

## SOILS

### INTRODUCTION

Soil is not an elemental material, but rather a mixture of various proportions of mineral and organic material, water, and air (Seglin 1975). The source, or parent material for the mineral component is weathered rock. The physical, biological, and chemical forces of nature cause the rock to break down, and through time, this weathered rock becomes very fine particles. In Hawthorne, the parent materials are the basalt rock of the Watchung Ridge, valley sandstone, and glacial sand and gravel deposits (Seglin 1975). The organic component is derived from plant material, such as, leaves, stems, and branches. Other important components include materials provided by animals, and the actions of bacteria and fungi.

Soils are a fundamental component of a region's plant, animal, and human ecology. These unconsolidated materials provide the growth media for plant communities, dictate the viability of the agricultural base, are the source of many construction materials and determine the capability of land development. Their permeability determines the infiltration rate of precipitation and surface water to the groundwater reservoir and the limitations for septic fields. Their strength and stability characteristics largely determine the type and size of foundations for all types of structures and the capacity to construct roads.

Although small in geographic area, Hawthorne displays a wide variety and number of different soil types (**Fig. 5**). This characterization can be attributed to the recent glacial period and the diversity of topography. Although much of the soil in Hawthorne has been altered by urbanization, a significant amount of soil is still close to or in its natural state. Understanding the structure and characteristics of soils in Hawthorne is essential for almost all planning and engineering activities.

### SOIL CLASSIFICATION

A number of different soil classification systems are in use, each designed to evaluate soils for different purposes, such as engineering and agriculture. The most common method of soil classification in this country is the United States Department of Agriculture's Soil Conservation Service (SCS) Survey (now the Natural Resources Conservation Service). This hierarchical method (United States Comprehensive Soil Classification System) divides soils into orders, suborders, great groups, subgroups, families, and series.

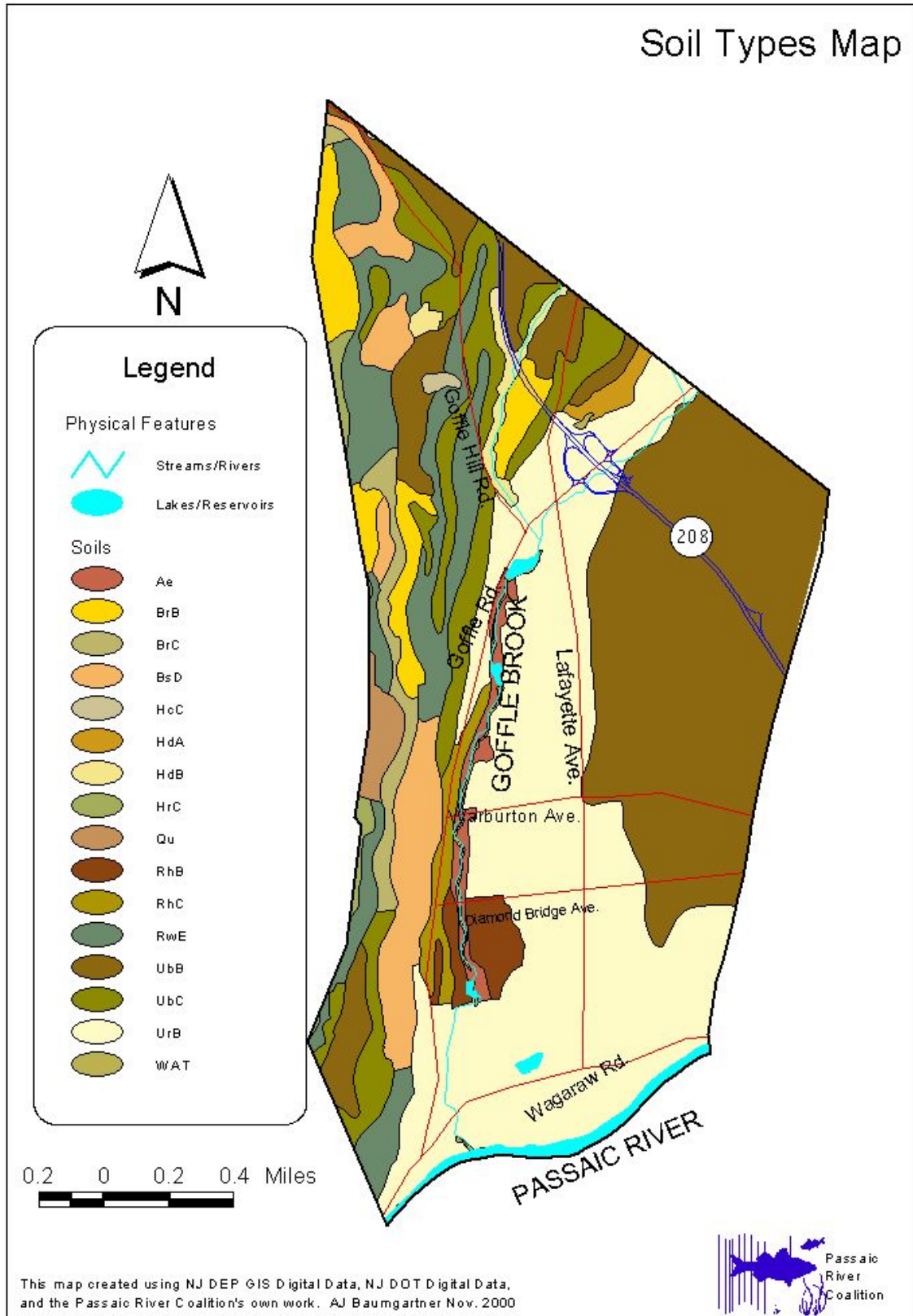


Fig. 5. Map of Soil Types in the Borough of Hawthorne.

Soil orders are very general and are identified according to the presence or absence of certain diagnostic horizons. Horizons are layers of soil representing relatively uniform materials that extend laterally (approximately parallel) to the ground surface (Fig. 6) (Brady 1984). In Hawthorne, there are three orders of soils: Inceptisols, Ultisols, and Alfisols (Seglin 1975). Generally, Inceptisols are much younger soils that lack significant development of soil horizons (Buol et al. 1973). Ultisols are older more weathered soils that display acidity and horizons with significant accumulations of clay. Alfisols are characterized by extensive horizon development, slight acidity, and are generally found in areas with ample rainfall.

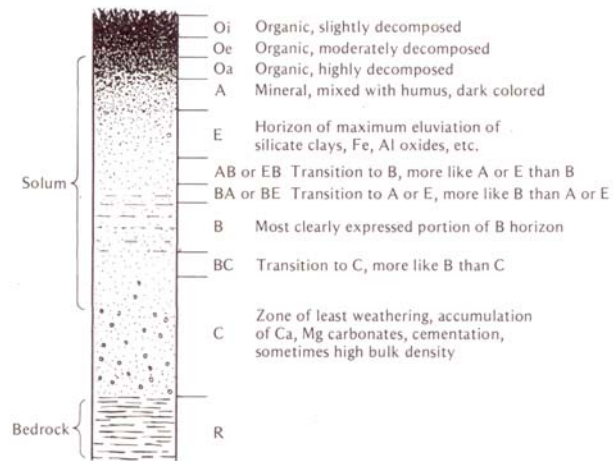


Fig. 6. Sketch of Soil Horizons. Figure modified for Brady 1984.

Soil series are very specific descriptions of a local soil's characteristics. A soil series is the most specific classification and is used to identify and differentiate local soils (Donahue and Shickluna 1977). Soils within a region that have similar profiles and horizons are assigned to a soil series (Brady 1984). The soils in a series, however, will have different surface characteristics such as slope or stoniness (Seglin 1975, Brady 1984). On the basis of such textural differences, a soil series is divided into phases named to indicate a feature that affects land management. In Hawthorne there are five such textural soil types (Seglin 1975).

The following is a list of local soil series found in the SCS survey for Hawthorne and the orders to which they belong: Haledon Wet Variant (HdA, HdB), Holyoke (HrC), Otisville (unknown), Pompton (PvA), Preakness (Px), and Riverhead Series (RhB, RhC) soils all belong to the Inceptisol order (Seglin 1975), while the Hibernia (HpC), and Rockaway series (unknown) belong to the Ultisol order (Seglin 1975). The Boonton (BrB, BrC, and BsD) and Haledon (HcC) series belong to the Alfisol order (Seglin 1975). The three letter abbreviations are used in the legend of the soil map to identify each series (Fig. 5).



## SOIL DESCRIPTIONS

The soils of Hawthorne are determining factors in the suitability of a site for agriculture, foundations for homes, septic tanks or landfills, roads, and other engineering or agricultural uses. A brief description of differing soil series in Hawthorne follows:

**UbB and UbC. Urban land, Boonton complex.** These soils exist in areas where the topography has been greatly altered by urbanization and development. The original soils in this complex were primarily Boonton type soils as well as smaller amounts of Holyoke and Haledon soils. Extensive areas of this soil complex are paved over, or covered with structures. Slopes are generally between 3 and 8 percent, and the average depth to bedrock typically ranges from 3-10 feet. The UbC type soil differs in that it exhibits a slope of 8-15%, 4.6-14.9 degrees; yet it is still highly urbanized. UbC type soil poses a limit to development because the land must be extensively cut and filled in order to be built upon. Both soils are derived from glacial deposits. Runoff is greatly increased due to the urban characteristics of the topography.

**UrB. Urban Land Riverhead complex.** This group consists of areas in which land has been altered through urbanization. Also included in this group are small inclusions of urbanized Otisville and Pompton soils. Slopes are generally between 3-8% or 1.7-4.6 degrees and large parts of the soil are under pavement or structures. Depth to bedrock is usually more than ten feet. The soil is characterized by its stony, gravelly, and sandy texture, as it was formed from glacial outwash.

**RwE. Rock Outcrop-Holyoke complex.** This complex is comprised of basalt bedrock outcrops and Holyoke soils. The basalt outcrops generally make up from 30-50% of the land area and Holyoke soils make up the other 50-70%. The slopes tend to range from 15-35% or 14.9-33.7 degrees. Small areas of Boonton and Haledon soils can also be found in this complex. The bedrock outcrops, shallow stony soils, and steep slopes seriously limit the use of the land in this complex. The land is generally not suited to construction of buildings with basements, and septic tanks are wholly impractical and ineffective on land of this type. Erosion is not a problem on land of this type that has been left unaltered.

**Boonton Series.** This type of soil is characterized by gently to steeply sloping loamy soils with a fragipans in the lower layers. A fragipan is a layer of silt and cemented fine sand that can range in thickness from a few inches to several feet. They have very low permeability and often result in perched water tables, as the water cannot penetrate it easily. Despite the presence of fragipans, this type of soil tends to drain well because it usually exists on sloped land. The perched water table poses a moderate limitation on the use of septic systems, and increases the risk of slope failure on road cuts. Stones on the surface are 30-100 feet apart. The erosion risk varies with steepness in the Boonton series.

**BrB. Boonton stony silt loam.** This soil's profile is characteristic of the Boonton series, and typically displays a slope of 3-8% or 1.7-4.6 degrees. Tiny areas of Holyoke and Haledon soils are found in this group as are small areas of Boonton soils that lack fragipans.

**BrC. Boonton stony silt loam.** This soil's profile is characteristic of the Boonton series, and typically displays a slope of 8-15% or 4.6-14.9 degrees. Small amounts of Holyoke and Haledon soils are found within this group, as are

some isolated areas of Boonton soils that lack fragipans. The risk of erosion is moderate in areas where the natural vegetation has been removed.

**BsD. Boonton very stony silt loam.** This soil's profile is generally characteristic of the Boonton series, but there are some deviations, and typically displays a slope of 15-30% or 14.9-29.2 degrees. It is different in that stones on the surface range from 5-30 feet apart. There were tiny amounts of Holyoke soil present in this group as well as small amounts of soil that lack a fragipan. Erosion becomes a problem on this type of soil when vegetation is removed due to its steepness.

**Riverhead Series.** This series of soils consists of deep, well drained, coarse textured soils. They are usually gently to strongly sloping and are found in areas adjacent to the Highlands. Permeability is relatively rapid; therefore, the soils are well drained. One hazard of this rapid permeability is that septic tank effluent may cause groundwater contamination. This series of soil formed largely from glacial outwash deposits and is an excellent source of sand and gravel.

**RhB. Riverhead sandy loam.** This soil contains all of the characteristics of the Riverhead series, and typically demonstrates a slope of 3-8% or 1.7-4.6 degrees. Included in this mapping group were small areas of Otisville, Pompton, Preakness, Rockaway, and Hibernia soils.

**RhC. Riverhead sandy loam.** This soil contains the characteristics of the Riverhead profile and displays a slope ranging from 8-15% or 4.6-14.9 degrees. As with other soils in the Riverhead series, there are isolated areas of Otisville, Pompton, Rockaway, and Hibernia soils included in this mapping area.

**HrC. Holyoke Series.** The Holyoke Series consists of well-drained soils with a shallow bedrock base. These soils range from gently sloping to very steep and are characteristically found on the sides and tops of the basalt ridges in the southern part of the county. Holyoke soils are moderately permeable

**Haledon Series.** The Haledon series is characterized by poorly drained loamy soils that generally have a fragipan in the lower subsoil. A fragipan is a layer of silt and cemented fine sand that can range in thickness from a few inches to several feet. They have very low permeability and often result in perched water tables, as the water cannot penetrate it easily. The Haledon series ranges in slope from gently to strongly sloping. They can be found in waterways and toe slopes near the basalt ridges in the southern part of Passaic County. The Haledon series soils were formed in glacial till derived from basalt, red sandstone, shale, and gneiss. The soil is moderately permeable above the fragipan, but its presence leads to perched water tables and lateral flow of water underground. This lateral flow severely limits the construction of basements, septic systems, and impairs road cuts by making them more susceptible to failure. Erosion is not a serious threat with Haledon soils that are covered by vegetation.

**HcB. Haledon very stony loam.** This soil's characteristics are identical to those of the series, and it exhibits a 3-8% or 1.7-4.6 degree slope. The soil has high water tables, abundant stones generally at distances of 5-30 feet from each other, and a dense fragipan. In this mapping group tiny areas of Boonton, Rockaway, and Haledon soils without rocks can be found.

**HcC. Haledon very stony loam.** This soil has characteristics, which follow those for the soil series, and displays a slope of 8-15% or 4.6-14.9 degrees. High stone content and perched water tables characterize this type of soil. It is possible to find isolated areas of Boonton, Holyoke, and Pompton soils in this mapping group.

**HdA. Haledon very stony silt loam, wet variant.** This soil contains most of the characteristics of the Haledon profile and has slopes ranging from 0 to 3% or 0-1.7 degrees. It differs in that it is wetter, more poorly drained, and usually almost perfectly flat. Stones are prevalent in this soil and are usually 5-30 feet apart, but concentration decreases with depth. Isolated spots of Whippany and Parsippany soils may be found in this mapping group.

**HdB. Haledon very stony silt loam, wet variant.** This soil contains most of the characteristics of the Haledon profile and has slopes ranging from 3 to 8% or 1.7-4.6 degrees. It is very poorly drained with very high water tables. Included in this mapping unit are isolated areas of Boonton soils.

**Ae. Alluvial land.** This type of topographic feature consists mostly of poorly drained soil on flood plains, 3-8 feet above the normal stream level. These soils are typically flooded one or more times each year, usually for a duration of 2-5 days. Slopes tend to range from 0-3% or 0-1.7 degrees. Generally the top 12 inches of alluvial land are comprised of a fine silt or sandy loam, and is typically underlain by coarse sand and gravel. The water table can vary from ½ -5 feet depending upon the season (lowest in summer), but the major limitation to use of this type of land is flooding.

**Px. Preakness Soil Series.** The Preakness soil series consists of deep, flat, poorly drained, loamy soils characterized by a water table at the surface during late winter and early spring. They are found in low positions on a landscape and receive large amounts of runoff. Permeability is moderate, despite the fact that it is found in areas with high water tables. Erosion is not a major threat with this type of soil, although wind toppling trees is because of the wetness of the soil

**Orc or OsD. Otisville Soil Series.** This soil series is unique since it is very well drained due to its sand and gravel sub-layer. Its steepness can range from gently sloping to steep. It is generally found on the sides of valleys. The permeability is very good, yet this poses a pollution risk in places with septic fields or leaking storage tanks because contaminated water is easily transported through it.

**PvA. Pompton Soil Series.** Pompton soils are characterized by their moderately coarse texture, gravel substratum, and poor drainage. They are derived from glacial outwash made up of shale, sandstone, gneiss, and basalt. They exhibit moderate permeability, but due to high water tables and low slopes, they are usually wet.

**HpC. Hibernia Soil Series.** This soil series is typified by extremely stony, poorly drained soils that have a fragipan in the lower soil layers. (Refer to Haledon series for definition of fragipan) This soil ranges from gently sloping to steeply sloping and is generally found near drainage ways. The surface of the soil is moderately permeable, but due to the presence of fragipans, perched water tables and poor drainage are very common (Seglin 1975).

The limitation of soil for engineering purposes for each of the above soil series is located in Table 1.

### SOIL DISTRIBUTION

Urban Land is the most common soil type in Hawthorne, encompassing the eastern two-thirds of the Borough (**Fig. 7**). This altered soil is a composite of gently sloping Boonton and Riverhead soils that have been utilized for construction of residential, commercial, and industrial areas. The Alluvial land in Hawthorne is located in the floodplain of Goffle Brook. The brook, due to erosion, is the source of deposition of new alluvial materials within the riparian course.

The Haledon and Riverhead series soils are located adjacent to the Alluvial soils in the Goffle Brook and Deep Brook sections of town. The Riverhead soils are remnants of glacial outwash, having high permeability rates that directly discharge into the water body. The Haledon soils containing a fragipan, have very low permeability levels and high water tables discharging water to the adjacent water body.

The Boonton, Holyoke-rock outcrop and Rockaway series soils are located on the western edge of the Borough on the steeper slopes of the First Watchung Ridge. These soils have as part of their parent material the underlying basalt. The Holyoke and Rockaway series are shallow soils with a high content of rock outcrops. Most of this land has substantial development constraints and therefore, large areas remain vegetated.

**Fig. 7.** Soil Distribution throughout Hawthorne. Data generated from the Map of Soil Types in the Borough of Hawthorne & NJDEP GIS Digital Data.

