

CHAPTER 4

LAND RESOURCES

The shape and stability of a watershed is based on the characteristics of the land. The way we develop, mitigate and transform the land directly affects the health of the surrounding and downstream water resources. Understanding the geology and soil characteristics within a watershed is an integral part of the Rivers Conservation process. The major geology and soil formations are briefly described here. For a more detailed discussion of basin geology and soils as well as the other physiographic provinces of the Delaware Watershed, please refer to the Background Section of the 2002 [Source Water Assessment Report](#). The Delaware Direct also shares similar characteristics with its surrounding watersheds. For more in-depth discussions of the greater Philadelphia and Delaware River region, please refer to the Land Resource sections in any of the other [River Conservation Plans](#).

4.1 Geology

A physiographic province is an area of land that is composed of a particular type(s) of rock as a result of having undergone certain environmental processes over time. Each province is distinguishable by its physical landforms, unique rock formations and groundwater characteristics. From north to south, the five physiographical provinces crossed by the entire length of the Delaware Basin are: the Appalachian Plateau, the Valley and Ridge, the New England Upland, the Piedmont and the Atlantic Coastal Plain. The Delaware Direct Watershed is located within the Piedmont and Atlantic Coastal Plain provinces. Figure 4.1 shows the geographical context of the provinces. Much of southeastern Pennsylvania consists of Piedmont land forms, with the exception of the far southeast corner where the portion of the Delaware Direct Watershed is surrounded by a sandy, flat coastal plain. This area is part of the Atlantic Coastal Plain, which also covers most of the eastern coast of the United States.

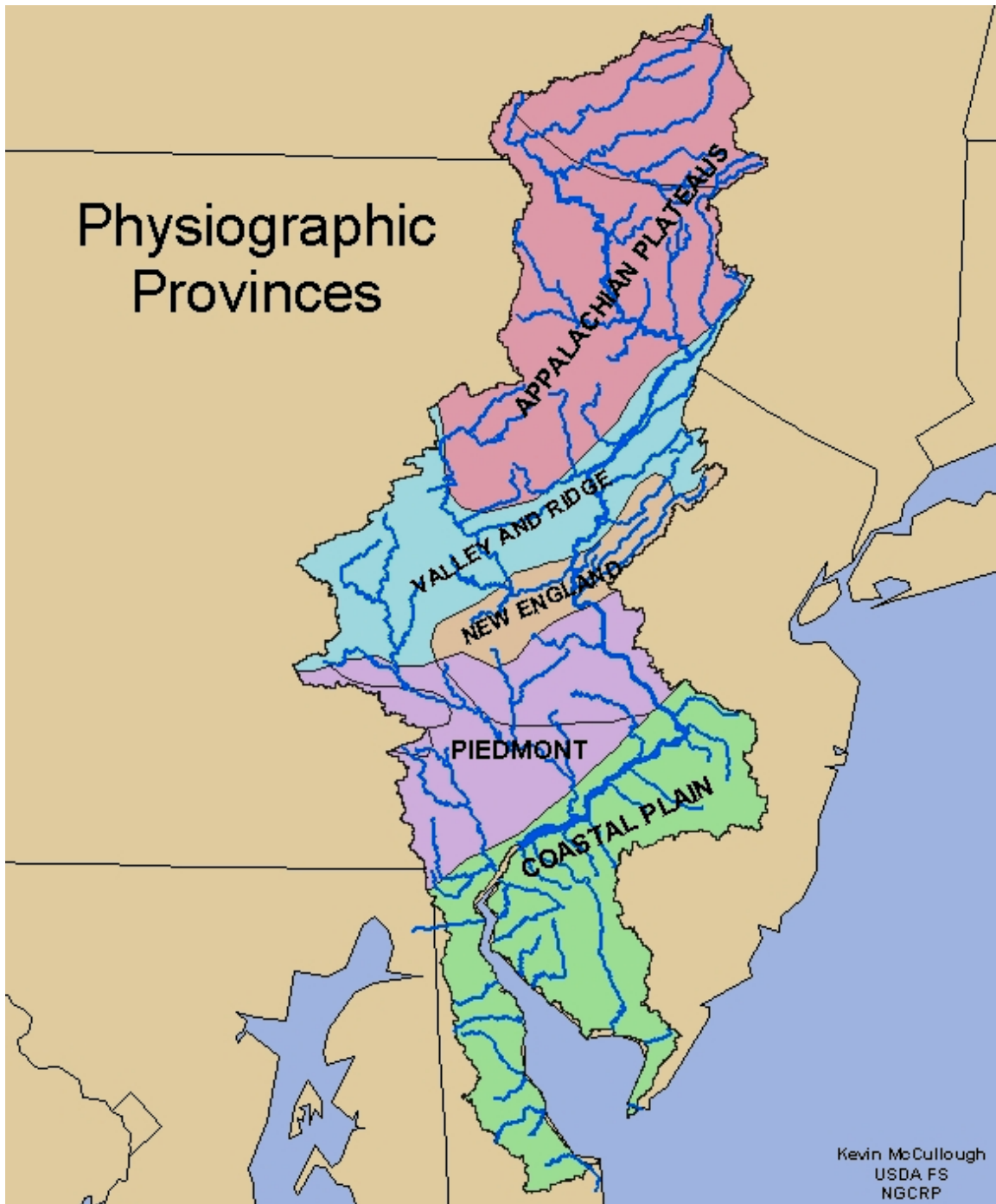


Figure 4.1: Physiographic Provinces of the Greater Philadelphia Region
 Source: [Physiographic Provinces](#)

The uplands of the Piedmont and the lowlands of the Coastal Plain are separated by the dramatic Fall Line, which sharply rises between the two provinces. The Fall Line is a physical barrier of waterfalls and rapids that flows over relatively erosion-resistant crystalline rock stretching from New Jersey to Texas. The Fall Line serves as a natural boundary that marks the extent of navigable waters. Baltimore, New York, Philadelphia, Trenton and Wilmington are major cities in the Delaware Basin that are located on the

Fall Line. Within Philadelphia only the tributary streams, such as the Schuylkill River, cross the Fall Line. The Delaware River actually crosses farther north near Trenton, New Jersey.

The Coastal Plain Province was formed when Triassic Era deposits were eroded and redeposited to the southeast by water and glaciers. The plain, which slopes southeast to the Continental Shelf, is divided into two sections: the Outer Coastal Plain, which is comprised of southern New Jersey and eastern Delaware, and the Inner Coastal Plain, which consists of a narrow belt in Pennsylvania, northern Delaware, and an area in New Jersey located roughly 20 miles to the east of the Delaware River. The two sections, which are divided by a line of hills, were formed in different geological time periods: the Inner Coastal Plain in the Cretaceous and Pleistocene Eras, and the Outer Coastal Plain in the Tertiary Era. The image below depicts the land characteristics of the flat coastal deposits along the shore of the Delaware River in Far Northeast Philadelphia.



Shoreline along the western banks of the Delaware River

Source: [North Delaware Aerials](#)

4.1.a - Soils

The physical properties of the soils in the Delaware River drainage basin are the determining factor in the sediment-transport characteristics of the river and its tributaries. The soils, in turn, are determined by the geology and weathering processes of the rock material.

Approximately 95% of the Delaware Direct watershed is dominated by soils classified as Urban Land because they have been highly modified through development.

Approximately 68% of the total land area is impervious surface resulting from buildings, parking lots, rooftops and roads dominating the landscape. Figure 4.2 shows the prevalence of urban soils, which are denoted as the striped white region. The remaining 5% of soil types range from loam to silty loam and are found in the northern reaches of the watershed where development and impervious cover become less prevalent.

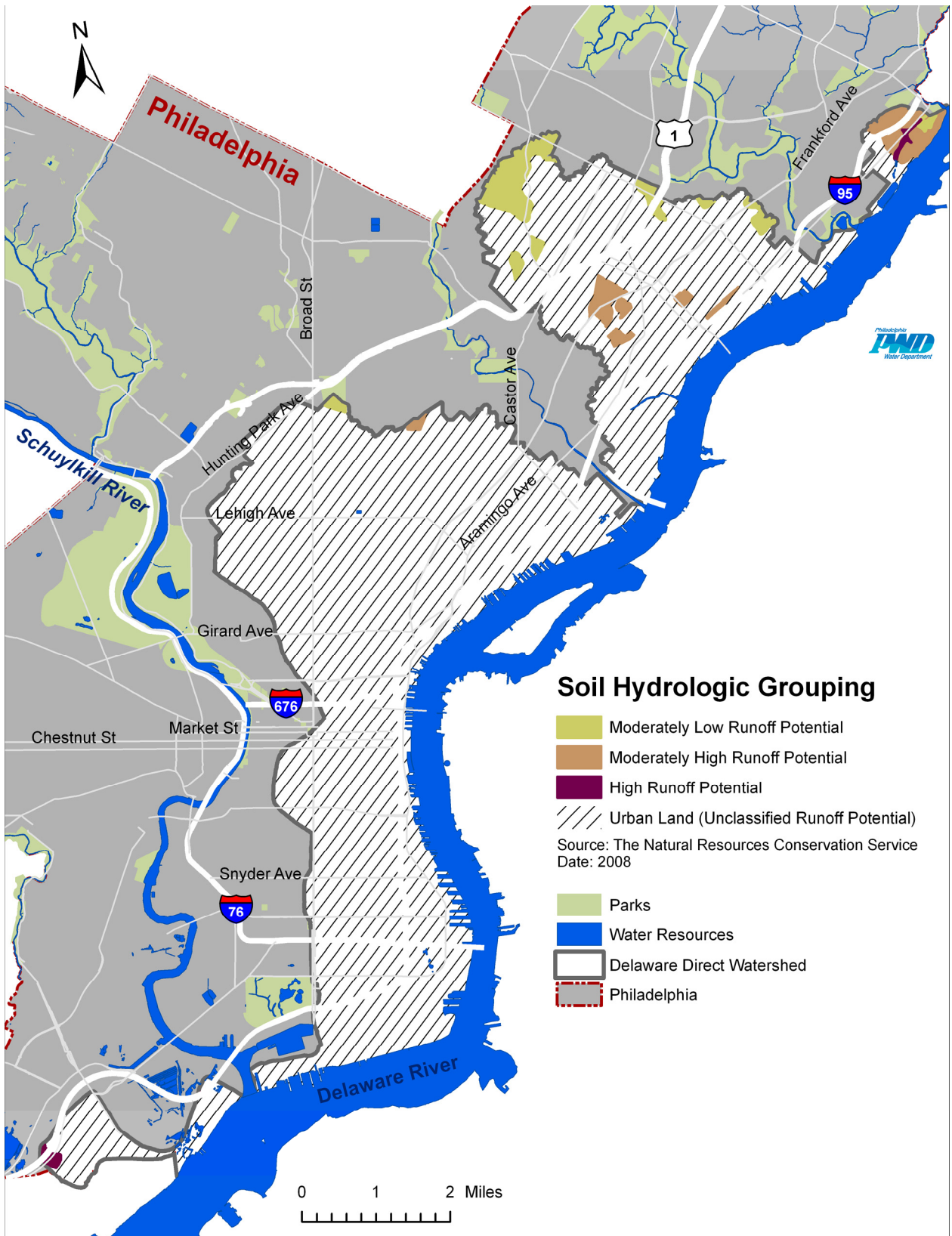


Figure 4.2 - Map depicting hydrologic soil groups in the Delaware Direct Watershed

The following points are examples of the composition of urban soils. In metropolitan areas, modification of the soil can vary, and these characteristics are defined by the United States Department of Agriculture ([USDA](#)) and the Natural Resources Conservation Service ([NRCS](#)) in their [Urban Soils Primer](#) document:

- Natural soil materials that have been moved around by humans
- Construction debris
- Materials dredged from waterways
- Coal ash
- Municipal solid waste
- A combination of any or all of the above

The USDA and NRCS have defined four hydrologic soil groups that are representative of the runoff potential. There are four categories of soil groups ranging from A to D, where Group A describes soils with very low potential for runoff and Group D contains soils with very high potential. The runoff potential is based on many hydraulic and hydrologic properties of fully saturated soils. Figure 4.3 outlines the hydrologic groups and depicts where extensive modification to the soils has not yet occurred. Urban soils do not fall under any of these hydrologic soil groups due to the uncertainty of the soil properties after alterations. Information regarding soil group definitions or characterization can be found in Part 630 Hydrology, Chapter 7 of the [National Engineering Handbook](#).

4.1.b - Sinkholes

Sinkholes are formed by dissolution of underlying bedrock most commonly composed of limestone, salt or gypsum. Cavities of all sizes can form from natural processes and anthropogenic stresses such as groundwater pumping. Collapse occurs when the land can no longer support the overburdening stresses. Although sinkholes are a dangerous and common trend across the state of Pennsylvania, the local geology and soil characteristics of the Delaware Direct Watershed are at low to no risk of sinkholes. The [United States Geological Survey](#) has further information about sinkholes.

4.2 Critical Areas

As human impacts continue to alter the landscape, recognition of critical and hazardous areas become more and more important to the health and safety of the nation's watersheds. Sites for the disposal of human and industrial wastes may occupy small areas within a watershed, but the lasting effects can have numerous impacts depending on the type of facility, abundance of chemicals and the compliance to regulations.

It is important to emphasize that hazardous site information is updated and changed on a regular basis. To review the most recent information in a specific location, please refer to the EPA's [Envirofacts](#) website.

4.2.a - Landfills and Waste Sites

The Pennsylvania Department of Environmental Protection records show there are currently no municipal waste landfill facilities within the Delaware Direct Watershed.

The City of Philadelphia promotes, develops and implements litter reduction programs in an effort to increase public awareness of litter as a source of pollution. There are 500 solar-powered compaction litter receptacles in Center City, and more than 700 standard litter baskets in other commercial districts throughout the City. The Inlet Cleaning (IC) unit is responsible for the inspection and cleaning of more than 78,000 stormwater inlets within the entire City of Philadelphia. The unit is also responsible for retrieving and installing inlet covers, replacing missing covers, installing locking covers and clearing choked inlet traps and outlet pipes, as well as alleviating flooded streets due to open hydrants, broken water mains, rain storms and during major fires. As a resident, business owner or community member, please visit the [What You Can Do](#) section at PWD's Office of Watersheds website for more simple ways to protect our waterways.

The Philadelphia More Beautiful Committee, supported by the City of Philadelphia Department of Streets, promotes the empowerment of local neighborhoods to keep streets clean, healthy and safe. Support, awards and resources are provided for neighborhood partners and residents and can be found on the [Philly Streets Department](#) website. The Department of Streets also runs the Streets and Walkways Education and Enforcement Program ([SWEEP](#)) to educate citizens about the laws of compliance and the benefits of keeping a clean city, with a main focus on commercial areas. The Streets Department has also launched the [UnLitter Us](#) campaign to unite the people of Philadelphia to end the blight of litter and put trash where it belongs.



Effects of anthropogenic debris along the Delaware Riverfront



Citywide initiatives and programs can keep the riverfront clean and green

The Philadelphia Automotive Scrap Yard Compliance Task Force Initiative was created specifically to address numerous complaints about scrap metal and auto salvage businesses operating in communities. The collaborative initiative includes support from federal, state and local organizations, including the U.S. Environmental Protection Agency ([EPA](#)) and the Pennsylvania Department of Environmental Protection ([DEP](#)). The task force conducts inspections, provides compliance and educational assistance and, where necessary, will support enforcement of noncompliance.

4.2.b - CERCLA/CERCLIS

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), frequently referred to as the Superfund Act, was enacted in 1980 to address abandoned hazardous waste sites. The United States EPA uses a national database called the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) to manage and track the activities and status of Superfund sites. The CERCLIS database is a non-enforced list of potential, known and archived areas of contamination.

Depending on the severity of contamination at a site, some projects may be added to the National Priority List (NPL) where federal funds would be set forth to remediate the area. The Superfund dollars are most commonly used on older sites where, due to the age of the contamination, the responsible party may be unknown. There are currently 148 sites on the CERCLIS list within the Delaware Direct Watershed. These sites vary with respect to their level of pollution and threat to the environment, with many of the sites only listed for investigation purposes and not due to public risk. Of the 148 sites, two are currently listed on the final NPL and one has been deleted from the final NPL. To reiterate, there may not be imminent pollution hazards associated with every location. Rather, there is potential for the EPA to further investigate the site and determine what future procedures, if any, the site may receive.

To view a complete table of the 148 listed sites located within the Delaware Direct Watershed, see Appendix C. The CERCLIS is updated approximately every three months and is publicly accessible on the [EPA Envirofacts](#) website.

4.2.c - Other Environmental Protection Databases

The Resource Conservation and Recovery Act (RCRA) was passed in 1976 to regulate and document the transportation, treatment and disposal of hazardous and non-hazardous waste. RCRA information, such as the CERCLIS database, tracks and reports the storage status and transportation locations of responsible parties and notifies the appropriate governmental entity if contamination to a site is found in association with any part of the waste cycle. The Delaware Direct Watershed contains many RCRA sites, as it is a hub for industrial, transportation and health services that handle a variety of waste products.

The Emergency Planning and Community Right to Know Act of 1986 (EPCRA) requires certain types of manufacturing facilities to submit annual reports of the chemicals released into the environment. The Toxic Release Inventory (TRI) program was

developed to provide a catalog of transported and released chemicals and make this information available to local communities. Businesses and landowners must provide documentation in the TRI database. In addition, all companies that come into contact with specified waste material (such as by storage or disposal) must report to the state and federal agencies.

Documentation for these programs is updated regularly at the state and federal levels. For local information regarding a specific area or site, refer to the [EPA Envirofacts](#) website for the most accurate data.

4.3 - Accidents and Spills

Spills and contamination events, accidental or intentional, pose a threat to the water quality of the Delaware River. Such catastrophic events can occur directly in the Delaware River or reach the water supply indirectly through a leak in a buried pipeline or car or truck accident. The most recent large spill occurred in 2004, when the single-hull tanker Athos I began leaking oil while docking. Approximately 263,000 gallons of oil were spilled into the Delaware River. This affected not only the Delaware, but also some upstream tributaries.

The Early Warning System (EWS) was established to notify drinking water utilities in the event of any change in the water quality of the Delaware River. To aid in the planning of emergency responses, the EWS is expanding to include catastrophes and terrorist attacks as well as industrial intakes and discharges into its system. Chapter 5 of this document provides more information about the water resources of the Delaware Direct Watershed.¹

Additional information:

[Geology of Pennsylvania](#)

[Sinkholes](#)

[Urban Soils Primer](#)

[EPA Envirofacts](#)

[SWEEP](#)

[Philadelphia More Beautiful](#)

[UnLitter Us](#)

¹ Philadelphia Water Department, Delaware River Source Water Protection Plan, 2007