U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
CITY OF BATAVIA, NEW YORK

INTRODUCTION

Demands for water in New York State continue to increase. Because ground water is generally easier to protect from contamination than surface water, many municipalities are seeking to develop their local ground-water resources. Most of the ground water in upstate New York comes from the saturated unconsolidated deposits that form valley-fill aquifers in most large glaciated valleys. Seismic-refraction techniques are useful for assessing hydrogeologic aspects of valley-fill aquifers, such as the altitude and configuration of refracting horizons such as the water table and the bedrock surface and, thus, can be used in siting test wells to evaluate the potential yield of an aquifer.

The city of Batavia withdraws water from the underlying valley-fill aquifer and from Tonawanda Creek. The aquifer supplies more than half of the city's water supply and is the only source of supply to many private and industrial wells. The chemical quality of water from the aquifer is generally better than the water from Tonawanda Creek (Cosner, 1984, p. 62). The city of Batavia wants to further develop its ground-water resources because the present supply wells might be inadequate to meet the needs of the city's growing population.

An area southeast of the city of Batavia that is potentially suitable for ground-water development was identified from (1) surficial geologic maps and aquifer-thickness maps (Terry and others, 1986), and (2) the inferred location of the buried preglacial Tonawanda Creek Valley (M.A. Pearce, United States Gypsum Co., written commun., 1991). In August 1992, the U.S. Geological Survey, in cooperation with the city of Batavia, conducted a seismic-refraction survey to define the thickness of unconsolidated deposits that could serve as potential aquifers in this area.

Purpose and Scope

This map depicts the thickness of unconsolidated deposits in southeastern Batavia, as interpreted from seismic-refraction data and well and test-well data. Well and test-well locations and the thickness of unconsolidated deposits along two geologic sections and four hydrogeologic sections as interpreted from the seismic-refraction data are indicated. Logs from wells and test wells provide additional information.

Acknowledgments

Thanks are extended to Dennis Larson, City Engineer for Batavia, and John Schaeffer, Superintendent of Water and Sewerage for the City of Batavia, for assistance in selecting the locations for seismic surveys. Well logs were provided by Moody's and Associates, Inc., Meadville, Pa., and Empire Soils Investigations, Groton, N.Y.

HYDROGEOLOGIC SETTING

The city of Batavia is in the Tonawanda Creek valley and is flanked by rolling glaciated uplands to the east and by hummocky morainal deposits to the north and west (Cosner, 1984, p. 61). The city occupies the northern part of the valley floor. The preglacial Tonawanda Creek flowed northward to Batavia, then northeastward to Lake Ontario. Glacial ice scoured the channel and widened and deepened the bedrock valley. The subsequent deposition of morainal till and ice-contact deposits near Seven Springs ponds blocked the creek outlet, altered the drainage pattern, and caused the creek to flow northwestward to the Niagara River at the outlet of Lake Erie. The major discharge area for local ground-water flow (shown as an arrow on the map) is east of the city of Batavia and follows the preglacial valley (Cosner, 1984, p. 71).

During deglaciation, meltwater filled the preglacial Tonawanda Creek Valley with outwash sand and gravel. These deposits are thickest south of Batavia and east of Tonawanda Creek and provide large quantities of water to wells. South of Batavia, the deepest part of the bedrock valley probably lies east of the present valley center, as interpreted from the southeastward dip of the bedrock and the steep east wall of the present valley (M.A. Pearce, United States Gypsum Co., written commun., 1991). Bedrock south of Batavia is primarily shale; bedrock northeast of Batavia is mainly limestone.

METHODS OF INVESTIGATION

The thickness of unconsolidated deposits in southeastern Batavia was delineated from seismic-refraction data and from well and test-hole data. Seismic-refraction surveys were completed in areas (1) where the surficial material has been mapped as outwash and alluvial sand and gravel, (2) where the surficial material's thickness is estimated to be 40 to 60 feet (Terry and others, 1986), and (3) at the inferred location of the buried preglacial Tonawanda Creek Valley (M.A. Pearce, United States Gypsum Co., written commun., 1991).

Seismic refraction is a surface geophysical technique that measures the time a compressional sound wave generated by a sound source takes to travel downward through various layers of earth materials and back up to detectors (geophones) at land surface. Physical laws that govern the propagation of sound are applied to the distances between the shotpoints and geophones and to the traveltimes of the refracted sound waves to interpret the thickness of unconsolidated deposits (Haeni, 1988, p. 3). The computer program for interpreting seismic-refraction data (Scott and others, 1972) generates a two-dimensional earth model that calculates sound velocities through unconsolidated deposits and bedrock The hydrogeologic sections shown below are interpretations of the program results.

The interpretation of seismic-refraction data requires certain assumptions regarding the seismic velocities and thickness of the various earth materials represented in the model. The error introduced by using seismic-refraction techniques to estimate the depth to refracting horizons, such as the water table or the bedrock surface, is commonly ± 10 percent of the true depth (Haeni, 1988, p. 19). Therefore, test drilling is needed to ascertain the composition of the unconsolidated deposits and their water-yielding potential and to confirm the depths to water and bedrock surface indicated by the seismic-refraction survey.

Well and test-hole data were used in conjunction with the seismic-refraction data to construct geologic sections A-A′ and B-B′. If the well did not penetrate bedrock, the bottom of the well was considered to represent the minimum depth to bedrock.

THICKNESS OF UNCONSOLIDATED DEPOSITS

The thickness of unconsolidated deposits is the difference in altitude between land surface and the bedrock surface. The geologic sections that cross the valley-fill aquifer are designated A-A′ and B-B′; the areas of seismic-refraction investigation include seismic lines C-C′ and D-D′ south of Batavia, and E-E′and F-F′ southeast of Batavia.

The thickness of unconsolidated deposits increases northeastward near the bend in section C-C′ shown on the map, and is assumed to increase in that direction. The total thickness along C-C′ exceeds 110 feet, and the minimum bedrock surface altitude is about 800 feet above sea level. A sand-and-gravel quarry to the east indicates coarse-grained deposits near land surface in this area. Unconsolidated deposits become thickest where geologic section A-A′ crosses seismic line D-D′. This area might represent the location of the buried preglacial Tonawanda Creek Valley. Here the thickness is about 150 feet, and the bedrock-surface altitude is about 750 feet above sea level. The bedrock surface probably begins to rise near the edge of the valley at point A′.

The thickness of unconsolidated deposits reaches 100 feet at point E′; here the bedrock-surface altitude is about 800 feet and rises southward to about 850 feet at seismic line F-F′, where the thickness of unconsolidated deposits decreases to 50 feet. Unconsolidated deposits about 100 feet thick are also found at the center of geologic section B-B′; if this location were connected with point E′, the connecting line would probably represent the axis of the buried preglacial valley.

SUMMARY

The unconsolidated valley-fill deposits southeast of Batavia, as calculated from seismic-refraction and well data, are thickest east of Tonawanda Creek, as shown in the sections along seismic line C-C′ between the bend in section and at point C′, and along seismic line D-D′ and point E′. These thick deposits could represent the location of the buried preglacial Tonawanda Creek Valley. Test drilling would be needed to identify the composition of the unconsolidated deposits and their water-yielding potential, and to confirm the depth to the water table and bedrock surface estimated by the seismic-refraction survey.

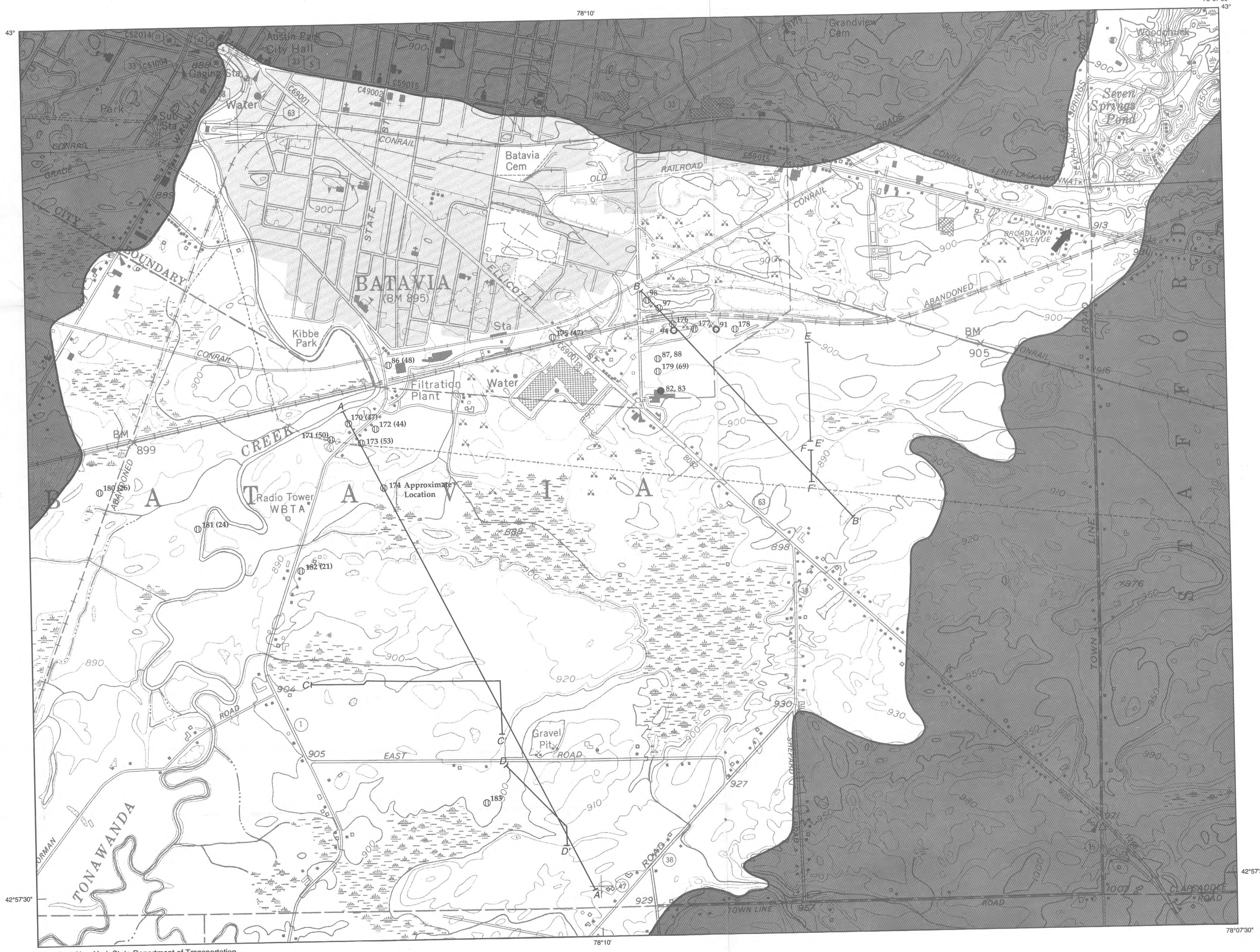
REFERENCES CITED

Cosner, O.J., 1984, Atlas of four selected aquifers in New York: U.S. Environmental Protection Agency, Contract No. 68-01-6389, Task No. 17, 102 p.

Haeni, F.P., 1988, Application of seismic-refraction techniques to hydrologic studies: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 2, Chap. D2, 86 p.

Scott, J.H., Tibbets, B.L., and Burdick, R.G., 1972, Computer analysis of seismic refraction data: U.S. Bureau of Mines, Report of Investigations 7595, 95 p.

Terry, D.B., Pagano, T.S., and Ingram, A.W., 1986, Geohydrology of the glacial-outwash aquifer in the Batavia area, Tonawanda Creek, Genesee County, New York: U.S. Geological Survey Water-Resources Investigations Report 85-4096, 7 sheets, 1:24,000 scale.



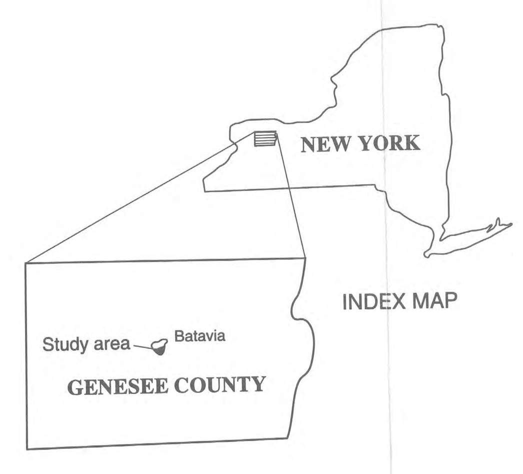
Base from New York State Department of Transportation, 1:24,000 series, Batavia South, N.Y., 1978

0 .5 1 MILE
0 .5 1 KILOMETER
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

- AQUIFER BOUNDARY--Modified from Terry, Pagano and Ingram, 1986
- C — C′ SEISMIC-REFRACTION LINE
- A — A′ GEOLOGIC SECTION
- GENERAL DIRECTION OF HORIZONTAL GROUND-WATER OUTFLOW--Modified from Cosner, 1984, p.71
- 175 (47) TEST WELL AND IDENTIFIER--Number in parentheses is the depth to bedrock from land surface, in feet
- 91 PUBLIC OR MUNICIPAL SUPPLY WELL AND IDENTIFIER
- 82, 83 COMMERCIAL OR INDUSTRIAL SUPPLY WELL AND IDENTIFIER

Well numbers are assigned by the U.S. Geological Survey according to a sequential numbering system for Genesee County.



INDEX MAP

Records of selected wells and test wells

U.S. Geological Survey (USGS) well numbers for Genesee County are assigned sequentially. Latitude (lat) and Longitude (long) are in degrees, minutes, and seconds. Altitude (Alt.) is land surface altitude, in feet above sea level. Date given is the nearest known date on which well or test well was completed. Owner's name is given for wells; driller's name and local well number are listed for test wells. Water levels are in feet below land surface. Depth ranges for the well logs (listed below) are in feet below land surface. Dashes indicate no data available.

Well Number	Lat ° ' "	Long ° ' "	Land-surface altitude	Date drilled	Owner	Driller	Local number	Water level	Date of measurement
82	425854	780948	903	08-01-58	O-At-Ka Milk Prod.	--	--	22.2	05-08-63
86	425859	781044	890	01-11-62	City of Batavia	Moody's and Assoc., Inc.	T1	--	--
87, 88	425902	780946	890	02-14-62	O-At-Ka Milk Prod.	Moody's and Assoc., Inc.	O-At-Ka 1,3	15	04-27-62
91	425905	780935	888.7	10-04-62	City of Batavia	Moody's and Assoc., Inc.	T14	11.7	05-06-63
94	425905	780940	889.8	09-25-62	City of Batavia	Moody's and Assoc., Inc.	T12	14.0	05-08-63
97	425908	780945	890	02-07-62	City of Batavia	Moody's and Assoc., Inc.	T8	13.7	02-15-62
98	425909	780946	890	02-12-62	City of Batavia	Moody's and Assoc., Inc.	T9	--	--
170	425851	781057	890	01-15-62	City of Batavia	Moody's and Assoc., Inc.	T2	--	--
171	425848	781102	887.7	01-62	City of Batavia	Moody's and Assoc., Inc.	T3	--	--
172	425850	781051	886.0	01-22-62	City of Batavia	Moody's and Assoc., Inc.	T4	--	--
173	425847	781054	889.1	01-25-62	City of Batavia	Moody's and Assoc., Inc.	T5	--	--
174	425840	781049	890	02-01-62	City of Batavia	Moody's and Assoc., Inc.	T6	--	--
175	425905	781009	890	09-14-62	City of Batavia	Moody's and Assoc., Inc.	T10	--	--
176	425907	781940	882.3	09-19-62	City of Batavia	Moody's and Assoc., Inc.	T11	9.8	09-19-62
177	425906	781935	891.6	10-01-62	City of Batavia	Moody's and Assoc., Inc.	T13	20.5	10-01-62
178	425906	781926	887.6	10-10-62	City of Batavia	Moody's and Assoc., Inc.	T15	17.7	10-10-62
179	425859	781944	890	02-22-62	O-At-Ka Milk Prod.	Moody's and Assoc., Inc.	O-At-Ka 2	--	--
180	425840	781156	895.8	05-23-79	USGS	Empire Soils Investigations	D-79-1	4.0	05-23-79
181	425833	781133	889.2	05-24-79	USGS	Empire Soils Investigations	D-79-2	5.0	05-24-79
182	425825	781109	893.9	05-22-79	USGS	Empire Soils Investigations	D-79-3	6.9	05-22-79
183	425745	781026	903.7	05-18-79	USGS	Empire Soils Investigations	D-79-4	8.2	05-18-79

Logs for wells and test wells

Well 82, 83
0-1 Topsoil
1-29 Clay, sand, and gravel
29-36 Sand, gravel, clay
36-40 Fine sand, clay
40-45 Sand and fine gravel, some clay
45-47 Sand and fine gravel
47-50 Sand, fine gravel, and clay

Well 86
0-8 Gravel fill
8-25 Coarse brown and blue-gray gravel
25-42 Fine blue sand with sand lumps
42-48 Hard-packed gravel
48-56 Black shale

Well 87, 88
0-7 Yellow clay
7-28 Coarse brown gravel, hard-packed boulders
28-62 Coarse brown gravel with sand mix
62-64 Yellow clay and gravel mix

Well 91
0-15 Clay
15-30 Clay and gravel
30-61 Fine to coarse gravel and sand
61-74 Fine to coarse sand
74-76 Clay, gravel, and sand
76-79 Fine to coarse gravel and sand
79 "Light clay" with gravel

Well 94
0-15 Fine to coarse gravel and sand
15-39 Fine gravel and sand
39-43 Coarse gravel and sand
43-52 Fine brown sand
52-60 Fine to coarse gravel and sand
60-67 Fine to coarse gravel and coarse sand
67-70 Cemented gravel and clay

Well 97
0-17 Coarse brown sand and gravel mix
17-27 Coarse brown gravel and sand mix
27-34 Fine brown sand, some gravel
34-59 Coarse blue sand, some gravel
59-60 Coarse gravel and clay, cemented (water bearing)

Well 98
0-3 Coarse brown gravel
3-23 Fine brown quicksand, water bearing
23-37 Coarse brown gravel and sand mix
37-41 Coarse blue gravel and sand mix
41-42 Blue clay and gravel mix

Well 170
0-6 Yellow clay and gravel
6-10 Brown sandy clay
10-24 Blue clay and gravel mix
24-28 Coarse gravel, fine sand
28-30 Blue clay and gravel with streaks of red clay
30-40 Coarse gravel
40-47 Black shale and gravel mix
47-48 Hard, black shale

Well 171
0-10 Yellow clay, gravel
10-16 Blue clay and gravel mix
16-26 Coarse gravel
26-47 Very hard-packed gravel and shale
47-50 Glacial drift or black shale
50-51 Hard shale

Well 172
0-6 Yellow clay
6-11 Blue quicksand
11-16 Blue clay and sand mix
16-29 Brown sand and coarse gravel mix
29-30 Coarse gravel with thin layer of clay
30-33 Coarse gravel, fine sand mix
33-39 Coarse gravel, hard packed
39-44 Angular gravel with pieces of black shale
44-47 Black shale

Well 173
0-5 Yellow clay and sand mix
5-18 Yellow sand
18-30 Coarse brown gravel
30-31 Blue clay, streaks of red clay mix with gravel
31-34 Angular blue gravel and shale mix
34-40 Blue gravel and clay mix
40-53 Cemented sand and gravel
53-57 Black shale with gas

Well 174
0-22 Coarse brown bank gravel, dry with boulders
22-38 Fine brown sand and gravel mix
38-44 Fine brown sand
44-48 Coarse brown fine sand
48-50 Fine blue sand, almost quicksand
50-72 Quicksand
72-76 Coarse gravel, fine mix with chunks of sandy clay
76-77 Coarse gravel, hard packed with boulders

Well 175
0-16 Fill, clay and gravel
16-29 Fine to medium gravel and sand
29-35 Clay and gravel
35-41 Clay and particles of gravel
41-44 Clay and gravel
44-47 Clay and shale
47-50 Shale

Well 176
0-5 Clay and gravel
5-16 Fine to coarse gravel and sand
16-21 Brown sand
21-26 Gravel and sand
26-30 Fine brown sand
30-32 Fine to coarse gravel and sand
32-34 Fine gravel
34-46 Fine to coarse gravel and sand
46-53 Fine brown sand
53-56 Fine to coarse gravel and sand (cemented)

Well 177
0-8 Clay with small amount of gravel
8-30 Gravel and clay
30-46 Sand
46-50 Fine to coarse gravel and sand
50-55 Clay and gravel
55-72 Fine to coarse gravel and sand
72-76 Brown sand

Well 178
0-1 Topsoil
1-13 Clay
13-39 Clay and gravel mixed
39-79 Fine to coarse gravel and sand

Well 179
0-7 Yellow clay
7-21 Bank gravel
21-30 Hard-packed gravel
30-32 Clay, hard packed
32-45 Coarse brown gravel
45-50 Gravel with sand
50-56 Coarse blue gravel
56-60 Blue gravel
60-61 Blue clay
61-69 Black shale
69-70 Very hard rock (shale?)

Well 180
0-2.0 Silty, fine sand
2.0-4.5 Pebbly silt, trace of grayish brown clay
4.5-6.0 Medium to coarse sand, trace of silt
6.0-7.5 Silty, pebbly sand
7.5-8.5 Silty fine sand, trace of clay and pebbles
8.5-9.0 Sandy, pebble gravel
9.0-11.5 Pebbly sand, trace of silt
11.5-12.0 Shale fragments
12.0-18.5 Pebbly sand till, trace of silt
18.5-19.0 Medium sand, trace of silt
19.0-26.5 Pebbly sand till
26.5-27.0 Broken, dark gray shale

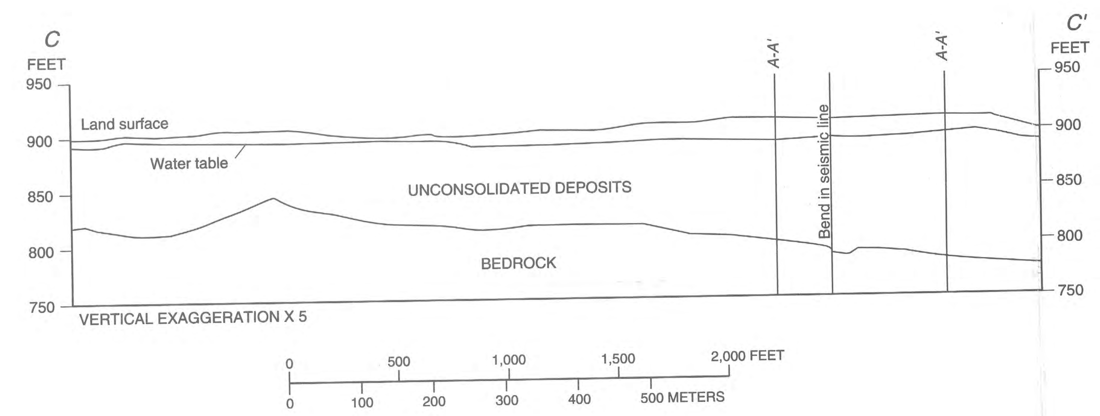
Well 181
0-1.5 Sandy silt, trace of clay
1.5-3.0 Medium sand, trace of silt
3.0-4.5 Fine to medium sand, trace of silt
4.5-14.0 Sand, trace of silt and pebbles
14.0-15.0 Till, pebbly silt, trace of clay
15.0-16.5 Broken shale
16.5-20.0 Till, sandy shale, pebbly and silty sand till, trace of silt and clay
20.0-22.5 Fine to medium sand, trace of silt, pebbles and cobbles
22.5-23.5 Till
23.5-30.0 Shale, some clay, soft, broken

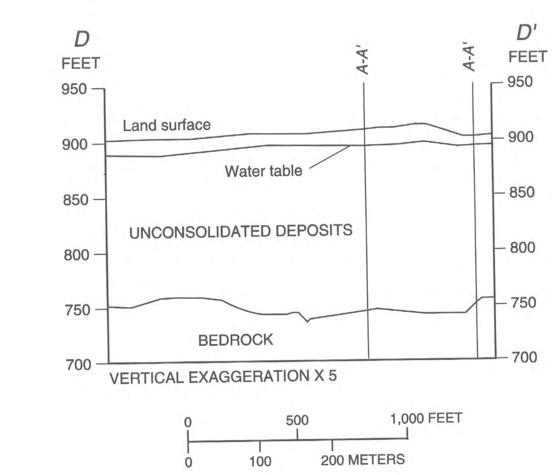
Well 182
0-9.5 Medium, well-sorted sand, trace of pebbles
9.5-10.5 Loose pebble gravel
10.5-11.5 Medium to coarse sand
11.5-17.0 Medium, well-sorted sand
17.0-18.0 Fine sand, trace of silt
18.0-20.0 Medium, well-sorted sand, trace of silt
20.0-21.0 Silty, fine sand
21.0-24.0 Shale

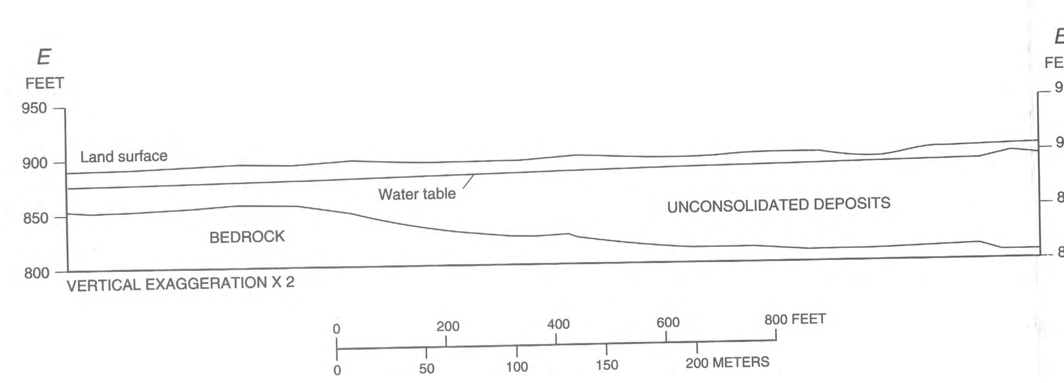
Well 183
0-1.5 Silty fine sand
1.5-6.0 Cobble gravel with fine to medium sand
6.0-7.5 Coarse sand with pebble gravel
7.5-16.5 Silty pebble or cobble gravel
16.5-18.0 Medium to coarse sand
18.0-20.0 Sandy, silty pebble gravel, trace of clay
20.0-21.0 Medium to coarse sand
21.0-22.0 Sandy, silty pebble gravel, trace of clay
22.0-30.0 Silty pebble till, trace of clay

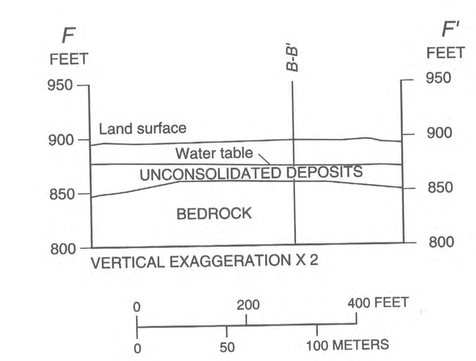
Note: The calculated seismic velocity for the saturated unconsolidated deposits at D-D' was significantly higher than for similar deposits studied at other sections. This probably indicates appreciable amounts of till within or underlying saturated sand and gravel in this area. Test drilling would be needed to determine the composition of this material.

Hydrogeologic sections interpreted from seismic-refraction data

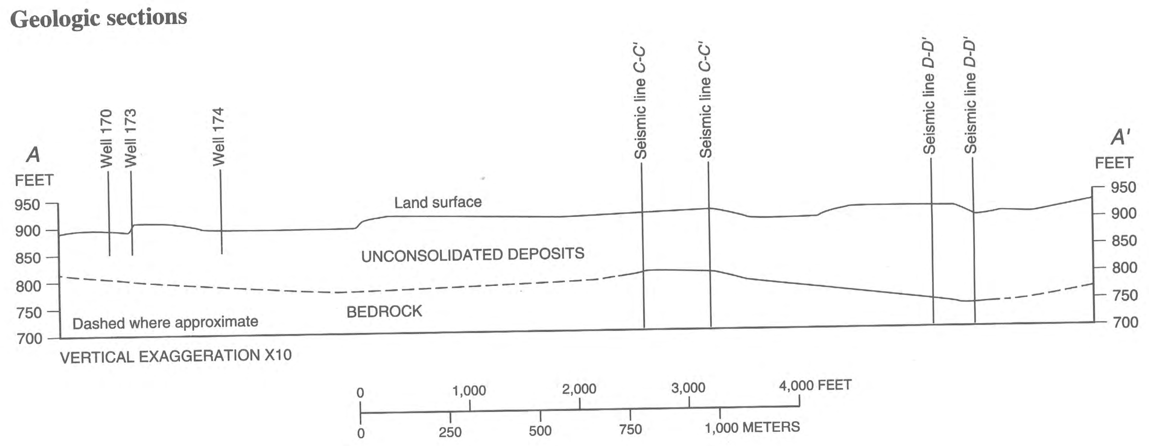


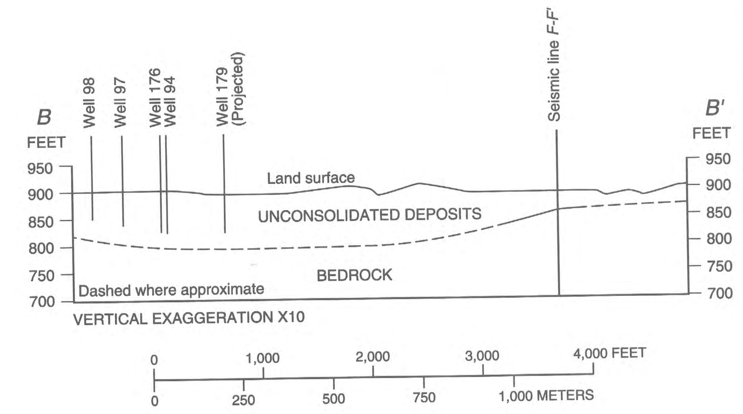






Geologic sections





THICKNESS OF UNCONSOLIDATED DEPOSITS IN SOUTHEASTERN BATAVIA, GENESEE COUNTY, NEW YORK

By
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1994