1.5 Surficial Geology

During the Pleistocene Epoch of the Quaternary Period, the sea level fell as much as 300 feet due to the amassing of ice sheets in the Northern Hemisphere. The advance of ice caused the erosion of hills and the deposition of various stratified and unstratified deposits (Plate 1.5.1).

Coarse-grained stratified deposits typically act as aquifers and provide water to wells in significant quantities (Gill and Vecchioli 1965; Stanford *et al*. 1990). Fine-grained stratified deposits tend to serve as confining layers, also known as aquitards. The unstratified material (called "till") tends to be poorly sorted and poorly permeable and may yield a small amount of water, sufficient for domestic wells. Typically fractured bedrock aquifers in the area are almost without primary porosity and hence have insignificant storage capacity. Where it directly covers a fractured rock aquifer, glacial till may act as a reservoir for the rock by means of its relatively much greater porosity (Vecchioli and Miller 1974).

Often the advance of ice into a pre-glacial drainage basin would block the stream that drains the basin. When this happened a glacial lake would form. These former glacial lakes were the site of multiple juxtaposed depositional environments and their associated sediments. The extent and character of these deposits are partly determined by the physiographic province.

Newark Basin Physiographic Subprovince

As the ice sheet advanced in the Newark basin portion of WMA 3, it blocked northward-flowing streams and the resultant back up formed several lakes. These lakes, which were common in the Newark Basin in northern New Jersey, ranged in size and longevity. The largest and more prominent was Glacial Lake Passaic, which formerly covered the area between the Second Watchung Mountain and the Highlands Province. Remnants of its shoreline extend from Kinnelon and Wayne Townships in the north to Bernards Township in the south. The Bog and Vly Meadows in the Borough of Lincoln Park are a remnant of Lake Passaic in WMA 3.

The principal types glacial lake stratified drift include: deltas, where meltwater streams entered glacial lakes; lacustrine fan deposits, where meltwater issued directly into a glacial lake from a submerged portion of the glacier front; and lakebed deposits, where suspended silt and clay settled through the water column at distance from where the meltwater entered the lake. Other stratified drift occurs in ice-contact deposits, where water-borne deposition occurred between the ice and till (or bedrock) or within a cavity in the ice itself.

After retreating from a locality, a glacier continues to supply meltwater, which can create thick sand and gravel aquifers in fluvial deposits, at times overlying glacial lake sediments (Stanford et al. 1990). These surficial sand and gravel deposits are the most prolific aquifers in WMA 3, especially those along the Ramapo River, between the

Second Watchung Mountain and the Ramapo Fault and in the Franklin Lakes area between the First and Second Watchung Mountains (Vecchioli and Miller 1973). Their surficial aspect and high permeability may these deposits vulnerable to the introduction and propagation of contamination.

In other areas, sheets of glacial till form a poor surficial aquifer, where sufficiently thick. Elsewhere, the till is not thick enough to provide a sustainable supply of water, but it does provide some recharge to underlying aquifers, including stratified drift and the Brunswick Group aquifers (Vecchioli and Miller 1973).

Highlands Physiographic Province

As in the Newark Basin, glacial lakes formed as a result of the blockage of north-flowing streams by the ice sheet. Wisconsinan till blankets the area, except for the higher elevations. Approximately 50 percent of the area of the Highlands portion of WMA 3 exhibits till deposits greater than 25 feet in thickness. Although lacustrine fan, deltaic, and lake bottom deposits are found in the Highlands, these are very limited in lateral extent, relative to sediments derived from comparable depositional environments in the Newark Basin.

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