HYDROGEOLOGY OF THE CROTON-OSSINING AREA WESTCHESTER COUNTY, NEW YORK

By Richard J. Reynolds

Abstract

The hydrogeology of a 29-square-mile area surrounding the village of Croton-on-Hudson, N.Y. is summarized on five sheets at 1:12,000 scale that show (1) locations of wells and test holes, (2) surficial geology and geologic sections, (3) bedrock geology and fracture systems, (4) land use, and (5) soil permeability.

The primary stratified-drift aquifer in this area is the Croton River aquifer, which consists of outwash sand and gravel that partly fills the Croton River valley from the New Croton Dam downstream to the Hudson River--a distance of approximately 3 miles. The valley is narrow and ranges in width from 100 to 1,500 ft, and its V-notch bedrock floor ranges in altitude from 30 to 50 ft below sea level. Detailed hydrogeologic studies conducted by the U.S. Geological Survey during 1936-38 revealed an upper outwash aquifer with a saturated thickness of about 35 feet that is underlain by a silt and clay confining unit 8 to 10 ft thick, which in turn is underlain by a lower confined sand and gravel aquifer about 40 ft thick. Aquifer-test data and laboratory permeability tests show the average hydraulic conductivity of the upper outwash aquifer to be 475 ft/d (feet per day) and that of the lower confined aquifer to be about 300 ft/d.

The Croton River aquifer is recharged through direct precipitation, runoff from adjacent hillsides, and leakage under the New Croton Dam. Previous studies show the average daily leakage under the dam to be about 0.65 Mgal/d (million gallons per day) and the total average daily recharge to the aquifer between New Croton Dam and Quaker Bridge to be about 1.73 Mgal/d. Supply wells for the village of Croton-on-Hudson pumped an average of 1.22 Mgal/d in 1984--an increase of approximately 35 percent over 1936 pumpage. In 1936 virtually all of the water pumped by the Croton supply wells consisted of induced infiltration from the Croton River. The higher 1984 pumpage rates can be expected to cause either an increase in the amount of induced infiltration, a reduction in ground-water storage, or a combination of the two.

Fractured metamorphic bedrock continues to be the most widely used aquifer for domestic and commercial wells in the Croton-Ossining area. The Fordham Gneiss and the Manhattan Schist are the two most widely tapped bedrock units and together underlie most of the Croton-Ossining area. A third unit, the Inwood Marble, is a small but productive bedrock aquifer of limited areal extent that underlies most of the major stream valleys.

INTRODUCTION

The most heavily used aquifers in upstate New York are composed mainly of glacial and alluvial deposits that partly fill bedrock valleys. Ground water in these aquifers can be under either water-table (unconfined) or artesian (confined) conditions. Urban, industrial, and agricultural development has taken place over many of these valley-fill aquifers because they form level areas suitable for development and generally provide an ample ground-water supply.

The typically high permeability of these valley deposits and their generally shallow depth to the water table makes ground water in these aquifers vulnerable to contamination from landfills, salt-storage stockpiles, fuel-storage tanks, and other facilities that have a potential for contaminant leakage. In addition, urban and agricultural runoff, septic-tank leachate, and other nonpoint sources of contamination are capable of degrading the quality of ground water over large areas.

In 1980, the U.S. Geological Survey, in cooperation with the New York State Department of Health, began a program to define the hydrogeology of 18 heavily used unconsolidated aquifers in upstate New York (New York State Department of Health, 1981) to facilitate management decisions by State and local water agencies regarding present or potential contamination of ground water. Of these, 15 have been studied to date (Waller and Finch, 1982; Cosner, 1984). As a continuation of these efforts, the Geological Survey, in cooperation with the New York State Department of Environmental Conservation, began a study in 1983 to define the hydrogeology of the remaining three aquifers and of several other heavily used aquifers.

Purpose and Scope

This map set, at 1:12,000-scale, depicts the available hydrogeologic data for the Croton-Ossining area. It consists of five sheets that show locations of wells and test holes (pl. 1), surficial geology and geologic sections, (pl. 2), bedrock geology and fracture systems (pl. 3), land use (pl. 4), and generalized soil permeability (pl. 5).

Croton-Ossining Area

The Croton-Ossining study area, in northwestern Westchester County, covers about 29 square miles and includes the villages of Croton-on-Hudson and Ossining. The principal unconsolidated aquifer in the area is a valley-fill sand and gravel deposit that occupies the 3-mile reach of the Croton River valley that stretches southwestward from the New Croton Dam to the Hudson River near Croton Point. This aquifer occupies a narrow, V-shaped bedrock valley that was formed by the preglacial Croton River and ranges in width from 100 ft to approximately 1,500 ft. At present, only one public water supplier--the village of Croton-on-Hudson--pumps from this aquifer and supplies a population of about 7,000. Average daily pumpage from Croton-on-Hudson's three production wells in 1981 was 1.2 million gallons per day (New York State Department of Health, written commun., 1984).

LOCATION OF WELLS AND TEST HOLES

This map shows the locations of wells and test holes from which hydrogeologic information was obtained. Most of the wells shown were inventoried by the U.S. Geological Survey during 1953-54 as part of a water-resources assessment of Westchester County (Asselstine and Grossman, 1955). Several observation wells and test holes (see inset map) were installed during 1933-38 for a series of detailed studies in the Croton River valley by the U.S. Geological Survey in cooperation with the Village of Ossining (Thompson and Harrington, 1935; Leggette and Jacob, 1938). Additional observation wells and test holes were installed at the county landfill on Croton Point during 1972-75 as part of several studies by a private consulting firm for the county of Westchester (Geraghty and Miller, 1973, 1975).

Wells shown here are identified by a four-digit hyphenated number representing the seconds of latitude and longitude. For example, a well with a latitude of 41°13'06" and a longitude of 73°51'53" is represented by the number 06-53. Wells that are described by Asselstine and Grossman (1955) are further identified by a number in parentheses that is keyed to that report. Public-supply well fields are indicated by a community water-supply number assigned by the New York State Department of Health.

Brackish-Water Zone

This map also shows an inferred area of stratified drift in which wells may be affected by induced encroachment of brackish water from the Hudson River estuary as a result of pumping. Because the most downstream reach of the Croton River below Croton dam is tidal, wells installed in sand and gravel deposits near the head of tidewater may risk inducing brackish-water encroachment into the aquifer when pumped. This area is inferred primarily from topography. The risk of brackish-water encroachment depends on the hydraulic conductivity of the local aquifer material, the pumping rate of the well, the duration of pumping, the salinity of the Hudson River in Croton and Haverstraw Bays, and the presence of local silt or clay zones, which would retard the horizontal or vertical movement of brackish water through the aquifer.

Much of the saturated stratified drift (represented by shaded areas) from Croton Point south toward Ossining is fine, silty sand with variable amounts of clay and thus consititutes poor aquifer material that is suitable only for small-diameter, low-yielding wells.

SELECTED REFERENCES

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Cosner, O. J., 1984, Atlas of four selected aquifers in New York: U.S. Evironmental Protection Agency, Water Management Division Report, Contract No. 68-01-6389, 101 p.

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Thompson, D. G. and Harrington, A. W., 1935, Ground-water conditions along Croton River below New Croton Dam: U.S. Geological Survey open-file report, Albany, N.Y., U.S. Geological Survey, 56 p.

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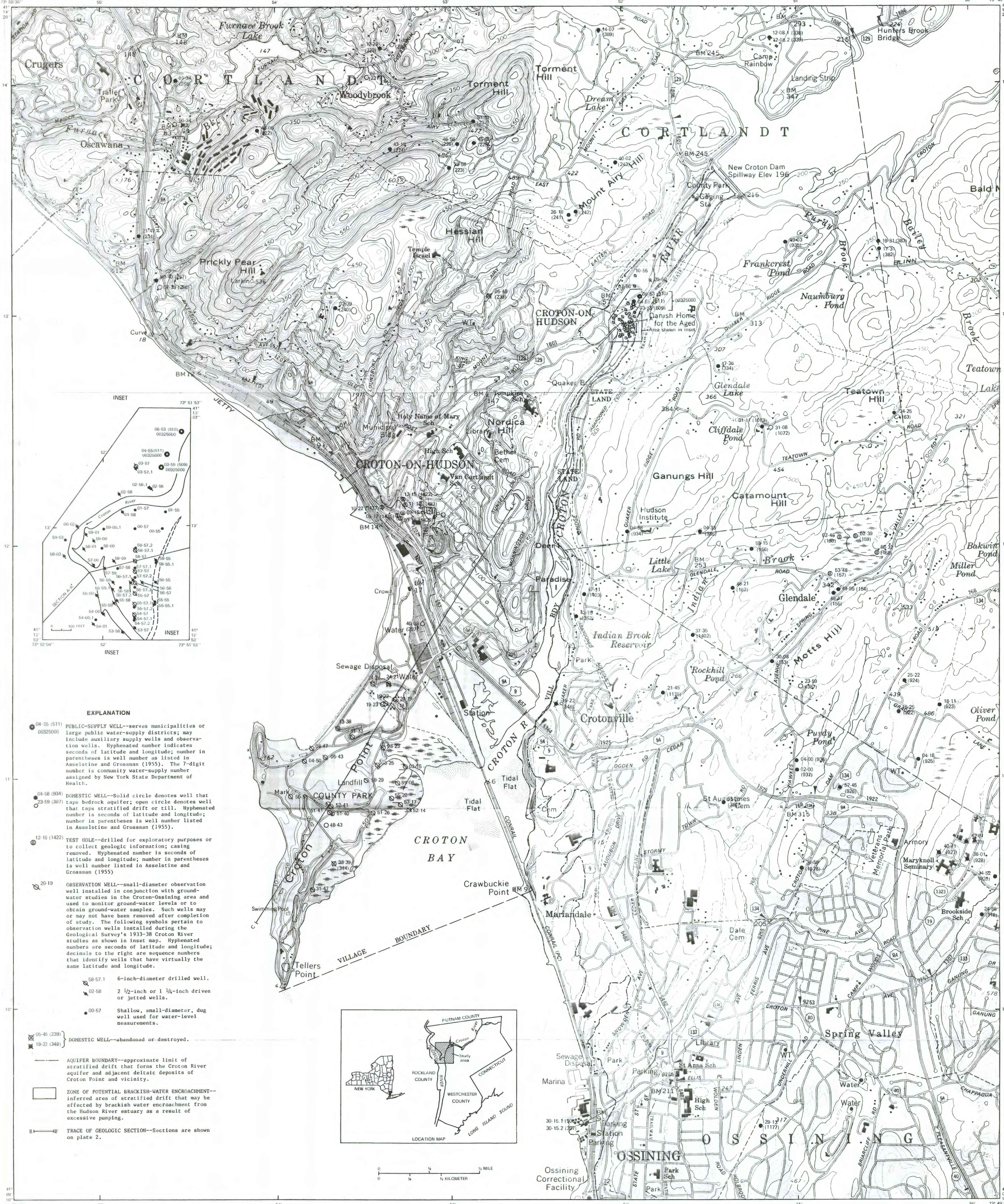
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

WATER RESOURCES INVESTIGATIONS REPORT 87-4156

PLATE 1--LOCATIONS OF WELLS AND TEST HOLES



EXPLANATION

04-55 (511) 00325000 PUBLIC-SUPPLY WELL--serves municipalities or large public water-supply districts; may include auxiliary supply wells and observation wells. Hyphenated number indicates seconds of latitude and longitude; number in parentheses is well number as listed in Asselstine and Grossman (1955). The 7-digit number is community water-supply number assigned by New York State Department of Health.

04-58 (934), 23-59 (387) DOMESTIC WELL--Solid circle denotes well that taps bedrock aquifer; open circle denotes well that taps stratified drift or till. Hyphenated number is seconds of latitude and longitude; number in parentheses is well number listed in Asselstine and Grossman (1955).

12-15 (1422) TEST HOLE--drilled for exploratory purposes or to collect geologic information; casing removed. Hyphenated number is seconds of latitude and longitude; number in parentheses is well number listed in Asselstine and Grossman (1955)

20-19 OBSERVATION WELL--small-diameter observation well installed in conjunction with ground-water studies in the Croton-Ossining area and used to monitor ground-water levels or to obtain ground-water samples. Such wells may or may not have been removed after completion of study. The following symbols pertain to observation wells installed during the Geological Survey's 1933-38 Croton River studies as shown in inset map. Hyphenated numbers are seconds of latitude and longitude; decimals to the right are sequence numbers that identify wells that have virtually the same latitude and longitude.

- 58-57.1 6-inch-diameter drilled well.
- 02-58 2 1/2-inch or 1 1/4-inch driven or jetted wells.
- 00-57 Shallow, small-diameter, dug well used for water-level measurements.

05-45 (239), 19-22 (348) DOMESTIC WELL--abandoned or destroyed.

AQUIFER BOUNDARY--approximate limit of stratified drift that forms the Croton River aquifer and adjacent deltaic deposits of Croton Point and vicinity.

ZONE OF POTENTIAL BRACKISH-WATER ENCROACHMENT--inferred area of stratified drift that may be affected by brackish water encroachment from the Hudson River estuary as a result of excessive pumping.

B B' TRACE OF GEOLOGIC SECTION--Sections are shown on plate 2.

Base from New York State Department of Transportation, 1:24,000, Ossining, 1982, Haverstraw, 1982

Hydrology by R.J. Reynolds, 1984

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Plate 1. Locations of Wells and Test Holes