

1.3 Topography

The water resource is related to the physical geography in several ways. Water availability is dependent upon climate, soil recharge properties, vegetative cover, artificial impermeable structures, stormwater runoff, and the ability of aquifers to store and redistribute water in response to recharge and diversions. The quality of the water in a basin is dependent upon the dissolved and suspended materials contained in the precipitation, the introduction of contamination at various points in the hydrologic cycle (see Section 1.16) from point and non-point sources, leachable materials that might naturally occur in the soils, the ability of the soils to absorb dissolved constituents and filter suspended constituents, the mineralogy of the aquifer, and the degree of protection conferred by the aquifer structure and location. The physical geography determines all of the naturally occurring features of the system. Indirectly, it influences the kinds of contaminants and the relative frequency of their incidence because the physical characteristics of a location determine its suitability for various forms of development, each with their characteristic forms of pollution.

This section and the following 3 sections (1.4 through 1.6) of this report relates how the physical geography in WMA 6 determines the availability and quality of the water resource through the physical characteristics of the bedrock and the soil. How these lithologic and pedologic features affect drinking water quality, well yield and mutual interference, the flow characteristics of streams, and the aquifer's vulnerability to contamination will be explained for each geologic unit and soil series as they are described in their respective sections of this report.

WMA 6 covers a portion of the state that is divided between two physiographic provinces (Plate 1.3.1). Physiographic provinces are subdivisions of a landmass based upon physical features. The areas within a province reflect a common geologic history and physical characteristics that continue to influence climate, hydrology, ecology, and cultural development. Each of the physiographic provinces is underlain by a specific group of geologic formations that were created by means of a specific combination of depositional and interior processes. This confers characteristic topography and landforms to each province (Plates 1.3.1 and 1.3.2).

Newark Basin Physiographic Subprovince

The southeastern half of the watershed management area is contained within the Newark Basin Physiographic Subprovince, which is primarily lowlands formed on inclined siltstone, shale, and sandstone strata, interrupted in places by long traprock ridges, and local hills formed of erosion-resistant diabase or conglomerate. In the northern areas, which include WMA 6, the surficial geology exhibits the effects of glaciation, including thick accumulations of till and laterally extensive glacial lake deposits.

The Newark Basin constitutes nearly all of the Piedmont Physiographic Province in New Jersey. The Piedmont Province (so called because of its location in the “foothills” of the Appalachians) is primarily a plateau region, underlain by Paleozoic and Precambrian rocks, extending from New York to Alabama. Although the entire region between the eastern foot of the Appalachian Mountains and the Coastal Plain was formerly designated “Piedmont” somewhat independently of physical geology, the Newark Basin and a string of related basins are distinct in being lowlands underlain by Mesozoic rocks. Some recent authors (Lyttle and Epstein 1989; Owens *et al.* 1998) have been treating the Newark Basin as distinct from the Piedmont proper. Others (Drake *et al.* 1996) retain the Newark Basin as a portion of the Piedmont. For the sake of continuity with older literature, this report refers to the Newark Basin as a subprovince of the Piedmont Province.

The Newark Basin Physiographic Subprovince extends from the foot of the Ramapo Mountains east to the Hudson River and south to the inner edge of the Atlantic Coastal Plain, which crosses the state along a line that stretches roughly from Woodbridge to Trenton (Lyttle and Epstein 1989). It extends northeast across the state border into Rockland County, New York and fills a triangular area between the state border, the Ramapo Fault, and the Hudson River (Fisher *et al.* 1970/1995). The term “Basin” in the name of a physiographic province should not be confused with a river basin. It is a geologic term referring to a locus for the accumulation of sediments and the formation of sedimentary rocks.

Highlands Physiographic Province

The northwestern half of the WMA 6 is contained within the New Jersey Highlands Physiographic Province. This province extends far beyond the borders of New Jersey and has also been referred to as the Reading Prong of the New England Highlands. Often it is simply referred to as the Highlands Province. The topography is hilly, with stream-dissected plateaus of high-grade metasedimentary rock (mostly gneisses) intruded (locally and regionally) by acidic and intermediate igneous rocks (including various types of granite and syenite, as well as diorite and amphibolite). Because of its rugged topography, the thickness of glacial materials varies greatly over relatively short distances. In contrast to the Newark Basin, where till is only really thin and discontinuous on the ridge crests, bedrock in the Highlands is never far from the surface, except in major stream valleys (Stanford 1989; Stanford *et al.* 1990, 1995). Glacial lakes in the Highlands were relatively very small and their deposits are thinner and more localized than those in the Newark Basin.

Within the Highlands Province in WMA 6, there is also a portion of the Green Pond Outlier, which has physiographic characteristics similar to the Valley and Ridge Physiographic Province to the northwest. In contrast to the crystalline plateau, it consists of narrow, isolated valleys underlain by soft carbonate rocks and shale bounded by ridges of resistant sandstone and conglomerate (Herman and Mitchell 1991).

In New Jersey, the Highlands Province is bounded on the northwest by the Valley and Ridge Physiographic Province, the boundary passing through the southeast portions of Sussex and Warren Counties. The Newark Basin borders the Highlands Province on the south and southeast.

Elevation and Terrain

The topography of WMA 6 is varied (Plates 4 and 5), with elevations extending from the confluence of the Passaic and Pompton Rivers at approximately 160 feet above sea level to a few ridges and high plateaus in the Highlands that reach above 1,200 feet. The portion that lies within the Newark Basin is generally lower, only occasionally exceeding an elevation of 450 feet above sea level along the ridge crests, with the majority of the land being between 150 and 250 feet above sea level.

WMA 6 consists of the Upper Passaic River Basin and two large tributary systems: the Rockaway River Basin and the Whippany River Basin (Plate 1.1.2). Each basin consists of ten to twenty sub-basins. The Upper Passaic River drains the southern portion of WMA 6, the Rockaway River drains the north, and the east-flowing Whippany River drains the center.

The basalt ridges in the Newark Basin tend to have moderately steep sides, occasionally exceeding grades of 10 percent (Plate 1.3.3). The areas between the ridges exhibit a rolling topography due to differential erosion and deposition by water and ice. The headwaters of streams tend to cut narrow ravines into exposed rock of the hills or ridges where they arise. The areas between ridges and hills are generally gently rolling to quite flat. These flat areas, which include the Great Swamp, Troy Meadows, Hatfield Swamp, and Great Piece Meadows, are the remnants of former glacial lakes and can be quite extensive, covering several square miles. Streams in the Newark Basin tend to form dendritic drainage patterns, except in the vicinity of former glacial lakes where drainage is often poorly developed or artificially augmented, and between ridges, where a mixture of dendritic and trellis patterns can be seen.

By contrast, the portion of WMA 6 that is in the Highlands exhibits extremely rugged terrain (Plate 1.3.3). While there are many flat areas, which are associated with former glacial lakes, these are not as extensive as those found in the Newark Basin. Streams in the Highlands tend to develop a mixture of dendritic and trellis patterns due to the strong regional structure with its northeast-southwest orientation superimposed upon unstratified crystalline rocks.