## 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 4 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 4 is completely contained in a single physiographic province: the Newark Basin portion of the Piedmont Province (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 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 beyond the boundaries of WMA 4, from the foot of the Ramapo Mountains east to the Hudson River and south to the inner edge of the Altantic 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.

The Newark Basin 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 (Nichols 1968). In the northern areas, which include WMA 4, the landscape is punctuated with small-scale topographic features typical of late-stage glaciation such as eskers, drumlins, kettles, and kames (Stanford 1994). There are also deposits associated with glacial lakes including deltas and lakebed silts and clays.

**Elevation and Terrain**

The topography of WMA 4 is varied (Plates 1.3.1 and 1.3.2), with elevations extending from approximately sea level, where the Passaic River empties into Newark Bay to over 850 feet at a few points along the crests of Watchung Mountains. The majority of the land surface is between 50 and 300 feet above sea level.

WMA 4 consists of the Passaic River downstream of the confluence with the Pompton River. This includes one major major tributary: the Saddle River (Plate 1.1.2). This section of the Passaic Basin, excluding the Saddle River and its tributaries is called the Lower Passaic River. There are also some relatively well-known lesser streams that are tributary either to the Saddle River or to the Lower Passaic directly. Tributaries to Saddle River include Pine Brook, Saddle Brook, Hohokus Brook, and Sprout Brook. Tributaries to the Lower Passaic include Preakness Brook, Deepavaal Brook, the Peckman River, Molly Ann Brook, Goffle Brook, the Third River, and the Second River.

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. 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.