# HYDROLOGY OF THE LITTLE ANDROSCOGGIN RIVER VALLEY AQUIFER, OXFORD COUNTY, MAINE

By Daniel J. Morrissey

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(in pocket)

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# CONVERSION FACTORS

Most values are given in this report in inch-pound units. For readers who prefer to use the International System (SI), the conversion factors for the terms used in this report are listed below.

| To convert from | to | multiply by |
|---|---|---|
| acre | square hectometer ($hm^2$) | 0.4047 |
| acre-foot (acre-ft) | cubic hectometer ($hm^3$) | 0.001233 |
| acre-foot per square mile (acre-ft/$mi^2$) | cubic meter per square kilometer ($m^3/km^2$) | 476.1 |
| cubic foot per second ($ft^3/s$) | cubic meter per second ($m^3/s$) | 0.02832 |
| foot (ft) | meter (m) | 0.3048 |
| foot per mile (ft/mi) | meter per kilometer (m/km) | 0.1894 |
| gallon per minute (gpm) | liter per second (L/s) | 0.06309 |
| inch (in) | millimeter (mm) | 25.40 |
| inch (in) | centimeter (cm) | 2.540 |
| mile (mi) | kilometer (km) | 1.609 |
| micromho (umho) | microsiemens (us) | 1 |
| square foot ($ft^2$) | square meter ($m^2$) | 0.0920 |
| square mile ($mi^2$) | square kilometer ($km^2$) | 2.590 |
| ton (short, 2,000 lbs) | megagram (metric ton) | 0.9072 |

Chemical concentrations and water temperatures are given in SI units. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (ug/L).

Water temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation: °F = 1.8(°C) + 32.

## NATIONAL GEODETIC VERTICAL DATUM OF 1929

National Geodetic Vertical Datum of 1929 (NGVD of 1929) is derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level.

# HYDROLOGY OF THE LITTLE ANDROSCOGGIN RIVER VALLEY AQUIFER, OXFORD COUNTY, MAINE

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## ABSTRACT

The Little Androscoggin River valley aquifer, a 15-square-mile sand and gravel valley-fill aquifer in southwestern Maine, is the source of water for several towns in Oxford County. The saturated thickness of coarse-grained deposits that make up the aquifer ranges from about 10 feet near the boundaries to 100 feet. Deposits up to 200 feet in thickness of clay and silt underlie the aquifer in the southern part of the study area. The northern part of the aquifer rests on till and bedrock.

Average inflows to the aquifer during the 1981 water year were 16.4 cubic feet per second from precipitation directly on the aquifer, 11.2 cubic feet per second from till-covered uplands adjacent to the aquifer, and 1.4 cubic feet per second from surface-water leakage. Average outflows from the aquifer during the 1981 water year were 26.7 cubic feet per second to surface water and 2.3 cubic feet per second to wells.

Analyses of data collected to describe background water quality of the aquifer show that the water is of excellent quality and suitable for use as a drinking water supply. The average dissolved-solids concentration was 67 milligrams per liter, and average total organic carbon concentration was 1.1 milligrams per liter. The only constituents found to exceed recommended standards for drinking water were dissolved iron (two wells) and dissolved manganese (5 wells).

Analyses of data collected to describe localized contamination of aquifer water show the effects of landfill leachates and highway road salt on water quality. Dissolved solids in ground water downgradient from one disposal site was more than ten times higher than average background levels. Dissolved chlorides and sodium concentrations more than three times average background levels were observed in a dug well close to a highway that is subject to salting during winter. These localized contamination sources have increased concentrations of constituents above permissible drinking water limits.

A finite-difference ground-water flow model was used to simulate conditions observed in the aquifer during 1981. Model simulations indicate that a 50-percent reduction of average 1981 recharge would cause water-level declines of up to 20 feet in some areas. Model simulations also indicated that increased pumping in the northern part of the aquifer will not cause changes sufficient in the water-table slope to intercept ground water contaminated by a sludge-disposal site.

# INTRODUCTION

The Little Androscoggin River valley aquifer extends from West Paris in the north to Mechanic Falls in the south, a distance of about 15 miles (fig. 1). The aquifer varies in width from less than one mile near South Paris to slightly greater than two miles near the town of Oxford. The aquifer consists of sands and gravel deposited during the last glacial period.

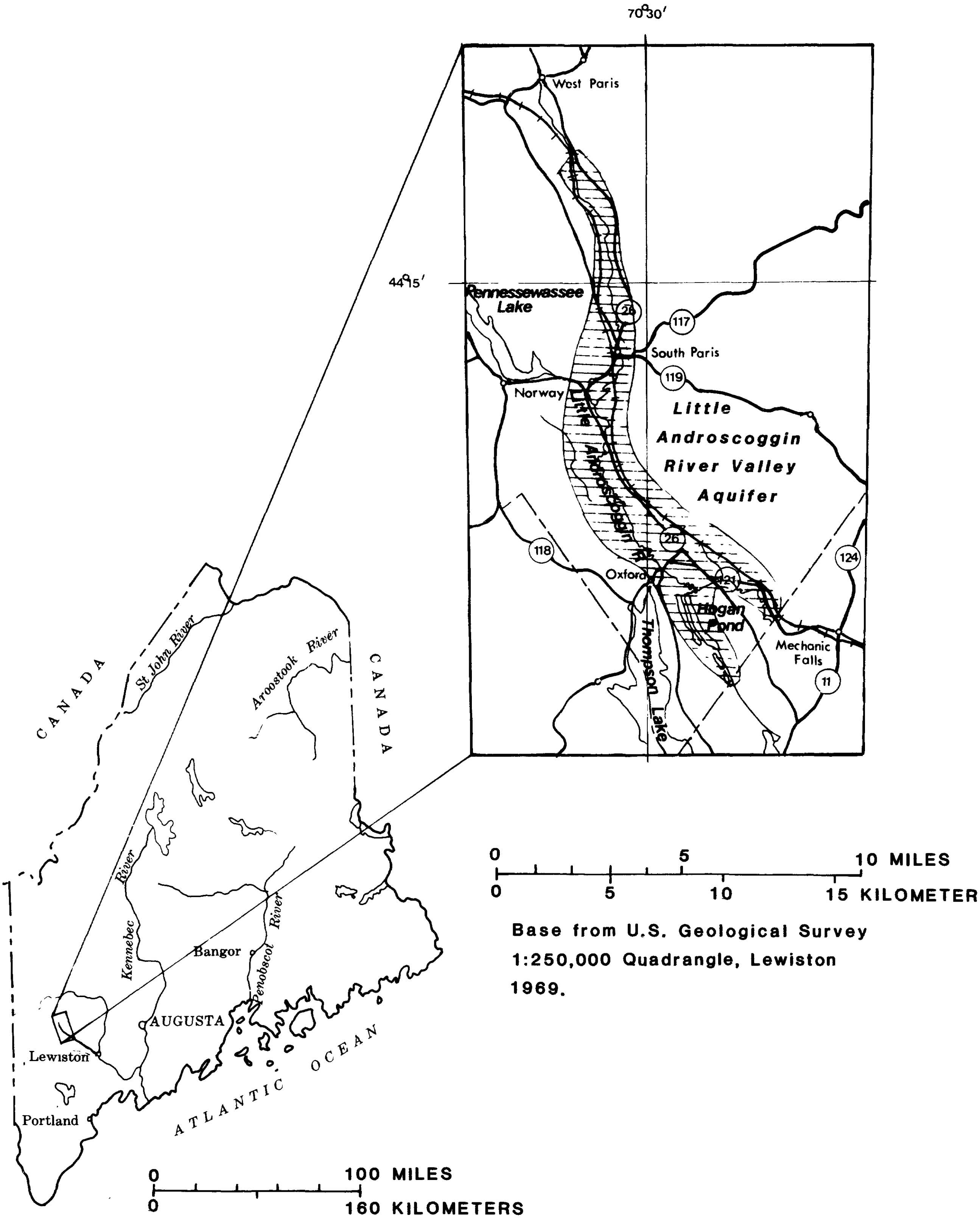
Three towns--South Paris, Oxford, and Norway--(combined population about 13,500) use water from the aquifer for municipal supply. In addition, numerous rural domestic wells tap the aquifer. Land-use activities threatening water quality in the aquifer include sanitary landfills, a sludge-disposal site, and road-salting operations.

## Purpose and Scope of Investigation

To gain a better understanding of the ground-water resource available from this aquifer, the U.S. Geological Survey, in cooperation with the Maine Geological Survey, Maine Department of Human Services and the Androscoggin Valley Regional Planning Commission (AVRPC), conducted a study from May 1980 through October 1982. The objectives were to: (1) determine the quantity and quality of water available from the Little Androscoggin River valley aquifer; (2) develop a better understanding of how ground-water moves through the aquifer, and (3) analyze effects of imposed stress on the aquifer.

## Acknowledgments

The author wishes to express his appreciation to the South Paris, Norway, and Oxford water utilities for their help during this study. Dave Bjerklie, formerly of the AVRPC, provided assistance during the data-collection phase of the study. The surficial geology of the area was remapped by Glenn Prescott of the U.S. Geological Survey. Thanks are also extended to town officials and the many private citizens who granted permission to drill test holes, run seismic surveys, and sample and test wells.



Base from U.S. Geological Survey 1:250,000 Quadrangle, Lewiston 1969.

INDEX MAP OF MAINE

Base from U.S. Geological Survey

Figure 1.--Location of the study area

## Previous Investigations

Hanley (1959) mapped the surficial geology of the southeastern part of the study area in the Poland quadrangle. The bedrock geology of the area was mapped by Creasy (1979a,b).

Prescott (1967, 1968) mapped the surficial geology of the area and presented hydrologic data. Geohydrologic conditions were described by Prescott and Attig (1977). The geohydrology of the South Paris sludge disposal site was investigated by the EPA (U.S. Environmental Protection Agency) (1977), the MDEP (Maine Department of Environmental Protection) (1980), and by the Environmental Assessment Council, Inc. (1979). The hydrogeology of the South Paris landfill site was also investigated by the MDEP (1980). A time-of-travel study was conducted on the Little Androscoggin River by Nichols and others (1981).

## Methods of Investigation

Fieldwork for the study ran from June 1980 through December 1981. During this time, a well and spring inventory was conducted in the study area. Wells, test holes, and springs where geohydrologic data were collected are shown on plate 1.

Sixty test holes were drilled as part of this study. Split spoon samples were taken every 5 feet below the water table at each test hole where possible. Observation wells were installed in 56 of the 60 test holes. Water levels were measured monthly at 79 locations in the aquifer and continuously at one location. All wells in the monthly network were leveled in to the NGVD of 1929. Numerous miscellaneous water-level measurements were also obtained from private wells during the well inventory.

Samples were collected from test holes throughout the study area for grain-size analysis. Saturated thickness and bedrock elevations were determined from seismic refraction data. Eight miles of seismic-refraction profiles were completed at 28 sites, and a detailed surficial geology map of the area was constructed.

To determine inflows to the Little Androscoggin River in the study area and to monitor outflow from the area, two continuous surface-water monitoring gages and two daily reading gage sites were installed. Two seepage runs were conducted during base-flow conditions. Precipitation data were collected during 1981 at two sites in the study area.

Seventy-two ground-water samples were collected for determination of dissolved inorganic chemical constituents from 56 wells and springs in the area. Samples obtained from municipal supply wells were analyzed for trace constituents, as were samples obtained near the South Paris sludge-disposal site. Two sets of samples were collected at 10 surface-water sites in the study area. The samples were analyzed for common dissolved inorganic, trace, and biological constituents.

A two-dimensional digital-computer model of ground-water flow in the aquifer was constructed to simulate conditions observed during the 1981 water year and to examine effects of pumping on the aquifer.

## Well and Site-Numbering System

Wells, springs, and test holes in Maine are numbered consecutively by county. Each local well number consists of a letter (or letters) designating county, and a number, for example O-1216. If two wells are located at the same site, this would be indicated by another number after the original well number, for example O-1217-8. Wells and springs inventoried as part of this study begin with the numbers O-1215 in Oxford County and An-1070 in Androscoggin County. Wells with numbers smaller than those above located in the Little Androscoggin River valley aquifer have been reported by Prescott (1967) and Prescott and Attig (1977).

The wells, springs, and test holes also have a location number based on their latitude and longitude in degrees, minutes, and seconds and a two-digit sequence number. This number is used by the U.S. Geological Survey nationwide to distinguish each well from all others. For example, well AN 1071, which is located at 44°28'23" north latitude and 70°11'50" west longitude, is given location designation 442823070115001. The "01" at the end of this designation is the two-digit sequence number assigned in the order in which wells within the specified latitude and longitude were recorded.

# GEOLOGY

## Bedrock Geology

With the exception of the area north of Norway which is underlain by gneiss and schist, the bedrock in the Little Androscoggin River valley is predominantly granite (Hussey, 1979). Although all the bedrock is relatively impermeable compared to the overlying sand and gravel aquifer, the yield to drilled wells in the granite is usually adequate for household requirements.

The altitude of the bedrock surface beneath the aquifer, shown on plate 2, was determined from seismic refraction profiling (table 11), logs of wells and test holes (table 12), and bedrock outcrops. The locations of seismic profiles and test holes are also shown on plate 2.

The seismic investigations were done by the Survey in 1980 and 1981 and interpretation of field data was based on time-delay and ray-tracing techniques described by Scott and others (1972). The well and test hole data were obtained from MDEP, well drilling contractors, water utilities in Norway, Oxford, and South Paris, and from drilling done by the Survey for this study.

## Surficial Geology

The unconsolidated deposits in the study area (plate 3) are the result of glaciations which occurred approximately 2,000,000 to 10,000 years ago, during the Pleistocene Epoch. Maine was covered at least twice by continental ice sheets which advanced southward from the region around Hudson Bay. The last continental glacier that covered Maine advanced across the state about 20,000 years ago in late Wisconsinan time (Schafer and Hartshorn, 1965). It flowed to the southeast, past the present coastline, and out onto the continental shelf. As it slowly advanced, the glacier picked up loose soil and rock materials, excavated large chunks of bedrock in places, and incorporated this material into the ice. The material was later deposited directly from the melting ice or from streams of meltwater flowing within, on top of, or in front of the ice.

The northern part of the aquifer (north of Norway) is generally composed of coarse-grained ice-contact sand and gravel. There are some deposits of fine grained sands and silt in this area but they are not extensive. Geologic cross section A-A' (plate 3), located approximately NE-SW across the South Paris well field, shows the predominance of coarse-grained ice-contact materials in this area. The general stratigraphic sequence here includes medium to coarse sand and gravel overlying till and bedrock.

The southern part of the aquifer study area (south of Norway) consists of fine to medium outwash sand on top of fine-grained marine silt and clay. An exception to this is an esker, consisting of coarse sand and gravel, extending from the Oxford area south between Hogan and Whitney Ponds. Cross section B-B' (plate 3) is located near the transition from ice-contact to outwash material. This section shows fine to medium sand and silt overlying till.

Cross section C-C' (plate 3) shows medium to fine sands overlying marine sediments. The marine sediments consist of very fine grey-colored sand and silt and massive blue-grey clay. In some places, the sand grades downward into interbedded silt and clay and eventually into massive marine clay. In other localities, the sand/clay contact is more distinct. Although the esker has not been mapped in section C-C', segments of it appear north and south of the line. The esker has been included in section C-C' to illustrate its general relationship with the outwash and marine sediments. Bedrock altitudes for this section are based on seismic profiles in the area.

In some localities, sand and gravel have been buried beneath the marine sediment. The Oxford municipal well O-336 is completed in coarse sand and gravel beneath approximately 30 feet of fine sand and clay. The coarse material at this site seems to be associated with the esker that runs through the area. At well O-1228, clean gravel was found between marine clay and till. At site O-1257, thin layers of medium to coarse sand and gravel were encountered in the marine deposits. All other deep drill holes in the southern part of the study area showed marine deposits directly on top of till.

# HYDROLOGY

## Saturated Thickness

The saturated thickness of an unconfined aquifer is the vertical distance from the water table to the base of the aquifer. In the northern part of the study area, where extensive fine-grained deposits are absent, the bottom of the aquifer is considered to be the bedrock surface. Saturated thickness of this material ranges from about ten feet near the aquifer boundaries to 100 feet (plate 4).

In the southern part of the study area, where extensive outwash plains have been mapped, the base of the aquifer is the top of the fine-grained marine deposits. The thickness of outwash sands that comprise the aquifer here ranges from a few feet to approximately 50 feet. Where the esker has been mapped in the southern part of the area, the saturated thickness of coarse-grained material is as much as 80 feet.

The saturated thickness of coarse-grained materials that comprise the aquifer is shown on plate 4. This map was constructed by superimposing water table and bedrock/till and marine deposit elevations. Although there are seasonal variations in the elevation of the water table, these variations (on the order of 2-8 feet during the 1981 water year) do not make a significant difference in the saturated thickness distribution shown on plate 4.

It is important to note that the saturated thickness map shown on plate 4 is for coarse-grained materials. North of Norway this includes the entire saturated thickness of the stratified drift. South of Norway this map shows the saturated thickness of only the coarse-grained stratified drift on top of fine-grained marine sediments and in the esker.

## Hydraulic Properties

The hydraulic conductivity of the aquifer was estimated at several locations with two techniques. Average values of hydraulic conductivity were obtained at each test hole or well where a reliable stratigraphic log was available. These estimates are based on the relationship between grain size of the aquifer sands and hydraulic conductivity (Masch and Denny, 1966). Specific capacity data from wells were also used to estimate average hydraulic conductivity, using a technique described by Theis (1963).

The resulting values of hydraulic conductivity range from about 150 to 200 ft/day in coarse-grained ice-contact material to less than 4 ft/day in till along the stratified drift boundary. The estimated values of conductivity for the outwash sands range from about 15-80 ft/day.

The ability of an aquifer to store water is expressed as the aquifer storage coefficient. The Little Androscoggin River valley aquifer is unconfined; therefore, water is released from storage mainly by gravity drainage and the storage coefficient is virtually equal to the specific yield. Specific yields for unconfined aquifers generally range from about 0.1 to 0.3 (Johnson, 1967). The average storage coefficient of the Little Androscoggin River valley aquifer was estimated to be about 0.15. The specific yield of the fine-grained material such as silt and clay is estimated to range from about 0.02 - 0.07 (Johnson, 1967).

## Availability of Water

The largest quantities of water are available from the Little Androscoggin River valley aquifer north of the Norway area. In this area, aquifer transmissivity is highest and several wells have been constructed that are capable of producing at least 300 gpm (gallons per minute) and as much as 1300 gpm. The average yield for the eight municipal wells in this area is about 650 gpm. All of these wells are located near enough to the Little Androscoggin River to induce infiltration.

South of Norway the only high-yield wells are located in the esker shown on plate 3. Wells completed in this esker could induce infiltration from surrounding fine-grained deposits, from adjacent outwash materials, and from the river, where it is in hydraulic connection with the esker. An example of such a location would be in the esker between Hogan and Whitney Ponds.

Elsewhere in the aquifer, saturated thickness is generally less than 50 feet and hydraulic conductivities are less than in ice-contact materials. However, there are hundreds of driven and washed points and dug wells completed in the outwash materials that yield enough water for household purposes. For example, well O-1214 (plate 1) was completed in the outwash aquifer with 4 feet of 6-inch well screen and developed to yield 6 gpm.

## Water-Table Configuration and Movement of Water

The approximate configuration of the water table in the Little Androscoggin River valley aquifer as measured in June 1981 is shown on plate 1. The data were obtained from existing test wells, observation wells constructed during this study, and unused dug wells. In constructing the water-level contours, the ground-water altitude was considered to be approximately coincident with surface-water altitudes along the Little Androscoggin River.

Most observation wells constructed for this study were screened near the water table. However, in the southern part of the study area, where the aquifer consists of outwash sands and gravel on top of fine-grained marine deposits, six deep observation wells were installed in addition to the water-table monitoring well. At five of these locations, the water-table elevation was higher than the deep piezometric head, indicating a downward movement of water. At one location the deep head was an average of 0.4 foot higher than the water table, indicating an upward movement of water.

The general movement of ground water in the aquifer is illustrated in figure 2. Water that recharges the aquifer moves downgradient toward the perennial stream (Little Androscoggin River) and is eventually discharged as streamflow. Deviations from this regional flow pattern can occur in the vicinity of minor tributary streams which create localized flow patterns. High-yield pumping wells located near the river, as in the South Paris well field, can reverse natural ground-water flow and cause water to move from the river toward the discharging well.

## Water Level Fluctuations

The most important factor influencing water level fluctuations in the study area is seasonal variation in recharge to the aquifer due to climatic conditions. The continuous hydrograph for the 1981 water year at well 0-1214, and hydrographs based on monthly water-level observations at wells 0-1231 and 0-1234 are shown in figure 3.

Well 0-1214 (plate 1) is located in the outwash aquifer in the Oxford Plains area. This hydrograph shows that most of the recharge occurred in the fall and spring. Water levels declined during winter and summer. The total range of fluctuation for the 1981 water year at this well was about one foot.

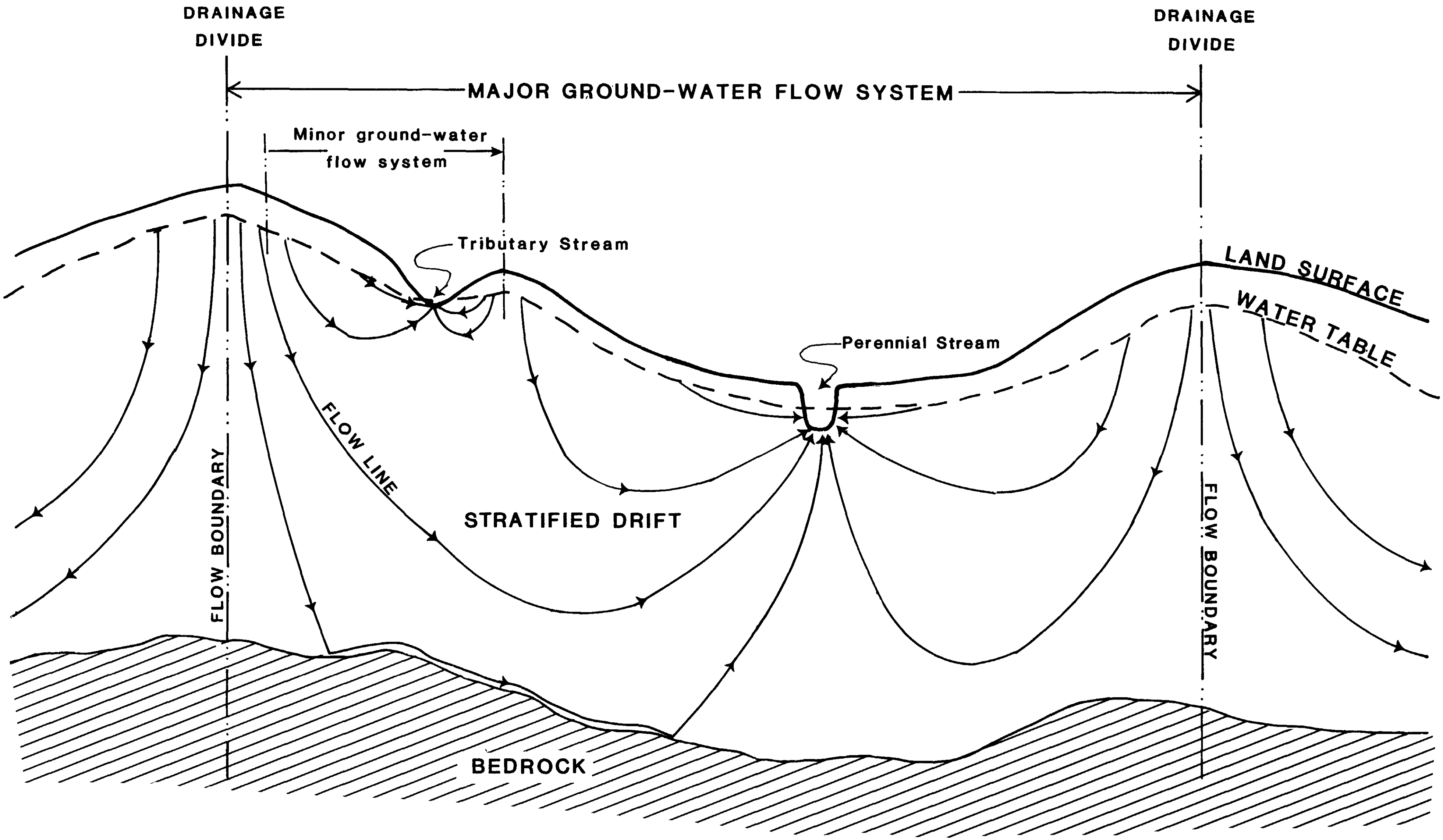


Figure 2.--Idealized pattern of water circulation in stratified drift. The directions of flow in stratified drift as depicted by flow lines. The actual configuration of these lines in nature is more complex than shown, principally because of variations in hydraulic conductivity of earth materials. From Cervione, Mazzaferro and Melvin (1972).

Well 0-1234 is located in the northern part of the aquifer about 150 feet from the Little Androscoggin River. The total range of fluctuation at this well was about 3 feet. The peaks on the hydrograph for this well are more closely associated with the river stage than either of the other two well hydrographs. The greatest average monthly flow on the Little Androscoggin River occurred in February of the 1981 water year (fig. 4). The highest water level observed in well 0-1234 also occurred during February 1981.

Well 0-1231 is located in the northeastern part of the study area near the boundary of the stratified drift aquifer and till. The most obvious feature of this well hydrograph is the large seasonal variation in water level as compared with the other hydrographs in figure 3. The peaks occur at about the same time as those in well 0-1214.

Each of the well hydrographs in figure 3 illustrates seasonal variations caused by different processes. Ground-water level fluctuations in well 0-1214 are attributable to effects of seasonal recharge directly on the aquifer. Well 0-1234 is affected by surface-water fluctuations and associated bank storage, and well 0-1231 shows the combined effects of direct recharge on the aquifer and lateral inflow from the till-covered uplands.

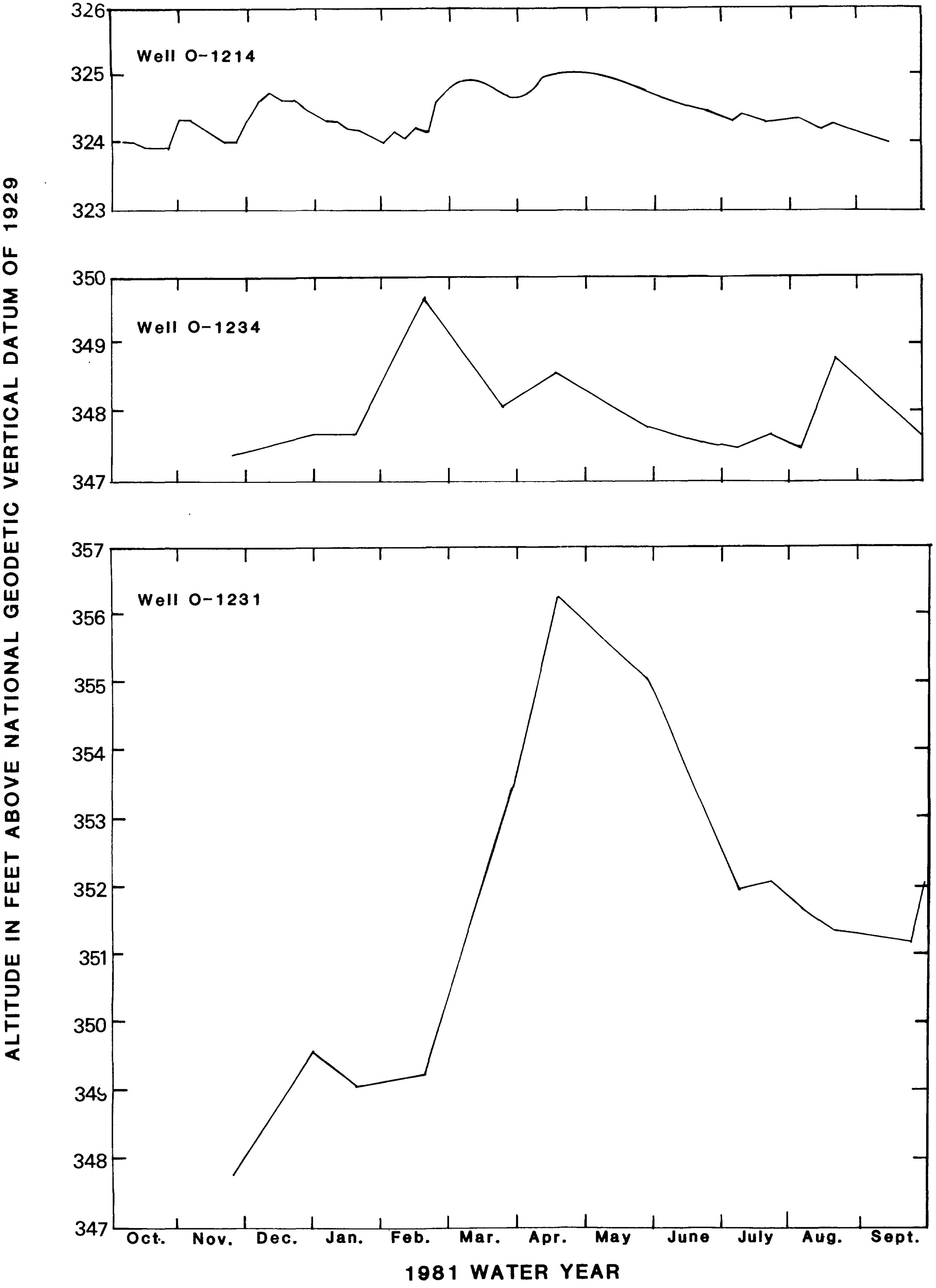


Figure 3.--Hydrographs at selected wells in the Little Androscoggin River Valley aquifer.

## Recharge and Discharge

### Precipitation

The major source of recharge to the Little Androscoggin River valley aquifer is from precipitation directly on the aquifer. The long-term average annual precipitation at Lewiston (10 miles southeast of the Little Androscoggin River valley aquifer) is 43.2 inches (U.S. Weather Bureau, National Weather Service Station 4566). The average annual precipitation at the same station during 1979-81 was 44.6 inches (U.S. Weather Bureau, 1979-1981). Since April 1978, daily precipitation data have been collected at West Paris (approximately 1 mile north of the Little Androscoggin River valley aquifer). The average precipitation for 1979-81 was 40.8 inches (U.S. Weather Bureau, National Weather Service Station 9538).

Precipitation at Lewiston and West Paris for the 1981 water year was 40.6 and 39.4 inches, respectively (U.S. Weather Bureau, 1981). Total runoff for the same period on the Little Androscoggin River near South Paris (gaging station number 01057000) was 18.6 inches (U.S. Geological Survey, 1981). Long-term average annual runoff at this station is 24.7 inches (U.S. Geological Survey, 1981).

Direct recharge to the stratified drift aquifer from precipitation in 1981 was estimated to be about 18 inches based on a method developed in Connecticut (Cervione and others, 1972). This estimate is based on total annual runoff for the 1981 water year on the Little Androscoggin River near South Paris.

### Lateral Inflows

Lateral inflow to the Little Androscoggin River valley aquifer consists of recharge from till-covered uplands along both sides of the aquifer. The total area of aquifer modeled is approximately 16 square miles. The adjacent till-covered area contributing drainage to this aquifer is approximately 23 square miles.

It was assumed that lateral recharge from till to the aquifer is equal to the ground-water runoff from till-covered areas. The ground-water component of runoff was determined for the 1981 water year for the gage on the Little Androscoggin River near South Paris (plate 1) using a hydrograph separation method described by Meinzer and Stearns (1929). The drainage area gaged by this station is hydrologically similar to the till uplands bordering the aquifer. The surface-water hydrograph for station 01057000 and the estimated ground-water runoff component are shown on figure 4.

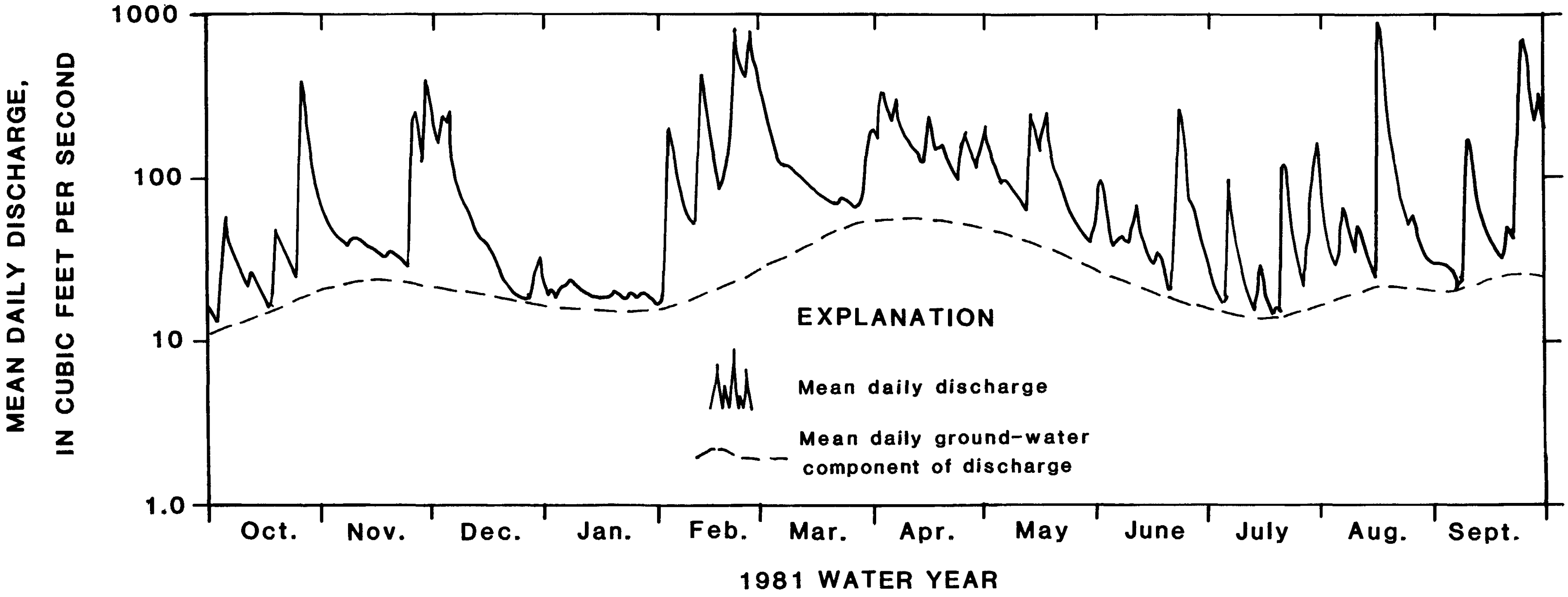


Figure 4.--Hydrograph of mean-daily discharge and approximate ground-water component of streamflow for the 1981 water year at gaging station 01057000 on the Little Androscoggin River near South Paris.

The resulting mean annual ground-water runoff was 7.4 inches, or 0.5 cubic feet per second per square mile of drainage area. The total lateral inflow to the aquifer was determined by applying 0.5 $ft^3/s$ per square mile over the 23 square miles of till-covered drainage that contribute to the aquifer.

The estimated ground-water runoff at station 01057000 was approximately 19 percent of total precipitation for the 1981 water year. Meinzer and Stearns (1929) estimated that ground-water runoff was 19.6 percent of precipitation in a till-covered drainage in Connecticut.

### Leakage to Surface Water

The Little Androscoggin River is the major drain for ground-water discharge from the aquifer. Several sets of seepage runs were conducted to determine the amount of ground water discharging from the aquifer to the Little Androscoggin River. The seepage runs were conducted during periods when surface runoff was minimal. Table 1 summarizes five sets of seepage runs conducted during 1978-1981.

For each set of seepage runs, the average gain in streamflow from Biscoe Falls to South Paris was 5.0 $ft^3/s$, or about 0.32 $ft^3/s$ per square mile of drainage. The average gain from South Paris to Oxford was 11.0 $ft^3/s$ or about 0.75 $ft^3/s$ per square mile of drainage. The contributing drainage does not include the Stony Brook or Pennessewassee Lake drainage areas.

The average observed gain in streamflow from Oxford to Welchville was 24.6 $ft^3/s$ or 1.5 $ft^3/s$ per square mile of drainage area. The contributing area does not include Thompson Lake drainage but does include the drainage area for Winter Brook upstream from Mud Pond. The average gain from Welchville to Mechanics Falls was 6.4 $ft^3/s$, or 0.49 $ft^3/s$ per square mile of drainage.

The average total gain in streamflow for five seepage runs was 47 $ft^3/s$, or 0.77 $ft^3/s$ per square mile of drainage area. The range in observed gain from Biscoe Falls to Mechanics Falls was from 36 $ft^3/s$ on September 24, 1978, to 53 $ft^3/s$ on July 11, 1978, and January 21, 1981.

Table 1.--Summary of seepage runs on the Little Androscoggin River.

| | Net gain on date indicated, in cubic feet per second | | | | |
|---|---|---|---|---|---|
| Reach | July 11,1978[1] | July 13,1978[1] | Sept. 24,1978[1] | July 11,1980 | Jan. 21,1981 |
| 1 Biscoe Falls to South Paris. | 8 | 6 | 1 | 4 | 6 |
| 2 South Paris to Oxford. | 11 | 10 | 10 | 12 | 12 |
| 3 Oxford to Welchville. | 22 | 32 | 24 | 23 | 22 |
| 4 Welchville to Mechanics Falls. | 12 | 2 | 1 | 4 | 13 |
| Total | 53 | 50 | 36 | 43 | 53 |

[1] Modified from Nichols and others (1980).

## Well Discharges

The amount of water pumped from the Little Androscoggin River valley aquifer for municipal supply for the period 1977-1981 is summarized in table 2. Also shown on the table are the number of customers served by each water utility. In each of the towns the amount of water pumped has remained fairly constant over the last five years. Although total pumped water in Oxford is unknown, the number of customers has remained fairly constant.

The amount of water pumped per customer for the towns of South Paris and Norway for 1981 was 990 and 449 gallons per person per day, respectively. These averages are high because of industrial use in South Paris for tannery and canning operations and because some of the water pumped from the Norway well is sold to Oxford. The town of Oxford has not had a totalizing meter on their well and only a small percentage of their customers are metered. If the amount of water used by each user in Oxford is estimated to be approximately the same as that for Norway, total pumped water in Oxford would be about 0.17 mgd.

Table 2.--Production of water for public supply from the Little Androscoggin River valley aquifer, 1977-1981.

Data from annual reports submitted to the Maine Public Utilities Commission by each town
na, not available

| | Water pumped, in million gallons per day | | | | | Number of customers | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Town | 1977 | 1978 | 1979 | 1980 | 1981 | 1977 | 1978 | 1979 | 1980 | 1981 |
| South Paris | 1.06 | 1.04 | 0.88 | 0.97 | 0.96 | 954 | 929 | 957 | 955 | 969 |
| Norway | na | na | 0.30 | 0.38 | 0.36 | 829 | 829 | 830 | 825 | 801 |
| Oxford | na | na | na | na | na | 229 | 250 | 259 | na | 259 |

### Evapotranspiration

The total evapotranspiration from the Little Androscoggin River drainage during the 1981 water year was approximately 53 percent of total precipitation. This percent was determined from total runoff at station 01057000 on the Little Androscoggin River and precipitation at West Paris.

The amount of evapotranspiration that occurred from the ground-water reservoir is unknown. Ground-water outflows were determined from seepage runs and consequently do not include that part of the recharge to the aquifer that was subsequently discharged by ground-water evapotranspiration.

## QUALITY OF WATER

### Ground Water

The quality of water in the Little Androscoggin River Valley aquifer is influenced by many factors. These factors include the dissolved solids concentration of precipitation that recharges the aquifer, the mineralogy of the sand and gravels that comprise the aquifer, residence time and flow directions of ground water, and land use activities. Some of these factors are the result of man's activities while others are the result of natural processes.

Three different objectives were considered in examining the ground-water quality of the aquifer. These objectives were (1) to assess the uncontaminated "background" water quality of the aquifer, (2) to detect long-term water-quality trends in areas of intensive ground-water development, and (3) to examine site specific water quality in two areas where contamination had previously been detected. Plate 1 shows locations where ground-water samples were obtained. Results of these analyses are included in table 13.

#### Background Water Quality

Background water quality in the Little Androscoggin River valley aquifer determined from water samples that were considered to be uncontaminated by human activity are summarized in table 3. Water quality for analyses of water obtained from bedrock beneath the aquifer are summarized in table 4. Where more than one analysis was available at any location, the most recent was used to determine the statistics shown in these tables.

Table 3.--Summary of background water quality for the Little Androscoggin River valley aquifer.

| Constituent or property | Number of samples | Average concentration(mg/L) | Range (mg/L) |
|---|---|---|---|
| Calcium (Ca) | 38 | 7.7 | 1.0 - 22 |
| Magnesium (Mg) | 38 | 1.1 | .2 - 3.9 |
| Sodium (Na) | 38 | 7.0 | 1.1 - 18 |
| Potassium (K) | 38 | 1.5 | .2 - 5.7 |
| Iron (Fe) | 34 | .06 | .00 - .34[1] |
| Manganese (Mn) | 34 | .018 | .00 - .100[1] |
| Zinc (Zn) | 6 | .038 | .010 - .120 |
| Silica (Si) | 38 | 9.5 | 5.3 - 15 |
| Alkalinity (as $CaCO_3$) | 37 | 21 | 3.0 - 58 |
| Chloride (Cl) | 38 | 8.8 | .7 - 31 |
| Fluoride (F) | 38 | .11 | .10 - .40 |
| Sulfate ($SO_4$) | 38 | 6.0 | 1.3 - 13 |
| Nitrite & nitrate ($NO_2$ + $NO_3$) | 34 | .88 | .02 - 4.9 |
| Phosphorus (P) | 34 | .01 | .0 - .06 |
| Arsenic (As) | 4 | .0005 | .00 - .0010 |
| Cadmium (Cd) | 3 | .00 | .00 - .00 |
| Chromium (Cr) | 6 | .015 | .01 - .02 |
| Cobalt (Co) | 6 | .0005 | .0 - .0010 |
| Copper (Cu) | 4 | .0015 | .0010 - .0030 |
| Lead (Pb) | 6 | .0038 | .001 - .011 |
| Mercury (Hg) | 4 | .0001 | .0001 - .0002 |
| Dissolved solids: | | | |
| Residue at 180°C | 37 | 67 | 20 - 139 |
| Sum of constituents | 38 | 54 | 15 - 119 |
| Hardness (Ca, Mg) | 38 | 24 | 3.0 - 64 |
| Noncarbonate hardness | 37 | 4.8 | .0 - 18 |
| Specific conductance (umho/cm at 25°C) | 37 | 92 | 15 - 190 |
| pH | 35 | | 4.4 - 7.4 |
| Total organic carbon (C) | 13 | 1.1 | .2 - 3.4 |

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[1] Exceeds limit of concentration recommended by MDHS, 1981

Table 4.--Summary of water quality for samples obtained from bedrock in the Little Androscoggin River valley.

(Statistics based on samples from eight wells)

| Constituent or property | Average concentration (mg/L) | Range (mg/L) |
|---|---|---|
| Calcium (Ca) | 21 | 8.1 - 47 |
| Magnesium (Mg) | 3.6 | 0.9 - 7.7 |
| Sodium (Na) | 16 | 3.0 - 49[1] |
| Potassium (K) | 2.3 | 1.0 - 5.2 |
| Iron (Fe) | 0.022 | 0.0 - 0.06 |
| Manganese (Mn) | 0.025 | 0.0 - 0.11[2] |
| Alkalinity (as $CaCO_3$) | 68 | 28 - 110 |
| Sulfate ($SO_4$) | 20 | 5.4 - 74 |
| Nitrite and nitrate ($NO_2 + NO_3$) | 0.39 | 0.0 - 1.4 |
| Silica (Si) | 13.7 | 5.6 - 21 |
| Phosphorus (P) | 0.01 | 0.0 - 0.04 |
| Dissolved solids: residue at 180°C | 128 | 58 - 238 |
| Hardness (Ca, Mg) | 68 | 24 - 150 |
| Noncarbonate hardness | 8.0 | 0 - 39 |
| Specific conductance (umho/cm at 25°C) | 206 | 80 - 400 |
| pH |  | 5.8 - 7.6 |
| Chloride (Cl) | 7.9 | 1.1 - 25 |
| Fluoride (F) | 0.65 | 0.1 - 2.2 |

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[1] exceeds limit of concentration permitted by MDHS, 1981

[2] exceeds limit of concentration recommended by MDHS, 1981

The quality of water from the aquifer can be classified as generally low in dissolved solids (average for 38 samples was 67 mg/L, table 3), slightly acidic and soft. The predominant cations are calcium and sodium and the predominant anion is bicarbonate. High levels of dissolved iron and manganese were observed in several domestic wells. In table 3 the MDHS (1981) recommended limit for iron (0.3 mg/L) was exceeded at wells O-1317 and O-1698. The MDHS (1981) recommended limit for manganese (0.05 mg/L) was equaled or exceeded at wells O-1317, O-1579, O-1378, and O-1466, and at spring O-1366. All other trace element concentrations from the uncontaminated group of wells shown in table 3 were below recommended limits.

Analyses of water from wells O-1286 and O-1361 both exceeded the MDHS (1981) recommended limit for sodium (20 mg/L). They were not included in table 3 because they have probably been contaminated by road salting. Both of these wells are shallow, dug wells near highways with winter road-salting operations.

Of the eight bedrock wells sampled during this study, the MDHS (1981) maximum permissible limit for sodium (20 mg/L) was exceeded at wells O-1279 and O-1338 and the MDHS (1981) recommended limit for manganese (0.05 mg/L) was exceeded at well O-1369.

## Water Quality Trends at Municipal Supply Wells

The municipal supply wells in South Paris, Norway, and Oxford were sampled several times during 1976-77 as part of a study by Prescott and Attig (1977). All of these wells were resampled during 1980-81 as part of this study. Dissolved solids concentrations for samples collected at the South Paris well O-412, Norway well O-387, and Oxford well O-336 during 1976-81 are shown in figure 5.

The dissolved-solids concentration is consistently highest in well O-387 and lowest at well O-412, with well O-336 at intermediate values. The range in dissolved solids is approximately 15 mg/L for each of these wells. A comparison of the dissolved-solids concentrations in figure 5 with the average background values shown in table 3 indicates that wells O-387 and O-336 have dissolved solids concentrations slightly higher than the average background value of 67 mg/L. The concentrations observed at well O-412 are less than the average background value.

There are no observable long-term trends for dissolved solids at any of the wells shown in figure 5. Highest observed concentrations at wells O-387 and O-336 were recorded during 1980-81. The concentrations of dissolved solids at well O-412 also seem to be consistently higher during the period 1979-81 than 1976-78. More samples would be needed to define seasonal variations in dissolved-solids concentrations.

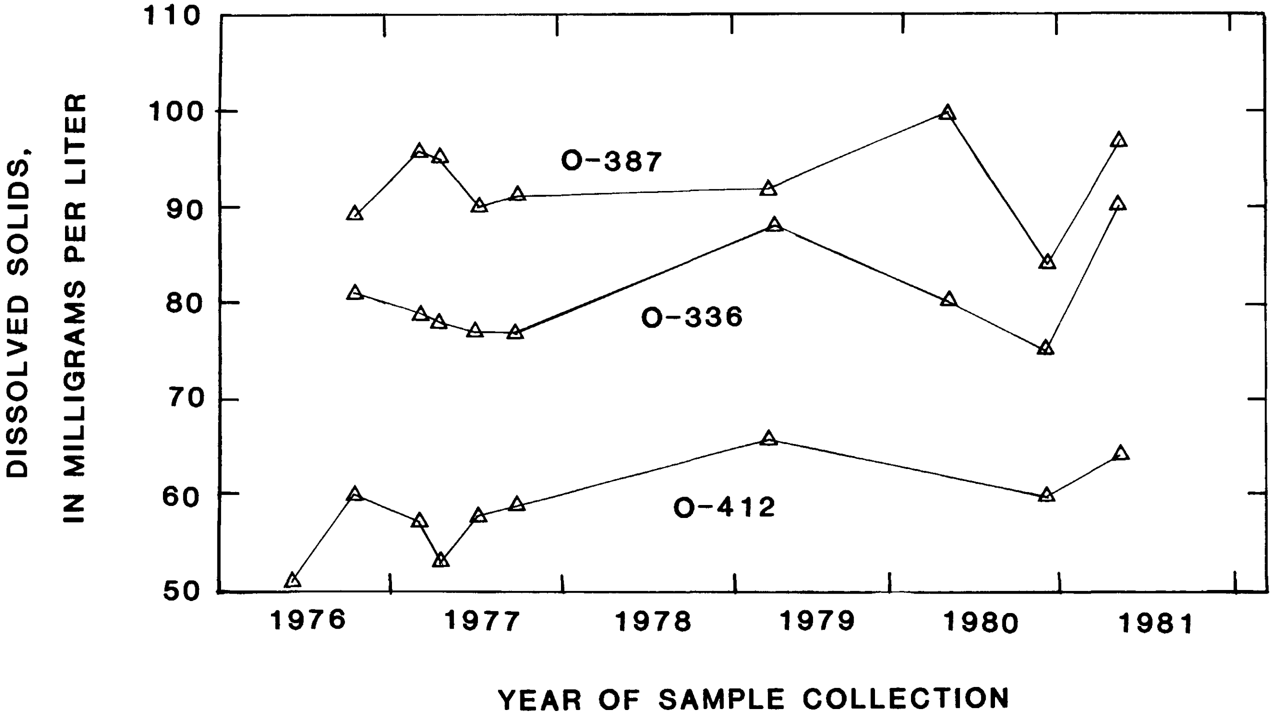


Figure 5.--Dissolved-solids concentrations at municipal supply wells O-412, O-387, and O-336, for the period 1976-81.

## Ground-Water Contamination Sites

Land use activities on the aquifer that have affected water quality include a sanitary landfill and a sludge disposal site both located in South Paris (MDEP, 1980). Sanitary landfills are also located in the towns of Norway and Oxford. The solid waste disposal sites in South Paris have been investigated because they illustrate the effects of disposing domestic waste and tannery waste on water quality in the aquifer.

### Sanitary landfill

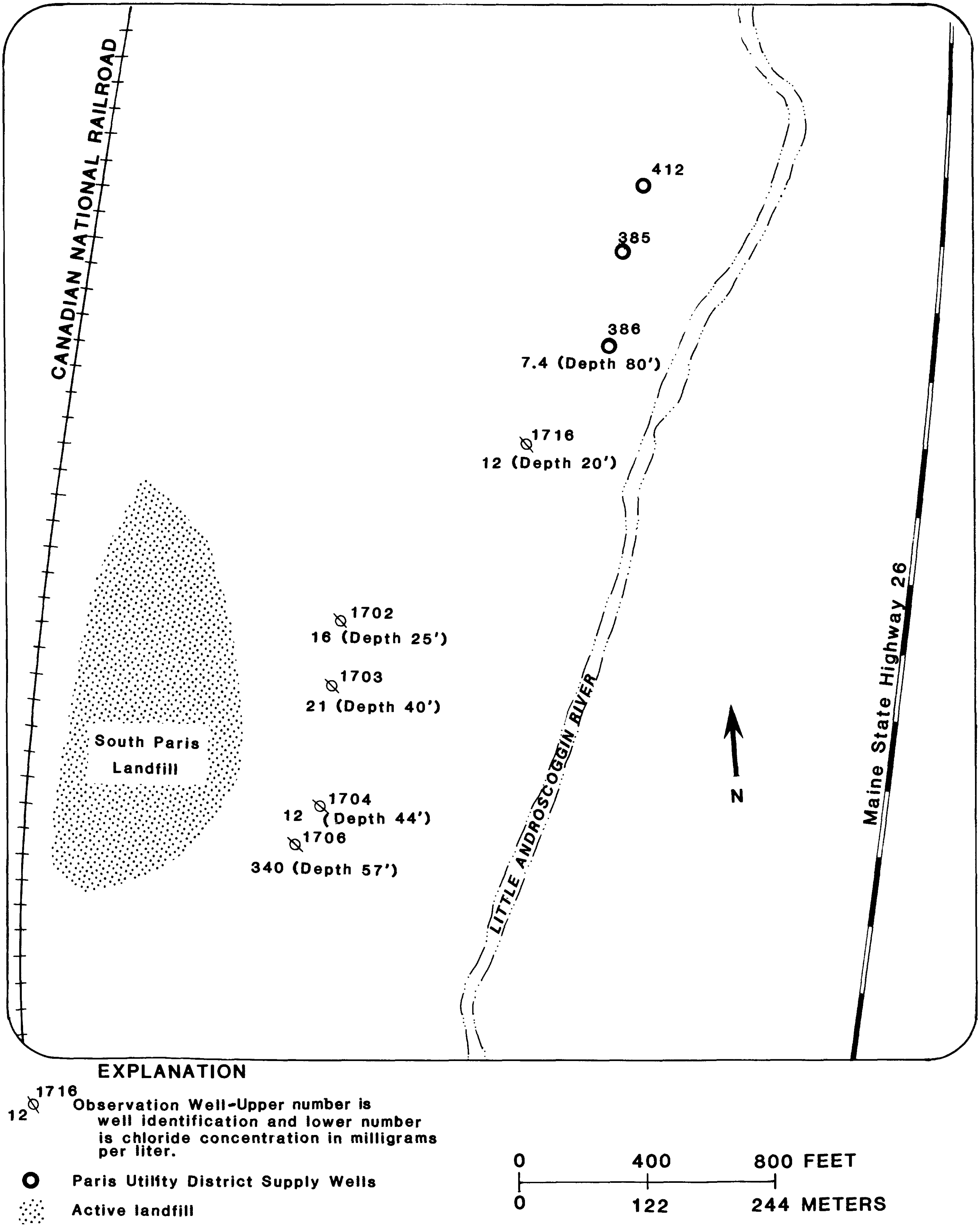
The South Paris municipal landfill has been in operation since 1965. Refuse is disposed of in a gravel pit excavated from a terrace above the Little Androscoggin River. An estimated 1700 tons of residential refuse and an unknown amount of tannery waste are disposed of at this site each year (MDEP, 1980).

Locations of the South Paris Utility District municipal supply wells and observation wells near the landfill site are shown in figure 6. The proximity of the landfill to the municipal supply wells has caused concern about potential contamination of the Paris water supply. To determine the effects of waste disposal on water quality in the aquifer samples were collected at six locations on September 16-17, 1981. Locations where samples were collected and observed chloride concentrations are shown in figure 6. Complete analyses for each well are included in table 13.

Because levels of dissolved chloride were high at the landfill (350 mg/L, MDEP, 1980) and the observation wells were isolated from other sources of chloride contamination, this parameter was used to trace contamination. A sample from well O-1706 downgradient of the landfill showed a dissolved-chloride concentration of 340 mg/L. Observed chloride concentrations at all other wells near the landfill and municipal wells ranged from 7.4 to 21 mg/L. The range of observed chloride concentration for background water quality in the aquifer was from 0.7 to 31 mg/L and averaged 9.3 mg/L.

Although this analysis of chloride concentrations was only a "snapshot" look at water quality of the area, it was done at a time when the cone of depression caused by the Paris wells was near its maximum extent; that is, near the end of the summer when all the wells were pumping. Flow in the Little Androscoggin River on September 16-17, 1981, was about 40 $ft^3/s$, a flow that is equalled or exceeded 67 per cent of the of the time.

Based on the chemical data and water levels at observation wells in this area it appears that leachate is moving downgradient toward the Little Androscoggin River and has not been diverted toward the pumping wells.



Observation Well--Upper number is well identification and lower number is chloride concentration in milligrams per liter.

Paris Utility District Supply Wells

Active landfill

Figure 6.--Locations of wells at the South Paris municipal well field and South Paris sanitary landfill.

## Tannery Sludge Disposal

Untreated tannery waste was disposed of at a site east of the Little Androscoggin River near Oxford Street (fig. 7) for about 20 years (MDEP, 1980). In 1975, when the South Paris sewage treatment facility opened, the tannery waste became the responsibility of the South Paris Utility District. Since that time, dewatered sludge from the treatment plant has been disposed of in shallow trenches near the old site.

Sludge generated by the South Paris sewage treatment facility is unusual because of the character of the influent to the facility. Some 90 percent of the raw wastewater currently originates at the tannery in South Paris, with the remaining 10 percent representing sanitary sewage and cannery effluent. As a result, the waste stream entering the treatment facility has a high solids content and high levels of chromium and other constituents used in the tanning process (USEPA, 1977). A summary of the metal content of the treated sludge is shown in table 5.

Concern for ground water in the vicinity of the disposal site and the proximity of the site to the Norway municipal well (fig. 7) has led to investigations by the EPA (1977), the Environmental Assessment Council (1979), and the MDEP (1980). The EPA report concludes that "sludge dumping at the site over the last 15 years has not led to significant or lasting effects on ground-water quality...", and that "...chromium concentration in ground water is negligible." The MDEP report states "...ground water in the general vicinity of the site has been seriously impacted..." and that levels of dissolved chromium are greater than the recommended limit of 0.05 mg/L (MDHS, 1981) in each of three wells (O-1698, O-1699, O-1700) constructed at the site.

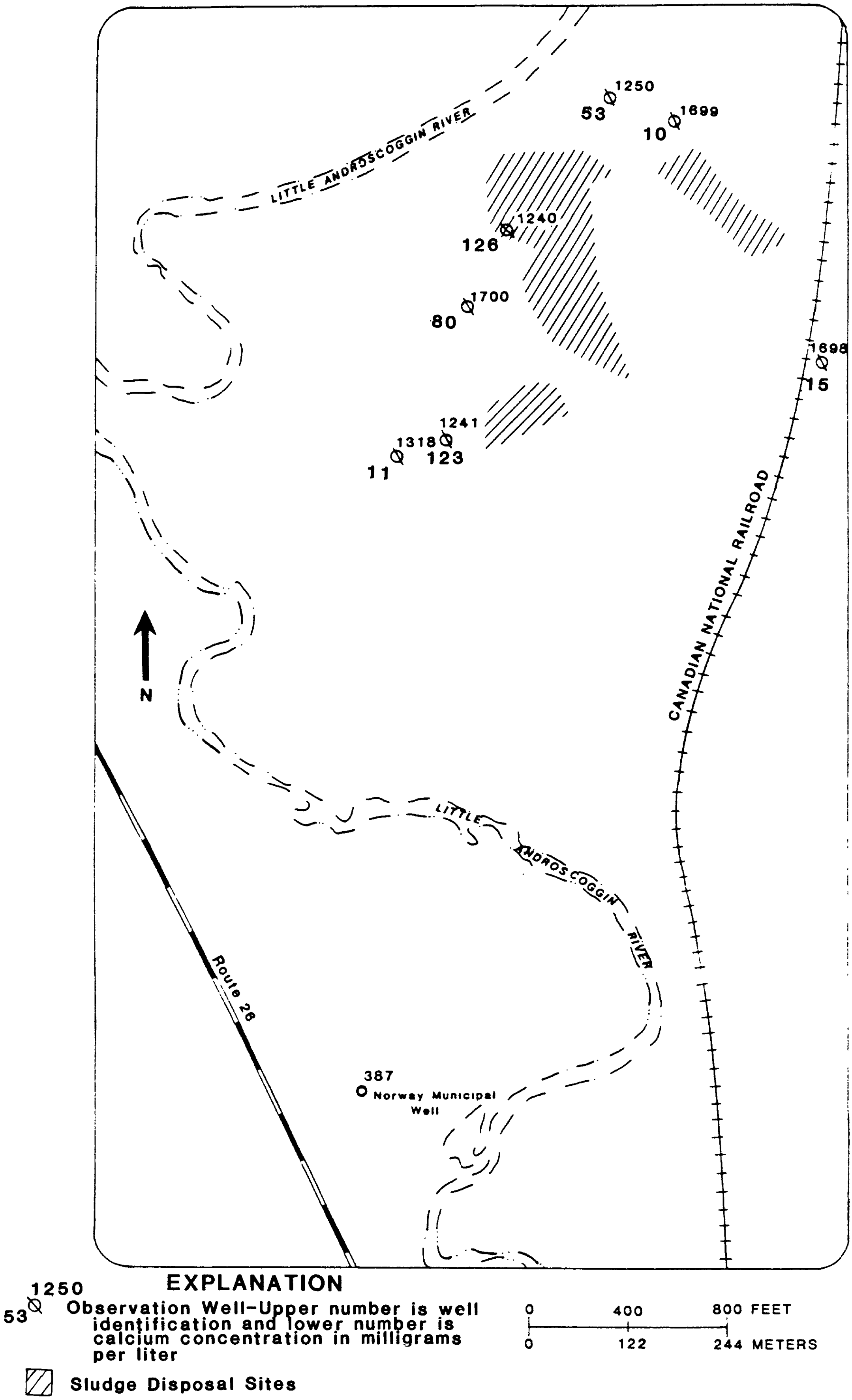


Figure 7.--Locations of wells near the South Paris sludge disposal site

As part of this study, three wells (0-1240, 0-1241, and 0-1250) were constructed to supplement the four existing wells at the site (fig. 7). Table 6 shows some of the results of the ground-water-quality analyses for 1980-81. Also shown on the table is the sampling interval (in feet below land surface) at each well and the dates the samples were collected. It should be noted that well 0-1318 shown on figure 7 is utilized for domestic and stock watering purposes.

The highest concentration of metals in the treated sludge are chromium and calcium (table 5). The highest concentrations of these elements observed in ground water during 1980-81 were at well 0-1240, which is completed beneath an abandoned sludge disposal site. Total chromium concentration at this well was 0.48 mg/L. Samples from all other wells had total chromium concentrations of 0.03 mg/L or less. Well 0-1318, a well used for domestic supply, had total chromium concentrations of 0.02 mg/L and samples taken from well 0-387, the Norway municipal well, had 0.01 mg/L total dissolved chromium.

The concentrations of calcium were near average background levels (8 mg/L) in wells 0-1698, 0-1699, and 0-1318. The highest observed calcium concentrations were at wells 0-1240 (126 mg/L) and 0-1241 (123 mg/L), nearest the sludge disposal site. Both have calcium concentrations approximately 15 times greater than the average background value shown in table 3. Wells 0-1700 and 0-1250 also showed elevated levels of dissolved calcium at 80 mg/L and 53 mg/L, respectively.

The dissolved solids at wells 0-1240, 0-1241, and 0-1700 are all greater than the recommended limit of concentration of 500 mg/L (MDHS, 1981). Total iron at well 0-1240 is 230 mg/L and 27 mg/L at well 0-1700. Sodium was also at relatively high levels in samples taken from wells in, or downgradient from, the sludge disposal site.

In summary, data indicate that a leachate plume is emanating from the sludge disposal site. Common inorganic constituents (calcium, sodium, and chloride) have moved at least 500 feet downgradient from the disposal site toward the Little Androscoggin River. High levels of chromium in ground-water were observed only at a well completed directly below the sludge disposal site. The leachate plume has apparently moved downward in the aquifer, as suggested by low levels of dissolved solids at the shallow well 0-1318.

Table 5.--Metal content of sludge from the South Paris treatment facility.

| | Metal content in milligrams per kilogram of dry weight | |
|---|---|---|
| | Aug. 18, 1976[1] | Feb. 15, 1979[2] |
| Arsenic | 6.8 | 9.9 |
| Cadmium | 0 | 2.9 |
| Calcium | 45,700 | 68,540 |
| Copper | 128 | 127 |
| Iron | 2,690 | -- |
| Lead | 518 | 325 |
| Magnesium | 1,643 | 2,060 |
| Manganese | 122 | -- |
| Mercury | 0.65 | $<$ 1.0 |
| Nickel | 17 | 14.6 |
| Potassium | 366 | 428 |
| Sodium | 10,200 | -- |
| Zinc | 154 | 122 |
| Chromium | 73,400 | 74,660 |

[1] From U.S. Environmental Protection Agency, 1977.

[2] From Environmental Assessment Council, Inc., 1979.

Table 6.--Selected chemical constituents of ground water near the South Paris sludge disposal site.

| Well identification no. | Date of sample collection | Sampling interval in feet below land surface | Constituents, in milligrams per liter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total chromium | Total iron | Total manganese | Dissolved calcium | Dissolved magnesium | Dissolved sodium | Dissolved solids | Total organic carbon | Dissolved chloride |
| 1318 | 6-19-80 | 15-20 | .01 | .11 | .01 | 8.1 | 1.3 | 2.2 | 64 | 0.0 | 7.1 |
| | 8-22-80 | | .02 | .05 | .01 | 11 | 1.8 | 2.4 | 69 | 0.5 | 7.5 |
| 1241 | 9-30-81 | 72-76 | .02 | .37* | .14* | 123 | 22 | 79* | 669* | 3.9 | 140 |
| 1700 | 6-19-80 | 70-75 | .01 | 29* | 8.5* | 99 | 14 | 140* | 752* | -- | 190 |
| | 8-22-80 | | .01 | 56* | 9.7* | 110 | 17 | 150* | 880* | 6.3 | 210 |
| | 4-22-81 | | .01 | 28* | 7.0* | 99 | 14 | 78* | 613* | 3.3 | 110 |
| | 9-30-81 | | .02 | 27* | 7.2* | 80 | 12 | 89* | 628* | 5.2 | 140 |
| 1240 | 9-30-81 | 71-76 | .48* | 230* | 14* | 126 | 20 | 77* | 716* | 22 | 120 |
| 1250 | 9-30-81 | 61-64 | .03 | .13 | 1.1* | 53 | 6.3 | 21* | 298 | 2.1 | 31 |
| 1699 | 6-19-80 | 50-55 | .01 | .61* | .01 | 11 | 1.6 | 3.4 | 78 | -- | 3.9 |
| | 8-22-80 | | .01 | .16 | .01 | 13 | 1.8 | 3.7 | 73 | 0.2 | 4.9 |
| | 4-22-81 | | .01 | .34* | .01 | 8.9 | 1.3 | 3.1 | 56 | 0.3 | 2.9 |
| | 9-30-81 | | .02 | 1.6* | .02 | 10 | 1.4 | 3.3 | 60 | 0.2 | 2.7 |
| 1698 | 6-19-80 | 50-55 | .02 | 2.9* | .05 | 16 | 2.5 | 3.4 | 80 | 4.2 | 1.7 |
| | 8-22-80 | | .01 | .38* | .01 | 17 | 2.6 | 3.4 | 80 | 1.0 | 1.3 |
| | 4-22-81 | | .02 | .41* | .01 | 16 | 2.3 | 3.1 | 88 | 0.6 | 3.5 |
| | 9-30-81 | | .02 | .16 | .01 | 15 | 2.5 | 3.1 | 80 | 0.2 | 1.8 |

* exceeds limit of concentration specified by MDHS, 1981

## Surface Water

In order to describe surface-water quality in the study area, the Little Androscoggin River and three tributaries were sampled on two different occasions. One set of samples was obtained on September 16-17, 1980, at low flow, conditions (26 $ft^3/s$ at station 01057000) equaled or exceeded 77 percent of the time. The second set of samples was taken on April 27-28, 1981, at flow conditions (136 $ft^3/s$ at station 01057000) equaled or exceeded 28 percent of the time. Sampling locations are shown on plate 1.

Selected dissolved solids and physical properties of samples taken on September 16-17, 1980 are summarized in table 7. The concentration of dissolved solids generally increases in a downstream direction from station 01057000. There is a distinct difference in water quality between station 44124107 at the railroad bridge in South Paris and station 44111507 at the Route 26 highway bridge. Between these two stations, the river receives outflow from the Norway and South Paris sewage treatment plants. These inflows cause an increase in most constituents as shown in table 7.

Water-quality samples taken on April 27-28, 1981 are summarized in table 8. In general, the levels of dissolved solids at all sampling stations are less than those observed in the previous sampling. Even at the higher flow, water quality below station 44124107 reflects sewage inflow to the river.

As discussed in the previous section, the South Paris sewage treatment plant disposes of large quantities of chromium from tannery waste. This disposal of chromium is reflected in the high levels of total chromium observed in the river during both sampling runs. On September 16-17, 1980, levels of total chromium in the river were at 0.04 mg/L just below the treatment plant and a maximum of 0.15 mg/L at station 44075607 in Welchville. On April 27-28, 1981, the total chromium concentrations were near background levels (0.01-0.02 mg/L) at all sampling locations except station 44081207 in Oxford where 0.15 mg/L was detected.

Total chromium concentrations in the South Paris treatment plant effluent are measured at monthly (or more frequent) intervals. Levels measured nearest in time to the sampling runs were 2.4 mg/L total chromium on September 25, 1980, and 4.9 mg/L on April 30, 1981 (Dennis Heschl, MDEP, oral communication 1982). Levels of total chromium in the sewage plant effluent were probably similar on the days the samples were taken from the river.

Table 7.--Selected chemical constituents and physical properties of the Little Androscoggin River and tributaries on September 16-17, 1980

(All chemical constituents are reported in milligrams per liter LAR, Little Androscoggin River)

| Sample[1] site | Instantaneous Discharge (ft$^3$/s) | Dissolved chloride | Dissolved oxygen | Dissolved solids | Total chromium | Total nitrogen as N | Total phospherus as P |
|---|---|---|---|---|---|---|---|
| 01057000 - LAR near Biscoe Falls | 26 | 4.3 | 10.2 | 47 | < .010 | .12 | .02 |
| 44150307 - LAR near South Paris well field | 33 | 5.3 | 11.4 | 52 | < .010 | .12 | .02 |
| 44132307 - Stony Brook | 1.6 | 5.5 | 9.7 | 76 | .010 | .13 | .01 |
| 44124107 - LAR near railroad bridge | 37 | 9.5 | 10.8 | 64 | < .010 | .27 | .02 |
| 44111507 - LAR near Rte. 26 bridge | 44 | 35 | 10.4 | 118 | .040 | .77 | .09 |
| 44101007 - LAR near Webber Brook | 51 | 30 | 10.0 | 111 | .040 | .64 | .10 |
| 44081207 - LAR near Oxford | 45 | 31 | 8.9 | 113 | .120 | .64 | .11 |
| 01058005 - Thompson Lake outlet | 75 | 2.4 | 8.2 | 35 | .010 | .05 | .03 |
| 44075607 - LAR near Welchville | 86 | 15 | 8.1 | 68 | .150 | .35 | .05 |
| 44063707 - LAR near Mechanic Falls | 86 | 36 | 9.0 | 137 | .130 | 1.1 | .04 |

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[1] Station location shown on plate 1.

Table 8.--Concentrations of selected constituents and physical properties of the Little Androscoggin River and tributaries on April 27-28, 1981.

(All chemical constituents are reported in mg/L; fecal coliform is reported in counts per 100 millimeters. LAR, Little Androscoggin River.)

| Sample[1] site | Instantaneous Discharge ($ft^3/s$) | Dissolved chloride | Dissolved oxygen | Total Dissolved Solids | Total Chromium | Total Nitrogen as N | Total Phosphorus as P | Fecal Coliform |
|---|---|---|---|---|---|---|---|---|
| 01057000 - LAR near Biscoe Falls | 136 | 3.9 | 12 | 36 | .020 | .08 | .01 | 10 |
| 44150307 - LAR near South Paris well field | 165 | 4.1 | 11.8 | 36 | .020 | .07 | < .01 | 3 |
| 44132307 - Stony Brook | 20 | 7.1 | 11.6 | 44 | .020 | .06 | < .01 | 33 |
| 44124107 - LAR near railroad bridge | 177 | 5.5 | 11.4 | 51 | .020 | .09 | < .01 | 6 |
| 44122307 - Pennessewassee Lake outlet | 33 | 4.9 | 10.6 | 51 | .010 | .03 | < .01 | 9 |
| 44101007 - LAR near Rte. 26 bridge | 203 | 13 | 10.0 | 68 | .020 | .81 | < .01 | 12 |
| 44081207 - LAR near Oxford | 232 | 17 | 10.2 | 73 | .150 | .86 | .04 | 10 |
| 01058005 - Thompson Lake outlet | 55 | 2.9 | 11.1 | 37 | .020 | .02 | < .01 | 105 |
| 44075607 - LAR near Welchville | 392 | 11 | 10.9 | 63 | .030 | .52 | .03 | 16 |
| 44063707 - LAR near Mechanic Falls | 402 | 12 | 11.2 | 55 | .030 | .53 | < .01 | 9 |

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[1] Station location shown on plate 1.

Fecal coliform counts for the Little Androscoggin River were determined on April 27-28, 1981, and are shown in table 8. As with dissolved constituents, fecal coliform are more prevalent downstream from the sewage outfalls. Highest levels of fecal coliform were observed in samples from station 01058005 at Thompson Lake outlet (105 counts per 100 milliliters) and at station 44132307 on Stony Brook (33 counts per 100 milliliters).

To summarize, water quality in the Little Androscoggin River is excellent north of the town of South Paris. Below South Paris, river quality deteriorates due to discharge from sewage treatment facilities in Norway and South Paris. The sampling runs indicate that the river is more seriously affected during low-flow conditions. Quality of water in tributaries was excellent during both sample runs with the exception of bacterial contamination at sites 44132307 on Stony Brook and 01058005 on Thompson Lake outlet.

## DIGITAL MODEL ANALYSIS

The finite-difference model used in this study is designed to simulate, in two dimensions, a ground-water flow system and its response to an imposed stress. The aquifer may be confined or unconfined, or a combination of both; heterogeneous and anisotropic and have irregular boundaries. The model permits constant recharge, evapotranspiration as a linear function of depth to water, well discharge, and leakage from confining beds in which the effects of storage are considered (Trescott, Pinder, and Larson, 1976).

Other assumptions inherent in the model are that pumping wells are 100 percent efficient and screened throughout the entire saturated thickness of the aquifer and that aquifer properties are uniform within individual grid blocks but may vary from block to block.

## Conceptualization of Aquifer System and Model Construction

In developing a model of the Little Androscoggin River valley aquifer, the complexity of the real system has been somewhat simplified. The goal has been to keep the conceptual model as simple as possible while retaining the essential features of the real system.

Simplifying assumptions included in the conceptual model of the aquifer system are:

1. Flow in the aquifer is horizontal; Although in actuality this is not true this assumption is not considered to introduce significant errors in simulated heads given the relative uncertainty of other parameters in the model such as hydraulic conductivity. The result of this assumption is that the model cannot accurately simulate ground-water elevations in areas with significant vertical flow components.
2. Recharge to the aquifer from precipitation is uniformly distributed over the modeled area. In actuality more recharge will occur through more permeable land surfaces atop the aquifer such as in gravel pits or on flat-lying surfaces as opposed to urbanized areas or steeply sloping surfaces.
3. The altitude of surface waters in the model remains constant in time. For steady-state simulations the use of average surface-water altitudes does not cause considerable error. However, in transient simulations, this assumption tends to reduce ground-water level changes in the vicinity of surface waters.
4. Discharges from the aquifer are to surface water bodies and to discharging wells. Evapotranspiration has been implicity modeled in the way that recharge to the aquifer is calculated.
5. The total area modeled is approximately 16 square miles (plate 5). Twenty-three square miles of upland areas adjacent to the river valley aquifer are included in the contributing drainage but not modeled because they do not contain any saturated stratified drift.

## Boundary Conditions

The northern and southern ends of the alluvial aquifer terminate where the saturated thickness of the valley fill becomes very small. In the model, these boundaries are simulated as no-flow. The eastern and western boundaries of the aquifer coincide with the contact of stratified drift and the bedrock/till valley walls. These contacts are simulated as constant flux boundaries. The model is arbitrarily terminated at a point just south of Mud Pond. This termination corresponds approximately with a flow line and has therefore been simulated as a no-flow boundary.

The bottom boundary of the aquifer is the contact between the highly permeable stratified drift and the less permeable till/bedrock or fine-grained marine deposits. In the model, this contact is simulated as a no-flow boundary. Some leakage probably occurs across this boundary but it is assumed to be small enough to be considered negligible in a water balance for the aquifer. The top boundary of the aquifer is the water table and is simulated by the model.

The internal boundaries of the model include the Little Androscoggin River and tributaries, bedrock outcrops, and Hogan and Whitney Ponds. The Little Androscoggin River, and Webber and Meadow Brooks are simulated as leaky boundaries. This type of simulation allows leakage across a semi-permeable streambed in response to a head gradient between water in the river and in the aquifer. Bedrock outcrops in the valley are simulated as no-flow boundaries; lakes in the aquifer are simulated as constant head boundaries. The locations of all boundaries in the model and how they are simulated are shown on plate 5.

## Grid

The finite-difference grid used to discretize the Little Androscoggin River valley aquifer is shown on plate 5. The grid consists of 55 rows and 107 columns, or a total of 5,885 nodes. Only the nodes located on the aquifer are considered "active" and are involved in the numerical computations. The total number of active nodes in this model is 1,282. The grid has variable spacing with node dimensions ranging from 400 to 800 feet on a side. The grid is finer in the northern and central parts of the area where the aquifer is narrow, and coarser in the wide outwash plains near the town of Oxford.

## Aquifer Parameters

Hydraulic properties of the aquifer that must be assigned to each grid block in the model include hydraulic conductivity, aquifer-bottom elevation, and specific yield. The values assigned to each grid block represent an average value over the entire area of the block. The hydraulic conductivity distribution resulting from model calibration is shown on plate 6. The values shown on plate 6 have been modified from the original estimates of aquifer hydraulic conductivity. In general, the calibrated values are less than the original estimated values. The most notable difference between original estimated hydraulic conductivity and values resulting from calibration occured in coarse-grained ice contact materials. Original estimated values were about 150-200 ft/day while calibrated values were 100-120 ft/day. Specific yield values were set equal to zero at each node during steady-state simulations. The specific yield was estimated to be 0.15 over the entire model area during transient verification.

Parameters identifying hydraulic properties of the streambed were assigned to nodes in the model that correspond to the location of the Little Androscoggin River and the tributaries Webber and Meadow Brooks. These parameters include streambed hydraulic conductivity and thickness, and river-head altitude. When the area of a streambed is less than the total area of the node, the ratio of streambed permeability to thickness is proportionally reduced to make the amount of leakage realistic. Streambed permeabilities were estimated to be 2 feet per day throughout the study area and river bed thickness was estimated at 2 feet. The permeability estimates are based on values reported by Haeni (1978).

## Recharge and Discharge

Recharge directly to the aquifer from precipitation was estimated to be approximately 16.4 cubic feet per second (18 inches) during the 1981 water year. As previously discussed, this figure is based upon the total annual runoff on the Little Androscoggin River near South Paris (station 01057000) and an estimate that 95 percent of total runoff from stratified drift is ground-water outflow (Cervione, 1972). Direct recharge from precipitation was distributed evenly over the model area.

Lateral inflow to the aquifer from till covered areas along the east and west boundaries was estimated as described in the section on "Lateral inflows". This estimated recharge for the 1981 water year was 11.2 cubic feet per second or 0.5 $ft^3/s$ per square mile of drainage. This recharge was distributed along model boundaries in proportion to contributing drainage area and size of boundary cells.

The major discharge from the aquifer, leakage to surface water, was computed by the model. The only other discharge from the model was from large municipal wells serving Norway, South Paris, and Oxford. The simulated discharge from these wells (average 1981 water year values) was 0.50, 1.50 and 0.25 cfs respectively.

## Calibration

Calibration of a ground-water flow model is the process of adjusting model input data to improve model results. The basis for calibration in this model was comparison of computed and measured head values and leakage to surface water.

### Steady State Analysis

In steady-state simulations, computed head values were compared with "average" heads observed in the aquifer during the 1981 water year. Average heads were considered to be those observed in the aquifer during June, 1981. At this time heads were at intermediate values between spring high water and summer low water (fig. 3). Water levels shown on plate 1 represent these approximate average conditions.

During the calibration process, changes were made to hydraulic conductivity, streambed parameters, and leakage across lateral boundaries to make computed head values agree with observed values. Water levels computed by the model were more sensitive to variations made in hydraulic conductivity values than to variations in streambed permeability or boundary flux. Changes in hydraulic conductivity values had the greatest effect in areas of thin saturated thickness or steep hydraulic gradients. The final average of absolute difference between computed and observed values of head at 63 locations in the model was 2.5 feet, ranging from 0.0 to 11.9 feet. The absolute difference was less than five feet at 90 percent of locations used to check model results. A water table map contoured from computer generated ground water altitudes is shown on plate 7.

As a further part of the calibration process computed leakage from the aquifer to surface-water bodies was compared with leakage observed during seepage runs. Comparisons were made along four reaches, shown in table 9. The computed values fall within the ranges of observed values.

Table 9.--Comparison of computed ground-water outflow from the aquifer with observed values.

| | Leakage, in cubic feet per second | | |
|---|---|---|---|
| Reach | Computed | Range, observed | Average |
| 1 | 4 | 1 - 8 | 5 |
| 2 | 12 | 10 - 12 | 11 |
| 3 | 5 | 5 - 8[1] | 7[1] |
| 4 | 8 | 1 - 13 | 6 |
| Total | 29 | 18 - 37 | 29 |

[1] Values of leakage along this reach have been proportionately reduced from table 1 to represent the amount of drainage area actually modeled.

The final criterion considered during steady-state calibration was the mass balance for inflow and outflow from the model. The mass-balance calculation checks the numerical accuracy of the solution and, for ground-water flow models, should be less than 0.1 percent (Konikow, 1978). The mass balance for the steady-state model was 0.08 percent and indicates that there were no significant errors pertaining to numerical computation in the model.

The computed steady-state water budget for the aquifer for "average" conditions during the 1981 water year is summarized in table 10.

Table 10.--Steady-state water budget for average 1981 water year conditions.

| Inflow | Rate in, cubic feet per second | Outflow | Rate in, cubic feet per second |
|---|---|---|---|
| Infiltration from precipitation | 16.4 | Ground water seepage to streams. | 26.7 |
| Flux from till | 11.2 | Pumpage | 2.3 |
| Leakage from streams | 1.4 | | |
| Total | 29 | Total | 29 |

## Verification

In order to verify model response, water-level changes observed from June - December 1981 were simulated in a transient analysis. The initial conditions were June 1981 water levels computed by the steady-state model. Specific yield of the aquifer was set uniformly to 0.15. Recharge directly to the aquifer and inflow across boundaries was varied monthly based on total runoff and base flow of the Little Androscoggin River.

The observed and computed hydrographs at three observation wells in the aquifer from June through December 1981 are shown in figure 8. Wells O-1253 and O-1258 are located near Oxford Plains and well O-1701 is located in the northern part of the model area near the South Paris well field. These wells have been selected because they illustrate model response in both the narrow northern part of the aquifer and in the wide outwash plains in the southern part of the aquifer. The hydrographs shown are generally typical of model response but show some of the best fit obtained with the model.

The final average of absolute difference between computed and observed heads at 52 locations after six months of transient simulation was 3.5 feet. The absolute differences ranged from 0.0 to 10.7 feet and at 73 percent of the locations the difference was less than five feet.

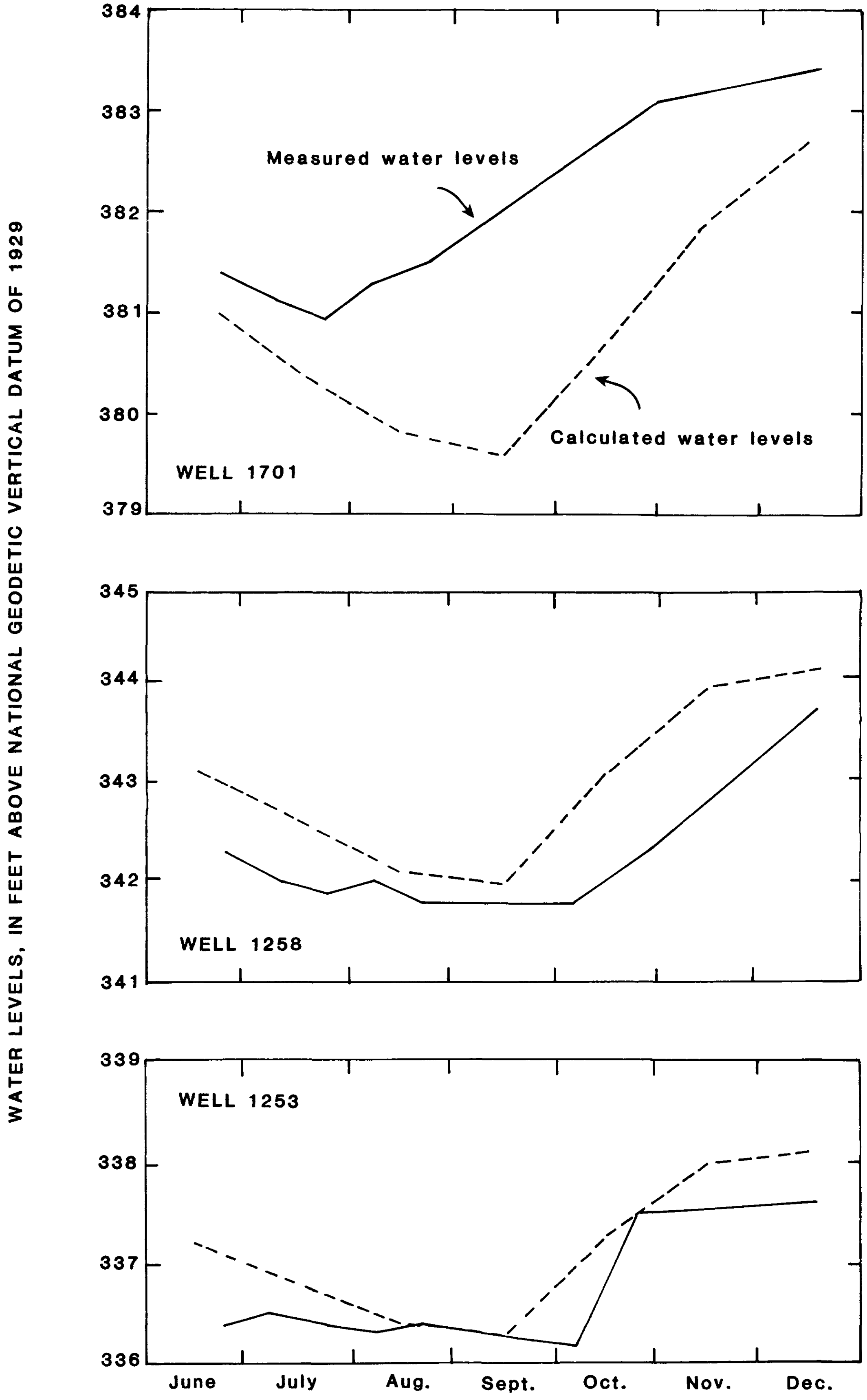


Figure 8.--Observed and calculated water levels at three wells during June-December, 1981.

As depicted in figure 8 simulated water levels approximate the water level changes observed from June through December 1981. The model did not closely reproduce observed hydrographs near surface waters. The reason for this inaccuracy is that river stage was held at a constant average level in the model and not allowed to vary as it does in nature. This constant average level tends to reduce water-level changes computed by the model at locations near the river.

## Model Application

When model calibration and verification are complete, the model can be used to investigate aquifer response to proposed future stresses. When using the model to predict aquifer response it is important to consider the relation of hypothetical future stresses to the magnitude and types of stresses used to calibrate and verify the model. In this case the individual pumping rates that have been used to calibrate the model range from 0.25 to 1.50 mgd. If future hypothetical pumping rates simulated with the model are several times greater than these (for instance 5 mgd at one well) the model results should be used carefully. The future-imposed stresses should be such that the physical limitations of the aquifer are not exceeded. Factors such as available aquifer thickness and type of aquifer material should be considered at locations where future stresses are to be applied.

The previous discussion on model calibration and verification should give a prospective user of this model a feel for its accuracy. Again, the absolute average difference between computed and observed heads obtained from model calibration was about 2.5 feet and ranged from 0-11.9 feet. After six months of transient simulation the absolute average difference between computed and observed heads was 3.5 feet and ranged from 0-10.7 feet. Transient simulations for periods much longer than this should be interpreted with the knowledge that only six months of data have been used for model verification. Also, transient response of computed water levels near surface-water bodies may be in error due the way in which surface waters in the model are simulated.

## Reduced Recharge

The model was first used to investigate the effects of reduced recharge on the aquifer. Instead of using average values of recharge and boundary flux from the 1981 water year, half of these values were used. The amount of drawdown from 1981 average water levels that the model simulated under these hypothetical drought conditions is shown on plate 8. Water-level declines were greatest along the boundaries of the aquifer, averaging about 10 feet or slightly more and as much as 15-20 feet in some places. Drawdowns in the center of the aquifer along the river were generally 5 feet or less. A prolonged drought that occurred in 1978 caused many shallow dug wells in the aquifer to go dry. Unfortunately, no water level data were collected in the Little Androscoggin River valley aquifer during that period to compare with the predicted drawdowns.

## Increased Pumping

The second hypothetical situation assumes increased pumping rates at large production wells in the northern part of the aquifer to determine if the cones of depression caused by the wells will intersect contaminated ground water. Both contamination sites, the sanitary landfill (fig. 6), and the sludge disposal site (fig. 7) have been previously discussed in the section on "Ground-water contamination sites".

### Sanitary landfill site

The average 1981 pumping rate for wells near the South Paris landfill was approximately 1.0 million gallons per day or about 695 gallons per minute. A contour map of computer generated water-table altitudes showing the relationship between the cone of depression caused by the municipal wells and the sanitary landfill under 1981 pumping conditions is shown in figure 9. Under these conditions, it appears that ground-water flow from the area of the landfill is toward the Little Androscoggin River and 33 percent of pumped water is from the river.

The model was used to simulate a pumping rate which is twice the average 1981 rate, or about 2.0 mgd. Under these conditions (fig. 10), the cone of depression caused by the wells extends about 400 additional feet south of the wells and leakage from the Little Androscoggin River constitutes 53 percent of pumped water. The larger cone of depression appears to divert some groundwater flow from the area of the South Paris landfill. Deterioration of water quality in the wells due to interception of leachate might be offset by the increase in leakage of good quality water from the Little Androscoggin River.

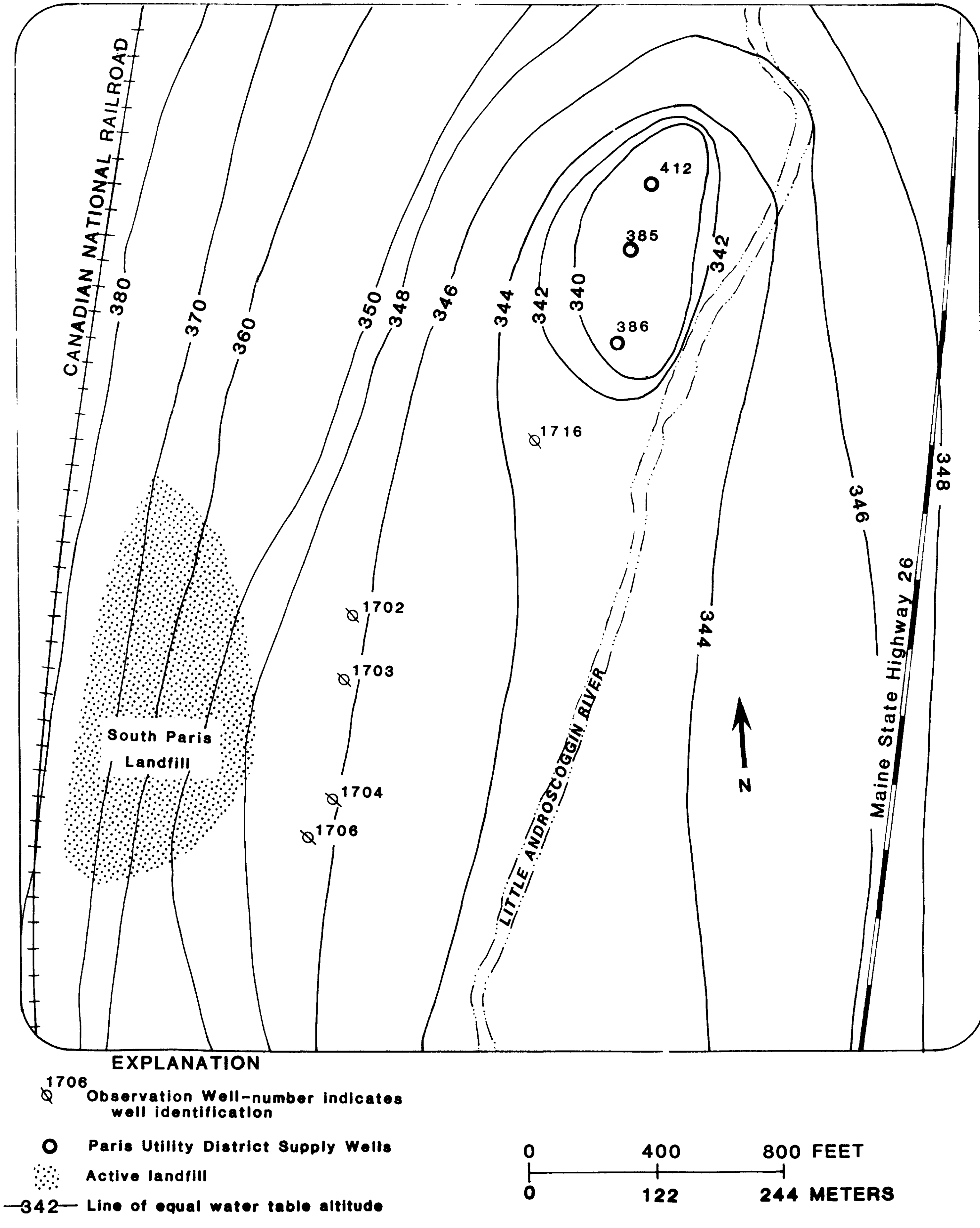


Figure 9.--Steady-state water levels near the South Paris landfill under average 1981 conditions (1 mgd pumping rate).

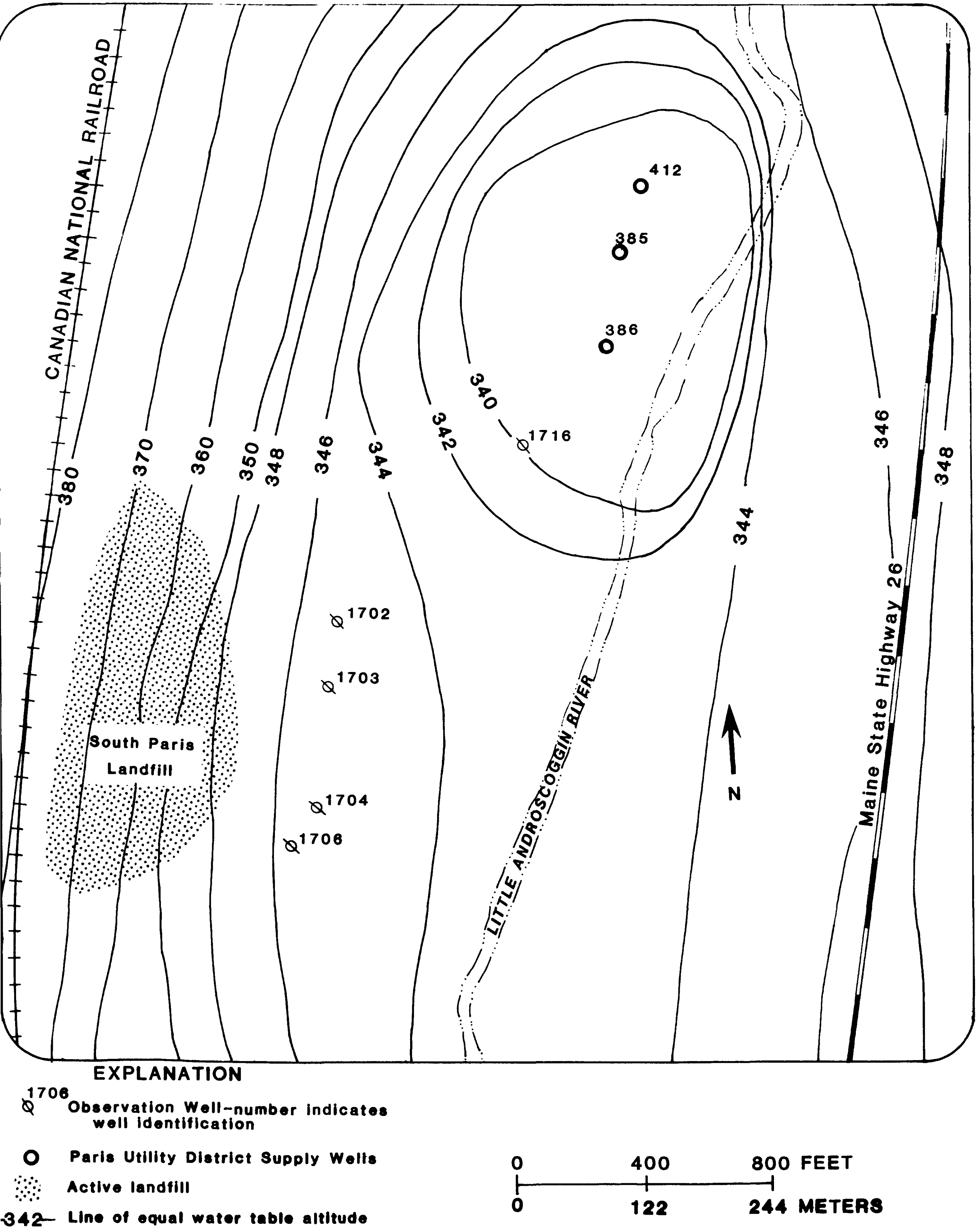


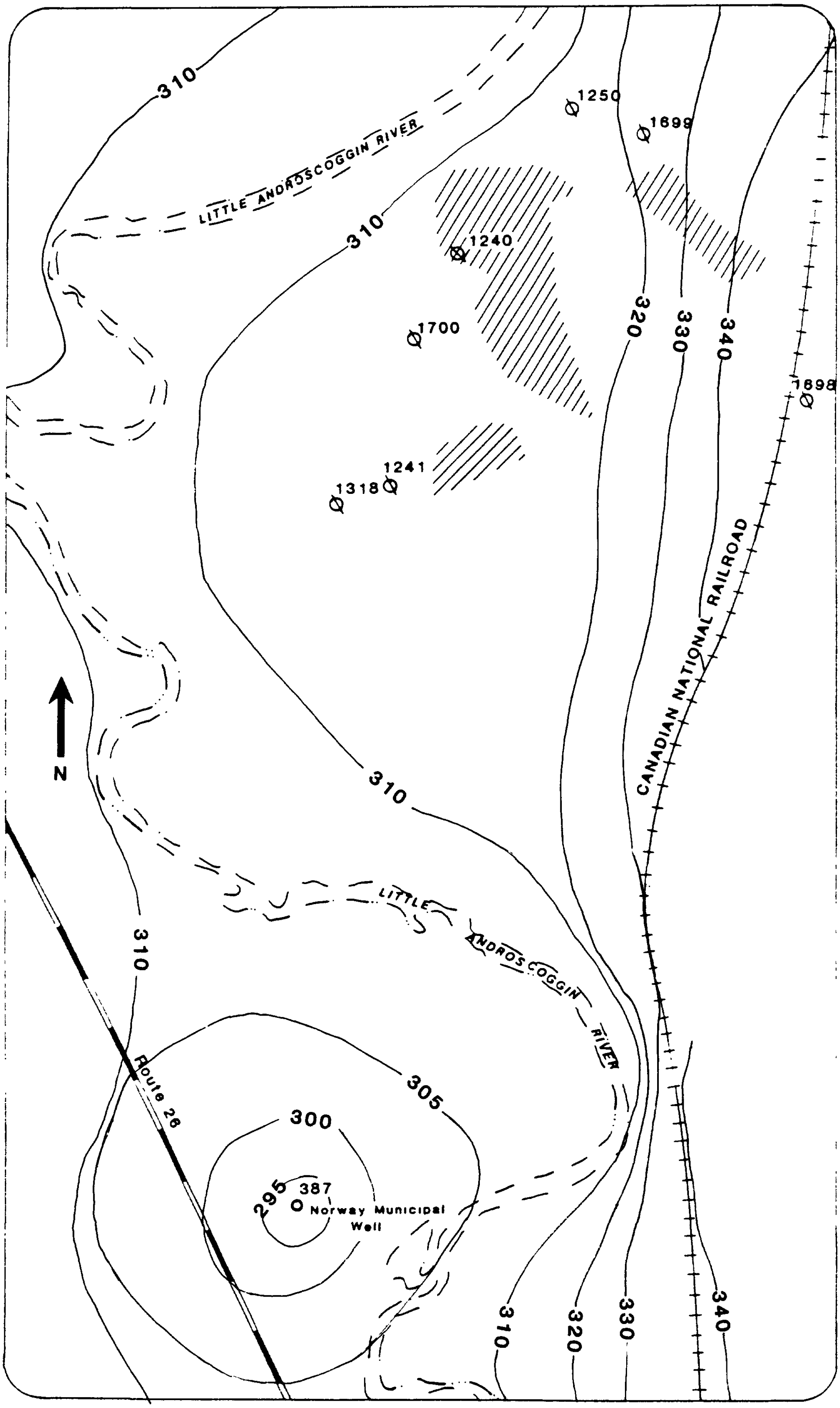
Figure 10.--Steady-state water levels near the South Paris landfill at hypothetical pumping rate of 2 mgd. (2x average 1981 rate).

Another hypothetical pumping scheme was simulated to investigate the effects of adding more wells to the well field. Under these conditions, the 1981 pumping rates were maintained at existing wells and an additional 0.65 mgd was pumped from hypothetical wells located north of the well field along the river. Under these conditions, the cone of depression did not extend as far south toward the landfill as when the current rate was doubled. Leakage from the river constituted 51 percent of pumped water.

### Sludge disposal site

The average 1981 pumping rate at the municipal well near the South Paris sludge disposal site was 0.38 mgd, or about 265 gpm. The estimated capacity of the well is 1300 gpm but it is pumped intermittently at about 600 gpm. A steady-state simulation of 1981 pumping estimates that induced infiltration from the Little Androscoggin River constitutes 10 percent of pumped water.

A simulated pumping rate of 0.65 mgd (1.7 times more than current pumping) will increase induced infiltration from the river to about 39 percent of the water pumped from the well. The cone of depression caused by this hypothetical pumping rate shown on figure 11 does not seem to extend far enough to the north to intercept ground-water flow from the vicinity of the South Paris sludge disposal site. The increase in induced infiltration from the Little Androscoggin River could be significant because the quality of water in the river is adversely affected by upstream sewage discharge, expecially at low flows.



## EXPLANATION

Ø Observation Well–number indicates well identification

▨ Sludge Disposal Sites

—310— Groundwater level Contour–5 and 10 foot contour intervals shown on map

| 0 | 400 | 800 FEET |
|---|---|---|
| 0 | 122 | 244 METERS |

Figure 11.--Steady-state water levels near the South Paris sludge disposal site under hypothetical pumping rate of 0.65 mgd.

# SUMMARY

Average 1981 estimated inflows to the Little Androscoggin aquifer are 16.4 $ft^3/s$ from precipitation and infiltration directly to the aquifer, 11.2 $ft^3/s$ from till-covered uplands adjacent to the aquifer, and 1.4 $ft^3/s$ leakage from surface-water bodies. Computed discharges are 26.7 $ft^3/s$ to surface waters on the aquifer, and 2.3 $ft^3/s$ to municipal wells. The saturated thickness of coarse-grained deposits that comprise the aquifer ranges from about 10 feet near the boundaries to 100 feet. In general, the northern part of the aquifer is composed of coarse-grained ice-contact and outwash material overlying till and bedrock. The southern part of the aquifer is composed of outwash deposits overlying fine-grained marine sediments.

The quality of water from the aquifer can be classified as generally low in dissolved solids (average for 38 samples was 67 mg/L), slightly acidic, and soft. The predominant cations are calcium and sodium and the predominant anion is bicarbonate. High levels of dissolved iron and manganese were observed at several wells in the aquifer. High levels of sodium also occured in several wells.

Degradation of ground-water quality has occurred in the vicinity of the South Paris landfill and sludge disposal sites. Dissolved solids concentrations in ground water near the sludge disposal site were as high as 880 milligrams per liter (13 times greater than average for the aquifer). Based upon water sampling, water levels in observation wells, and digital simulations, it appears that municipal supply wells near both of these sites are currently unaffected by the contaminated ground water.

Water quality in the Little Androscoggin River upstream from Norway and South Paris is good. Samples taken from the river in this area had total dissolved solids concentrations that ranged from 36 to 52 mg/L. The quality of water downstream from Norway and South Paris is deteriorated by sewage outfalls from both towns. Levels of total chromium as high as .15 mg/L were observed in the river downstream from the South Paris treatment plant.

A finite-difference digital-computer model was used for steady-state and transient analyses of ground-water flow in the aquifer. The model was calibrated based upon observed water levels and ground-water discharges measured during 1981. Water levels computed by the model were most sensitive to changes in hydraulic conductivity of the aquifer.

The calibrated model predicted that water-level declines of up to 20 feet would occur in a hypothetical drought situation (50 percent of 1981 recharge). Model simulations of increased pumping in the northern part of the aquifer indicate that resulting changes in the water table will not be sufficient to intercept ground-water contaminated by a sludge disposal site.

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## GLOSSARY

Aquifer: A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable materials to yield significant quantities of water to wells and springs.

Bedrock: Solid rock, commonly called "ledge", that forms the Earth's crust. It is locally exposed at the surface but more commonly is buried beneath a few inches to more than 300 feet of unconsolidated deposits.

Coliform organisms: Any of a group of bacteria, some of which inhabit the intestinal tracts of vertebrates. Their occurrence in a water sample is regarded as evidence of possible sewage pollution and fecal contamination, although these are generally considered to be nonpathogenic.

Confined aquifer: One in which the water is under pressure significantly greater than atmospheric, and its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the aquifer material.

Dissolved solids: The residue from a clear sample of water after evaporation and drying for 1 hour at 180°C; consists primarily of dissolved mineral constituents, but may also contain organic matter and water of crystallization.

Drainage area: The area or tract of land, measured in a horizontal plane, that gathers water and contributes it ultimately to some point on a stream channel, lake, reservoir, or other water body.

Drawdown: The lowering of the water table or potentiometric surface by the withdrawal of water from an aquifer by pumping; equal to the difference between the static water level and the pumping level.

Esker: Long ridges of sand and gravel that were deposited by running water in tunnels within or beneath stagnant glacial ice.

Evapotranspiration: Loss of water to the atmosphere by both direct evaporation from water surfaces and moist soil, and by transpiration from living plants.

Flow duration (of a stream): The percentage of time during which specified daily discharges have been equaled or exceeded in magnitude within a given time period.

Ground-water discharge: The discharge of water from the saturated zone by (1) natural processes such as ground-water runoff, ground-water evapotranspiration, underflow, and (2) discharge through wells and other man-made structures.

Ground-water evapotranspiration: Ground water discharged into the atmosphere in the gaseous state either by direct evaporation or by the transpiration of plants.

Ground-water outflow: The sum of ground-water runoff and underflow; it includes all natural ground-water discharge from a drainage area exclusive of ground-water evapotranspiration.

Ground-water recharge: The amount of water that is added to the saturated zone.

Ground-water runoff: Ground water that has discharged into stream channels by seepage from saturated earth materials.

Hardness: The property of water generally attributable to salts of the alkaline earths. Hardness has soap-consuming and encrusting properties and is expressed as the concentration of calcium carbonate ($CaCO_3$) that would be required to produce the observed effect.

Head, static: The height of the surface of a water column above a standard datum that can be supported by the static pressure at a given point.

Hydraulic conductivity: A measure of the ability of a porous medium to transmit a fluid. The material has a hydraulic conductivity of unit length per unit time if it will transmit in unit time a unit volume of water at the prevailing kinematic viscosity through a cross section of unit area, measured at right angles to the direction of flow, under a hydraulic gradient, of unit change in head over unit length of flow path.

Ice contact deposits: Well to poorly stratified deposits of sand, gravel and cobbles which were emplaced within or adjacent to stagnant glacial ice. Landforms include eskers, kame deltas, kame fields and kame terraces.

Induced recharge: The amount of water entering an aquifer from an adjacent surface-water body by the process of induced infiltration.

Marine deposits: Dark blue to grey silt, clay and fine sands washed out of the melting glacier onto the ocean floor.

Milligrams per liter (mg/L): A unit for expressing the concentration of chemical constituents in solution by weight per unit volume of water.

Noncarbonate hardness: A measure of the amount of alkaline-earth cations in excess of available carbonate (and bicarbonate) anions.

Outwash deposits: Stratified deposits of sand and gravel carried beyond the glacier margin by meltwater streams. Usually occuring, in flat or gently sloping outwash plains.

Perennial stream: A stream that flows during all seasons of the year.

pH: The negative logarithm of the hydrogen-ion activity. A pH of 7.0 indicates neutrality; values below 7.0 denote acidity, those above 7.0 denote alkalinity.

Recharge: Water that infiltrates to, and supplies the saturated zone. Recharge may be natural or artificial depending upon the source of the water and the process that allows it to infiltrate to an aquifer.

Runoff: That part of precipitation that appears in streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man in or on the stream channels.

Saturated thickness: Thickness of an aquifer below the water table.

Saturated zone: The subsurface zone in which all open spaces are filled with water. The water table is the upper limit of this zone. Water in the saturated zone is under pressure equal to or greater than atmospheric.

Specific capacity, of a well: The rate of discharge of water from a well divided by the corresponding drawdown of the water level in the well (gal/min)/ft.

Specific conductance, of water: A measure of the ability of water to conduct an electric current, expressed in micromhos per centimeter at 25°C. It is related to the dissolved-solids concentration and serves as as approximate measure thereof.

Specific yield: The ratio of the volume of water which, after being saturated, a rock or soil will yield by gravity, to its own volume.

Storage coefficient: The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. In an unconfined aquifer, the storage coefficient is virtually equal to the specific yield.

Stratified drift: A predominantly sorted sediment laid down by or in bodies of meltwater from a glacier; includes gravel, sand, silt, or clay deposited in layers of similar grain size.

Surface runoff: Water that travels over the soil surface to the nearest stream channel.

Till: Nonsorted, nonstratified sediments deposited directly by a glacier and composed of boulders, gravel, sand, silt, and clay.

Transmissivity: The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of aquifer under a unit hydraulic gradient. Equal to the average hydraulic conductivity times the saturated thickness.

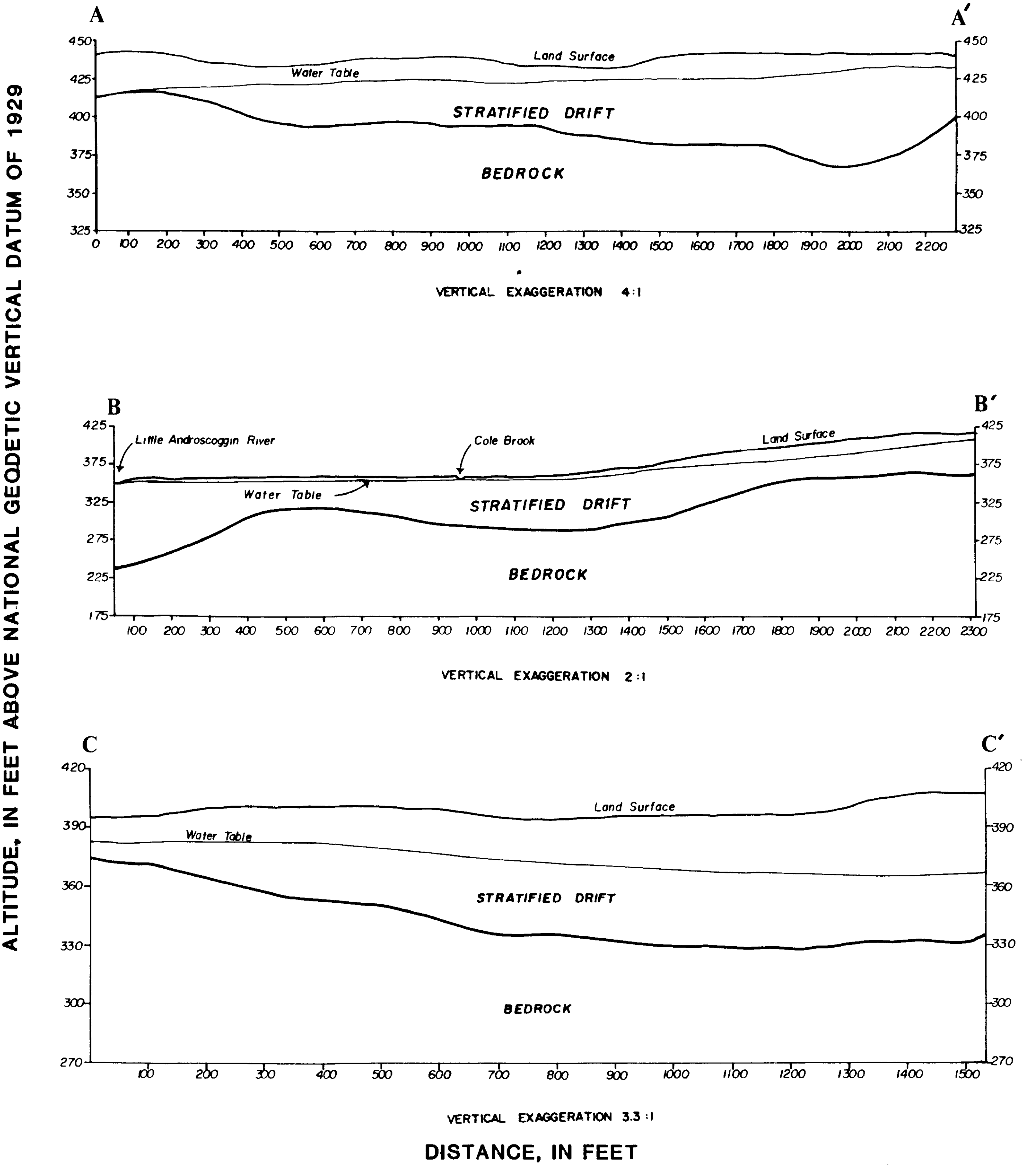
Turbidity, of water: The extent to which penetration of light is restricted by suspended sediment, microorganisms, or other insoluble material. Residual or "permanent" turbidity is that caused by insoluble material that remains in suspension after a long settling period.

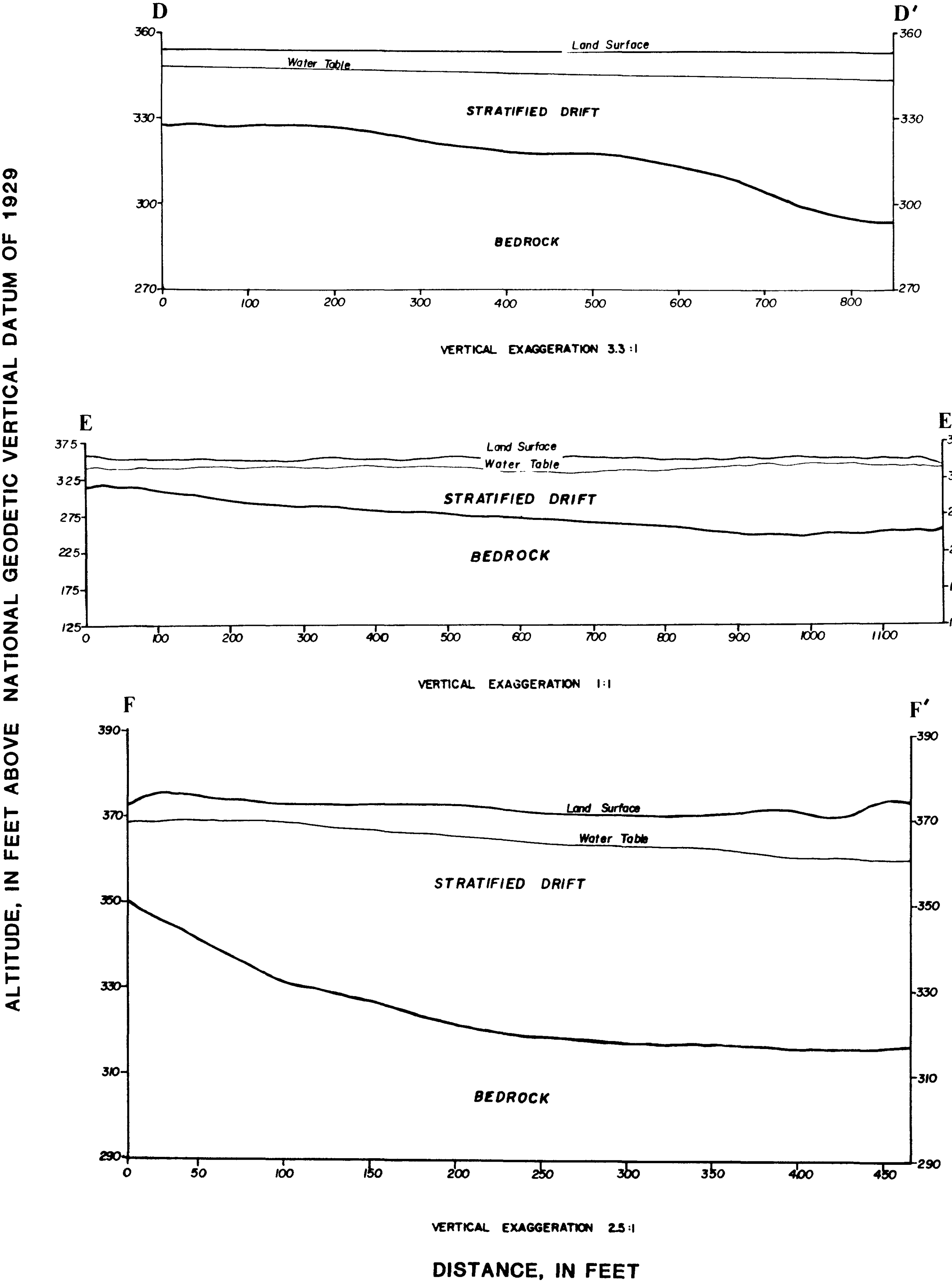
Unconfined aquifer (water-table aquifer): One in which the upper surface of the saturated zone, the water table, is at atmospheric pressure and is free to rise and fall.

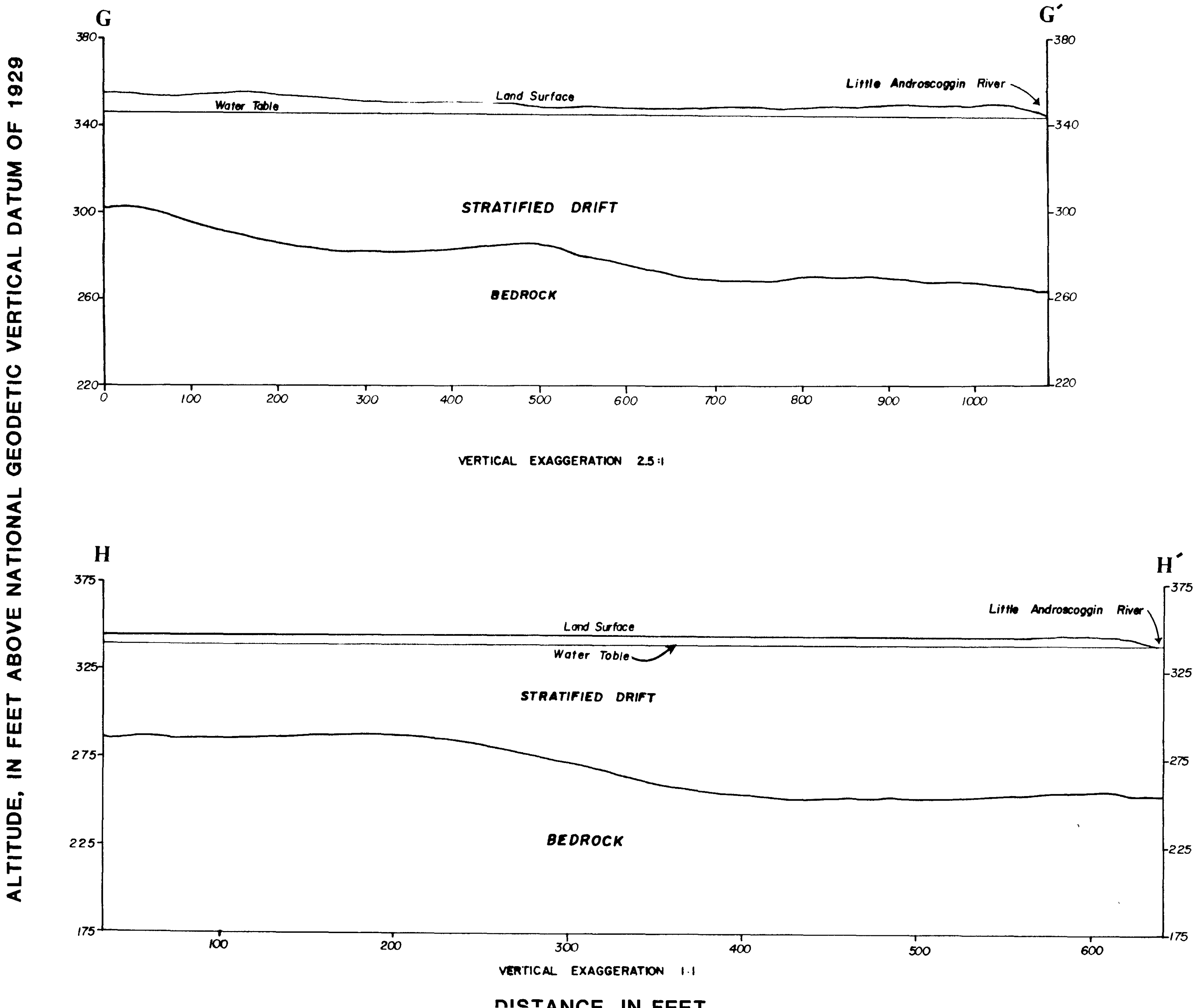
Water table: The upper surface of the saturated zone.

# Table 11.--Seismic refraction profiles

Hydrogeologic sections from seismic refraction surveys conducted by the U.S. Geological Survey in 1981. Locations of individual profiles shown on plate 2. Interpretation of field data based on a computer modeling program described by Scott and others (1972)




D
D′
360
330
300
270
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
0
100
200
300
400
500
600
700
800
VERTICAL EXAGGERATION 3.3:1
E
E′
375
325
275
225
175
125
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
0
100
200
300
400
500
600
700
800
900
1000
1100
VERTICAL EXAGGERATION 1:1
F
F′
390
370
350
330
310
290
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
0
50
100
150
200
250
300
350
400
450
VERTICAL EXAGGERATION 2.5:1
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
DISTANCE, IN FEET



ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
G
G´
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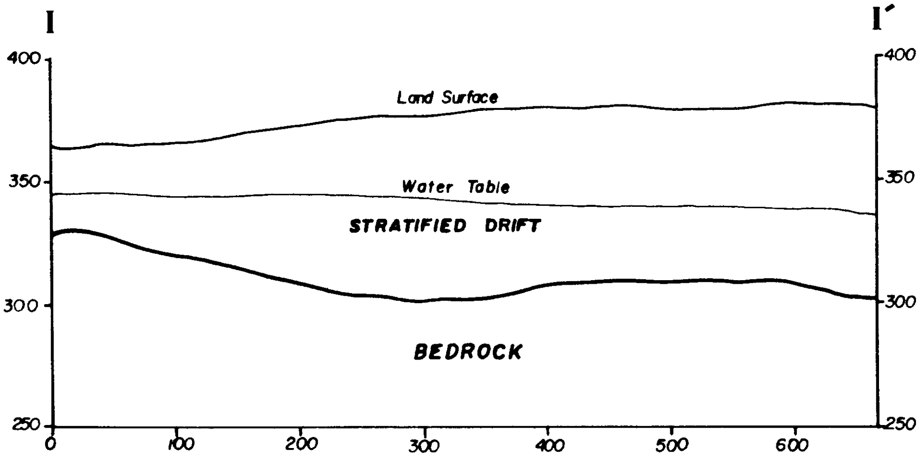
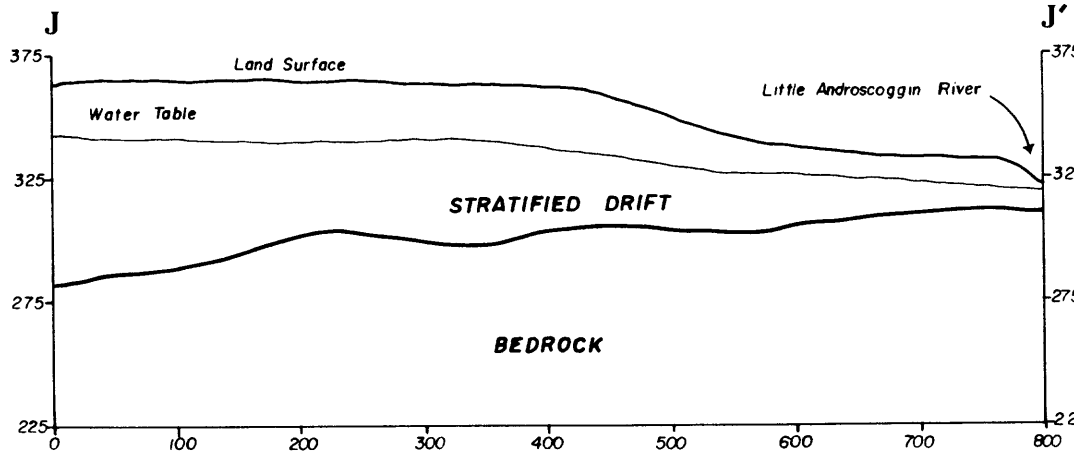
340
300
260
220
0
100
200
300
400
500
600
700
800
900
1000
Little Androscoggin River
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
VERTICAL EXAGGERATION 2.5:1
H
H´
375
325
275
225
175
100
200
300
400
500
600
Little Androscoggin River
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
VERTICAL EXAGGERATION 1:1
DISTANCE IN FEET

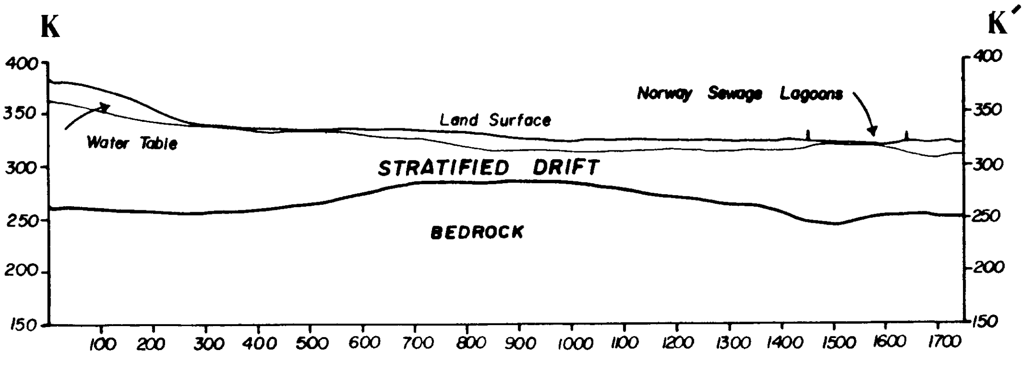
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929



VERTICAL EXAGGERATION 2:1

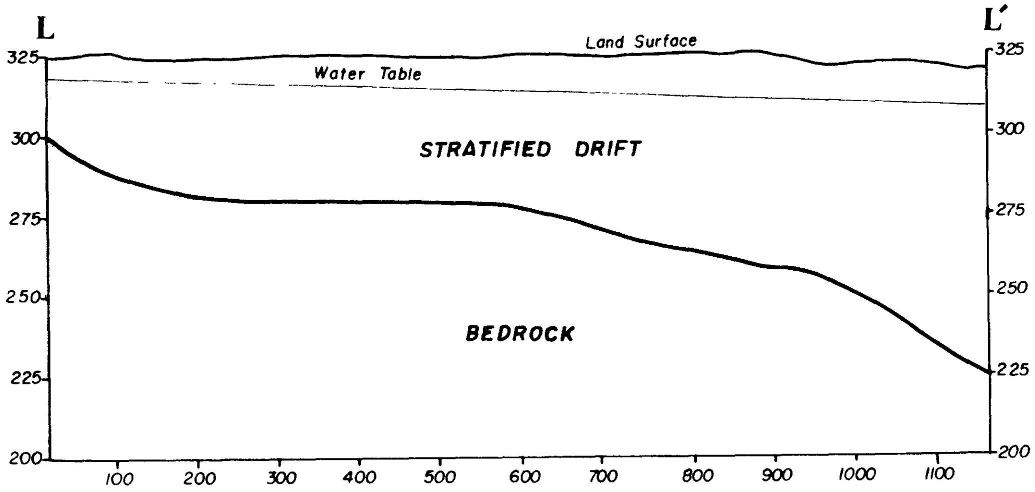


VERTICAL EXAGGERATION 2:1

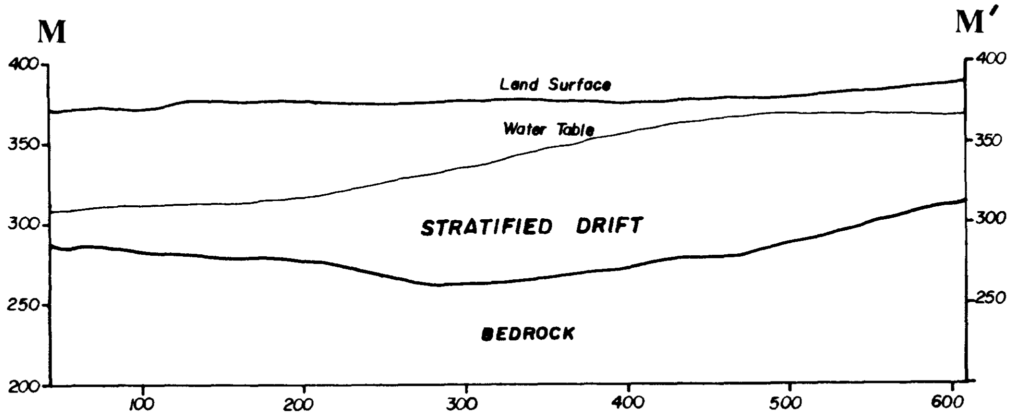


VERTICAL EXAGGERATION 2:1

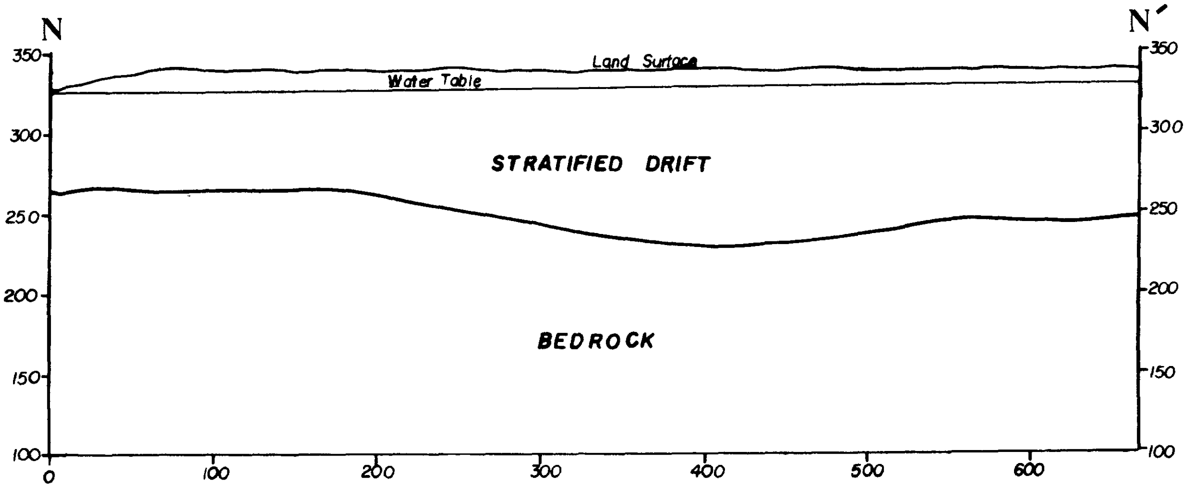
DISTANCE, IN FEET



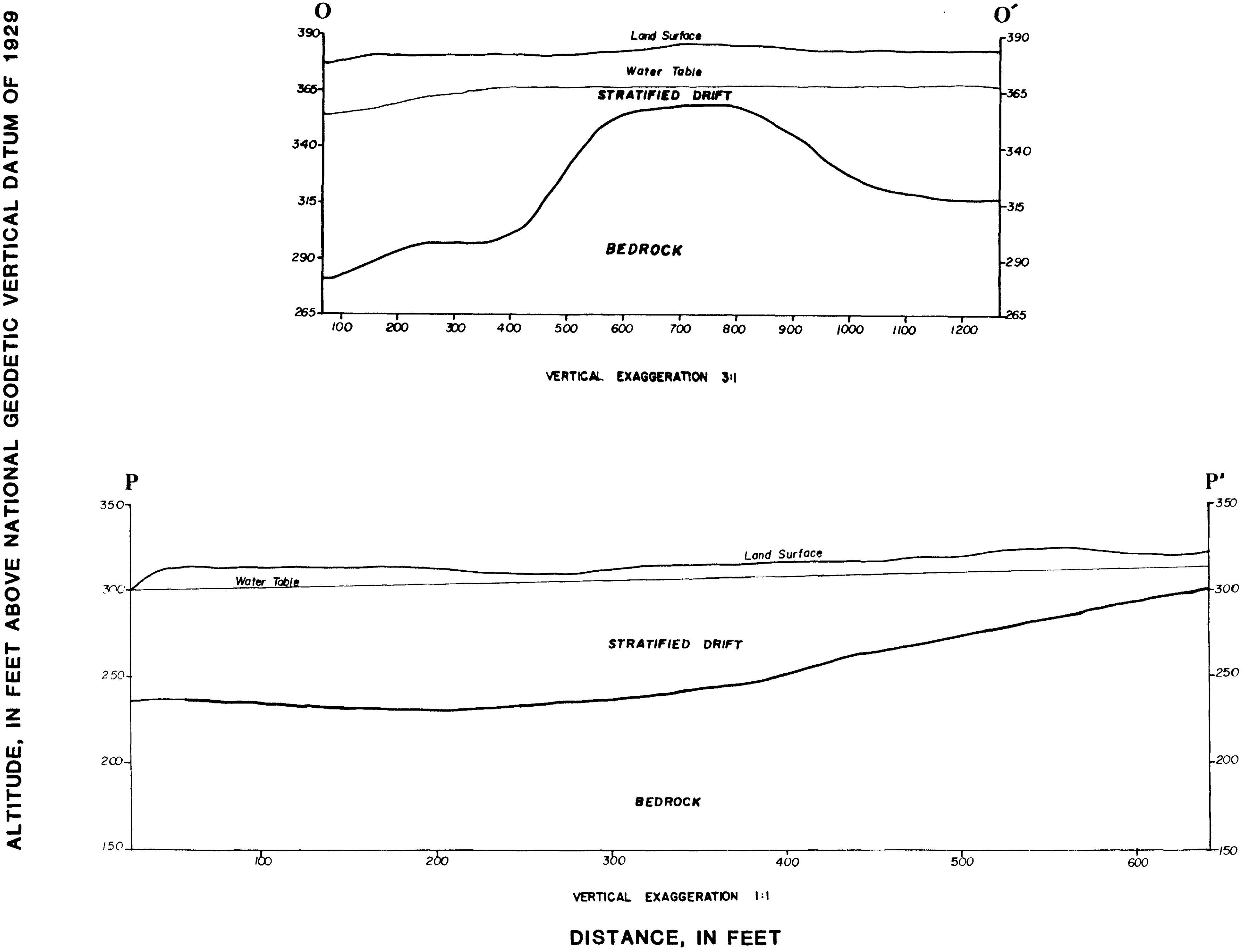
VERTICAL EXAGGERATION 4:1

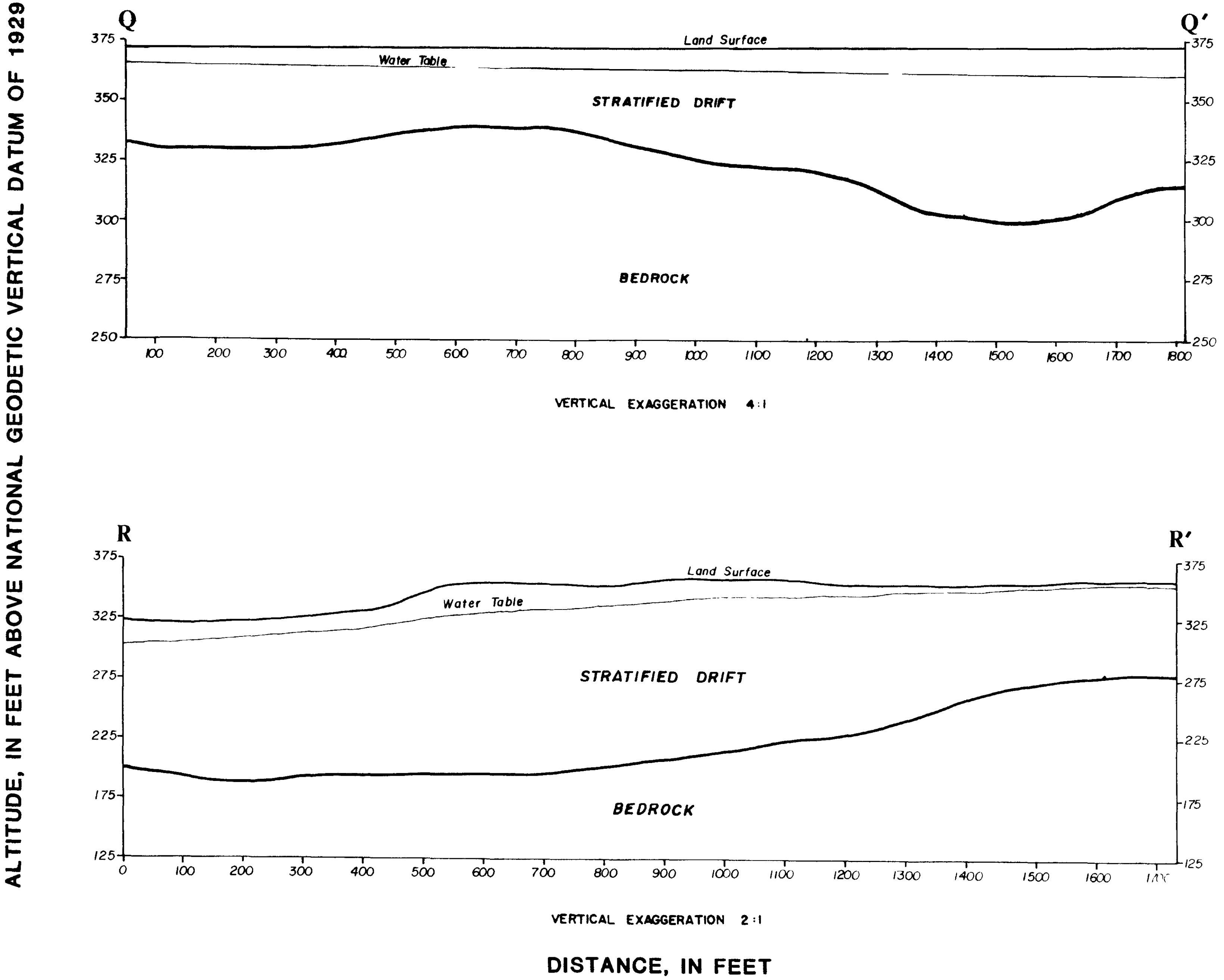


VERTICAL EXAGGERATION 1:1

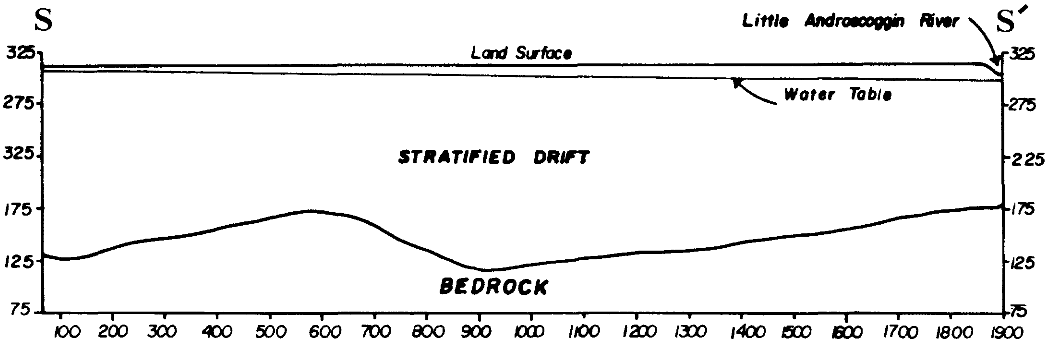


VERTICAL EXAGGERATION 1:1

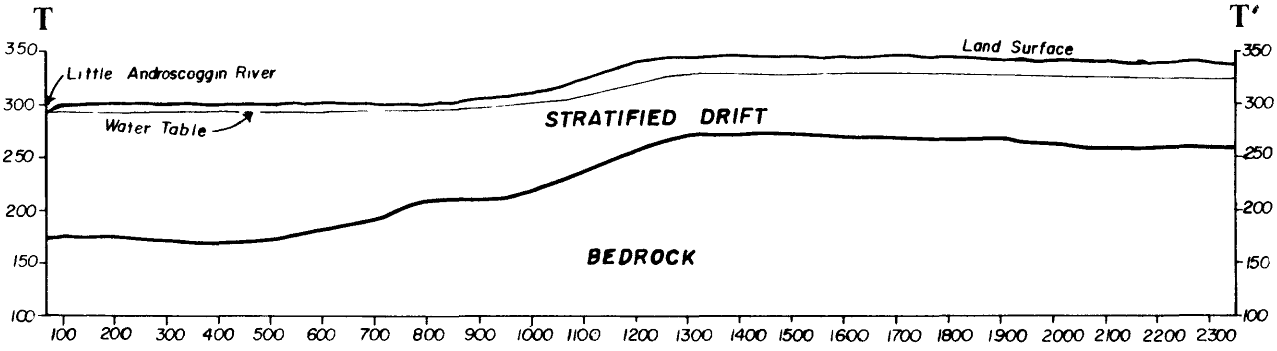

O
O´
390
365
340
315
290
265
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
100
200
300
400
500
600
700
800
900
1000
1100
1200
VERTICAL EXAGGERATION 3:1
P
P'
350
300
250
200
150
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
100
200
300
400
500
600
VERTICAL EXAGGERATION 1:1
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
DISTANCE, IN FEET


Q
Q′
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
375
350
325
300
275
250
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
VERTICAL EXAGGERATION 4:1
R
R′
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
375
325
275
225
175
125
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
VERTICAL EXAGGERATION 2:1
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
DISTANCE, IN FEET

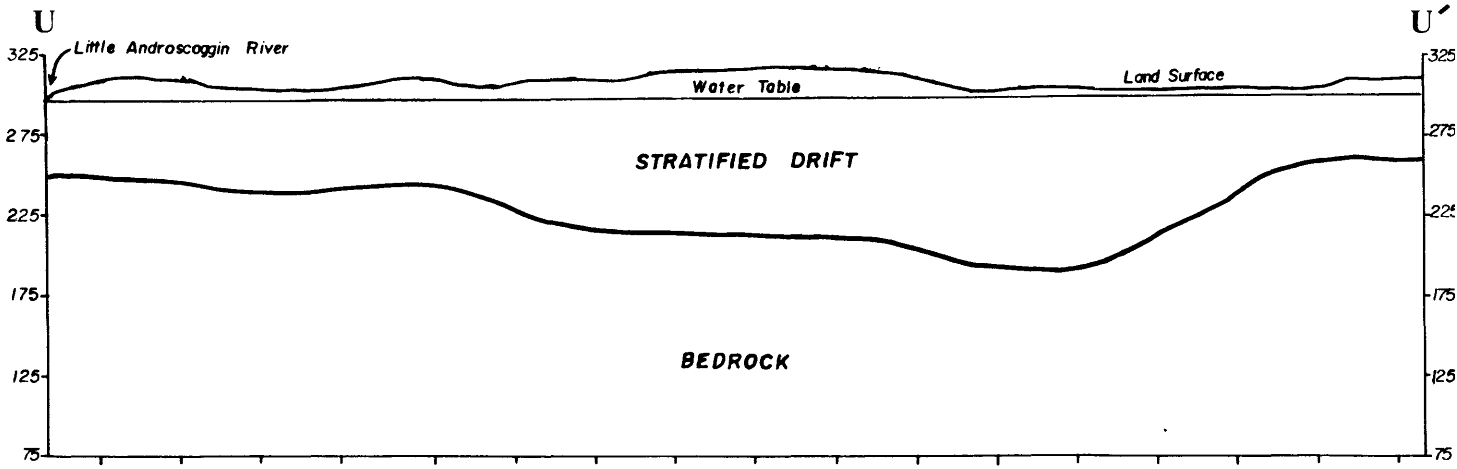
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929



VERTICAL EXAGGERATION 2:1

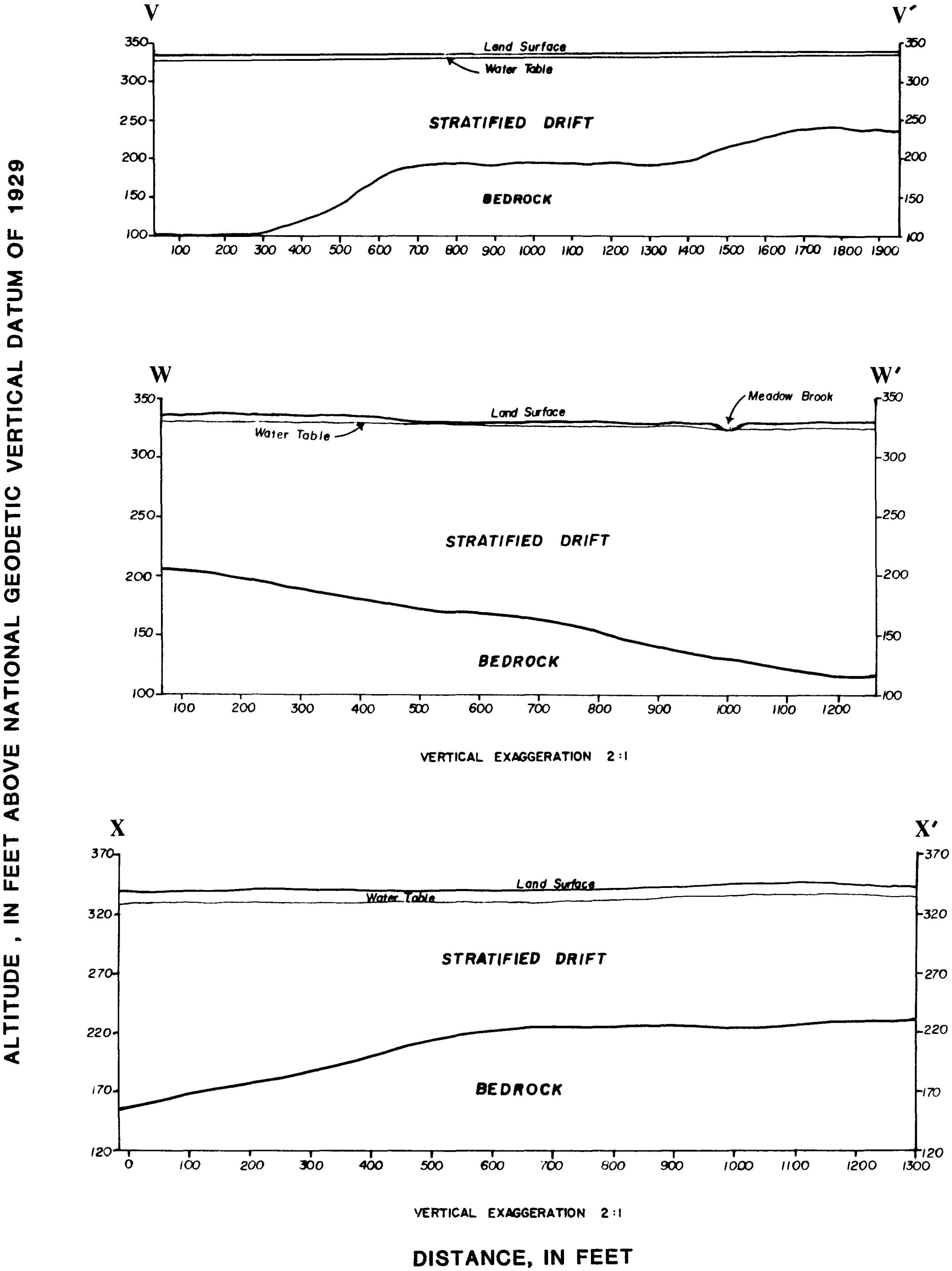


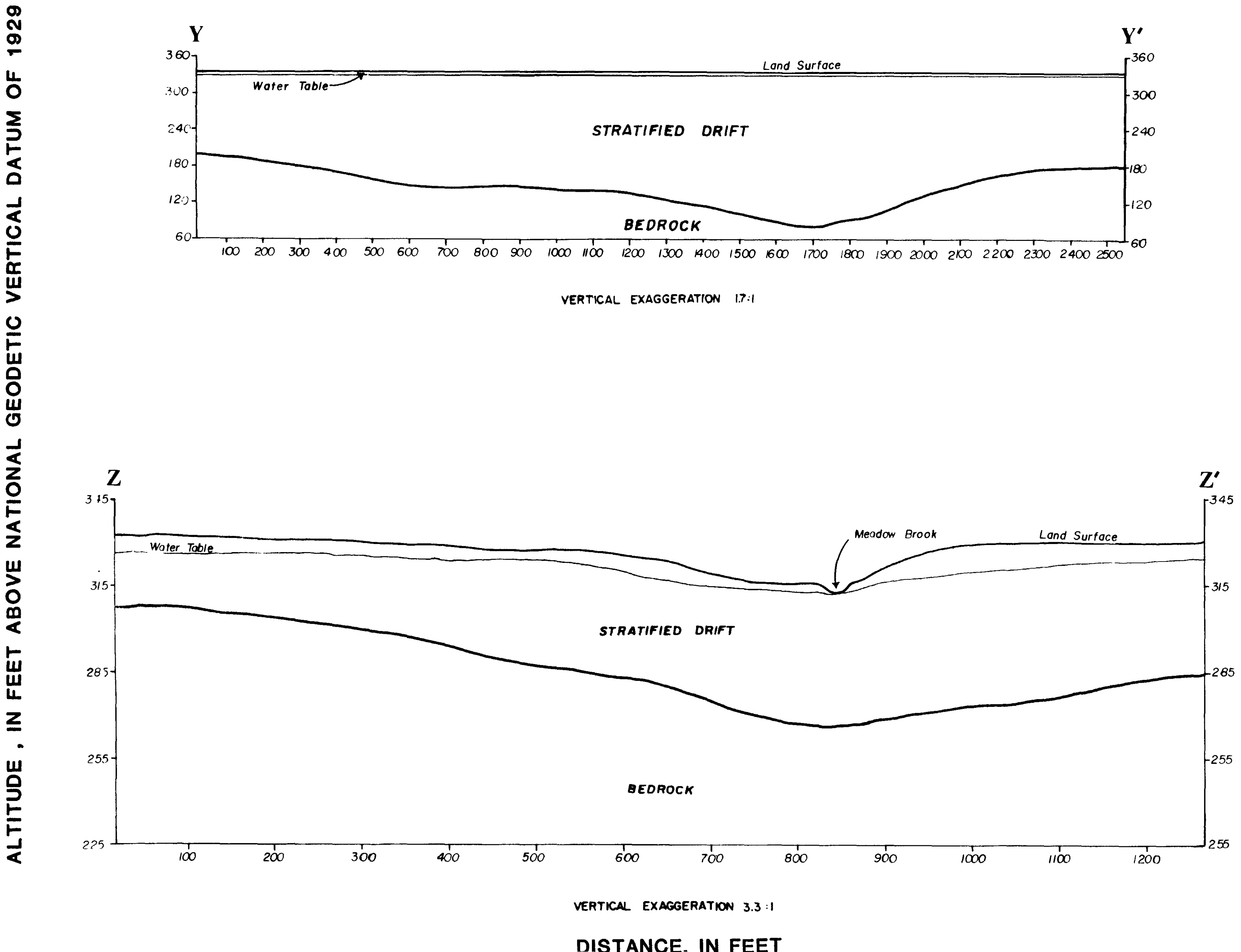
VERTICAL EXAGGERATION 2:1

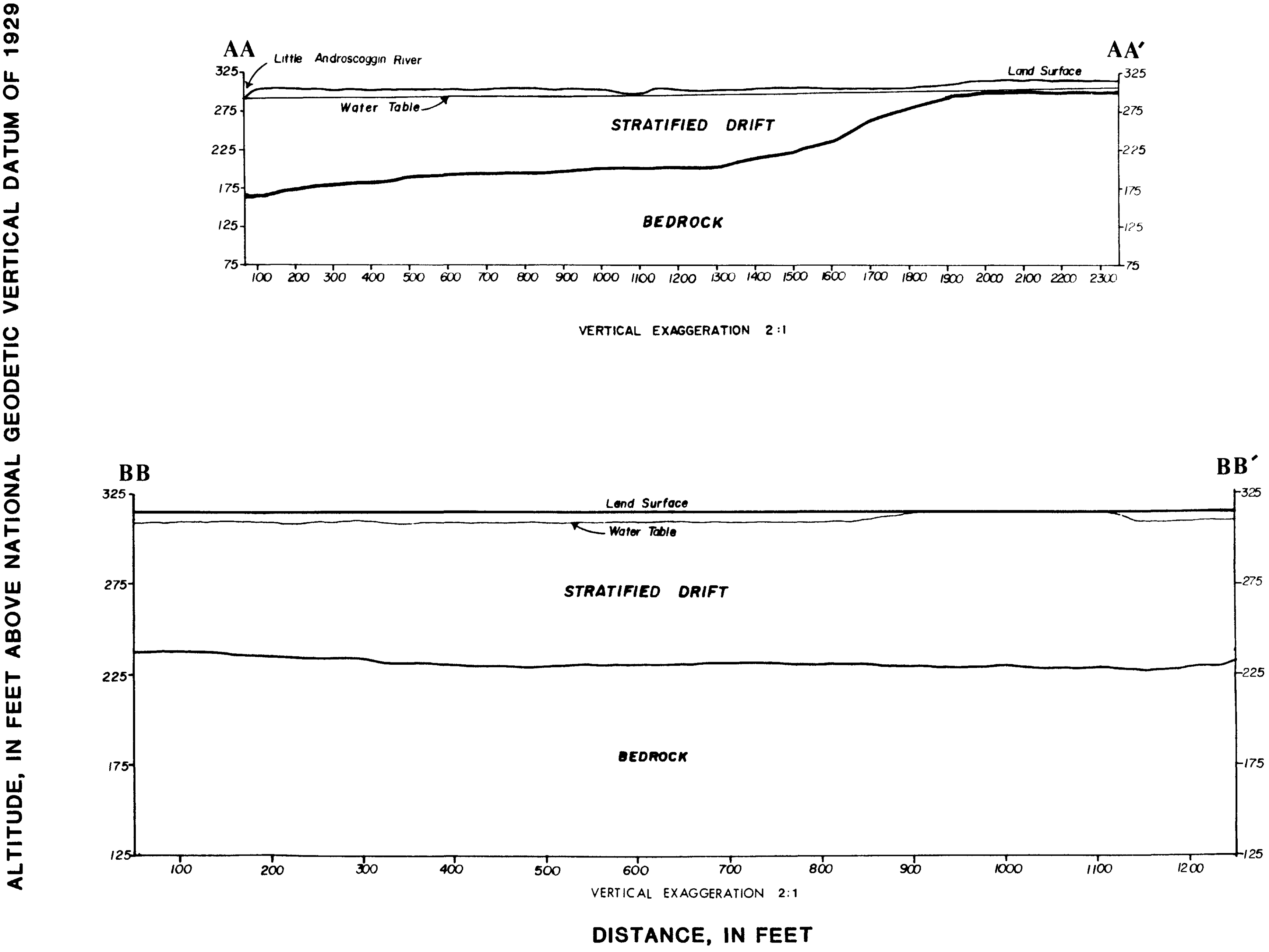


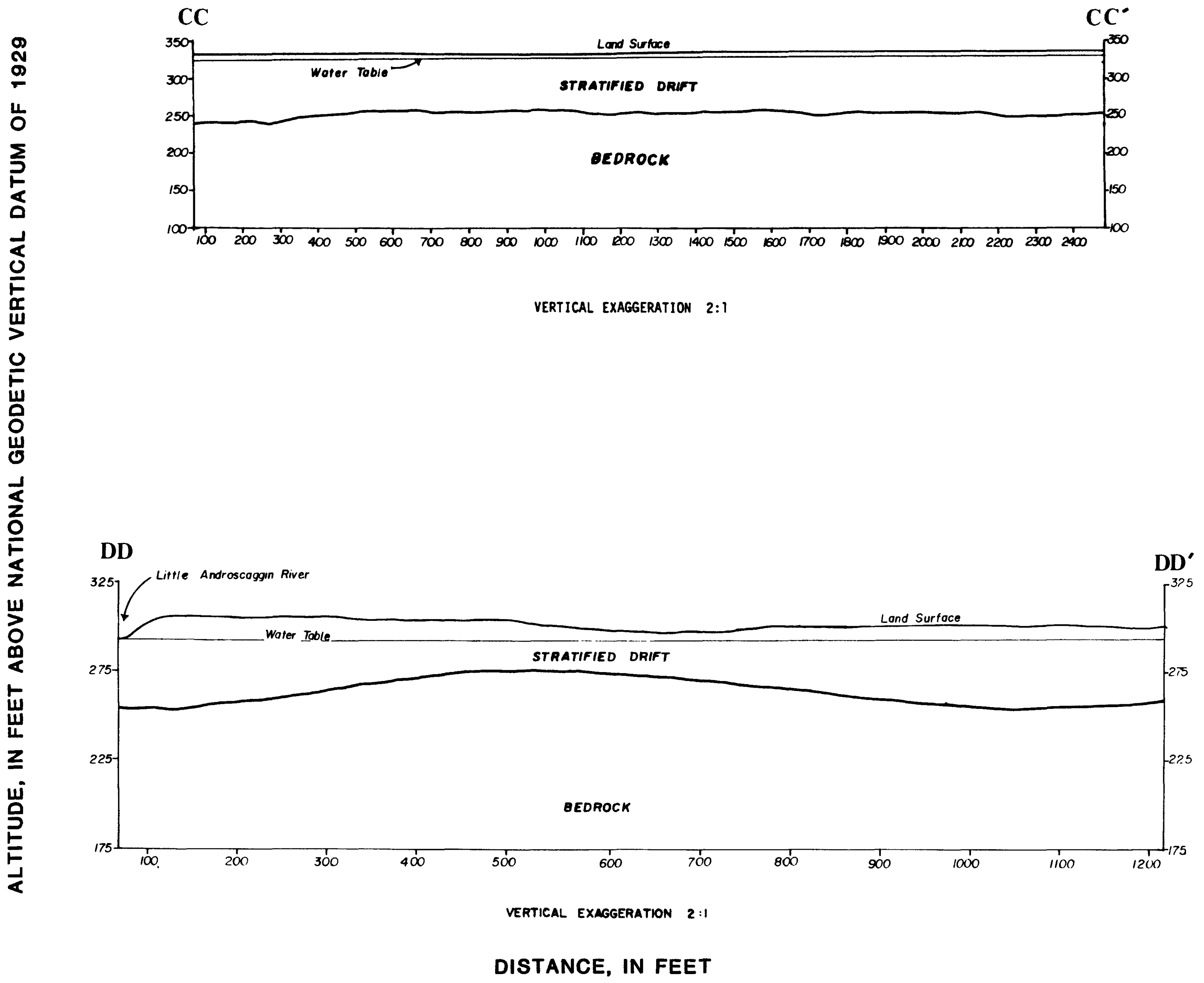
VERTICAL EXAGGERATION 2:1

DISTANCE, IN FEET


ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
V
V′
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
350
300
250
200
150
100
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900
W
W′
Meadow Brook
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
350
300
250
200
150
100
100 200 300 400 500 600 700 800 900 1000 1100 1200
VERTICAL EXAGGERATION 2:1
X
X′
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
370
320
270
220
170
120
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300
VERTICAL EXAGGERATION 2:1
DISTANCE, IN FEET


ALTITUDE , IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
Y
Y'
360
300
240
180
120
60
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
VERTICAL EXAGGERATION 1.7:1
Z
Z'
345
315
285
255
225
Meadow Brook
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
VERTICAL EXAGGERATION 3.3:1
DISTANCE, IN FEET


AA
AA′
Little Androscoggin River
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
325
275
225
175
125
75
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
VERTICAL EXAGGERATION 2:1
BB
BB′
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
325
275
225
175
125
100
200
300
400
500
600
700
800
900
1000
1100
1200
VERTICAL EXAGGERATION 2:1
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929
DISTANCE, IN FEET


CC
CC′
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
350
300
250
200
150
100
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400
VERTICAL EXAGGERATION 2:1
DD
DD′
Little Androscaggin River
Land Surface
Water Table
STRATIFIED DRIFT
BEDROCK
325
275
225
175
100 200 300 400 500 600 700 800 900 1000 1100 1200
VERTICAL EXAGGERATION 2:1
DISTANCE, IN FEET
ALTITUDE, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929

## Table 12.--Logs of selected wells and test holes.

Location number: Location is the latitude and longitude of the test hole or well site

Altitude: Land surface at test-hole site, in feet above NGVD of 1929. Altitude of wells drilled by Geological Survey determined by leveling.

Depth to water: Measurement made shortly after completion of well or test hole. Expressed in feet below land surface.

Description of earth materials: Logs of test holes by the Geological Survey are based on the Wentworth grade scale.

Terms used in logs of test holes of the U.S. Geological Survey.

Sand and gravel--Sorted stratified sediment varying in size from boulder to very find sand. "Poorly sorted" indicates approximately equal amounts, by weight, of all grain sizes.

Till--A predominately nonsorted, nonstratified sediment deposited directly by a glacier and composed of boulders, gravel, sand, silt, and clay.

End of hole--Depth of bottom of test hole in which bedrock or refusal was not reached.

Refusal--Depth at which drill equipment could not penetrate further.

Percentage by weight of individual components in the sample

| | |
|---|---|
| Trace | 0 - 10 |
| Little | 10 - 20 |
| Some | 20 - 35 |
| --and-- | 35 - 50 |

Terms on all other logs are those used by drillers; however, some are rearranged for uniformity of presentation.

O 1215. 4415250703123.01. Town of Paris. Drilled 1980. Altitude 398.4 ft. Depth to water 13.3 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium well sorted and gravel, fine | 0 - 9 | 9 |
| Sand, medium to coarse and gravel, fine | 9 - 10 | 1 |
| Cobbles, small | 10 - 11 | 1 |
| Sand, medium to coarse, gravel, small | 11 - 13 | 2 |
| Sand, medium | 13 - 16 | 3 |
| Sand, medium to fine and silt | 16 - 19 | 3 |
| Sand, medium and gravel, fine | 19 - 21 | 2 |
| Sand, medium to coarse | 21 - 25 | 4 |
| Cobbles, and sand, fine to medium | 25 - 26 | 1 |
| Refusal | at 26 | |

O 1216. 4411160703223.01. Barry Cordwell. Drilled 1980. Altitude 380.10. Depth to water 9.00 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, fine and gravel, fine | 0 - 6 | 6 |
| Sand, medium to coarse and gravel, fine | 6 - 16 | 10 |
| Sand, fine to medium | 16 - 18 | 2 |
| Refusal | at 18 | |

O 1217. 4411210703207.01. Barry Cordwell. Drilled 1980. Altitude 378.27. Depth to water 18.1 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium, some gravel | 0 - 16 | 16 |
| Sand, medium | 16 - 23 | 7 |
| Clay and fine sand | 23 - 45 | 22 |
| Till | 45 - 47.5 | 2.5 |
| Refusal | at 47.5 | |

O 1219. 4411340703138.01. Town of Oxford. Drilled 1980. Altitude 378.12 ft. Depth to water 19.62 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, medium to fine and gravel | 2 - 10 | 8 |
| Sand, coarse to very coarse and gravel | 10 - 17 | 7 |
| Sand, coarse and gravel | 17 - 23 | 6 |
| Sand, medium to coarse some gravel | 23 - 25 | 2 |
| Sand, fine to medium | 25 - 28 | 3 |
| Sand, medium | 28 - 30 | 2 |
| Sand, fine to medium | 30 - 41 | 11 |
| Sand, fine to medium and clay | 41 - 45 | 4 |
| Sand, fine, silt and clay | 45 - 51 | 6 |
| Sand, fine to medium, and laminated clay | 51 - 63 | 12 |
| Sand, very fine | 63 - 68 | 5 |
| Sand, fine to medium and clay laminations | 68 - 73 | 5 |
| Clay, fine to very fine sand | 73 - 78 | 5 |
| Silt, fine sand | 78 - 83 | 5 |
| End of hole | at 83 | |

O 1220. 4409470703144.01. George Allen. Drilled 1980. Altitude 366.57 ft. Depth to water 5.0 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium, well sorted | 0 - 12 | 12 |
| Clay, blue grey | 12 - 23 | 11 |
| End of hole | at 23 | |

O 1221. 4410410703219.01. Maurie Roy. Drilled 1980. Altitude 369.57 ft. Depth to water 6.66 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse | 0 - 13 | 13 |
| Sand, fine grey | 13 - 25 | 12 |
| Sand, very fine, grey | 25 - 35 | 10 |
| Clay, and fine grey sand | 35 - 38 | 3 |
| Clay, and very fine sand | 38 - 43 | 5 |
| Clay, laminated with fine grey sand | 43 - 63 | 20 |
| Clay and fine sand | 63 - 66 | 3 |
| Clay laminated with fine sand and some granite chips | 66 - 69 | 3 |
| Clay and fine sand | 69 - 72 | 3 |
| Till | 70 - 80 | 8 |
| Refusal | at 80 | |

O 1223. 4409090702828.01. Town of Oxford. Drilled 1980. Altitude 335.25 ft. Depth to water 4.75 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse | 0 - 5 | 5 |
| Sand, coarse to very coarse some gravel | 5 - 11 | 6 |
| Clay and silt | 11 - 13 | 2 |
| Sand, medium and clay | 13 - 18 | 5 |
| Sand, fine to medium and clay | 18 - 23 | 5 |
| Sand, fine to very fine grey | 23 - 28 | 5 |
| Sand, fine to medium | 28 - 33 | 5 |
| Sand, fine to very fine and silt | 33 - 51 | 18 |
| Sand, fine to very fine with clay laminations | 51 - 58 | 7 |
| Sand, very fine, grey with clay laminations | 58 - 73 | 15 |
| Clay, blue grey | 73 - 78 | 5 |
| Sand, very fine, grey and clay | 78 -112 | 34 |
| End of hole | at 112 | |

O 1225. 4409200702803.01. Edward Cummings. Drilled 1980. Altitude 340.85 ft. Depth to water 7.37 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse | 0 - 7 | 7 |
| Sand, coarse to very coarse some gravel | 7 - 17 | 10 |
| Sand, fine, brown | 17 - 25 | 8 |
| Sand, medium to fine, brown | 25 - 30 | 5 |
| Sand, fine to very fine | 30 - 40 | 10 |
| Sand, very fine, grey and clay laminations | 40 - 47 | 7 |
| Clay, blue grey | 47 -102 | 55 |
| Till | 102 -114 | 12 |
| End of hole | at 114 | |

O 1226. 4408390702740.01. M. Foster. Drilled 1980. Altitude 333.57 ft. Depth to water 14.16 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium some gravel | 0 - 6 | 6 |
| Sand, medium to coarse some gravel | 6 - 13 | 7 |
| Clay, brown, silty | 13 - 15 | 2 |
| Sand, very fine and clay | 15 - 26 | 11 |
| Clay, blue grey | 26 - 66 | 40 |
| Clay, blue grey with brown silty clay and very fine sand some granite chips | 66 - 71 | 5 |
| Till | 71 - 77 | 6 |
| Refusal | at 77 | |

O 1228. 4408150702703.01. Mr. Martin Drilled 1980. Altitude 316.30 ft. Depth to water 15.50 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil, brown silty clay | 0 - 6 | 6 |
| Clay, brown grey, silty | 6 - 11 | 5 |
| Clay, blue grey, hard layers encountered at 40 and 48 ft | 11 - 50 | 39 |
| Sand, well sorted coarse and fine gravel | 50 - 55 | 5 |
| Till | 55 - 59 | 4 |
| Refusal | at 59 | |

O 1229. 4412330703135.01. Town of Norway. Drilled 1980. Altitude 349.01 ft. Depth to water 23.0 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse and gravel | 0 - 6 | 6 |
| Sand, medium some gravel | 6 - 11 | 5 |
| Sand, coarse to very coarse | 11 - 22 | 11 |
| Sand, very coarse to coarse some gravel | 22 - 40 | 18 |
| Sand, medium to coarse some clay laminations | 40 - 44 | 4 |
| Sand, fine with clay laminations, trace medium sand | 44 - 54 | 10 |
| Sand, coarse to very coarse some fine and medium sand and gravel | 54 - 65 | 11 |
| Sand, medium, brown | 65 - 70 | 5 |
| Till | 70 - 78 | 8 |
| Refusal | at 78 | |

O 1230 th. 4413050703223.01. Miller Shoe Company. Drilled 1980. Altitude 380 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil, peat and sandy brown clay | 0 - 6 | 6 |
| Clay, brown and grey | 6 - 11 | 5 |
| Clay, sandy grey | 11 - 16 | 5 |
| Clay, some sand and silt | 16 - 21 | 5 |
| Sand, very fine and silt | 21 - 31 | 10 |
| Till | 31 - 36 | 5 |
| Refusal | at 36 | |

O 1231. 4414230703045.01. Bancroft Construction Co. Drilled 1980. Altitude 393.51 ft. Depth to water 45.71 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium dirty | 0 - 6 | 6 |
| Sand, medium to fine | 6 - 41 | 35 |
| Sand, medium with fine sand and silt, trace of grey clay | 41 - 43 | 2 |
| Sand, medium to fine with trace of silt and clay | 43 - 45 | 2 |
| Sand, medium with trace of clay | 45 - 48 | 3 |
| Sand, medium | 48 - 56 | 8 |
| Sand, fine with silt | 56 - 72 | 16 |
| Till | 72 - 81 | 9 |
| Refusal | at 81 | |

O 1232. 4414040703114.01. Maine Machine Products Co. Drilled 1980. Altitude 393.45 ft. Depth to water 14.61 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, coarse to very coarse some medium gravel | 2 - 7 | 5 |
| Sand, medium to coarse some fine with gravel | 7 - 17 | 10 |
| Sand, coarse to very coarse with fine gravel | 17 - 19 | 2 |
| Sand, very coarse and some gravel, trace medium sand | 19 - 21 | 2 |
| Sand, very coarse and gravel also fine sand and silt with some clay laminations | 21 - 25 | 4 |
| Sand, fine with some coarse sand and gravel | 25 - 30 | 5 |

O 1233. 4416210703106.01. Vernon Smith. Drilled 1980. Altitude 379.44 ft. Depth to water 20.62 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, coarse and gravel | 0 - 6 | 6 |
| Sand, medium to coarse some gravel | 6 - 11 | 5 |
| Sand, coarse and gravel | 11 - 16 | 5 |
| Sand, very coarse and fine gravel | 16 - 21 | 5 |
| Sand, coarse and gravel | 21 - 26 | 5 |
| Sand, coarse and fine gravel some very fine sand | 26 - 30 | 4 |
| Sand, coarse and fine gravel | 30 - 34 | 4 |
| Sand, medium to coarse and gravel | 34 - 40 | 6 |
| Till | 40 - 61 | 21 |
| Refusal | at 61 | |

O 1234. 4415220703100.01. Town of South Paris. Drilled 1980. Altitude 351.40 ft. Depth to water 4.01 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, fine to very fine | 0 - 6 | 6 |
| Sand, fine | 6 - 13 | 5 |
| Refusal | at 13 | |

O 1235. 4411110703124.01. Richard B. Henderson. Drilled 1980. Altitude 320.37 ft. Depth to water 9.97 ft. Log be U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, medium to fine | 2 - 6 | 4 |
| Sand, medium and gravel | 6 - 11 | 5 |
| Sand, coarse and gravel | 11 - 16 | 5 |
| Sand, very coarse and gravel | 16 - 20 | 40 |
| Gravel, fine | 20 - 24 | 4 |
| Sand, very coarse and gravel | 24 - 26 | 2 |
| Sand, very coarse and gravel and very fine grey sand with clay laminations | 26 - 30 | 4 |
| Clay, blue grey and fine grey sand | 30 - 35 | 5 |
| Sand, fine to very fine with trace blue grey clay | 35 - 40 | 5 |
| Sand, very fine, grey | 40 - 45 | 5 |
| Clay, blue grey with fine grey sand laminations | 45 - 50 | 5 |
| Sand, very fine, grey with clay laminations | 50 - 70 | 20 |
| Sand, fine, grey | 70 - 80 | 10 |
| Sand, fine to very fine, clean grey | 80 - 88 | 8 |
| Till | 88 - 93 | 5 |
| Refusal | at 93 | |

O 1237. 4414320703124.01. Albert Soule. Drilled in 1981. Altitude 393.97 ft. Depth to water 26.64 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, coarse and gravel | 0 - 5 | 5 |
| Sand, medium, brown | 5 - 16 | 11 |
| Sand, medium, with iron stains | 16 - 20 | 4 |
| Sand, medium to fine with iron stains | 20 - 25 | 5 |
| Sand, fine to medium | 25 - 31 | 6 |
| Till | 31 - 39 | 8 |
| Refusal | at 39 | |

O 1238. 4413500703032.01. John Kelly. Drilled in 1981. Altitude 399.14 ft. Depth to water 11.72 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse with gravel and cobbles | 0 - 6 | 6 |
| Till | 6 - 30 | 24 |
| Refusal | at 30 | |

O 1239. 4413090703034.01. Mrs. Swett. Drilled in 1981. Altitude 379.73. Depth to water 29.47 ft. Log by U.S. Survey.

| | | |
|---|---|---|
| Sand, fine, brown | 0 - 6 | 6 |
| Sand, coarse and gravel | 6 - 11 | 5 |
| Sand, medium, brown | 11 - 16 | 5 |
| Sand, coarse, brown | 16 - 21 | 5 |
| Sand, fine to medium | 21 - 26 | 5 |
| Sand, coarse to very coarse and gravel, some medium sand | 26 - 31 | 5 |
| Sand, coarse and gravel | 31 - 37 | 5 |
| Sand, very coarse and gravel | 37 - 48 | 11 |
| Sand, coarse - very coarse and gravel | 48 - 52 | 4 |
| Refusal | at 52 | |

O 1240. 4412150703113.01. Town of South Paris. Drilled in 1981. Altitude 374.83 ft. Depth to water 59.33 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, fine-medium | 0 - 6 | 6 |
| Sand, medium and grey sludge | 6 - 11 | 5 |
| Sand, medium | 11 - 16 | 5 |
| Sand, medium and black sludge | 16 - 21 | 5 |
| Sand, medium to fine and black sludge | 21 - 26 | 5 |
| Sand, medium, brown | 26 - 31 | 5 |
| Sand, medium to coarse and black sludge | 31 - 41 | 10 |
| Sand, coarse - very coarse, grey brown | 41 - 46 | 5 |
| Sand, coarse with gravel at 52 ft | 46 - 56 | 10 |
| Sand, coarse, grey | 56 - 61 | 5 |
| Sand, coarse to very coarse | 61 - 73 | 12 |
| Till | 73 - 78 | 5 |
| Refusal | at 78 | |

O 1241. 4412090703121.01. Mr. Kilgore. Drilled 1981. Altitude 341.22 ft. Depth to water 26.42 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, medium to fine | 2 - 6 | 4 |
| Sand, medium to coarse, brown | 6 - 16 | 10 |
| Sand, medium | 16 - 21 | 5 |
| Sand, coarse to very coarse and gravel | 21 - 36 | 15 |
| Sand, medium | 36 - 38 | 2 |
| Sand, medium to very coarse and some gravel | 38 - 48 | 10 |
| Sand, coarse to very coarse and medium to fine sand some thin grey clay laminations | 48 - 55 | 7 |
| Sand, coarse to very coarse and gravel | 55 - 68 | 13 |
| Sand, medium-coarse and gravel | 68 -110 | 42 |
| Till | 110 -129 | 19 |
| Refusal | at 129 | |

O 1242. 4412540703122.01. Brian Goodwin. Drilled in 1981. Altitude 398.37 ft. Depth to water 20.85 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse and medium gravel | 0 - 6 | 6 |
| Sand, medium to coarse and fine gravel | 6 - 11 | 5 |
| Sand, medium, brown | 11 - 21 | 10 |
| Sand, coarse to very coarse and fine gravel, trace fine sand | 21 - 24 | 3 |
| Sand, fine, brown some coarse sand and gravel | 24 - 30 | 6 |
| Sand, very fine and silt with some thin grey clay laminations | 30 - 40 | 10 |
| Till | 40 - 43 | 3 |
| Refusal | at 43 | |

O 1243. 4413250703056.01. South Paris V.F.W. Drilled 1981. Altitude 397.72 ft. Depth to water 42.0 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, medium to coarse and gravel | 1 - 6 | 5 |
| Sand, coarse with fine and medium gravel | 6 - 15 | 9 |
| Sand, medium | 15 - 20 | 5 |
| Sand, coarse to very coarse and some medium sand | 20 - 30 | 10 |
| Sand, medium to coarse | 30 - 40 | 10 |
| Sand, medium | 40 - 43 | 3 |
| Till | 43 - 48 | 5 |
| Refusal | at 48 | |

O 1244. 4410510703059.01. William Knightly. Drilled in 1981. Altitude 359.25 ft. Depth to water 7.60 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to very coarse and gravel | 0 - 6 | 6 |
| Gravel, fine | 6 - 8 | 2 |
| Clay, grey blue | 8 - 23 | 15 |
| Till | 23 - 30 | 7 |
| Refusal | at 30 | |

O 1245. 4412410703148.01. Superior Muffler Co. Drilled in 1981. Altitude 378.26 ft. Depth to water 29.76 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to fine, iron staining................ | 0 - 6 | 6 |
| Sand, medium................... | 6 - 21 | 15 |
| Sand, fine to very fine........ | 21 - 25 | 4 |
| Sand, fine, with thin brown clay laminations....... | 25 - 30 | 5 |
| Sand, fine to very fine with some brown clay......... | 30 - 40 | 10 |
| Sand, fine to very fine and silt..................... | 40 - 59 | 19 |
| Till........................... | 59 - 67 | 8 |
| Refusal........................ | at 67 | |

O 1246. 4410260703045.01. Brian Goodwin. Drilled 1981. Altitude 354.46 ft. Depth to water 18.92 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, very coarse and gravel... | 0 - 17 | 17 |
| Sand, fine to very fine some brown clay............. | 17 - 25 | 8 |
| Sand, very fine and silt with thin clay laminations... | 25 - 35 | 10 |
| Sand, very fine and grey clay, some silt............. | 35 - 45 | 10 |
| Sand, very fine and blue grey clay.................... | 45 - 60 | 15 |
| Clay, blue grey................ | 60 - 93 | 33 |
| Till........................... | 93 -109 | 16 |
| End of hole.................... | at 109 | |

O 1248. 4409020703008.01. Town of Oxford. Drilled in 1981. Altitude 316.60 ft. Depth to water 14.70 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, very coarse and fine gravel.............. | 0 - 18 | 18 |
| Gravel, fine to medium and cobbles................... | 18 - 25 | 7 |
| Gravel, fine to medium and medium to coarse sand.......................... | 25 - 35 | 10 |
| Gravel, fine to medium some large and medium sand.......................... | 35 - 50 | 15 |
| Sand, medium and gravel......... | 50 - 55 | 5 |
| Sand, medium to fine........... | 55 - 60 | 5 |
| Gravel, fine to medium and medium to coarse sand.......................... | 60 - 75 | 15 |
| Sand, medium to coarse and gravel.................... | 75 - 81 | 16 |
| Till, cobbles.................. | 81 - 97 | 16 |
| Refusal........................ | at 97 | |

O 1249. 4408410702842.01. Thomas Ryan. Drilled 1981. Altitude 340.81 ft. Depth to water 6.13 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse, brown........................ | 0 - 11 | 11 |
| Sand, coarse................... | 11 - 15 | 4 |
| Sand, coarse to very coarse, trace fine to very fine sand and silt..... | 15 - 25 | 10 |
| Sand, fine, grey and silt trace clay................... | 25 - 35 | 10 |
| Sand, very fine, silty, trace clay................... | 35 - 38 | 3 |
| End of hole.................... | at 38 | |

O 1250. 4412210703108.01. Don Mason. Drilled 1981. Altitude 355.76 ft. Depth to water 22.02 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, very coarse and fine to medium gravel............ | 0 - 21 | 21 |
| Gravel, fine to medium......... | 21 - 45 | 24 |
| Sand, very coarse and gravel fine to medium........ | 45 - 61 | 16 |
| Sand, very coarse and gravel, some cobbles......... | 61 - 76 | 15 |
| Till........................... | 76 - 78 | 2 |
| Refusal........................... | at 78 | |

O 1251. 4411320703058.01. Gerald Bryant. Drilled 1981. Altitude 369.04 ft. Depth to water 29.38 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil........................... | 0 - 1 | 1 |
| Sand, medium to fine some very coarse sand and gravel.................... | 1 - 8 | 7 |
| Clay, brown grey............... | 8 - 16 | 8 |
| Clay, silty with some fine to very fine sand....... | 16 - 21 | 5 |
| Clay and very fine sand........ | 21 - 33 | 12 |
| Sand, fine - very fine......... | 33 - 40 | 7 |
| Till........................... | 40 - 45 | 5 |
| Refusal........................ | at 45 | |

O 1252. 4409000702900.01. Robert Baer. Drilled 1981. Altitude 340.95 ft. Depth to water 4.29 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil........................... | 0 - 1 | 1 |
| Sand, coarse to very coarse with some fine gravel.................. | 1 - 15 | 14 |
| Sand, fine to medium, brown some thin clay laminations.................. | 15 - 30 | 15 |
| Sand, fine to very fine, grey.......................... | 30 - 40 | 10 |
| Sand, fine, grey with clay laminations.................. | 40 - 48 | 8 |
| End of hole.................... | at 48 | |

O 1254. 4409180702910.01. Robert Baer. Drilled 1981. Altitude 347.97 ft. Depth to water 5.46 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil........................... | 0 - 1 | 1 |
| Sand, coarse to very coarse........................ | 1 - 11 | 10 |
| Sand, very coarse and fine gravel.................. | 11 - 20 | 9 |
| End of hole.................... | at 20 | |

O 1255. 4410480703147.01. James Deshon. Drilled 1981. Altitude 370.96 ft. Depth to water 31.27 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil, medium sand............. | 0 - 2 | 2 |
| Sand, very coarse and fine to medium gravel........ | 2 - 12 | 10 |
| Sand, coarse and fine gravel....................... | 12 - 15 | 3 |
| Sand, coarse some medium and very coarse sand......... | 15 - 20 | 5 |
| Sand, medium, grey with some coarse - very coarse sand and medium gravel....... | 20 - 25 | 5 |
| Sand, medium to fine, grey..... | 25 - 32 | 7 |
| Clay, blue grey with some fine to very fine sand....... | 32 - 42 | 10 |
| Sand, fine to very fine and silt with clay laminations.................. | 42 - 89 | 47 |
| Till........................... | 89 - 90 | 1 |
| Refusal........................ | at 90 | |

O 1257. 4409530703008.01. Robert Chadbourne. Drilled 1981. Altitude 317.46 ft. Depth to water 8.65 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, medium to fine, brown | 2 - 4 | 2 |
| Sand, medium, brown | 4 - 7 | 3 |
| Sand, coarse and gravel | 7 - 12 | 5 |
| Sand, very fine grey and silt | 12 - 15 | 3 |
| Sand, fine to very fine, brown | 15 - 20 | 5 |
| Sand, very fine, grey with silt and clay laminations | 20 - 50 | 30 |
| Clay, blue grey with some coarse to very coarse sand interbeds | 50 - 77 | 27 |
| Clay, blue grey with some medium sand interbeds | 77 - 85 | 8 |
| Silt, blue grey and clay with coarse to very coarse sand interbeds | 85 -101 | 16 |
| Sand, coarse to very coarse | 101 -103 | 2 |
| End of hole | at 103 | |

O 1258. 4409300702932.01. Town of Oxford. Drilled 1981. Altitude 349.99 ft. Depth to water 7.08 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, very coarse and fine gravel | 2 - 12 | 10 |
| Sand, coarse to very coarse with some medium sand | 12 - 20 | 8 |
| Sand, medium to fine, grey brown | 20 - 25 | 5 |
| Sand, fine, brown | 25 - 30 | 5 |
| Sand, fine to very fine with clay laminations | 30 - 35 | 5 |
| Clay, blue grey with some fine sand interbeds | 35 - 45 | 10 |
| Clay, blue grey | 45 - 77 | 32 |
| Till | 77 - 85 | 8 |
| Refusal | at 85 | |

O 1259. 4409370702917.01. Mr. Schiavi. Drilled 1981. Altitude 348 ft. Depth to water 4.51 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, coarse to very coarse and fine gravel | 1 - 6 | 5 |
| Gravel, fine to medium and coarse to very coarse sand | 6 - 18 | 12 |
| Sand, fine grey and silt | 18 - 20 | 2 |
| End of hole | at 20 | |

O 1260. 4408190702940.01. Peter Dunbar. Drilled 1981. Altitude 338 ft. Depth to water 9.14 ft. Log by U.S. Geol. Survey,

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, medium | 1 - 6 | 5 |
| Sand, medium to fine and brown grey clay | 6 - 11 | 5 |
| Clay, blue grey | 11 - 13 | 2 |
| Sand, fine to very fine and silt some blue clay | 13 - 31 | 18 |
| Till | 31 - 37 | 6 |
| Refusal | at 37 | |

O 1261. 4407180702939.01. Gordon Sedgley. Drilled 1981. Altitude 332.63 ft. Depth to water 5.50 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, medium | 1 - 11 | 10 |
| Sand, medium to fine brown | 11 - 16 | 5 |
| Clay, brown grey | 16 - 18 | 2 |
| End of hole | at 18 | |

O 1262. 4407380702717.01. Cleon F. Coburn. Drilled 1981. Altitude 315.45 ft. Depth to water 3.57 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, medium to coarse, brown | 2 - 7 | 5 |
| Sand, coarse and medium to fine sand | 7 - 11 | 4 |
| Sand, fine to very fine, grey and clay | 11 - 38 | 27 |
| Till | 38 - 54 | 16 |
| Refusal | at 54 | |

O 1263. 44084407029224.01. L. Herrick. Drilled 1981. Altitude 336.63 ft. Depth to water 10.34 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, coarse | 1 - 6 | 5 |
| Sand, medium to coarse | 6 - 11 | 5 |
| Sand, fine, grey | 11 - 15 | 4 |
| Sand, fine, grey brown | 15 - 20 | 5 |
| Sand, fine to very fine, grey brown | 20 - 25 | 5 |
| Sand, fine to medium | 25 - 35 | 10 |
| Sand, fine, grey | 35 - 46 | 11 |
| Clay, blue grey | 46 - 48 | 2 |
| End of hole | at 48 | |

O 1264. 4406230702715.01. Hugh Polland. Drilled 1981. Altitude 335.87 ft. Depth to water 5.20 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Till | 1 - 14 | 13 |
| Refusal | at 14 | |

O 1265 th. 4409530703008.01. Rodger Twitchell. Drilled 1981. Altitude 345.67 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 2 | 2 |
| Sand, medium to coarse | 2 - 7 | 5 |
| Clay, brown and grey | 7 - 11 | 4 |
| Clay, blue grey | 11 - 21 | 10 |
| End of hole | at 21 | |

O 1266. 4409530703008.02. Rodger Twitchell. Drilled 1981. Altitude 345.67 ft. Depth to water 23.17 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse | 0 - 6 | 6 |
| Sand, medium to coarse | 6 - 10 | 4 |
| Gravel | 10 - 11 | 1 |
| Sand, very coarse and fine to medium gravel | 11 - 26 | 15 |
| Sand, medium to coarse and gravel, trace fine sand | 26 - 31 | 5 |
| Sand, very fine and grey silt | 31 - 35 | 4 |
| Sand, fine, grey with clay laminations | 35 - 45 | 10 |
| Sand, fine and silt with some clay | 45 - 58 | 13 |
| End of hole | at 58 | |

O 1267 th. 4408340702805.01. Kimball Airport. Drilled 1981. Altitude 350 ft. Depth to water 5 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, medium to coarse | 1 - 11 | 10 |
| Till | 11 - 18 | 7 |
| Refusal | at 18 | |

O 1268. 4408360702803.01. Kimball Airport. Drilled 1981. Altitude 328.26 ft. Depth to water 1.88 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, medium to coarse | 1 - 4 | 3 |
| Clay | 4 - 5 | 1 |
| End of hole | at 5 | |

O 1269. 4407210702851.01. Mr. Herrick. Drilled 1981. Altitude 328.77. Depth to water 24.16 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, fine and silt | 1 - 6 | 5 |
| Sand, fine to very fine, brown | 6 - 24 | 18 |
| Till | 24 - 28 | 4 |
| Refusal | at 28 | |

O 1270 th. 4407510702744.01. Evan Thurlow. Drilled 1981. Altitude 320 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, fine to very fine angular gravel | 1 - 6 | 5 |
| Till | 6 - 9 | 3 |
| Refusal | at 9 | |

O 1271. 4406230702750.01. Evan Thurlow. Drilled 1981. Altitude 345.05 ft. Depth to water 45.78 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, fine brown | 1 - 6 | 5 |
| Sand, fine to medium, brown | 6 - 11 | 5 |
| Sand, medium, brown, and some very coarse sand | 11 - 16 | 5 |
| Sand, medium to coarse and very coarse | 16 - 46 | 30 |
| Sand, medium to coarse and gravel | 46 - 55 | 9 |
| Sand, medium and gravel | 55 - 65 | 10 |
| Gravel, medium and very coarse sand | 65 - 95 | 30 |
| Gravel, some fine sand | 95 - 98 | 3 |
| End of hole | at 98 | |

O 1272. 4409450702848.01. Rodger Roderick. Drilled 1981. Altitude 349.00 ft. Depth to water 6.01 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, medium, brown | 1 - 5 | 4 |
| Sand, coarse to very coarse | 5 - 6 | 1 |
| Sand, very coarse and fine gravel, trace fine sand | 6 - 11 | 5 |
| Sand, very coarse and fine gravel | 11 - 16 | 5 |
| Clay, blue grey | 16 - 18 | 2 |
| Refusal | at 18 | |

O 1273. 4416460703119.01. Mr. Robinson. Drilled 1981. Altitude 377.05 ft. Depth to water 10.73 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Soil | 0 - 1 | 1 |
| Sand, coarse and gravel with some fine sand and silt | 1 - 11 | 10 |
| Sand, coarse to very coarse and fine gravel | 11 - 15 | 4 |
| Sand, very coarse to coarse | 15 - 30 | 15 |
| Sand, coarse and gravel | 30 - 39 | 9 |
| Till | 39 - 40 | 1 |
| Refusal | at 40 | |

O 1274. 4415170703054.01. C. B. Cummings and Sons. Drilled 1981. Altitude 377.38 ft. Depth to water 30.52 ft. Log by U.S. Geol. Survey.

| | | |
|---|---|---|
| Sand, medium to coarse | 0 - 11 | 11 |
| Sand, medium to fine | 11 - 16 | 5 |
| Sand, medium | 16 - 50 | 34 |
| Gravel | 50 - 55 | 5 |
| Sand, medium to coarse | 55 - 60 | 5 |
| Till | 60 - 63 | 3 |
| Refusal | at 63 | |

O 1698. 4412100703057.01. Town of South Paris. Drilled 1979. Altitude 377.99 ft. Depth to water 16.72 ft. Log by Maine Dept. Environmental Protection.

| | | |
|---|---|---|
| Sand, silty, gravelly, with trace organics | 0 - 3 | 3 |
| Sand, medium, brown | 3 - 7 | 4 |
| Sand, medium brown with trace gravel | 7 - 10 | 3 |
| Sand, medium | 10 - 16.5 | 6.5 |
| Sand, medium, silty | 16.5- 17.0 | 0.5 |
| Sand, fine, silty, brown | 17.0- 17.5 | 0.5 |
| Clay, silty, brown | 17.5- 18.5 | 1.0 |
| Silt, sandy, brown | 18.5- 21 | 2.5 |
| Sand, fine, silty, brown | 21 - 48 | 27 |
| Sand, silty, gravelly, grey | 48 - 56 | 8 |
| Sand, silty, gravelly, grey with cobbles | 56 - 60.4 | 4.4 |
| Refusal | at 60.4 | |

O 1699. 4412200703105.01. Don Mason. Drilled 1979. Altitude 355.77 ft. Depth to water 16.05 ft. Log by Maine Dept. Environmental Protection.

| | | |
|---|---|---|
| Sand, medium, silty, brown | 0 - 3 | 3 |
| Sand, medium, brown with trace gravel | 3 - 17 | 14 |
| Sand, medium to fine | 17 - 40 | 23 |
| Sand, medium to fine, brown, silty with trace gravel | 40 - 53 | 13 |
| Sand, brown, silty, gravelly (till?) | 53 - 63.6 | 10.6 |
| Refusal | at 63.6 | |

O 1700. 4412110703117.01. Central Maine Power. Drilled 1979. Altitude 331.92 ft. Depth to water 15.6 ft. Log by Maine Dept. Environmental Protection.

| | | |
|---|---|---|
| Sand, medium, brown | 0 - 8 | 8 |
| Sand, medium, reddish with trace coarse sand | 8 - 18 | 10 |
| Sand, medium to fine, silty, brown | 18 - 37 | 19 |
| Sand, medium, brown, silty | 37 - 40 | 3 |
| Sand, medium to coarse, brown, silty | 40 - 82 | 42 |
| End of hole | at 82 | |

O 1701. 4414440703120.01. Town of South Paris. Drilled 1977. Altitude 399.06 ft. Depth to water 17.85 ft. Log by Maine Dept of Environmental Protection.

| | | |
|---|---|---|
| Soil | 0 - 0.3 | 0.3 |
| Sand, fine to medium, mottled | 0.3- 2 | 1.7 |
| Sand, fine to medium, brown | 2 - 20 | 18 |
| Sand, coarse, silty, brown | 20 - 23.5 | 3.5 |
| Sand, gravelly, silty with cobbles | 23.5- 30 | 6.5 |
| Rotten rock (till?) | 30 - 32.4 | 2.4 |
| Refusal | at 32.4 | |

O 1702. 4414480703116.01. Town of South Paris. Drilled 1977. Altitude 348.8 ft. Depth to water 4.01 ft. Log by Maine Dept. of Environmental Protection.

| | | |
|---|---|---|
| Soil | 0 - 0.5 | 0.5 |
| Sand, silty | 0.5- 2 | 1.5 |
| Sand, gravelly, silty, brown | 2 - 18 | 16 |
| Sand, gravelly, silty, brown with cobbles | 18 - 25 | 7 |
| End of hole | at 25 | |

O 1703. 4414460703116.01. Town of South Paris. Drilled 1977. Altitude 347.56 ft. Depth to water 4.41 ft. Log by Maine Dept. of Environmental Protection.

| | | |
|---|---|---|
| Soil, organic | 0 - 0.5 | 0.5 |
| Sand, brown, silty | 0.5- 5 | 4.5 |
| Sand, gravelly, silty, with cobbles | 5 - 10 | 5 |
| Sand, fine to medium, silty, brown | 10 - 33 | 23 |
| Sand, fine, silty, grey | 33 - 40 | 7 |
| End of hole | at 40 | |

O 1704. 4414440703115.02. Town of South Paris. Drilled 1977. Altitude 346.54 ft. Depth to water 3.20 ft. Log by Maine Dept. of Environmental Protection.

| | | |
|---|---|---|
| Soil, organic | 0 - 0.5 | 0.5 |
| Sand, silty, brown | 0.5- 5 | 4.5 |
| Sand, gravelly, silty, brown | 5 - 15 | 10 |
| Sand, fine to medium, silty, brown | 15 - 35 | 20 |
| Sand, fine, silty, brown | 35 - 41 | 6 |
| Sand, fine, silty, grey | 41 - 42 | 7 |
| Sand, gravelly, silty, grey, with cobbles (till?) | 42 - 45 | 3 |
| Refusal | at 45 | |

O 1706. 4414420703116.01. Town of South Paris. Drilled 1977. Altitude 347.37 ft. Depth to water 4.04 ft. Log by Maine Dept. of Environmental Protection.

| | | |
|---|---|---|
| Soil, organic | 0 - 1 | 1 |
| Sand, fine to medium, silty, brown | 1 - 5 | 4 |
| Sand, gravelly, silty, brown | 5 - 15 | 10 |
| Sand, fine to medium, silty | 15 - 49 | 34 |
| Sand, gravelly, silty | 49 - 57 | 8 |
| Refusal | at 57 | |

O 1707. 4414560703111.01. Raymond Colby Drilled 1964. Altitude 351.13 ft. Depth to water 9.19 ft. Log by Stephen B. Church Co.

| | | |
|---|---|---|
| Sand, coarse and gravel | 0 - 20 | 20 |
| Silt, and clay | 20 - 24 | 4 |
| Sand, medium to coarse | 24 - 40 | 16 |
| Sand, fine | 40 - 46 | 6 |
| Sand, medium to fine | 46 - 51 | 5 |
| Sand, fine | 51 - 57 | 6 |
| Sand, coarse | 57 - 73 | 16 |
| End of hole | at 73 | |

O 1708. 4414570703116.01. Don Mason. Drilled 1964. Altitude 350 ft. Depth to water 5 ft. Log by Stephen B. Church,Co.

| | | |
|---|---|---|
| Gravel | 0 - 10 | 10 |
| Silt and clay | 10 - 16 | 6 |
| Sand, fine | 16 - 36 | 20 |
| Sand, medium | 36 - 56 | 20 |
| Sand, fine | 56 - 60 | 4 |
| Gravel, hardpan (till?) | 60 - 63 | 3 |
| Refusal | at 63 | |

O 1710. 4415080703120.01. Philip Plummer. Drilled 1977. Altitude 354.33 ft. Depth to water 7.74 ft. Log by Stephen B. Church Co.

| | | |
|---|---|---|
| Top soil, and fine sand | 0 - 7 | 7 |
| Sand, medium to coarse some cobbles | 7 - 15 | 8 |
| Sand, medium to coarse some gravel | 15 - 20 | 5 |
| Sand, medium to coarse | 20 - 25 | 5 |
| Sand, coarse and gravel | 25 - 30 | 5 |
| Sand, medium to coarse | 30 - 40 | 10 |
| Sand, medium to coarse, trace clay and fines | 40 - 45 | 5 |
| Sand, very coarse and gravel | 45 - 50 | 5 |
| Sand, coarse, thin silt and clay layers | 50 - 55 | 5 |
| Sand, coarse, silt and clay layers | 55 - 59 | 4 |
| Refusal | at 59 | |

O 1713. 4415110703119.01. Philip Plummer. Drilled 1977. Altitude 354.08 ft. Depth to water 5.6 ft. Log by Stephen B. Church Co.

| | | |
|---|---|---|
| Topsoil, subsoil | 0 - 2 | 2 |
| Gravel, coarse | 2 - 12 | 10 |
| Sand, fine to medium, some gravel | 12 - 20 | 8 |
| Sand, medium | 20 - 25 | 5 |
| Sand, medium to coarse, some gravel | 25 - 30 | 5 |
| Sand, coarse, some gravel | 30 - 35 | 5 |
| Sand, medium to coarse | 35 - 40 | 5 |
| Sand, medium to coarse with some fines | 40 - 45 | 5 |
| Sand, fine to medium with some silt and thin coarse layers | 45 - 48 | 3 |
| Gravel hardpan (till?) | 48 - 49 | 1 |
| Refusal | at 49 | |

O 1714. 4415130703120.01. Philip Plummer. Drilled 1977. Altitude 351.61 ft. Depth to water 2.67 ft. Log by Stephen B. Church Co.

| | | |
|---|---|---|
| Topsoil | 0 - 2 | 2 |
| Sand, medium to coarse, some cobbles | 2 - 10 | 8 |
| Sand, fine to medium, some coarse sand layers | 10 - 20 | 10 |
| Sand, very coarse and some gravel | 20 - 35 | 15 |
| Sand, coarse | 35 - 40 | 5 |
| Sand, coarse, some fine sand and silty layers | 40 - 45 | 5 |
| Gravel hardpan (till?) | 45 - 46.5 | 1.5 |
| Refusal | at 46.5 | |

O 1715. 4414080703049.01. Mr. Cornwall Drilled 1964. Altitude 359.75 ft. Depth to water 15.69 ft. Log by Stephen B. Church Co.

| | | |
|---|---|---|
| Sand, coarse and gravel | 0 - 20 | 20 |
| Sand, coarse | 20 - 32 | 12 |
| Sand, medium | 32 - 42 | 10 |
| Sand, coarse | 42 - 47 | 5 |
| Sand, coarse and gravel | 47 - 53 | 6 |
| Sand, coarse | 53 - 59 | 6 |
| Sand, coarse and gravel | 59 - 72 | 13 |
| Sand, coarse, dark brown | 72 - 73 | 1 |
| Sand, fine | 73 - 74 | 1 |
| End of hole | at 74 | |

# Table 13.--Chemical analyses of water

**Location: See description of well - and spring- numbering system. Sp, sample collected from spring; Br, sample collected from bedrock well;**

**Method of Collection: B, bailed; P, pumped. pH: Field determination except L, determined in laboratory.**

| Well | Date of collection | Temperature (C) | pH (units) | Specific conductance (micromhos) | Method of collection | Milligrams per | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Dissolved calcium (Ca) | Dissolved magnesium (Mg) | Dissolved sodium (Na) | Dissolved potassium (K) | Alkalinity (as CaCO$_3$) | Dissolved sulfate (SO$_4$) | Dissolved chloride (Cl) | Dissolved silica (Si) | Dissolved fluoride (F) |
| | ANDROSCOGGIN COUNTY | | | | | | | | | | | | | |
| 127,b | 08-12-80 | -- | 6.5 | 96 | P | 2.2 | 0.4 | 14 | 0.9 | 16 | 5.4 | 14 | 8.0 | 0.1 |
| | OXFORD COUNTY | | | | | | | | | | | | | |
| 1,b | 08-06-80 | 6.5 | 5.3 | 143 | P | 12 | 1.4 | 12 | 1.8 | 25 | 7.0 | 20 | 8.9 | 0.1 |
| 315Sp,b | 08-08-80 | 8.5 | 6.3 | 40 | B | 4.9 | 1.0 | 3.3 | 0.6 | 15 | 4.9 | 2.0 | 13 | 0.1 |
| 336,b | 04-28-80 | 8.0 | 6.2 | 150 | P | 15 | 2.5 | 8.0 | 1.5 | 25 | 8.8 | 17 | 12 | 0.1 |
| | 11-26-80 | 8.5 | 7.2 | 144 | P | 9.9 | 2.1 | 12 | 1.5 | -- | 9.1 | 5.4 | 12 | 0.3 |
| | 04-29-81 | 8.5 | 7.4 | 130 | P | 11 | 2.2 | 16 | 1.6 | -- | 11 | 6.1 | 12 | 0.4 |
| 385,b | 07-08-80 | 6.5 | 5.6 | 130 | P | 17 | 1.4 | 3.8 | 1.0 | 42 | 8.2 | 6.3 | 8.8 | 0.1 |
| 386,b | 09-16-81 | 12.0 | 7.3 | 74 | P | 7.1 | 0.8 | 3.9 | 0.9 | 13 | 6.9 | 7.4 | 8.1 | 0.1 |
| 387,b | 04-28-80 | 9.0 | 6.2 | 178 | P | 13 | 4.3 | 14 | 1.6 | -- | 12 | 34 | 8.6 | 0.1 |
| | 11-26-80 | 8.5 | 6.4 | 164 | P | 15 | 2.6 | 8.9 | 1.5 | 25 | 10 | 18 | 13 | 0.0 |
| | 04-21-81 | 8.5 | 6.6 | 165 | P | 17 | 2.9 | 10 | 1.6 | 36 | 11 | 19 | 14 | <.1 |
| 398,b | 04-28-80 | 5.0 | 5.1 | 48 | P | 4.8 | 0.9 | 1.9 | 0.6 | 18 | 2.9 | 1.0 | 12 | 0.1 |
| 412,b | 12-01-80 | 8.5 | 6.4 | 84 | P | 11 | 1.0 | 5.2 | 1.0 | 15 | 11 | 12 | 9.3 | 0.0 |
| | 04-21-81 | 5.5 | 6.3 | 95 | P | 11 | 1.1 | 5.5 | 0.9 | 27 | 9.6 | 10 | 9.1 | <.1 |
| 1108Sp,b | 08-12-80 | -- | -- | -- | B | 3.6 | 0.6 | 2.2 | 0.3 | 14 | 2.9 | 1.2 | 14 | 0.1 |
| 1240,c | 09-30-81 | 9.0 | 6.4 | 1250 | B | 126 | 20 | 77 | 9.1 | 540 | 14 | 120 | 30 | <.1 |
| 1241,c | 09-25-81 | 9.0 | 6.5 | 1075 | P | 123 | 22 | 79 | 6.1 | 400 | 24 | 140 | 15 | <.1 |
| 1250,c | 09-30-81 | 9.0 | 6.2 | 460 | P | 53 | 6.3 | 21 | 1.9 | 58 | 70 | 31 | 14 | <.1 |
| 1275Br,b | 08-08-80 | 9.0 | 6.7 | 155 | P | 20 | 3.5 | 6.6 | 1.6 | 57 | 7.3 | 6.7 | 18 | 0.4 |
| 1278Sp,b | 08-04-80 | 7.0 | 4.8 | 30 | B | 2.5 | 0.6 | 5.6 | 0.8 | 5 | 2.9 | 6.6 | 7.4 | 0.1 |
| 1279Br,c | 08-12-80 | 12.0 | 7.3 | 400 | P | 31 | 1.9 | 49 | 2.0 | 68 | 74 | 25 | 15 | 2.2 |
| 1281,b | 08-14-80 | 12.0 | 5.5 | 65 | P | 5.0 | 0.8 | 5.3 | 0.6 | 12 | 4.4 | 9.1 | 8.3 | 0.1 |
| 1286,c | 07-08-80 | 9.0 | 5.9 | 1060 | B | 50 | 4.0 | 180 | 6.1 | 16 | 12 | 380 | 8.7 | 0.1 |
| 1290Br,b | 08-12-80 | 12.5 | 7.6 | 168 | P | 19 | 3.4 | 12 | 1.6 | 89 | 6.1 | 1.1 | 12 | 0.4 |
| 1295,b | 08-12-80 | 16.0 | 6.3 | 65 | P | 6.0 | 0.5 | 3.1 | 5.0 | 30 | 3.1 | 1.5 | 10 | 0.1 |
| 1299,b | 08-14-80 | 9.5 | 5.3 | 64 | P | 6.4 | 1.2 | 3.2 | 0.6 | 19 | 2.7 | 4.9 | 11 | 0.1 |
| 1303Br,b | 08-14-80 | 14.5 | 5.8 | 80 | P | 8.1 | 0.9 | 3.0 | 5.2 | 28 | 5.4 | 2.0 | 5.6 | 0.1 |
| 1317,b | 08-12-80 | 15.0 | 5.7 | 127 | P | 7.5 | 1.1 | 13 | 2.2 | 22 | 16 | 1 0 | 5.3 | 0.1 |
| 1318,b | 05-21-80 | 8.5 | 5.5 | 70 | P | 8.1 | 1.3 | 2.2 | 0.8 | 14 | 5.8 | 7.1 | 11 | 0.0 |
| | 04-22-81 | 7.5 | 6.4 | 90 | P | 11 | 1.8 | 2.4 | 1.0 | 18 | 7.0 | 7.5 | 13 | <.1 |
| 1324,b | 08-14-80 | 13.0 | 5.5 | 145 | P | 5.9 | 1.3 | 18 | 1.6 | 16 | 6.2 | 21 | 9.9 | 0.1 |
| 1325Br,b | 08-14-80 | 10.0 | 7.2 | 147 | P | 16 | 4.8 | 8.1 | 1.6 | 62 | 13 | 1.6 | 12 | 0.3 |
| 1338Br,c | 08-15-80 | 11.0 | 7.4 | 250 | P | 14 | 4.1 | 33 | 2.4 | 83 | 15 | 14 | 12 | 1.3 |
| 1361,c | 08-15-80 | 11.5 | 5.9 | 300 | P | 18 | 3.1 | 28 | 11 | 58 | 19 | 31 | 14 | 0.1 |
| 1365Sp,b | 08-04-80 | 8.0 | 6.7 | 190 | B | 19 | 3.9 | 14 | 1.7 | 46 | 6.5 | 31 | 15 | 0.2 |
| 1366Sp,b | 08-04-80 | 9.0 | 4.4 | 110 | B | 4.6 | 1.1 | 15 | 2.3 | 13 | 4.0 | 17 | 8.6 | 0.1 |
| 1367,b | 08-12-80 | 10.0 | 5.2 | 35 | P | 2.9 | 0.5 | 1.5 | 0.4 | 3 | 5.3 | 1.6 | 6.6 | 0.1 |
| 1369Br,b | 08-26-80 | 10.0 | 6.5 | 340 | P | 47 | 7.7 | 9.0 | 3.0 | 110 | 28 | 11 | 14 | 0.3 |
| 1374,c | 08-26-80 | 13.0 | 6.3 | 360 | P | 52 | 3.5 | 12 | 7.9 | 140 | 15 | 14 | 18 | 0.1 |
| 1378,b | 08-26-80 | 8.0 | 5.7 | 50 | B | 3.9 | 0.2 | 5.7 | 0.5 | 16 | 4.2 | 3.2 | 6.6 | 0.1 |
| 1392,b | 08-26-80 | 16.0 | 6.9 | 135 | P | 8.8 | 1.2 | 11 | 5.7 | 19 | 10 | 11 | 6.5 | 0.1 |
| 1393Br,b | 08-26-80 | 10.0 | 7.5 | 105 | P | 14 | 2.7 | 4.5 | 1.0 | 45 | 9.0 | 1.7 | 21 | 0.2 |
| 1399,b | 08-26-80 | 9.0 | 5.6 | 100 | P | 3.8 | 0.9 | 8.3 | 3.9 | -- | 7.0 | 9.2 | 8.4 | 0.1 |
| 1466,b | 08-27-80 | 12.5 | 5.4 | 70 | B | 5.0 | 0.8 | 4.6 | 2.2 | 8 | 7.2 | 3.8 | 8.8 | 0.1 |
| 1471,b | 08-27-80 | 18.0 | 5.4 | 52 | P | 4.3 | 0.8 | 2.5 | 0.6 | 8 | 4.8 | 5.4 | 12 | 0.1 |
| 1476,b | 08-27-80 | 9.0 | -- | 15 | P | 1.0 | 0.2 | 1.1 | 0.2 | 8 | 1.3 | 0.7 | 6.0 | 0.1 |
| 1491,b | 08-27-80 | 11.0 | 5.8 | 45 | P | 2.6 | 0.5 | 3.4 | 0.4 | 15 | 1.5 | 5.1 | 7.1 | 0.1 |
| 1510,b | 08-27-80 | 11.0 | 5.6 | 115 | P | 3.6 | 0.6 | 14 | 1.9 | 11 | 5.7 | 18 | 6.8 | 0.1 |
| 1546,b | 08-27-80 | 8.0 | 5.4 | 100 | P | 7.0 | 0.6 | 10 | 1.5 | 17 | 5.3 | 17 | 6.0 | 0.1 |
| 1579,b | 08-15-80 | 8.5 | 5.3 | 47 | P | 1.2 | 0.3 | 4.6 | 0.6 | 5 | 6.9 | 1.1 | 5.3 | 0.1 |
| 1580,b | 08-15-80 | 10.0 | 5.9 | 66 | P | 7.7 | 0.6 | 1.9 | 1.6 | 21 | 3.4 | 1.4 | 8.2 | 0.1 |
| 1698,b | 06-19-80 | 7.5 | 6.8 | 125 | P | 16 | 2.5 | 3.4 | 2.6 | 46 | 9.5 | 1.7 | 13 | 0.2 |
| | 08-22-80 | 8.0 | -- | 121 | P | 17 | 2.6 | 3.4 | 2.5 | 52 | 9.5 | 1.3 | 15 | 0.2 |
| | 04-22-81 | 8.0 | 7.0 | 120 | P | 16 | 2.3 | 3.1 | 2.0 | 40 | 9.4 | 3.5 | 14 | 0.1 |
| | 09-24-81 | 9.0 | 6.9 | 115 | P | 15 | 2.5 | 3.1 | 2.1 | 47 | 10 | 1.8 | 14 | 0.1 |
| 1699,b | 06-18-80 | 7.0 | 6.0 | 92 | P | 11 | 1.6 | 3.4 | 1.6 | 24 | 8.6 | 3.9 | 13 | 0.1 |
| | 08-22-80 | 8.0 | -- | 101 | P | 13 | 1.8 | 3.7 | 1.6 | 34 | 7.8 | 4.9 | 14 | 0.1 |
| | 04-22-81 | 8.0 | 6.5 | 72 | P | 8.9 | 13 | 3.1 | 1.3 | 20 | 7.0 | 2.9 | 13 | <.1 |
| | 09-24-81 | 9.0 | 6.4 | 84 | P | 10 | 1.4 | 3.3 | 1.5 | 25 | 7.5 | 2.7 | 12 | <.1 |
| 1700,c | 06-19-80 | 7.5 | 6.6 | 1350 | P | 99 | 14 | 140 | 5.8 | 400 | 13 | 190 | 21 | 0.1 |
| | 08-21-80 | 8.5 | -- | 1540 | P | 110 | 17 | 150 | 6.5 | 450 | 8.8 | 210 | 25 | 0.1 |
| | 04-22-81 | 8.5 | 6.7 | >1000 | P | 99 | 14 | 78 | 4.8 | 360 | 29 | 110 | 26 | <.1 |
| | 09-24-81 | 9.0 | 6.6 | 975 | P | 80 | 12 | 89 | 4.6 | 320 | 40 | 140 | 22 | <.1 |
| 1702,b | 09-16-81 | 14.0 | 6.9 | 185 | P | 15 | 1.5 | 14 | 2.5 | 33 | 13 | 16 | 12 | <.1 |
| 1703,b | 09-17-81 | 9.0 | 6.4 | 340 | P | 39 | 3.5 | 19 | 2.7 | 98 | 27 | 21 | 14 | <.1 |
| 1704,b | 09-17-81 | 9.0 | 6.8 | 189 | P | 22 | 2.1 | 8.9 | 2.1 | 58 | 10 | 12 | 11 | <.1 |
| 1706,c | 09-17-81 | 9.5 | 6.5 | 2650 | P | 120 | 12 | 160 | 22 | 270 | 7.8 | 340 | 17 | <.1 |
| 1716,b | 09-16-81 | 9.0 | 6.9 | 101 | P | 12 | 1.2 | 5.5 | 1.0 | 18 | 5.0 | 11 | 11 | <.1 |
| 1718,b | 08-08-80 | 7.0 | 6.3 | 75 | P | 5.4 | 0.7 | 8.9 | 0.7 | 14 | 4.0 | 15 | 7.4 | 0.1 |

## from wells, test holes and springs

**b, analysis used in statistics for "background" water quality; C, analysis considered contaminated and not used to characterize "background" water quality.**

**Dissolved Solids: Residue at 180°C. Specific Conductance: Field determination except L, determined in laboratory.**

| liter | | | | | Micrograms per liter | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total dissolved solids | Dissolved nitrite +nitrate ($NO_2$+$NO_3$) | Dissolved phosphorus (P) | Total organic carbon (C) | Hardness as $CaCO_3$ | Total iron (Fe) | Total manganese (Mn) | Total Zinc (Zn) | Total arsenic (As) | Total cadmium (Cd) | Total chromium (Cr) | Total cobalt (Co) | Total copper (Cu) | Total lead (pb) | Total mercury (Hg) | Dissolved iron (Fe) | Dissolved manganese (Mn) |
| 62 | 0.6 | 0.0 | | 7 | | | | | | | | | | | 60 | 30 |
| 97 | 1.5 | 0.18 | 1.0 | 36 | 100 | 10 | 10 | 1 | 0 | 10 | 0 | 1 | 3 | 0.2 | 20 | 3 |
| 49 | 0.12 | 0.0 | | 16 | | | | | | | | | | | 20 | 10 |
| 104 | 1.5 | | 3.8 | 48 | 90 | 10 | 0 | 1 | 0 | 10 | 0 | 0 | 3 | | 40 | 10 |
| 81 | 0.26 | | 0.3 | 33 | 70 | 0 | 30 | 0 | 1 | 20 | 0 | 4 | 8 | | 0 | 0 |
| 71 | 0.40 | | 0.5 | 37 | 20 | 20 | -- | -- | -- | -- | -- | -- | -- | | 20 | <1 |
| 77 | .18 | .01 | 3.4 | 48 | 70 | 10 | 10 | 0 | 0 | 10 | 0 | 1 | 1 | .1 | 40 | 8 |
| 55 | | | | 21 | | <10 | | | | | | | | | | 0.8 |
| 140 | .32 | .03 | 1.9 | 50 | 320 | 10 | 60 | -- | 0 | 10 | 0 | 30 | 10 | -- | 20 | 5 |
| 132 | 1.2 | 0.0 | 0.2 | 48 | 70 | 10 | 30 | 0 | 0 | 10 | 0 | 3 | 0 | <.1 | 40 | 6 |
| 109 | 1.4 | <0.1 | 0.4 | 54 | 50 | 10 | -- | -- | -- | -- | -- | -- | -- | -- | 40 | 7 |
| 38 | 0.03 | 0.0 | 0.6 | 16 | 320 | 20 | 10 | 1 | 0 | 10 | 0 | 1 | 2 | <.1 | 160 | 20 |
| 35 | 0.13 | 0.0 | 2.1 | 32 | 100 | 10 | 30 | 1 | 0 | 20 | 0 | 4 | 4 | <.1 | 60 | 5 |
| 62 | 0.21 | <0.01 | 2.0 | 32 | 70 | 10 | -- | -- | -- | -- | -- | -- | -- | -- | 60 | 6 |
| 36 | 0.07 | 0.0 | | 11 | | | | | | | | | | | 20 | 10 |
| 716 | 0.10 | 1.3 | 22 | 400 | 230000 | 140000 | 1700 | -- | 1 | 480 | 50 | 630 | 32 | | 53000 | 11000 |
| 669 | 0.03 | <0.01 | 3.9 | 400 | 370 | 140 | 1100 | -- | 1 | 20 | 3 | 8 | 16 | -- | 170 | 130 |
| 298 | 11 | <0.01 | 2.1 | 160 | 130 | 1100 | 840 | -- | 1 | 30 | 7 | 7 | 12 | -- | 65 | 1100 |
| 94 | 1.0 | 0.01 | | 64 | | | | | | | | | | | 10 | 10 |
| 40 | 1.8 | 0.04 | 1.6 | 9 | | | | | | | | | | | 10 | 20 |
| 238 | 0.0 | 0.0 | | 85 | | | | | | | | | | | 50 | 30 |
| 58 | 0.35 | 0.0 | | 16 | | | | | | | | | | | 30 | 10 |
| 780 | 1.30 | 0.0 | 0.4 | 140 | 530 | 760 | 30 | 1 | 2 | 10 | 3 | 7 | 4 | 0.1 | 510 | 790 |
| 92 | 0.0 | 0.03 | | 61 | | | | | | | | | | | 30 | 30 |
| 52 | 0.12 | 0.0 | | 17 | | | | | | | | | | | 50 | 10 |
| 70 | 0.42 | 0.0 | | 21 | | | | | | | | | | | 0 | 0 |
| 58 | 0.55 | 0.0 | | 24 | | | | | | | | | | | 60 | 10 |
| 70 | 0.14 | 0.0 | | 23 | | | | | | | | | | | 340 | 50 |
| 88 | 0.81 | 0.0 | 0.0 | 26 | 110 | 10 | 40 | 0 | 0 | 10 | 0 | 18 | 8 | 0.1 | 110 | 2 |
| 80 | 0.84 | 0.02 | 0.5 | 35 | 50 | <10 | 30 | 0 | -- | 20 | 1 | 3 | 1 | <0.1 | 20 | 1 |
| 90 | 2.3 | 0.0 | | 20 | | | | | | | | | | | 150 | 10 |
| 94 | 0.0 | 0.0 | | 60 | | | | | | | | | | | 70 | 0 |
| 150 | 0.0 | 0.0 | | 52 | | | | | | | | | | | 10 | 0 |
| 183 | 4.3 | 0.0 | | 58 | | | | | | | | | | | 50 | 0 |
| 139 | 0.35 | 0.02 | 1.2 | 64 | | | | | | | | | | | 0 | 4 |
| 92 | 4.9 | 0.02 | 2.6 | 16 | | | | | | | | | | | 0 | 100 |
| 30 | 0.27 | 0.0 | | 9 | | | | | | | | | | | 30 | 20 |
| 219 | 1.4 | 0.01 | | 150 | | | | | | | | | | | 10 | 110 |
| 225 | 0.01 | 0.0 | | 140 | | | | | | | | | | | 23000 | 3000 |
| 32 | 0.04 | 0.02 | | 11 | | | | | | | | | | | 10 | 50 |
| 87 | 3.2 | 0.03 | | 27 | | | | | | | | | | | 10 | 10 |
| 80 | 0.14 | 0.04 | | 46 | | | | | | | | | | | 10 | 10 |
| 37 | 1.1 | 0.01 | | 13 | | | | | | | | | | | 10 | 10 |
| 63 | 2.3 | 0.00 | | 16 | | | | | | | | | | | 180 | 70 |
| 62 | 0.02 | 0.00 | | 14 | | | | | | | | | | | 230 | 20 |
| 20 | 0.05 | 0.01 | | 3 | | | | | | | | | | | 10 | 10 |
| 54 | 0.52 | 0.01 | | 9 | | | | | | | | | | | 60 | 10 |
| 74 | 2.3 | 0.00 | | 11 | | | | | | | | | | | 40 | 10 |
| 79 | 0.43 | 0.06 | | 20 | | | | | | | | | | | 10 | 10 |
| 31 | 1.90 | 0.02 | | 4 | | | | | | | | | | | 0 | 70 |
| 52 | 0.71 | 0.00 | | 22 | | | | | | | | | | | 0 | 0 |
| 80 | 0.22 | 0.28 | 4.2 | 50 | 2900 | 50 | 30 | 1 | 0 | 20 | 0 | 32 | 4 | <0.1 | 50 | 5 |
| 80 | 0.21 | 0.02 | 1.0 | 53 | 380 | 10 | 10 | 1 | 0 | 10 | 0 | 7 | 3 | <0.1 | 30 | 10 |
| 88 | 0.48 | 0.07 | 0.6 | 49 | 410 | 10 | 40 | 0 | -- | 20 | 1 | 4 | 8 | <0.1 | <10 | 2 |
| 80 | 0.16 | <0.01 | 0.2 | 48 | 160 | <10 | 30 | -- | -- | 20 | 1 | -- | 1 | -- | 16 | 1 |
| 78 | 0.54 | 0.01 | -- | 34 | 610 | 10 | 10 | 1 | 0 | 10 | 0 | 7 | 3 | <.1 | 30 | 3 |
| 73 | 0.56 | 0.00 | 0.2 | 40 | 160 | 10 | 20 | 1 | 0 | 10 | 0 | 2 | 2 | <.1 | 30 | 20 |
| 56 | 0.54 | 0.02 | 0.3 | 28 | 340 | 10 | 40 | 0 | 1 | 10 | 0 | 5 | 8 | <.1 | 50 | 30 |
| 60 | 0.43 | 0.03 | 0.2 | 31 | 1600 | 20 | 50 | -- | -- | 20 | 1 | -- | 5 | -- | 32 | 3 |
| 752 | 0.23 | 0.01 | -- | 300 | 29000 | 8500 | 30 | 15 | 0 | 10 | 16 | 8 | 4 | 0.1 | 21000 | 8200 |
| 880 | 0.19 | 0.00 | 6.3 | 340 | 56000 | 9700 | 30 | 20 | 1 | 10 | 16 | 7 | 6 | 0.2 | 45000 | 10000 |
| 613 | 0.79 | 0.02 | 3.3 | 300 | 28000 | 7000 | 60 | 20 | 1 | 10 | 12 | 6 | 7 | <.1 | 27000 | 7200 |
| 628 | 2.5 | 0.03 | 5.2 | 250 | 27000 | 7200 | 40 | -- | -- | 20 | 14 | -- | 3 | -- | 26000 | 6800 |
| 124 | | | | 44 | 4000 | | | | | | | | | | | |
| 205 | | | | 110 | 30 | | | | | | | | | | | |
| 120 | | | | 64 | 300 | | | | | | | | | | | |
| 1020 | | | | 350 | 21000 | | | | | | | | | | | |
| 81 | | | | 35 | 10 | | | | | | | | | | | |
| 69 | 0.70 | 0.00 | | 16 | | | | | | | | | | | 300 | 10 |

## Table 14.--Chemical analyses of water from

| Station number | Date of collection | Instantaneous Discharge (ft 3/s) | Turbidity (NTU) | pH | Specific conductance (micromhos) | Fecal coliform (colonies per 100 ml) | Streptococci (colonies per 100 ml) | Milligrams | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Dissolved calcium (Ca) | Dissolved magnesium (Mg) | Dissolved potassium (K) | Dissolved Sodium (Na) | Dissolved chloride (Cℓ) | Dissolved fluoride (F) | Dissolved sulfate ($SO_4$) | Alkalinity (as $CaCO_3$) | Dissolved nitrate nitrate ($NO_3$+$NO_2$) |
| | LITTLE ANDROSCOGGIN RIVER | | | | | | | | | | | | | | | |
| 01057000 | 09-16-80 | 26 | 0.25 | 6.8 | 48 | -- | -- | 4.0 | 0.7 | 0.9 | 3.5 | 4.3 | 0.1 | 6.1 | 11 | 0.12 |
| | 04-27-81 | 136 | -- | 6.6 | 46 | 10 | 6 | 3.5 | 0.8 | 0.8 | 3.3 | 3.9 | 0.1 | 5.4 | 17 | 0.08 |
| 44150307 | 09-16-80 | 33 | 0.30 | 6.8 | 57 | -- | -- | 4.5 | 0.8 | 1.0 | 3.9 | 5.3 | 0.1 | 5.9 | 16 | 0.11 |
| | 04-27-81 | 165 | -- | 6.6 | 48 | 3 | 1 | 3.8 | 0.7 | 0.7 | 3.5 | 4.1 | 0.1 | 5.5 | 4 | 0.07 |
| 44124107 | 09-16-80 | 37 | 0.30 | 6.9 | 86 | -- | -- | 5.9 | 0.9 | 1.3 | 6.1 | 9.5 | 0.1 | 6.1 | 14 | 0.15 |
| | 04-27-81 | 177 | -- | 6.6 | 55 | 6 | 0 | 3.8 | 0.7 | 0.7 | 3.6 | 5.5 | 0.1 | 6.3 | 4 | 0.09 |
| 44111507 | 09-17-80 | 44 | 0.20 | 6.9 | 215 | -- | -- | 11 | 1.1 | 1.6 | 27 | 35 | 0.1 | 21 | 14 | 0.66 |
| | 04-28-81 | 203 | -- | 6.8 | 108 | 12 | 15 | 6.1 | 0.9 | 0.9 | 13 | 13 | 0.1 | 11 | 10 | 0.81 |
| 44101007 | 09-16-80 | 51 | 0.25 | 6.9 | 188 | -- | -- | 9.7 | 1.0 | 1.6 | 23 | 30 | 0.1 | 19 | 14 | 9.51 |
| 44081207 | 09-17-80 | 45 | 0.25 | 6.8 | 200 | -- | -- | 10 | 1.0 | 1.6 | 25 | 31 | 0.1 | 19 | 15 | 0.56 |
| | 04-28-81 | 232 | -- | 6.8 | 120 | 10 | 10 | 6.6 | 0.9 | 1.0 | 15 | 17 | 0.1 | 14 | 6 | 0.86 |
| 44075607 | 09-17-80 | 86 | 0.20 | 6.9 | 120 | -- | -- | 6.0 | 0.7 | 0.9 | 14 | 15 | 0.1 | 14 | 12 | 0.29 |
| | 04-28-81 | 392 | -- | 6.7 | 102 | 16 | 19 | 5.7 | 0.9 | 0.9 | 12 | 11 | 0.1 | 11 | 14 | 0.52 |
| 44063707 | 09-17-80 | 86 | 0.20 | 6.9 | 250 | -- | -- | 11 | 0.9 | 1.5 | 33 | 36 | 0.1 | 35 | 12 | 0.95 |
| | 04-28-81 | 402 | -- | 6.6 | 105 | 9 | 15 | 5.4 | 0.9 | 0.8 | 10 | 12 | 0.1 | 11 | 7 | 0.53 |
| | STONY BROOK | | | | | | | | | | | | | | | |
| 44132307 | 09-17-80 | 1.6 | 0.40 | 6.9 | 76 | -- | -- | 7.2 | 1.1 | 0.9 | 4.6 | 5.5 | 0.1 | 7.1 | 17 | 0.51 |
| | 04-27-81 | 20 | -- | 6.6 | 63 | 33 | 2 | 4.3 | 0.7 | 0.6 | 4.1 | 7.1 | 0.1 | 6.9 | 6 | 0.06 |
| | PENNESSEWASSEE LAKE OUTLET | | | | | | | | | | | | | | | |
| 01057510 | 04-28-81 | 33 | -- | 6.7 | 64 | 9 | 3 | 6.8 | 1.0 | 0.9 | 3.5 | 4.9 | 0.1 | 5.9 | 20 | 0.03 |
| | THOMPSON LAKE OUTLET | | | | | | | | | | | | | | | |
| 01058005 | 09-17-80 | 75 | 0.20 | 6.7 | 44 | -- | -- | 3.0 | 0.6 | 0.4 | 3.2 | 2.4 | 0.1 | 5.6 | 10 | 0.02 |
| | 04-28-81 | 55 | -- | 6.8 | 62 | 105 | 25 | 3.1 | 0.8 | 0.5 | 7.0 | 2.9 | 0.1 | 11 | 16 | 0.02 |

**the Little Androscoggin River and tributaries.**

| per liter | | | | | | | Micrograms per liter | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total hardness (as $CaCO_2$) | Total phosphorus (P) | Total organic carbon (C) | Total nitrogen (N) | Dissolved solids | Dissolved silica (Si) | Dissolved oxygen (O) | Total arsenic (As) | Total cadmium (Cd) | Total chromium (Cr) | Total cobalt (Co) | Total copper (Cu) | Total iron (Fe) | Total lead (Pb) | Total manganese (Mn) | Total mercury (Hg) | Total selenium (Se) | Total zinc (Zn) |
| 13 | 0.02 | 4.5 | 0.36 | 47 | 7.4 | 10.2 | 0 | 0 | <10 | 0 | 3 | 250 | 2 | 20 | <0.1 | 0 | 20 |
| 12 | <.01 | -- | -- | 36 | 5.4 | 12.0 | -- | -- | 20 | -- | 6 | 120 | 3 | 10 | -- | -- | -- |
| 15 | 0.02 | 3.9 | 0.28 | 52 | 7.0 | 11.4 | 1 | 0 | <10 | 0 | 2 | 210 | 1 | 20 | <0.1 | 0 | 20 |
| 12 | <.01 | -- | -- | 36 | 5.7 | 11.8 | -- | -- | 20 | -- | 6 | 130 | 1 | 10 | -- | -- | -- |
| 18 | 0.02 | 3.3 | 0.71 | 64 | 6.2 | 10.8 | 1 | 1 | <10 | 0 | 6 | 360 | 6 | 40 | <0.1 | 0 | 90 |
| 12 | <.01 | -- | -- | 51 | 5.5 | 11.4 | -- | -- | 20 | -- | 5 | 150 | 1 | 20 | -- | -- | -- |
| 32 | 0.09 | 4.0 | 1.2 | 118 | 6.3 | 10.4 | 1 | 0 | 40 | 0 | 3 | 270 | 3 | 20 | 0.1 | 0 | 30 |
| 19 | <.01 | -- | -- | 68 | 5.5 | 10.0 | -- | -- | 20 | -- | 4 | 170 | 3 | 10 | -- | -- | -- |
| 28 | 0.10 | 3.9 | 0.98 | 111 | 5.9 | 10.0 | 1 | 0 | 40 | 0 | 3 | 440 | 3 | 20 | <.1 | 0 | 20 |
| 29 | 0.11 | 4.3 | 0.88 | 113 | 5.5 | 8.9 | 1 | 0 | 120 | 0 | 4 | 590 | 6 | 20 | <.1 | 0 | 290 |
| 20 | 0.04 | -- | -- | 73 | 5.8 | 10.2 | -- | -- | 150 | -- | 6 | 440 | 8 | 20 | -- | -- | -- |
| 18 | 0.05 | 4.4 | 0.59 | 68 | 2.7 | 8.1 | 0 | 0 | 150 | 0 | 5 | 270 | 3 | 20 | <.1 | 0 | 70 |
| 18 | 0.03 | -- | -- | 63 | 4.3 | 10.9 | -- | -- | 30 | -- | 5 | 210 | 7 | 20 | -- | -- | -- |
| 31 | 0.04 | 5.9 | 1.4 | 137 | 2.8 | 9.0 | 1 | 0 | 130 | 0 | 5 | 220 | 3 | 30 | <.1 | 0 | 30 |
| 17 | <.01 | -- | -- | 55 | 4.5 | 11.2 | -- | -- | 30 | -- | 5 | 200 | 89 | 10 | -- | -- | -- |
| 23 | 0.01 | 6.5 | 0.36 | 76 | 9.0 | 9.7 | 0 | 0 | 10 | 0 | 2 | 190 | 1 | 20 | <0.1 | 0 | 20 |
| 14 | <.01 | -- | -- | 44 | 6.4 | 11.6 | -- | -- | 20 | -- | 5 | 130 | 1 | 10 | -- | -- | -- |
| 21 | <.01 | -- | -- | 51 | 3.5 | 10.6 | -- | -- | 10 | -- | 6 | 130 | 1 | 10 | -- | -- | -- |
| 10 | 0.03 | 2.7 | 0.25 | 35 | 1.3 | 8.2 | 1 | 1 | 10 | 0 | 6 | 130 | 4 | 10 | <0.1 | 0 | 60 |
| 11 | <0.01 | -- | -- | 37 | 1.5 | 11.1 | -- | -- | 20 | -- | 4 | 90 | 1 | 10 | -- | -- | -- |