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Water Table in the Inland Bays Watershed
Delaware

Special Publication No. 27
Water Table in the Inland Bays
Watershed, Delaware
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What is the water table?

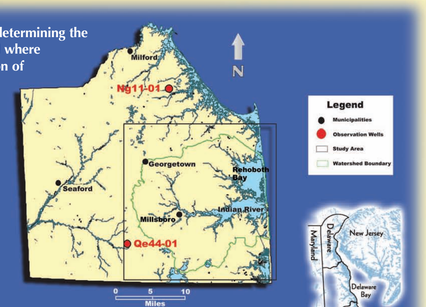
Freeze and Cherry (1979, p. 39) define the water table as "the surface on which the fluid pressure in the pores of a porous medium is exactly atmospheric." In practice, the water-table surface is measured in wells constructed with openings along their lengths and penetrating deep enough to encounter standing water. All water found at and beneath the water table is ground water.

Why map the water table?

Depth to the water table affects many aspects of how people use the land and live in the Inland Bays watershed. Depth to the water table determines whether a site is suitable for a standard subsurface wastewater disposal (septic) system or will require an alternative design or even centralized sewage collection and disposal. Shallow depth to ground water has been the driving factor for construction of the extensive ditch networks found south of Indian River Bay. The direction of ground-water flow can be estimated from water-table elevation maps. In many areas the water table is the top of the aquifer that supplies water for potable, agricultural, commercial, and industrial uses. Thickness of this aquifer is one factor controlling the amount of water available to wells.

In areas immediately adjacent to the bodies of salt water, elevation of the water table, in part, controls the location of salt water in the aquifer. Aquifer thickness and ground-water flow rate are the other primary controls on the location of salt water.

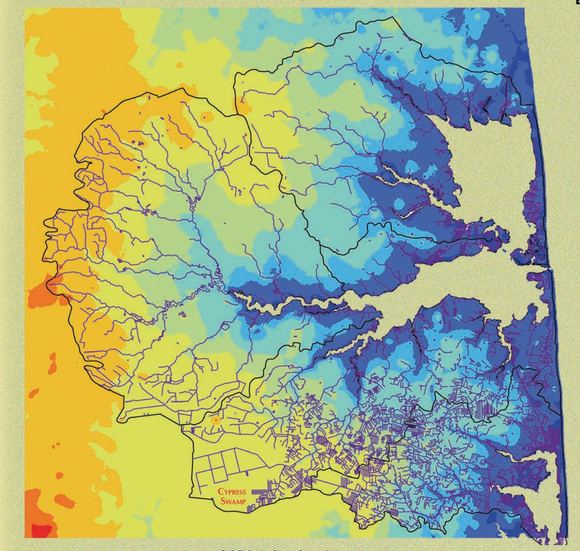
Depth to the water table is a dominant factor in determining the ecologic function of a landscape. Wetlands are found where the water table is at or near land surface. The duration of standing water or shallow depth to water table conditions in large part prescribes the plant and animal communities that can live at that site. Under fair weather conditions, stream surfaces represent the intersection of the water table with land surface.



What does this poster show?

This poster shows three different map views of the water table as well as information about how the maps were made, how the depth to the water table changes with seasons and climate, and how the water table affects use and disposal of water. The map views are of depth to the water table, water-table elevation (similar to topography), and water-table gradient (related to flow velocity). Andres and Martin (2005) provide technical details of water-level data analysis and map production.

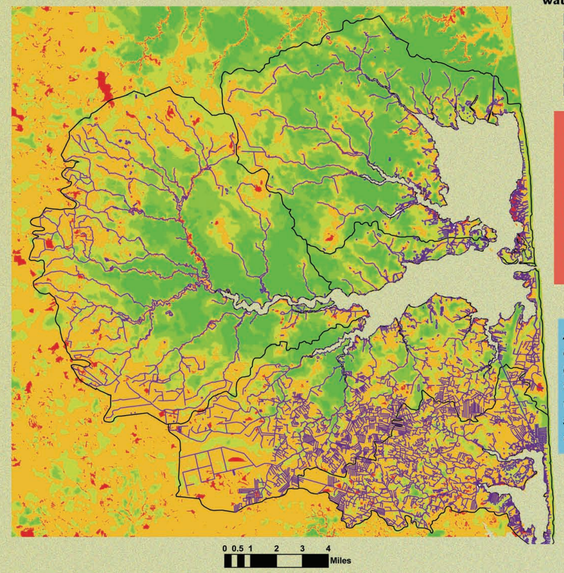
Water-Table Elevation



Water flows from high elevations to low elevations.

Water-table elevation maps are routinely used to determine ground-water flow directions.

Depth to Water



Under normal conditions 79% of the land area within the Inland Bays watershed has a depth to water of less than ten feet.

Additional evaluations of depth to water in the Inland Bays watershed are shown in the table below.

Depending on hydrologic conditions, 19-49% of the Inland Bays watershed has depth to water of less than 5 feet, which makes a large portion of the watershed unsuitable for standard subsurface wastewater desposal systems.

Wetlands, such as Cypress Swamp, occur where the water table is at or near land surface for a portion of the year. Shallow depth to water, in large part, prescribes the plant and animal communities that can live at a site.

Percentage of land area related to depth to water

Water-Table Condition	Depth to water in feet below land surface					
	0	<2	<5	<10	<15	<20
Wet	1%	9%	49%	86%	98%	>99%
Normal	1%	6%	30%	79%	96%	>99%
Dry	1%	4%	19%	63%	96%	>99%

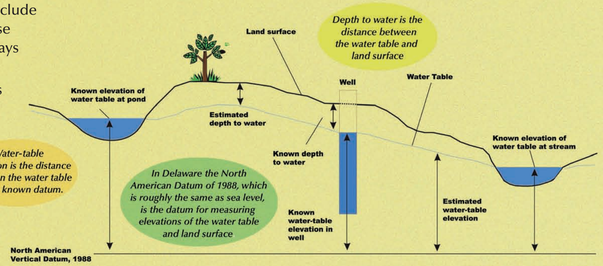
References Cited

Andres, A. S., and Martin, M. J., 2005, Estimation of the water-table surface for the Inland Bays Watershed, Delaware: Delaware Geological Survey Report of Investigations No. 68 p., 28 p.

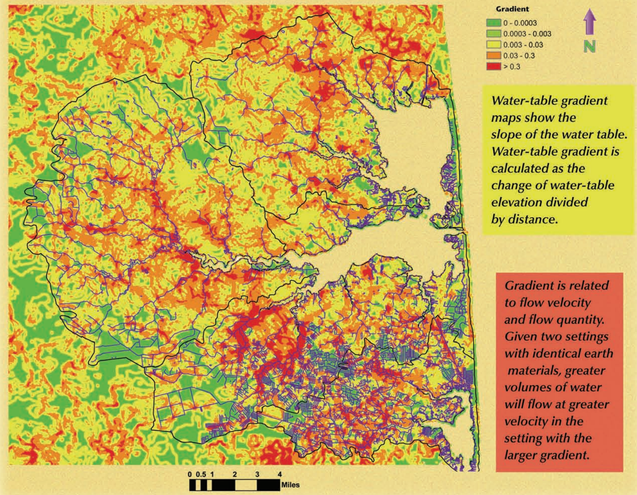
Freeze, R. A., and Cherry, J. A., 1979, Groundwater: Englewood Cliffs, NJ, Prentice-Hall, Inc., 604 p.

Mapping methods and concepts

The data used to create these water-table maps include water levels measured in about 400 wells. Because streams, ponds, ditches, and swamps almost always represent the intersection of the water table and land surface, the elevations of these features are also used as data to estimate the elevation of the water table. Geographic information systems (GIS) software use the data in statistical equations to estimate the elevation of the water table at over 1.2 million points arranged in a rectangular grid over the map area. The GIS software displays the results on color-coded maps.



Gradient Map

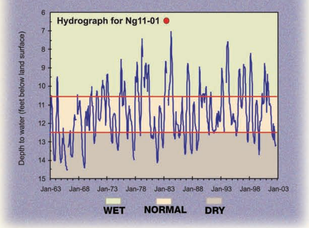


Water-table gradient maps show the slope of the water table. Water-table gradient is calculated as the change of water-table elevation divided by distance.

Gradient is related to flow velocity and flow quantity. Given two settings with identical earth materials, greater volumes of water will flow at greater velocity in the setting with the larger gradient.

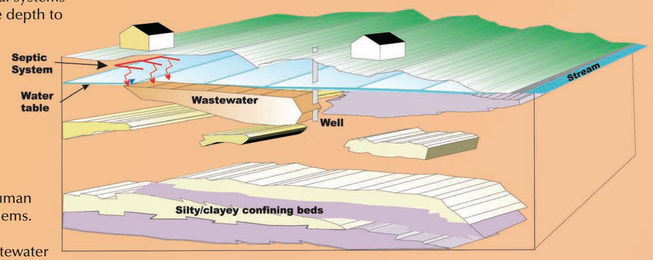
Water-table conditions

Water-table depths have been measured in a number of observation wells in Delaware every month for several decades. From these measurements we have learned that depth to water generally is deeper when it is warmer and drier, and shallower when it is colder and wetter. Water depths are usually greater in the summer even though more rain falls during summer months because water evaporates and is used by plants faster than rainfall can flow through the soil to the water table. Comparisons of the years of data are used to classify water-table conditions as dry, normal, or wet. The adjacent chart shows a plot of water-level measurements with time, or hydrograph, for well Ng11-01. Water levels from this well were used with water-level measurements made in well Qe44-01 to define average water-level conditions for the entire watershed.



Water-table and wastewater disposal

The water table plays an important role in the design and operation of individual on-site wastewater disposal systems (i.e., septic systems). In areas where the depth to the water table is too shallow, however, septic systems will often fail causing untreated wastewater to back up into homes or flow out on the land surface. In some cases, alternative system designs may be adequate be to prevent back ups and break outs from occurring.



Because of the rapid development in the watershed, the continued reliance on septic systems can be expected to cause potential human health and certain environmental health problems. This is a main reason why state and county governments are constructing centralized wastewater collection, treatment, and disposal systems, and removing septic systems.