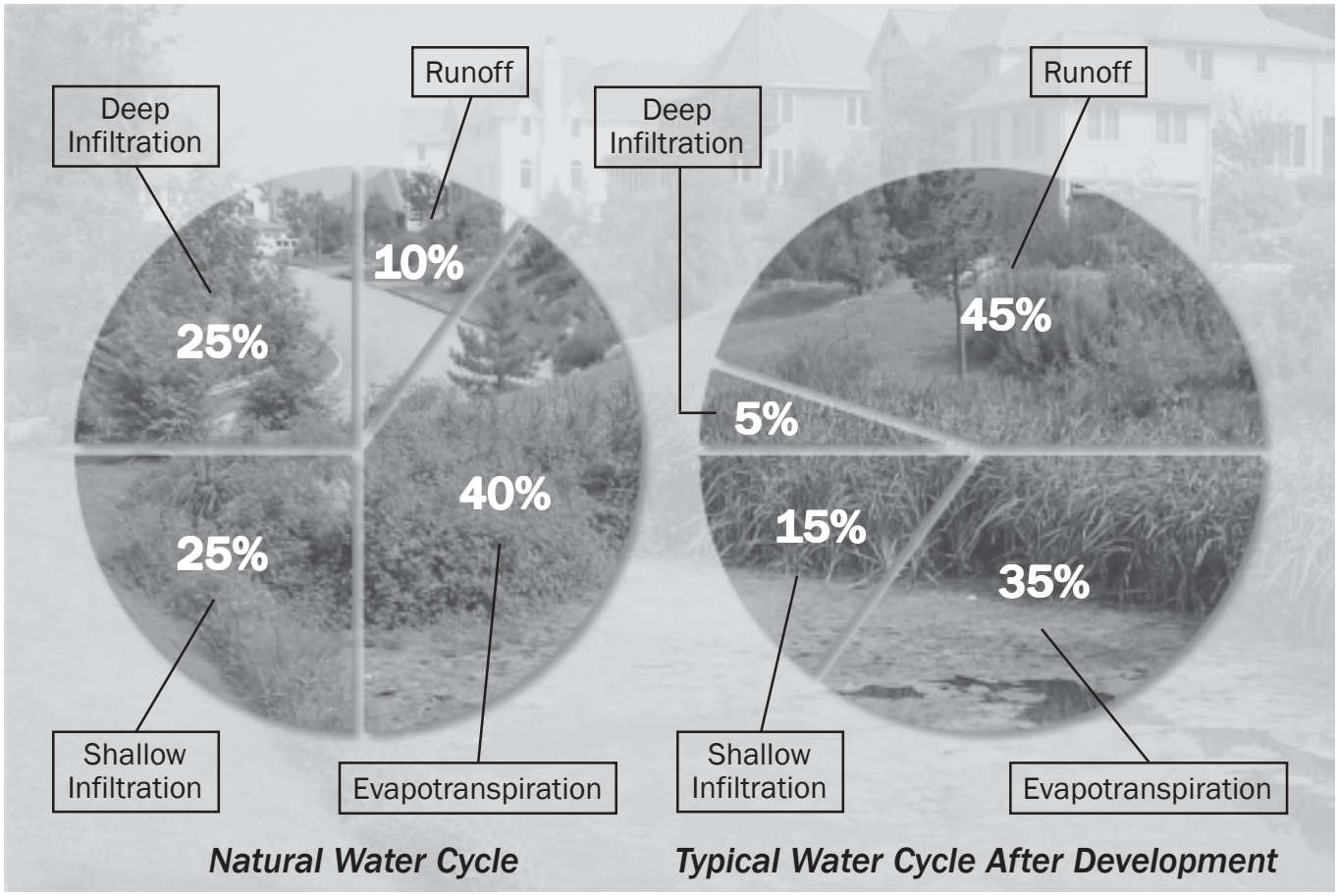
The design of these components is influenced by ordinance requirements, the volume of stormwater, and economic considerations. Most ordinances stipulate the level of stormwater control, for example requiring that post development peak stormwater flow rates should not exceed predevelopment rates. The volume of stormwater is a result of allowable building coverage, maximum impervious surface allowance, and grading. Economic considerations frequently dictate that stormwater system components get "squeezed into" a site design that maximizes the number of saleable lots; detention basins are among the cheapest ways to control large amounts of stormwater runoff. These influences do little to preserve the hydrology of the site, but merely convey stormwater quickly off the site and to a nearby stream. As a result, beneficial aspects of stormwater management, such as groundwater recharge or water quality improvements, are often missed. Moreover, because stormwater is managed on many individual sites, cumulative impacts may lead to increased flooding, decreased base flow, and degraded streams.

Managing Runoff

In a developing watershed, the volume of stormwater resulting from a particular rainfall event increases because of the increase in the amount of impervious land area (such as natural land being covered by pavement, concrete, or buildings) or changes in the overall landscape (such as decreased woodlands, site grading, or the compaction of natural soil). That is, the conversion of natural land and topography to residential, commercial, industrial, and even agricultural uses results in decreased infiltration of rainfall and an increased rate and volume of runoff. Figure 15 illustrates this change in site hydrology.

As development occurs, the increased quantity of stormwater runoff must be addressed. Past efforts to manage stormwater have usually focused on controlling the rate of discharge at the municipal level. This approach, however, does not consider stormwater impacts on a comprehensive, watershed-wide basis. As a result of this piecemeal approach to stormwater management, stormwater problems have worsened in many areas undergoing development. The impacts of development on stormwater are described on the following page.

Figure 15
Development's Impact on the Water Cycle



- **Increased Flooding:** Ground that is covered by buildings or pavement, or is regraded, allows less water to infiltrate into the ground. Development throughout a watershed sends these increased flows downstream. Where tributaries meet, the increased stormwater flows can combine and cause greater flooding. New development also expands flood-plain boundaries – putting new areas at risk. Floods can easily damage public and private property, as well as water control structures. Flood management is described in more detail in Chapter 4 of this plan.
- **Reduced Groundwater Recharge:** The other side of the impervious surface coin is that reduced infiltration means less groundwater recharge. Groundwater slowly makes its way to surface waters, and during dry weather is responsible for keeping streams flowing. Without the contribution of groundwater, streams will dry up, and aquatic habitat will be stressed. Water quality also suffers, as there is less water in the stream to dilute nutrients or other pollution to safe levels.

Heavy summer rainstorms can easily cause floods that result in local damage and dangerous situations.

- **Water Quality:** Most stormwater regulations are concerned with controlling stormwater from large storms. Stormwater basins built to these regulations often allow the smaller (2" or less), more frequent summer storm to pass through unimpeded. The first inch or so of rainfall washes off pollutants that settle on roads and sidewalks. Stormwater from these smaller storms carries the pollutants through the basin and discharges them in the receiving stream. Another common design feature is the concrete low-flow channel. This is a concrete trough running through the bottom of the basin that allows the basin to drain completely and makes maintenance easier. However, in a treeless basin, the concrete heats up in the summer sun. When stormwater from a small storm travels over the hot concrete, the water heats up. The warm stormwater is then discharged to the receiving stream, where the thermal pollution causes stress to aquatic organisms. These low-flow channels are also undesirable as they limit infiltration of stormwater and prevent natural filtering of stormwater during summer storms.
- **Aquatic Organisms:** Declining water quality, along with increasing pollutant loads, negatively impacts aquatic wildlife. As little as 10 percent imperviousness in areas around a waterway can lead to declines in the richness, diversity, and abundance of species. Studies done in areas across the country have shown varying declines in amphibians, insects, plant life, and fish when impervious coverage is added.
- **Stream Protection:** Comparing a 20 year old map of streams in the county to a current map shows that many of the smaller streams have been lost. This loss can be attributed to changes in hydrology brought on by development, and the practice of enclosing small steams and intermittent drainage ways in pipes or culverts. Most stormwater ordinances do not require a developer to preserve site hydrology, including natural streams. As a result, streams are relocated or put underground so the site can be fully developed. The natural drainage of the site is disrupted, and the habitat and aesthetic aspects of the stream are lost when this is allowed.
- **Basin Design and Function:** Stormwater ordinances often contain standards for side slopes, vegetation, and other design features. Stormwater

management facilities built under these standards have an engineered look that makes them appear as an unnatural addition to the landscape. Prohibiting large vegetation within the basin makes it difficult to design and install basins that blend into the environment or have additional benefits like wildlife and plant habitat or water quality improvement.

Cumulative Impacts

Individual land development projects are often reviewed separately, and not necessarily as a part of a bigger picture. Even if a municipality takes a comprehensive look at development, its focus usually does not extend beyond municipal borders. However, the cumulative nature of individual developments dramatically affects flooding conditions. This cumulative effect includes flooding, stream bank erosion, and property damage (sometimes running into the millions of dollars and even causing loss of life). Given the distributed and cumulative impacts of development, a comprehensive (i.e., watershed-based) approach will be most successful.

Pennsylvania enacted the Stormwater Management Act (Act 167) in 1978 in part to address these cumulative impacts. The Stormwater Management Act requires Montgomery County to prepare stormwater management plans for its 17 designated watersheds. Figure 16 is a list of the plans completed and the Montgomery County municipalities within the watershed that are affected by the plan, while Figure 17 shows the location of all watersheds in the county. In order to coordinate the control levels developed in the planning process, the behavior of stormwater in the watershed needs to be understood. This is accomplished through a computer model of the watershed that depicts the volume and timing of stormwater flows throughout the watershed. Based on the model results, an ordinance is prepared that stipulates stormwater control measures to prevent new flooding from occurring and keep existing flooding from becoming worse. Recent changes to the program by DEP require infiltration, streambank protection, and water quality measures to be included in the ordinance.

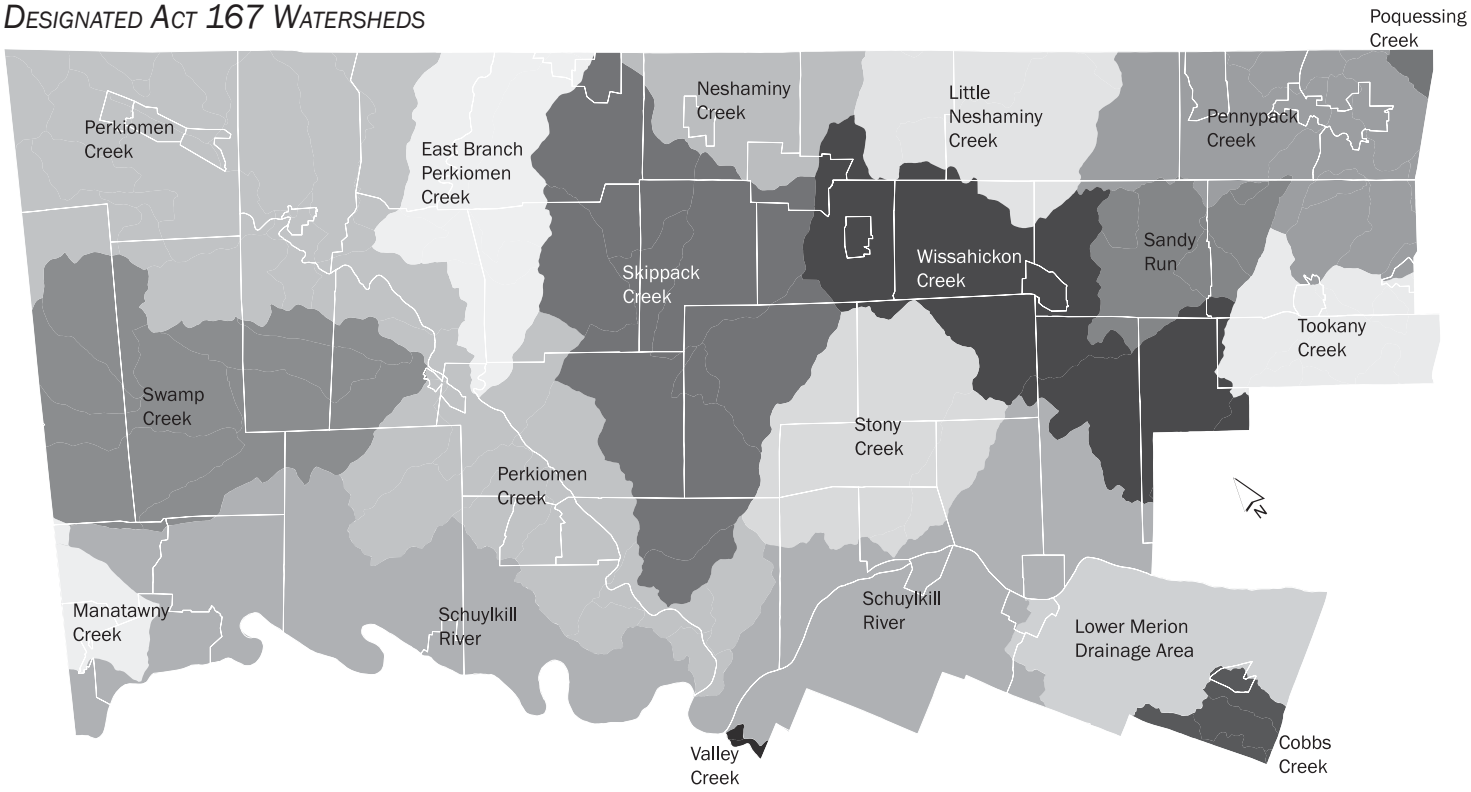
Some of these watersheds originate in or flow to neighboring counties. In these cases, a neighboring county may initiate a stormwater management plan for a watershed that may not be a top priority for Montgomery County. Regardless, the county will

The East Branch of the Perkiomen Creek is the subject of one of the most recent stormwater management plans to be finalized by the county.

Figure 16
Completed and In-Progress Watershed Plans in Montgomery County

Watershed Plan	Affected Municipalities
Stony Creek/Saw Mill Run Watershed Stormwater Management Plan (1991)	Worcester Township Whitpain Township Lower Providence Township West Norriton Township East Norriton Township Norristown Borough Plymouth Township
Neshaminy Creek Watershed Stormwater Management Plan (1992)	Hatfield Township Hatfield Borough Lansdale Borough Montgomery Township Lower Moreland Township
Little Neshaminy Creek Watershed Stormwater Management Plan (1996)	Montgomery Township Horsham Township Upper Dublin Township Lower Gwynedd Township
Lower Merion Drainage Area (1997)	Lower Merion Township Narberth Borough
East Branch Perkiomen Creek Watershed Stormwater Management Plan (2004)	Franconia Township Telford Borough Souderton Borough Salford Township Upper Salford Township Lower Salford Township Perkiomen Township Skippack Township
Swamp Creek Watershed Stormwater Management Plan (in progress)	Douglass Township Upper Pottsgrove Township Lower Pottsgrove Township New Hanover Township Upper Frederick Township Lower Frederick Township Limerick Township Schwenksville Borough
Darby/Cobbs Creek Watershed Stormwater Management Plan (in progress)	Lower Merion Township Narberth Borough
Sandy Run Watershed Stormwater Management Plan (in progress)	Abington Township Upper Dublin Township Springfield Township Whitemarsh Township
Tookany/Tacony/Frankford Creek Watershed Stormwater Management Plan (in progress)	Abington Township Cheltenham Township Jenkintown Borough Rockledge Borough
Valley Creek Watershed Stormwater Management Plan (in progress)	Upper Merion Township

Figure 17
DESIGNATED ACT 167 WATERSHEDS



Source: Pennsylvania Department of Environmental Protection.

participate in the preparation of that plan, as resources allow, even if plans for higher priority watersheds have not been prepared. Municipalities in lower priority watersheds should take interim measures to preserve site hydrology by adopting a stormwater management ordinance that requires stormwater BMPs. A model ordinance prepared by the Montgomery County Planning Commission should be used as a guide.

Stormwater Plan

Stormwater management must be considered in every land development proposal or any proposal that causes changes in land surface conditions (such as highway construction). How it is being addressed is undergoing a change for the better. Stormwater is increasingly being viewed as a resource and not as a nuisance. With proper design of new construction and stormwater systems, the natural hydrology of the site can be preserved or replicated. In this way, water is allowed to infiltrate to recharge groundwater, or flow gradually along the land to join surface water resources.

For more information on Best Management Practices, go to the Pennsylvania Department of Environmental Protection website.

The address is: www.dep.state.pa.us/dep/subject/advcoun/stormwater/stormwatercomm.htm.

Parking lots are a natural place to trap runoff - such as here in Fischers Park.

Best Management Practices

Stormwater runoff generated from a site can be managed to control the volume, rate of discharge, and water quality. State policies for management recommend that controls be located close to the source of stormwater (as opposed to at the lowest point of the property), and that more than one management method be employed for greatest effectiveness. Stormwater quality often is improved when the design of a development preserves predevelopment hydrology. The Pennsylvania Department of Environmental Protection (DEP) and other agencies employ strategies known as best management practices (BMPs) for stormwater management. These techniques include direct approaches, such as naturalized basins and subsurface infiltration beds, and indirect methods of reducing runoff such as reduced impervious surfacing. Wherever possible, predevelopment site hydrology should be preserved through the use of stormwater BMPs. Site conditions will determine which BMPs are best suited for a particular site, and inspection and maintenance activities are critically important. One or more of the BMPs listed here should be used at new construction sites as well as at redeveloping areas to restore infiltration rates, purify runoff, and manage the volume of stormwater.

- **Naturalized basins:** These basins are stormwater control facilities planted with native vegetation rather than a grassy lawn. The stems and leaves of the native plants, and the detritus, or dead twigs and leaves, help filter stormwater. The plants may remove pollutants, like excess fertilizer, before the stormwater is discharged to a stream. The roots and stems keep the soil loose, encouraging infiltration.
- **Vegetated swales:** Swales are long, shallow drainage ways planted with native vegetation and designed to hold and convey stormwater. The vegetation in the swales encourages infiltration and slows runoff, which allows pollutants to filter out before the stormwater has a chance to reach local waterways.
- **Reduced or disconnected impervious surfaces:** This disconnection allows for greater infiltration and filtration of runoff. Limiting the length of flow over paved areas limits the velocity and amount of conveyed water that

must be handled by stormwater facilities at the end of the paved area. An example of this technique would be a residential subdivision in which stormwater from each dwelling's roof top drains through a vegetated swale before reaching the road surface.

- **Rain gardens:** Rain gardens are essentially perennial gardens with native, water loving plants that are placed between stormwater runoff sources (such as driveways, roofs, or parking lots) and runoff destinations (like storm drains or streams). This landscaped area allows for runoff to soak back into the ground; the plants remove pollutants from the runoff.
- **Bioretention areas or bioswales:** These are like rain gardens, but are used on a larger scale and can be adapted for commercial, residential, or industrial properties. They utilize soil and plant material to remove pollutants from stormwater runoff and can be adapted to be used with less pervious soil types.
- **Porous pavement:** Porous pavement is either modified asphalt or concrete that allows for stormwater to be absorbed through the paved area. This results in a reduction in the amount of stormwater runoff that flows off of paved areas, such as parking lots or roads (and is especially applicable for paved areas that do not get much traffic). Some municipalities have paired permeable paved areas with engineered reservoirs underneath to enhance stormwater infiltration.
- **Infiltration basins or trenches:** These basins are shallow impoundments that use the natural filtering ability of soil to remove pollutants from runoff and slowly release the runoff into the water table. Infiltration basins may be challenging to apply on some sites because of soil requirements. A common permutation of the infiltration basin is the underground infiltration facility. Advances in stormwater management tools have allowed stormwater to be stored and released underground. This is accomplished through either hollow or rock-filled chambers or pipes. Such practices allow for greater development of the site (such as additional parking), since the land formerly used for a basin is now available for other uses. The bottom of the storage facility can be open,

Landscaped rain gardens can be an aesthetically pleasing addition to any development, like these houses in Maryland.

Bioretention areas use plant material to remove pollutants from runoff and allow stormwater to infiltrate back into the ground.

This parking lot at Morris Arboretum is paved with a porous surface that allows stormwater to soak into the ground below.

allowing for infiltration, or closed, in which case stormwater is stored and released to surface waters. In either case, periodic inspection and maintenance must be considered. Without such activities, it is likely that the underground and out of sight facility will be neglected and could cease to manage stormwater as required.

- **Sediment forebays:** Sediment forebays are small pools placed by the inlet of a storm basin or other stormwater management facility and are designed as initial storage areas to trap sediment and other pollutants before they reach the main basin. Sediment forebays are a pretreatment feature on a stormwater pond and can simplify maintenance and lower costs.
- **Stormwater extended detention ponds:** These temporarily detain part of stormwater runoff for longer than 24 hours after a storm. These ponds normally are "dry" between storm events and do not have permanent standing water.
- **Stormwater ponds:** Stormwater ponds are designed to have a permanent pool, with higher sides to accommodate additional stormwater flows. The water level rises after a storm, then slowly returns to a static level.
- **Constructed wetlands:** Constructed wetlands are engineered systems that are constructed to use the natural processes involving wetland vegetation, soils, and their associated microbial assemblages to assist in treating wastewater. They are designed to take advantage of many of the same processes that occur in natural wetlands, but do so within a more controlled environment. However, existing natural wetlands should not be used.
- **Basin retrofits:** Retrofits can be used in nearly any environment, and involve the installation of a new BMP or improving an existing BMP in a previously developed area.

Existing development can easily be retrofitted with a variety of best management practices to improve local water quality.

Best management practices can be implemented on a number of levels. Local municipalities can sponsor demonstration projects or retrofits to specific neighborhoods that employ these techniques. Municipalities that do use best management practices may have to make some provisions for maintenance and upkeep, but many residents may see things like rain gardens or swales as value-added amenities and will independently provide for

upkeep. Additionally, municipalities can save money on what would otherwise be standard infrastructure and utility costs. Zoning and/or subdivision ordinances can be amended to promote the use of best management practices – especially as municipalities update their stormwater ordinances to comply with the National Pollutant Discharge Elimination System program (explained in more detail below). Lower Merion, for example, has a detailed stormwater management ordinance that outlines a variety of best management practices, such as wet meadows and infiltration beds, which can be used to achieve better water quality.

Developers also have a role to play – by actively including best management practices in their designs and projects. Developers should be encouraged to use narrower street and alternate lot layouts, in addition to protecting natural systems like wetlands or mature forests. Developers also stand to save money by using best management practices.

Stormwater Basins

Despite recent innovations in stormwater management, the technique most commonly used today is the detention basin. The standard basin does little more than control runoff from significant storms. Basins should be used in conjunction with other BMPs, and should be designed for more than just stormwater volume control. Where basins are used to manage stormwater, they should be carefully designed to include as many of the following functions as is practicable:

- Stormwater infiltration protects the bottom of the basin from compaction, when locating on suitable soils.
- Stormwater can also be purified through short-term retention or through the use of native vegetation.
- Temperature reduction can be achieved through the prevention of concrete low-flow channels and by shading with native vegetation.
- Native vegetation that is attractive to birds and butterflies provides quality habitat and aesthetics for local wildlife.
- Streambank protection can be achieved through modifying the outfall to control stormwater from the frequent smaller storms.

There are plenty of low-cost ways of using best management practices at home.

Local residents can:

- *Limit impervious concrete or paved surfaces and replace them with gravel or mulch pathways, wood decks, or pervious asphalt driveways.*
- *Practice green landscaping by reducing the use of power mowers and other lawn equipment and reducing the use of fertilizers and pesticides.*
- *Conserve water by watering lawns and plants early in the morning or evening (which cuts down on water evaporation).*
- *Mulch plants with compost to conserve moisture.*
- *Implement small-scale stormwater control measures. Rain gardens or rain barrels can be placed in strategic areas to collect roof or other impervious surface runoff. Neither of these strategies have to be expensive; rain barrels are little more than big plastic garbage cans with a lid and the main cost of rain gardens comes from purchasing plants (which can be minimized by using native plants from your yard).*

- Protection of adjacent property should be a priority; concentrated discharge should be located well back from the property line, and discharges should be designed to avoid erosion in adjacent areas.
- Stormwater volume control can be accomplished by preventing flooding on-site and immediately down slope of the discharge. Watershed-wide flooding control is addressed under the context of Act 167.

The maintenance needs of all stormwater management components should be considered during site design. Stormwater management techniques that are difficult to inspect and maintain (such as underground detention chambers) should be avoided.

Periodically, municipalities should analyze their stormwater control facilities, looking for ways to improve the functioning of the system. In certain areas this analysis should be done on a multi-municipal level to deal effectively with a whole watershed.

NPDES Phase II

The National Pollutant Discharge Elimination System (NPDES) Phase II program is primarily an effort to protect water quality through proper stormwater management. The U.S. Environmental Protection Agency (EPA) has mandated the Pennsylvania Department of Environmental Protection (DEP) to implement Phase II of the NPDES program. Under the state's requirements, the county needs to develop a program for its departments and employees that provides education and policy guidance regarding county construction/maintenance/operation activities and stormwater management. Phase II regulates construction sites between one and five acres, and stormwater discharge systems in smaller, urbanized areas, called MS4s (Municipal Separate Storm Sewer Systems). The county's NPDES Phase II program will cover the six minimum control measures required by the EPA:

1. Education and Outreach
2. Staff Participation
3. Illicit Discharge Detection and Elimination
4. Construction Stormwater Runoff Management
5. Post-Construction Stormwater Runoff Management
6. County Operations

County operations that could affect stormwater quality should be reviewed periodically to insure compliance with the county NPDES Phase II program.

Every municipality in the county has been designated an MS4 operator, meaning that they must implement the DEP protocol or similar program developed under NPDES Phase II, which call for:

- Prohibiting non-stormwater discharges (with certain exceptions).
- Implementing erosion and sediment controls.
- Controlling post-construction runoff from new development and redevelopment, including the operation and maintenance of stormwater BMPs.
- Adopting sanctions to ensure compliance with the above provisions.

Construction sites between one and five acres are regulated under the NPDES Phase II Program.

The permits issued to the MS4 operators under the program are renewed every 5 years, and it is likely that the regulations will become stricter with each renewal. Municipal programs under NPDES Phase II and the county's Act 167 plans should be closely coordinated. When a new stormwater management plan is being developed or updated under Act 167, the ordinance prepared will need to incorporate the requirements of the municipal MS4 programs.

Conclusion

Though frequently seen as a nuisance, stormwater should be viewed as a resource. There are numerous tools and techniques that can be used by developers to preserve or restore predevelopment site hydrology. Developments can utilize stormwater best management practices to minimize the volume of stormwater runoff. Local municipalities should promote good stormwater management design to protect water quality, encourage groundwater infiltration, and minimize flooding risks.

The county, state, nonprofits, and local universities can hold workshops and provide educational materials to help municipalities, civil engineers, homeowners, and other implement better stormwater control.

Conscientious planning of stormwater facilities , such as this rain garden, allows for environmental protection and minimized amounts of stormwater runoff.

Chapter 6
Pulling It All Together – The Water Cycle

The water cycle is a natural process that can be profoundly affected by people and development. With thoughtless human action, streams can become polluted, wells can run dry, and downstream neighbors may see an increase in flooding. Over the past few decades, the human impact on water has been recognized and addressed with various regulations, including requirements for stormwater control, discharges into streams, and withdrawals from groundwater supplies. Despite these efforts, flooding, water shortages, and pollution still exist. As the county grows in population with more development, the impact on water resources will become even stronger.

In better managing water resources, we can benefit from a long-term dependable water supply, healthy streams, reduced flooding, and enjoyable water-based recreation resources. This chapter discusses ways to address both current water resource problems and future water resource impacts.

Water Resources as a Whole

Although water resources extend well-beyond local jurisdictions and are not controlled by one entity, local governments, developers, businesses, and everyday residents can take a number of steps to protect water and reduce flooding. These steps are described in detail in each chapter of this plan, and a few key steps are briefly highlighted below.

- Having an adequate water supply is critical for the county. By 2025, the county is expected to add 107,000 more people and 77,000 more workers. Generally, public water and ground supplies will be adequate to meet the water demands of these people, but localized shortages could occur during extreme weather conditions. Municipalities in rural areas that are dependent on wells should limit new development in these sensitive locations, possibly through performance based zoning or transfer of development rights programs.

  On an individual basis, residents and businesses can help protect water supplies by conserving water at all times, and not just during droughts. Actions can include replacing water-wasting plumbing fixtures with more efficient ones,

using drought-tolerant landscaping, and instituting regular maintenance and repair of leaking water lines and fixtures.

Treatment plants, and other wastewater dischargers, have to comply with increasingly stricter regulations under the NPDES Program.

- Water quality in the county has improved since the Clean Water Act was passed in 1972, yet much still needs to be done, especially for the persistent problem of nonpoint source pollution.

  Over the next few years, point source polluters, public sewage treatment plants, and industrial dischargers will have to comply with more stringent federal regulations. Nonpoint source pollution, on the other hand, is often the largest source of contamination in some parts of the county. It must be controlled through less explicit actions, including stormwater best management practices, better erosion and sediment controls, natural landscaping around homes, alternative landscaping on golf courses, proper implementation of soil conservation plans by farmers, and more extensive protection of environmentally sensitive lands, including steep slopes, wetlands, floodplains, and woodlands.

Flooding is common in areas of the county developed before stormwater control facilities were required.

- Flooding is a major problem for many local streams in the county, particularly streams in areas developed before stormwater control facilities were required.

  Through Act 167, the county will continue to study local watersheds to determine the best rates of discharge for stormwater control structures built for new development. In areas with existing development, municipalities should require redeveloping properties to control previously unaddressed stormwater runoff, and these municipalities might also want to consider building new stormwater control facilities on open land. Municipalities may also want to consider assisting residents in the removal of homes and other buildings that may lie within the floodplain. Individual property owners can help ease flood threats through various techniques, such as rain gardens, rain barrels, natural landscaping, individual detention basins, and seepage beds.

- The impact of human development on the water cycle can be mitigated with good stormwater design. Where room is available, the natural drainage system should be maintained intact,

with regraded areas mimicking this natural system. In all cases, the amount of impervious coverage should be reduced as much as possible, with impervious areas broken up with landscaping and natural areas.

In addition, stormwater should be retained longer on site to allow groundwater recharge and sedimentation of pollutants.

Relationship of Water Resources to the Whole Comprehensive Plan

Water is one of the key factors that affect planning decisions – such as the location of new development, roads, and open space. The relationship of other plan elements to water resources is briefly described below.

- **Vision Plan**. This plan includes the *Growth and Preservation Map*, which shows designated growth areas and proposed open space. Designated growth areas are generally shown where water supply is available. On the other hand, open space areas are primarily shown along stream and river corridors, where the open space can be used to protect water quality and provide room for flooding. In addition, areas with particularly poor groundwater yields, such as places with diabase geology, are identified as open space or rural resource areas, with very limited new development intended.
- **Community Facilities Plan**. The water facilities chapter of the *Community Facilities Plan* is directly linked to the *Water Resources Plan*, particularly the water supply chapter. Water purveyors owning water facilities need a reliable supply of water. Additionally, the development of adequate sewage facilities, addressed in this plan, is important to protecting water quality.
- **Economic Development Plan**. Economic development decisions can affect water resources, particularly for industries that need their own well and water supply. New development can also affect flooding and must be designed with best management stormwater practices. The redevelopment of many of the industrial areas in the county's older communities will involve floodplain management issues.

Preserved open space around stream corridors is an effective way of protecting local water quality.

New construction can dramatically increase the amount of runoff entering local waterways.

Public Review

This plan was mailed to county municipalities and school districts for review as well as abutting counties, municipalities, and school districts. The plan was put online and made available for free to anyone requesting a copy.

In addition, public meetings on the plan were held in the following locations:

- ***November 15, 2004 in Upper Dublin Township.***
- ***November 16, 2004 in New Hanover Township.***

Comments from these public meetings and the mailings were incorporated into the final version of this plan.

- **Housing Plan**. Housing decisions can affect water supply and flooding. New residential development should have naturalized stormwater control facilities that are designed to recharge the water table.
- **Land Use Plan**. The *Land Use Plan* identifies appropriate locations for new development, which should have adequate water supply and not increase the potential for flooding.
- **Open Space Plan**. This plan encourages the protection of sensitive natural features, expansion and improvement of parks, completion of a county trail network, continuation of farming, and preservation of historic properties. All of these efforts can help protect watersheds, streams, and water quality. Within open space areas, riparian corridors should be established along streams and ponds.
- **Transportation Plan**. Transportation systems often have unintended impacts on water resources. For example a SEPTA bridge along the R-5 Lansdale line was one of the major causes of flooding in the Fort Washington area. When the opening was widened, the flooding in Fort Washington lessened. The impact of transportation bridges and culverts on floodways must be taken into consideration during the construction or reconstruction process of these facilities.

Implementation

Water is a dynamic resource that everyone needs but no one controls. This makes implementation challenging, with no one agency or group able to resolve all concerns. Instead, many different actors pursuing a variety of approaches are needed to adequately address water concerns. By working together to pursue an integrated approach to manage water resources within the county, various levels of government and private individuals should address the fundamentally interrelated aspects of water resources – including water supply, water quality, stormwater, and floods.

Since water is such a complex issue, there will always be a need for coordination, cooperation, and communication among all the players that have a role in protecting and providing water for Montgomery County. Federal and state governments must provide regulations and money to address

water issues. Municipal governments can improve their stormwater regulations, while seriously examining their own land and road maintenance procedures. Developers and farmers can work more effectively at limiting soil erosion and designing new landscapes for proper stormwater control. And individual property owners and businesses can conserve water inside while changing their own outside landscaping choices to use less water and keep pollution to a minimum.

Additionally, all of these players should assist in educational efforts. Though water resources may seem basic, the movement of water through our environment is dynamic and complex – and depends upon interactions with different land uses and the natural environment. Public education will be an important component of keeping safe, reliable water as a priority issue in the county.

Overall, the actions of all these various organizations and individuals can make a positive change to the water cycle, leading to cleaner water, less flooding, and a more reliable water supply.

Figure 18 lists the tasks, parties responsible for implementation, and general time frame for the *Water Resources Plan.*

Figure 18
Water Resources Plan Implementation Matrix

Water Supply - Tasks	Responsible for Implementation	Short-term	Medium-term	Long-term
Maintain an adequate public water supply and strengthen this supply with new water sources and interconnections between water systems	Water Purveyors, Municipalities, Public Utility Commission			
Continue regional regulation and oversight of water withdrawals	Delaware River Basin Commission			
Eliminate water regulation exemptions for mining and agricultural operations	State Government			
Focus water improvements in designated growth areas; amend zoning ordinances to allow for more than one dwelling unit per acre in designated growth areas	Water Purveyors, Municipalities, Public Utility Commission			
Restrict the extension of public water into rural resource areas, except for cluster developments	Water Purveyors, Municipalities, Public Utility Commission			
Conserve water	Residents, Businesses, Institutions, and All Levels of Government			
Encourage developments of greater than 15 units in rural resource areas and more than a half mile from existing public water facilities to install community water systems	Municipalities			
Improve and maintain the county's well monitoring network	Montgomery County Health Department (MCHD), DEP			
Examine the cumulative impact of well operating permits in a given area	MCHD			

Water Quality - Tasks	Responsible for Implementation	Short-term	Medium-term	Long-term
Work to eliminate combined sewer overflows and septic tank failure problem areas	Sewer Authorities and Treatment Plants, Municipalities, State Government			
Amend local ordinances to encourage more effective erosion and sediment controls	Municipalities			
Limit the amount of vegetation that can be cleared from construction sites; and reduce the area and length of time a site is cleared and graded	Municipalities, Developers			
Restrict the amount of impervious surface used around homes	Municipalities, Developers			
Use native vegetation for landscaping as much as possible	Municipalities, Developers, Property Owners			
Limit the use of pesticides and other chemicals on lawns, golf courses, and playing fields	Municipalities, School Districts, Golf Courses and other Recreation Areas			
Maintain riparian corridors; amend zoning ordinances to protect these areas from development	Municipalities, Watershed Conservancy Organizations			
Encourage farmers to improve their conservation practices	Municipalities, Montgomery County Farmland Preservation Program, 4-H and other Agricultural Organizations, Federal and State Governments			
Amend zoning ordinances to include natural features protection standards	Municipalities			

Flooding - Tasks	Responsible for Implementation	Short-term	Medium-term	Long-term
Continue to collaborate with various agencies to implement the county's flood warning system	Mongomery County Emergency Services, USGS, National Weather Service, DRBC			
Ensure that new development, unless done as a redevelopment activity, does not take place in the floodplain	Municipalities, Developers, Property Owners			
Remove debris from inlets, storm sewers, and bridge culverts to ensure sufficient capacity in stormwater systems	Municipalities, Property Owners			
Require older areas that are being redeveloped to add proper stormwater management devices	Municipalities, Developers			
Reconstruct constriction points (such as older railroad bridges)	Municipalities, SEPTA, PADOT, County Government			
Retrofit structures in the floodplain when feasible; purchase and remove properties that are especially susceptible to flooding	Municipalities, FEMA, Property Owners, County Government			
Encourage homeowners with vulnerable properties to purchase flood insurance	Municipalities, NFIP			
Establish partnership to promote flood awareness through various educational programs	Municipalities, MCES, Red Cross, Local Civic Associations, State and Federal Governments			

Stormwater Management - Tasks	Responsible for Implementation	Short-term	Medium-term	Long-term
Complete Stormwater Management Act studies and adopt corresponding ordinances	Mongomery County, State DEP, Municipalities			
Use best management practices for stormwater management in new construction as well as redevelopment projects	Municipalities, Developers			
Amend subdivision ordinances to allow for innovative stormwater management practices	Municipalities			
Continue implementing NPDES Phase II requirements for better water quality	Municipalities, County Government, EPA, State DEP			

Appendix A

Montgomery County Health Department Water Quality Standards

Water Standards for Wells

Maximum pollutant levels allowed when wells are tested are listed below:

Parameter	Current PADEP Limit
Total Coliform	0 cfu/100ml
pH 6.5 to 8.5	
Nitrate as N	10 mg/l
Volatile Organic Compounds	
Benzene	0.005 mg/l
Carbon Tetrachloride	0.005 mg/l
o-Dichlorobenzene	0.6 mg/l
para-Dichlorobenzene	0.075 mg/l
1, 2 - Dichloroethane	0.005 mg/l
1, 1 - Dichloroethylene	0.007 mg/l
cis-1, 2 - Dichloroethylene	0.07 mg/l
trans-1, 2 - Dichloroethylene	0.1 mg/l
Dichloromethane	0.005 mg/l
1, 2 - Dichloropropane	0.005 mg/l
Ethylbenzene	0.7 mg/l
Monochlorobenzene	0.1 mg/l
Styrene	0.1 mg/l
Tetrachloroethylene	0.005 mg/l
Toluene	1 mg/l
1, 2, 4 - Trichlorobenzene	0.07 mg/l
1, 1, 1 - Trichloroethane	0.2 mg/l
1, 1, 2 - Trichloroethane	0.005 mg/l
Trichloroethylene	0.005 mg/l
Vinyl Chloride	0.002 mg/l
Xylenes (total)	10 mg/l

Isolation Distances for Wells

Minimum isolation distances shall be maintained from the proposed well to the facilities listed below:

Source of Pollution	Minimum Distance
1. Delineated wetlands or floodplains.	25 feet
2. Lakes, ponds, streams or other surface waters.	25 feet
3. Storm drains, retention basins, storm water stabilization ponds, rainwater pits.	25 feet
4. Community spray irrigation site: sewage sludge and septage disposal sites.	100 feet
5. Farm silos, barnyards, manure pits or tanks or other storage areas of animal manure.	200 feet

6.	Subsurface sewage absorption areas, elevated sand mounds, cesspools, sewage seepage pits, single family spray irrigation system, etc.	100 feet
7.	Septic tanks, aerobic tanks, sewage pump tanks, holding tanks.	50 feet
8.	Gravity sewer lines and drains carrying domestic sewage or industrial waste *(unless item 9 applies).*	50 feet
9.	Gravity sewer lines and drains using cast iron pipe with watertight lead caulked or neoprene gasketed joints, or Schedule 40 polyvinylchloride (PVC) pipe with solvent welded joints.	10 feet
10.	Sewer lines and drains carrying domestic sewage or industrial waste under pressure *(except welded steel).*	50 feet
11.	Commercial preparation area or storage area of hazardous spray materials, fertilizers or chemicals; salt piles.	300 feet
12.	Other potential sources of pollution as determined by MCHD.	As approved

Any proposed deviation or modification from the above isolation distances must be submitted in writing to MCHD stating reasons for such deviation or modification. Upon review of the material, a waiver may be granted. Additional conditions may be required prior to permit issuance. These conditions may also apply to isolation distances unable to be determined by the applicant.

Appendix B
Superfund Sites as of 2004 Montgomery County, PA

Community	Site Name	National Priority List Status
Hatboro	Raymark	Final
Hatfield	North Penn – Area 2	Final
Horsham	Willow Grove Naval Air and Air Reserve Station	Final
Lansdale	North Penn Area 6	Final
Lower Pottsgrove	Occidental Chemical Corp./Firestone Tire & Rubber Co.	Final
Lower Providence	Commidore Semiconductor Group	Final
Lower Providence	Moyers Landfill	Final
Montgomery Township	North Penn – Area 5	Final
North Wales	North Penn – Area 7	Final
Souderton	North Penn – Area 1	Final
Upper Merion	Crater Resources/Keystone Coal/Alan Wood Steel Co.	Final
Upper Merion	Henderson Road	Fina
Upper Merion	Stanley Kessler	Final
Upper Merion	Tyson's Dump	Final
Worcester	North Penn – Area 12	Final

Appendix C
Common Household Hazardous Waste

Paint and Paint Related Materials

Solvent-based paints and stains
Paint thinner
Varnish
Paint stripper and paint brush cleaners
(Note: Latex paint is not hazardous)

Lawn and Garden Products and Outdoor Products

Pesticides *(fungicides, herbicides, insecticides, rodenticides)*
Chemical fertilizers
Grill type propane cylinders *(Up to 20 lbs.)*
Swimming pool chemicals

Kitchen, Bathroom Products, and Cleaning Solvents

Cleaning solvents
Fire extinguishers
Aerosol cans
Bathroom and tile cleaner
Toilet bowl cleaner
Oven cleaners
Drain cleaners

Automotive Products

Used motor oil
Antifreeze
Lead-acid batteries
Auto body repair products
Brake fluid
Degreasers

Flammable Materials

Kerosene
Old gasoline

Other Materials

PCBs
Dioxin forming compounds
Mercury
Asbestos
Artists' paints
Photographic chemicals
Lead products, including solder, fishing weights, and similar items

Household Batteries

Rechargeable computer and cell phone batteries
Button cell batteries used for hearing aids, watches, and calculators
(Note: household batteries size D, C, AA, AAA and 9-volt are not considered hazardous)

Other Household Products

Mothballs
Stain and spot removers

Plan Elements of

Shaping Our Future: A Comprehensive Plan for Montgomery County

- Vision Plan
- Community Facilities Plan
- Economic Development Plan
- Housing Plan
- Land Use Plan
- Open Space, Natural Features, and Cultural Resources Plan
- Transportation Plan
- Water Resources Plan