GROUND-WATER RESOURCES OF THE LAMPREY RIVER BASIN, SOUTHEASTERN NEW HAMPSHIRE

By John E. Cotton

U.S. GEOLOGICAL SURVEY

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PLATE

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CONVERSION FACTORS AND ABBREVIATIONS

The following factors may be used to convert the inch-pound units published herein to the International System of Units.

Multiply inch-pound unit	By	To obtain metric unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	0.4047	hectare (ha)
square mile (mi^2)	2.59	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Flow	
foot squared per day (ft^2/d)	0.0929	meter squared per day (m^2/d)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer [$(m^3/s)/km^2$]
foot per day (ft/d)	0.3048	meter per day (m/d)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Temperature

Temperature in degrees Fahrenheit (° F) can be converted to degrees Celsius (° C) as follows: ° C = 5/9 (° F -32).

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level of 1929."

Ground-Water Resources of the Lamprey River Basin, Southeastern New Hampshire

By John E. Cotton

ABSTRACT

Communities in the Lamprey River basin are experiencing the rapid population growth common to all communities in southeastern New Hampshire. The population of 15 towns within the basin increased about 40 percent from 1970 to 1980. This growth is expected to continue. Future water demand, both municipal and private, will increase in response to this population growth. By 2020, the demand may be 3 to 9 times greater than the present 3 Mgal/d (million gallons per day) pumpage.

Saturated sand and gravel deposits in the Lamprey and Piscassic River valleys and the area of Newmarket Plains are the most productive or potentially productive stratified-drift aquifers in the basin. Except for the aquifer at Newmarket Plains, induced infiltration of stream water would allow higher, but still modest, sustained yields to correctly placed wells. The aquifer near Deerfield Fairgrounds has the potential to yield at least 0.06 Mgal/d. The aquifer in northwest Raymond may yield 1.7 Mgal/d. A sustained withdrawal of 1 Mgal/d is probable in the west Epping area. The aquifer in central Epping may already be fully developed. Further exploration for a confined aquifer beneath estuarine deposits in eastern Epping is warranted. Pumpage from the Newmarket Plains aquifer could be increased to an estimated 0.6 Mgal/d. Systematic exploration for highly fractured zones in bedrock may allow siting of wells with relatively high yields.

The chemical quality of ground water is generally suitable for domestic use. Recent and anticipated improvements in surface-water quality may result in little or no degradation of ground-water quality in those aquifers where pumpage results in induced infiltration.

Chemical quality of ground water reflects highway deicing policies, and may reflect other land-use practices. Judicious land-use planning could protect the few extensive sand and gravel aquifers in this basin.

INTRODUCTION

This report is an assessment of the ground-water resources of the Lamprey River basin in southeastern New Hampshire (fig. 1). Demand for water in this 212-mi^2 river basin has been increasing due to rapid population growth. This appraisal was done in cooperation with the New Hampshire Water Resources Board.

Background

Population in southeastern New Hampshire doubled from 1940 to 1970. The population of 15 towns entirely or partly within the Lamprey River basin increased from 39,729 in 1970 to 56,178 in 1980, an increase of 41 percent (U.S. Bureau of the Census, 1980). The 11 towns with population centers in the basin or more than 25 percent of their land in the basin had a population of 37,132 in 1980, a 40 percent increase during the 1970's. Population projections differ significantly, but continued rapid growth seems certain (Anderson-Nichols, 1969, U.S. Corps of Engineers, 1976).

At present (1984), 5 of these 11 towns have municipal water supplies. Durham pumps from the Oyster River (adjacent to the Lamprey River basin) to serve the center of population which also lies in the Oyster River basin. The rural popula-

Figure 1.--Location of study area.

tion of Durham in the Lamprey River basin is served by private wells. Newmarket pumps from Folletts Brook and a well on Newmarket Plains. Municipal systems in Epping, Newfields, and Raymond rely on ground water. The wells and the town center in Newfields are located just southeast of the Lamprey River basin. The systems from all five towns have an estimated sustained yield of 3.6 Mgal/d. In 1969, the average daily pumpage was 1.25 Mgal/d (U.S. Corps of Engineers, 1976; New Hampshire Water Supply and Pollution Control Commission, 1970). Incomplete data for 1979 suggest that daily pumpage may have approached 1.5 Mgal/d. Essentially all the remaining 2.1 Mgal/d of available pumpage is from the Durham and Newmarket systems. Pumpage from the Epping wells presently equals or exceeds the estimated sustained yields.

Per capita water use in 1969 for the 14,300 people served by municipal systems ranged from 79 to 93 gal/d and averaged 87.5 gal/d. The average per capita use declined to about 83 gal/d in 1974 (U.S. Corps of Engineers, 1976). These values reflect small industrial water demands; a situation that has not changed substantially during the last decade. Preliminary data suggest that per capita demand in 1979 has not changed significantly. Estimates of future water demand include a gradual increase in daily per capita use to 2020. For the five basin communities with existing municipal systems, the predicted demands for 2020 range from 114 to 156 gal/d (U.S. Corps of Engineers, 1976). Other estimates which also included the 6 communities without existing municipal systems range from 111 to 208 gal/d (Anderson-Nichols, 1969).

If water demands from private wells in the 11 towns in 1969 are estimated by assuming that the 12,200 people not served by public supplies had similar per capita use as those on public supplies, then about 1.1 Mgal/d was pumped from private wells. If the percentage of the population not served by public supply in 1969 (46) remained the same throughout the decade, then private pumpage may have been about 1.5 Mgal/d in 1980.

Calculations of future water demands of basin communities vary greatly depending upon projections of population and per capita use. In addition, estimates vary as to what percentage of the total population will be served by public supplies, not only in the five towns with existing systems, but also in the six towns presently without municipal systems (Anderson-Nichols, 1969; U.S. Corps of Engineers, 1976). To illustrate the magnitude of variation in projected water use for the 11 basin communities in 2020, both public and private, a per capita use of 130 gal/d and a population range of 70,000 (U.S. Corps of Engineers, 1976) to 200,000 (Anderson-Nichols, 1969) was assumed. The total water demand would range from about 9 Mgal/d to 26 Mgal/d--3 to almost 9 times the pumpage in 1980.

Purpose and Scope

This report (1) assesses the location and extent of stratified drift that has potential for ground-water development in the Lamprey River basin, including areas that could be recharged by induced infiltration of surface water; (2) provides quantitative estimates of potential ground-water yields; and (3) assesses ground-water quality.

Approach

Previous descriptions of ground-water resources in this area by the Geological Survey include a reconnaissance map of southeastern New Hampshire (Cotton, 1977) and a study that included the lower part of the Lamprey River basin, (Bradley, 1964). These reports indicated that the greatest potential for locating municipal wells was primarily in coarse-grained, stratified glacial deposits in the valleys of the basin.

This study included a review of previous studies on water resources (Camp, Dresser and McKee, 1960; Southeastern New Hampshire Regional Planning Commission, 1972; Strafford Regional Planning Commission, 1975; U.S. Army Corps of Engineers, 1976; Anderson-Nichols & Co., Inc., 1980). The investigation included hydrogeologic mapping of the glacial deposits from observation of surficial materials, excavations, geomorphology, and lithologic descriptions of test holes. Descriptions and locations of 111 wells (tables 4 and 5 in appendix) and 71 test borings (tables 6 and 7 in appendix) were recorded and analyzed. Streamflow measurements during low-flow periods were made at 37 different sites throughout the basin. Water levels were measured monthly in 13 observation wells. Water samples from nine wells and one spring were analyzed for common dissolved constituents, including iron, nitrogen species, and phosphorous.

Acknowledgments

The author appreciates the information and assistance received from State and municipal officials, residents of the area, well drillers, and consulting engineers. Michael Welch assisted in data collection and hydrogeologic mapping. T. J. Fagan and S. E. Fisher assisted in data compilation and preparation of illustrations.

GEOLOGIC SETTING

Bedrock

The Lamprey River basin is underlain by rocks of the Avalonian structural stratigraphic province of the Caledonian-Hercynian orogen (Lyons and others, 1982). These are predominantly metamorphic units consisting of varieties of gneiss, slate, schist, quartzite, and metavolcanic rocks. These rocks are intruded by a subordinate volume of granite throughout the basin and by granodiorite in the eastern part of the basin (Novotny, 1969). Gneiss is intruded by gabbro, diorite, and monzonite in a circular complex forming the Pawtuckaway Mountains in the central part of the basin (Freedman, 1950).

The major rock units (metamorphic rocks, granite, and granodiorite) occur in northeasterly belts parallel to the regional structural grain (Billings, 1956). The orientation of the Massabesic anticlinorium (mostly gneiss) on the northwest and the Merrimack trough (mostly lower grade metamorphic rocks) on the southeast, the principal structural elements that traverse the basin (Lyons and others, 1982), clearly demonstrates the northeasterly grain.

The metamorphic rocks are deformed and repeated at the surface by folding, and both the metamorphic and intrusive rocks are dislocated by faults. The most extensive faults are oriented parallel to the regional structural grain. These nearly vertical faults are part of a system forming splayed or horsetail patterns, and which link, along strike, the Clinton-Newbury system of Massachusetts with the Nonesuch River-Norumbega system of Maine (Lyons and others, 1982). The strike faults are characteristically traced by local zones of silicification or brecciated zones. Extensive fracturing within adjacent rock units generally occurred during the last movement along these strike faults.

The metamorphic rocks vary in grade from greenschist facies on the southeast, northwestward through the amphibolite facies, to migmatite on the northwest. Some repetition of metamorphic zones results locally from dislocation along the strike faults. The granite and granodiorite occur in sheets of variable thickness up to hundreds of feet. These sheets are characteristically conformable to the bedding in the metamorphic rocks and parallel to the regional structural grain.

Faults striking northwesterly cut across the regional structural grain. The expression of these nearly vertical faults is more subtle than the northeast faults, but many of them are traced by topographic lineaments in which ponds and swamps are common. The northwest faults are commonly associated with relatively wide zones of fracturing and large-scale brecciation, but do not seem to dislocate rock units more than a few tens of meters.

Surficial Deposits

Bedrock is covered by unconsolidated deposits formed during the last period of glaciation. Till, generally an unsorted mixture of grain sizes from clay to boulders, was deposited directly by glacial ice during both the waxing and waning stages of glaciation. Beneath active (moving) ice, basal till was deposited discontinuously on the bedrock surface. Thickness of basal till is generally less than a few tens of feet. In places, basal till was preferentially deposited on small bedrock highs that locally hindered the movement of the debris-laden basal ice; resulting till thickness in these places may exceed 100 feet. Most till deposited beneath the ice is compact. Ablation till discontinuously overlies the compact till. Ablation till formed as residual material on the wasting ice surface and was gradually laid down on the underlying land surface with continued disappearance of the inactive ice. Ablation till is less compact than basal till and occasionally "washed" or faintly stratified. Till is the most common surficial deposit in the Lamprey River basin, and is by far the dominant surficial material in all the upper basin and on the hills and many undulating surfaces of the lower basin.

Stratified-drift deposits within this basin were formed during the waning stages of glaciation by sediment-laden glacial meltwater streams and by standing water. Coarse-grained, ice-contact deposits were formed by meltwater streams in ice-margin areas. The coarseness of these deposits ranges from predominantly sands to sandy gravel. This range in grain size reflects the variation of stream velocities (energy levels) of the depositional environments. These variations occur within an individual deposit in addition to variations among different deposits. Ice-contact deposits commonly form terraces along valley walls. In this basin, these terraces are generally small. A few deposits are large and form relatively flat-topped plains, such as Newmarket Plains.

Outwash deposits were formed by meltwater streams beyond or away from the ice margin. The coarseness of these deposits ranges from predominantly sand to gravelly sand. Sorting (distribution of grain sizes) generally increases with distance of transport. Thus, outwash deposits generally are better sorted than ice-contact deposits. In this basin, outwash forms thin deposits in valley lowlands.

Coarser suspended sediment in meltwater streams that entered standing water was deposited as deltaic deposits, whereas finer sediment (silt and clay) temporarily remained in suspension. The coarseness of deltaic sediment reflects the suspended load of the stream. Foreset beds of the deltas are commonly well-sorted sands, and, where the ice margin and standing water were in close proximity, sandy gravel may predominate.

Bottom deposits, formed by the settling of the fine-grained suspended sediment in standing water (ponds and lakes), consist of silt and clay. In nearshore areas, these deposits may also contain fine sand and sandy lenses. Extensive bottom deposits are present in lowlands of the eastern part of the basin where they formed in estuarine or marine environments.

In the Piscassic Valley in Epping, relatively thin outwash was deposited over the estuarine bottom deposits. These deposits are sandy gravels in west Epping and become finer grained and better sorted to the east.

OCCURRENCE OF GROUND WATER

Bedrock

The metamorphic rocks are all hard and compact; they contain recoverable water only in open fractures (secondary porosity). The size, number, distribution, and degree of interconnection of fractures are highly variable, but are commonly minimal. The number of fractures generally decreases with depth. Thus, the storage capacity of bedrock is small and generally decreases with depth. Therefore, bedrock generally does not yield enough water for municipal or industrial use, although wells penetrating bedrock commonly yield dependable supplies of good quality water for single family domestic needs.

Studies indicate that there are no significant differences in the water-bearing characteristics of the bedrock types in the basin (Bradley, 1964; Stewart, 1968). However, on a statewide basis, Stewart found that average yield in metamorphic rocks is slightly higher (13.4 gal/min) than in igneous rocks (10.3 gal/min). There have been instances where obtaining an adequate domestic supply from the migmatite has been difficult.

Zones where bedrock is extensively fractured may yield larger quantities of water. These zones are related to the geologic structure. The northeast- and northwest-trending faults mentioned previously are zones where higher well yields may be expected. Published bedrock geology maps show some of the northeast-trending faults (Freedman, 1950; Billings, 1956; Novotny, 1969). Wells drilled in silicified zones may have average or below average yields.

Wells drilled in the brecciated zones may have above average yields. Extension fractures occur within and adjacent to the fault zones and also aid in providing higher yields to wells. The northwest-trending faults have not been mapped systematically, and no information has been published. Because brecciation is common, the delineation of these features may prove to be important in prospecting for larger water yields from the bedrock aquifer. Areas where this family of faults intersect may prove to be the best producing zones. Systematic exploration may allow siting of wells with relatively high yields.

Surficial Deposits

Till

The ability of unconsolidated deposits to yield water is dependent on the hydraulic conductivity, which in turn is dependent on the number and size of the pores and the degree of interconnection of the pores. In deposits of material of many different grain sizes (unsorted or poorly sorted), finer and coarser particles are intermixed, with the net effect that pore size and degree interconnection are relatively small.

Till, being an unsorted mixture with a wide range in grain sizes, has a relatively low hydraulic conductivity. Accordingly, till is a poor aquifer and normally will not yield enough water to meet most municipal, industrial, or commercial needs. In some places, till will yield enough water to large-diameter dug wells to supply single-family domestic needs, but this yield may not be dependable during droughts, when the water table declines and there is less water in storage.

Stratified Drift

Stratified deposits of gravel, sand, silt, and clay have abundant pore space between grains; primary porosity may be greater than 30 percent. Primary porosity increases with degree of sorting, but not necessarily as a function of average grain diameter. A well-sorted medium sand and a well-sorted fine gravel may have similar primary porosities.

Pores between grains of clay, silt, and fine sand are so small that water flows through them very slowly. On the other hand, the relatively large pore spaces between grains of medium to very coarse sand and gravel allow relatively rapid transmission of water. Consequently, the hydraulic conductivity of silt and clay of the estuarine bottom deposits is low, with the result that these deposits are poor aquifers, whereas the hydraulic conductivity of medium sand and coarse-grained material is relatively high. Thus, saturated sand and gravel in ice-contact and outwash deposits can store and transmit large quantities of water.

Ground-water exploration and development in southeastern New Hampshire has been most successful in thick, saturated sand and gravel deposits. But in the study basin, most sand and gravel deposits are thin, which results in small storage capacities. Continual recharge is needed to sustain large yields of wells developed in these aquifers.

GROUND-WATER RECHARGE AND DISCHARGE

All water in the study basin is derived from precipitation. Water leaves the basin by returning to the atmosphere through evapotranspiration or by surface flow in the Lamprey River to Great Bay. There are two paths by which water from precipitation may enter the Lamprey River and its tributaries: (1) by flowing over the land surface directly into streams, and (2) by infiltrating the soil where some of the water is retained as soil moisture and the rest percolates downward to the water table (upper limit of the zone of saturation). This water becomes ground water that then moves through the pores of sediments and the fractures in bedrock to discharge into lakes, ponds, and streams.

Hydrographs of water levels from observation wells illustrate the natural patterns of ground-water recharge and discharge (figs. 2, 3, and 4, table 1).

Rising water table shows recharge to be greater than discharge during the nongrowing season. During the growing season, discharge exceeds recharge because most of the precipitation does not reach the water table, but is returned to the atmosphere through evapotranspiration.

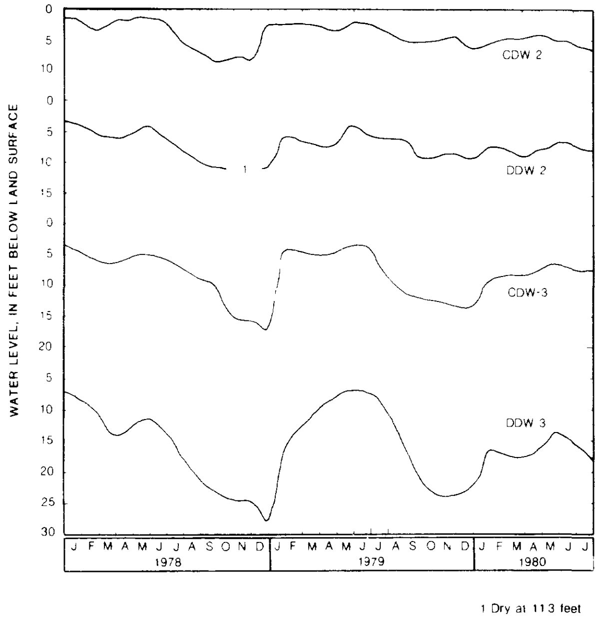


Figure 2.--Wells in upland areas developed in till.

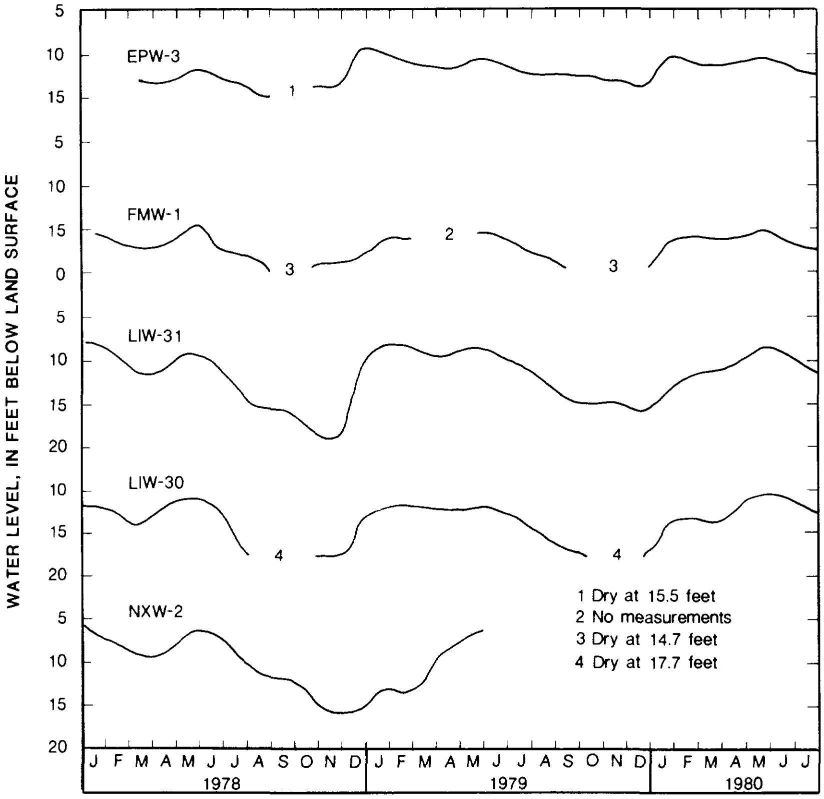
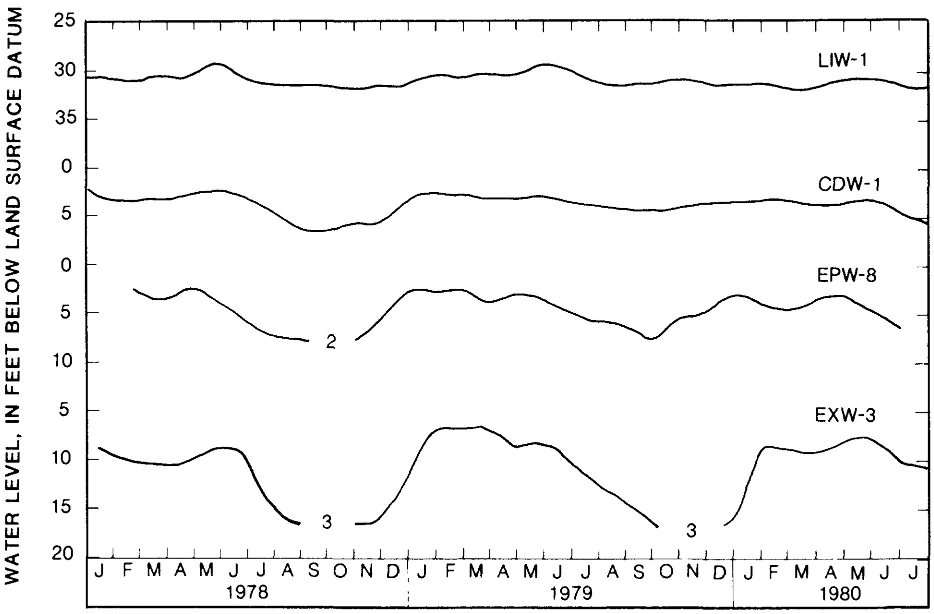


Figure 3.--Wells in lowland areas developed in till.



1 Records of water levels are available from 1953 to 1957 (Bradley and Petersen,1962), 1973-1977 (U.S.Geological Survey, 1975-1977).

2 No measurement

3 Dry at 16.5 feet

Figure 4.--Wells developed in stratified drift.

Ground-water discharge sustains streamflow during dry periods. Flow measurements were made at 37 stream sites to assess this discharge to aid in estimating the ground-water resources of the basin. Flow duration of the Oyster River--the river basin to the north--rather than the Lamprey River is used for comparison in this report because of flow regulation in parts of the Lamprey River drainage system above the gaging station. Base-flow measurements in 1977 and 1978 (table 2) were made when the Oyster River was at 90 percent flow duration. Low values in terms of cubic feet per second per square mile reflect the low percentage (13 percent) of stratified sand and gravel in this basin. Release from surface storage in the Little River masks ground-water discharge to that tributary. The significance of these flows to each of the aquifer areas investigated is included in the description of the aquifers in the next section of this report.

LOCATIONS AND DESCRIPTIONS OF SELECTED STRATIFIED-DRIFT AQUIFERS

Deerfield Fairgrounds

In the upper Lamprey River valley in the vicinity of the Deerfield Fairgrounds (pl. 1) generally thin stratified sand and gravel deposits overlie an irregular bedrock surface (fig. 5). These deposits are as much as 62 feet thick (well DD-1) of which about 40 feet is water saturated. The water table in this area is about the same level as in Hartford Brook and about 20 feet higher than the Lamprey River. Bedrock seems to form a dam to ground-water movement between the thickest part of these deposits and the Lamprey River. Thus, it is unlikely that water could be induced to infiltrate from the Lamprey River. Hartford Brook may be a source of recharge.

Discharge measurements were made at Hartford Brook (site 10), at State Road, and at the Lamprey River (site 11) just north of the Fairgrounds in September 1977 and in September 1978 when the adjacent Oyster River was at 90 percent flow duration. In 1977, discharge at both sites was 0.01 [$(ft^3/s)/mi^2$]. In 1978, there was no flow in Hartford Brook and 0.06 [$(ft^3/s)/mi^2$] in the Lamprey River. Assuming that periodic and irregular pumping of DDW-1 induced infiltration of water from Hartford Brook, it is estimated that a minimum of 0.09 ft^3/s (0.06 Mgal/d)--the 90 percent flow-duration value--could be pumped from the aquifer. Considerably higher withdrawal rates might be possible at times when flow in Hartford Brook is greater. Such higher rates of withdrawal probably cannot be sustained during seasonal low-flow periods or droughts because the volume of the aquifer is small and withdrawal would deplete storage rapidly.

Northwest Raymond

Ice-contact deposits, dominated by eskers in the Lamprey River valley in the northwest part of Raymond, form a water-table aquifer (pl. 1, fig. 5). These deposits are characteristically coarse grained and have poor to moderate sorting. Seismic lines, run for the U.S. Army Corps of Engineers in the center of the valley, show the deposits to be 30 to 65 feet thick with 25 to 40 feet of saturated thickness (Anderson-Nichols, 1980).

Recharge from precipitation on the surface of these deposits may average approximately 0.8 Mgal/d. However, the larger potential source of recharge to this aquifer is the Lamprey River. Base-flow measurements at site 6 in 1977 and 1978, (table 2 and pl. 1) made when the Oyster River was at 90 percent flow duration, averaged 1.00 ft^3/s (0.65 Mgal/d). Aquifer storage is adequate to sustain short-term depletion. Therefore, it is estimated that about 1.7 Mgal/d is the maximum that could be withdrawn from wells in this aquifer during years of normal precipitation.

West Epping

Stratified drift with an undulating surface extends from the Lamprey Valley, across a low drainage divide, to a tributary portion of the Piscassic River subbasin (pl. 1, fig. 6). Sand and gravel overlie silt, clay, till, and bedrock within this area. Within the Lamprey Valley, the sand and gravel are chiefly in the form of ice-contact deposits as much as 46-feet thick that have a highly variable degree of sorting. Saturated thickness of this water-table aquifer is as much as 40 feet. Within the Piscassic Valley, the sand and gravel is chiefly outwash. The gravel is finer grained, and sorting of the deposits is better than in the Lamprey section. However, the deposits are thin and have very limited saturated thickness.

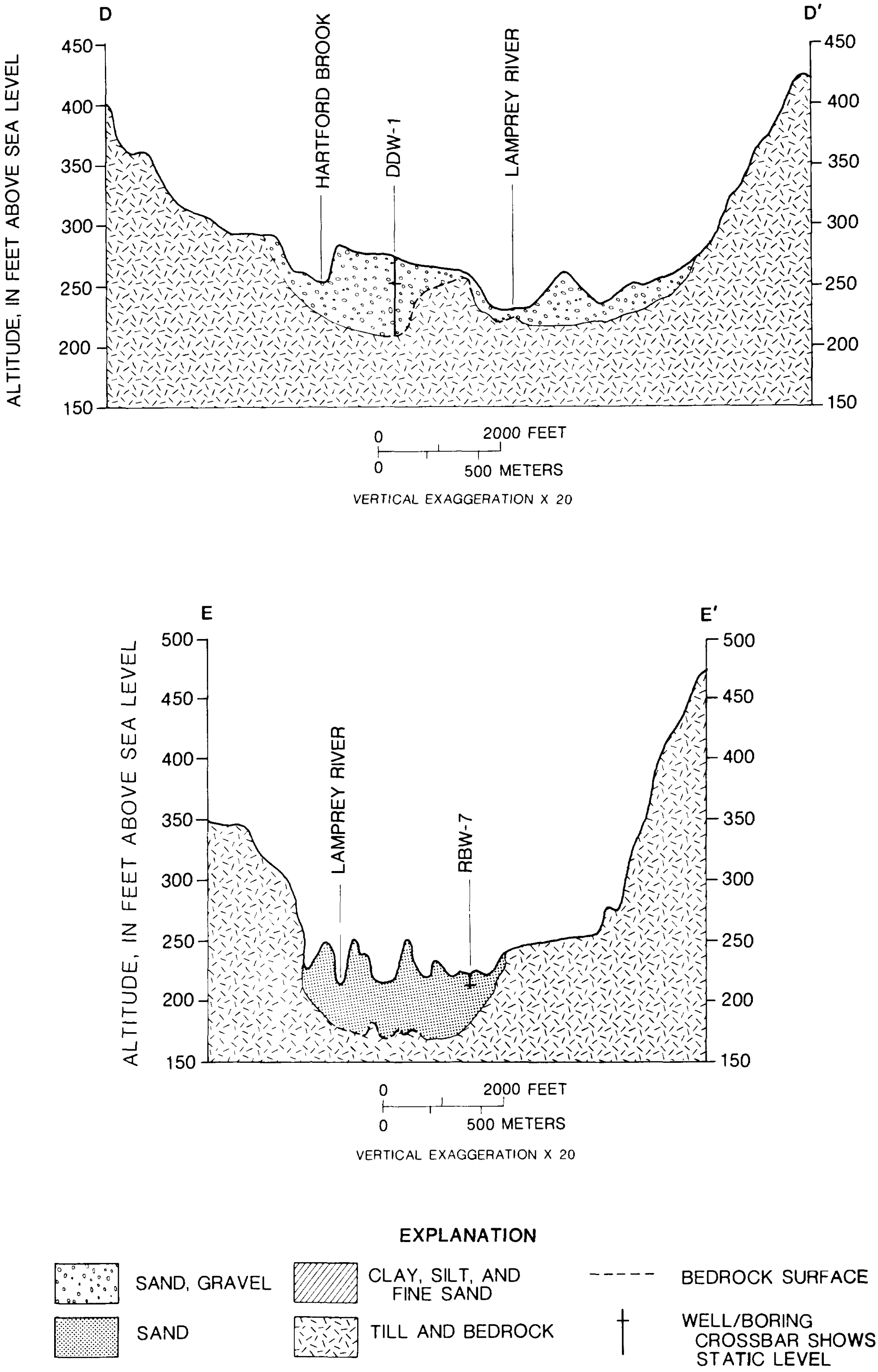


Figure 5.--Hydrogeologic sections of the Lamprey River valley at Deerfield Fairgrounds (D-D´) and northwest Raymond (E-E´).

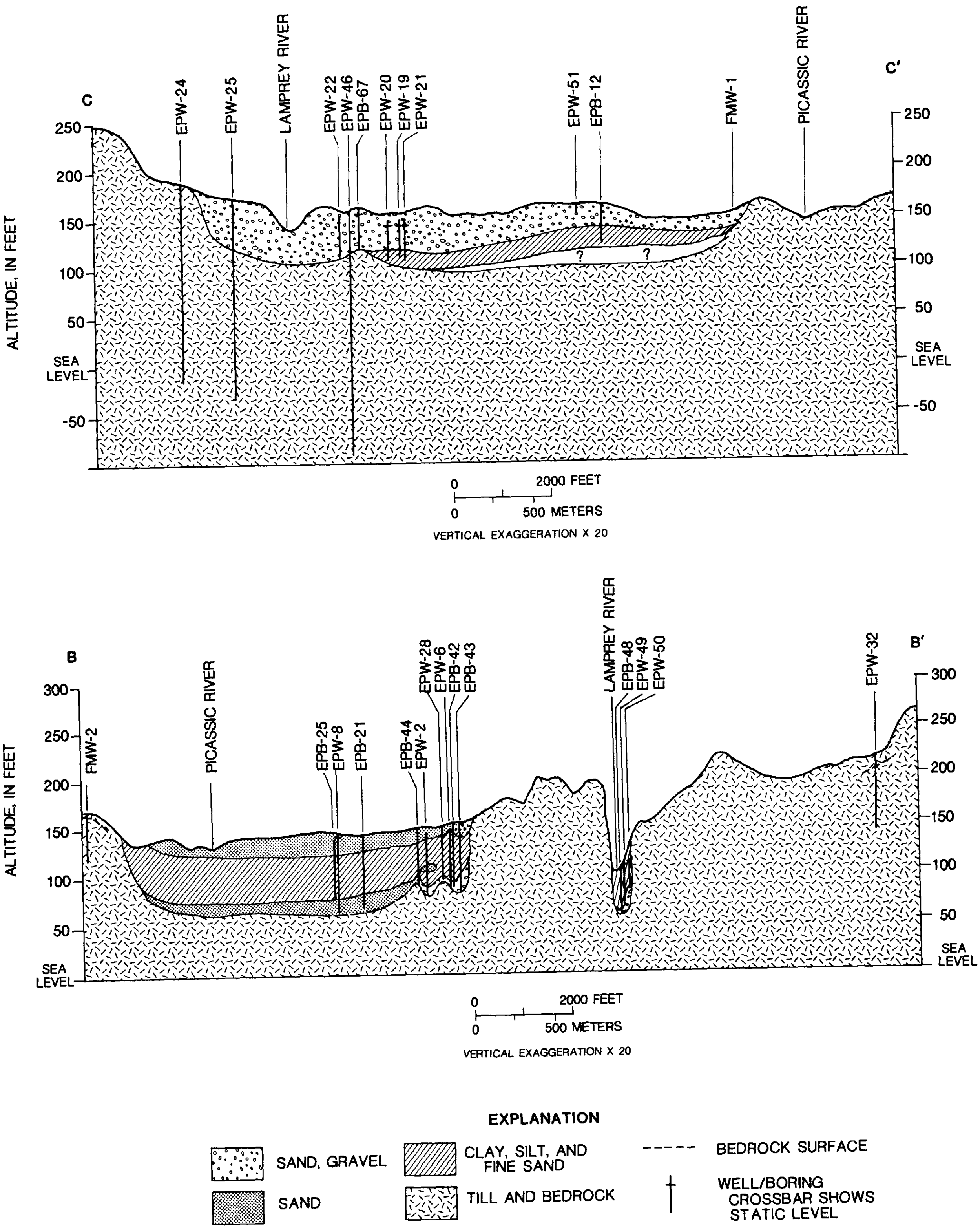


Figure 6.--Hydrogeologic sections of the Lamprey and Piscassic River valleys in west Epping (C-C′) and central Epping (B-B′).

Small topographic highs of till and (or) bedrock interrupt the surface of the stratified sediments.

Potential recharge from precipitation on the surface may average approximately 0.3 Mgal/d. In spring, the thin aquifer, which has limited storage, becomes fully saturated. Potential recharge from tributaries to the Piscassic River is negligible within the headwater area. However, the greatest potential recharge is the Lamprey River, which has an estimated flow of 3.4 ft^3/s (2.2 Mgal/d) or more across this aquifer 90 percent of the time. Based on specific capacity of municipal test wells, individual wells in this aquifer might yield as much as 200 gal/min. A total sustained withdrawal of around 1 Mgal/d is probable considering the small amount of water in aquifer storage and the limited river reach that traverses the aquifer.

Central Epping

The Lamprey River valley is very narrow in Epping (pl. 1, fig. 6). Stratified drift, as much as 43 feet thick, is generally fine grained with a discontinuous thin layer of sand and gravel at shallow depths and a poorly sorted sandy gravel generally less than 8 feet thick at the bottom of the sequence. This lower sand and gravel unit reportedly yielded moderate amounts of water to old town wells. However, the yield of the aquifer is severely limited due to the small lateral and vertical extent of the unit and the poor hydraulic connection to sources of recharge such as the Lamprey River.

The broad lowland of the Piscassic River valley just south of Epping is underlain by sandy outwash less than 20 feet thick. This outwash is underlain by silty clay as much as 60 feet thick. Sandy sediments also generally underlie the clay; however, the range of grain sizes of these sands is variable. In the central part of the lowland, fine and medium sand with some silt and clay underlie the clay discontinuously. One test hole penetrated 28 feet of this sand; others have penetrated none. However, the test holes in this area were terminated in clay, and sand may be present beneath the clay. Lithologic logs from other test holes in this central area suggest that the basal sequence represents a transitional environment of deposition with fluvial/deltaic sands from the west interfingering with estuarine silt and clay that become more dominant to the east.

At the northern part of the lowland, clay generally is underlain by 0 to 15 feet (locally as much as 30 feet) of clayey silt and sand that grades to a sandy gravel 1 foot to 9 feet thick at the bottom. Two Epping municipal wells (EPW-2 and EPW-6) are screened in the confined sandy gravel aquifer at the northern margin of the lowland. These wells have been assigned safe yields of 150 gal/min each by the New Hampshire Water Supply and Pollution Control Commission; however, there is significant hydraulic interference because they are only about 400 feet apart. Present average pumpage from these two wells is less than 0.2 Mgal/d and may approach the sustained yield for these wells. However, further testing, here and in areas to the west, with judicious sampling and precise material descriptions might further identify and delineate this confined aquifer over a much larger area.

The saturated thickness of the water-table aquifer in the upper sands is limited to a few feet. Adequate domestic supplies may be obtained in non-wetland areas from this aquifer through the construction of dug or driven wells. Larger, though still modest, withdrawals from a shallow well field may be possible if areas of greater than average saturated thickness can be located near the Piscassic River, a potential source of induced recharge.

Eastern Epping

The broad plain of the Lamprey River valley east of Epping and southeast of the river is underlain by as much as 20 feet of sand which overlies silt and clay of unknown thickness (pl. 1). A low till hill at Camp Hedding extends above the plain. Casing records of two wells (EPW 38 and 37) indicate a bedrock surface at depths of 130 and 140 feet, respectively, however, the nature of the deeper, overburden is unknown (fig. 7). The low terraces and present flood plain of the Lamprey River are erosional features cut into the estuarine silts and clays.

A number of thin water-bearing deposits of sand and gravel are near this reach of the Lamprey River. Tributary valleys northwest of this reach of the Lamprey River contain thin ice-contact deposits of sand and gravel and outwash deposits of sand. Along the western side of the Lamprey Valley from the Epping landfill downstream to Wadley Falls are scattered ice-contact deposits of sand and gravel. The saturated

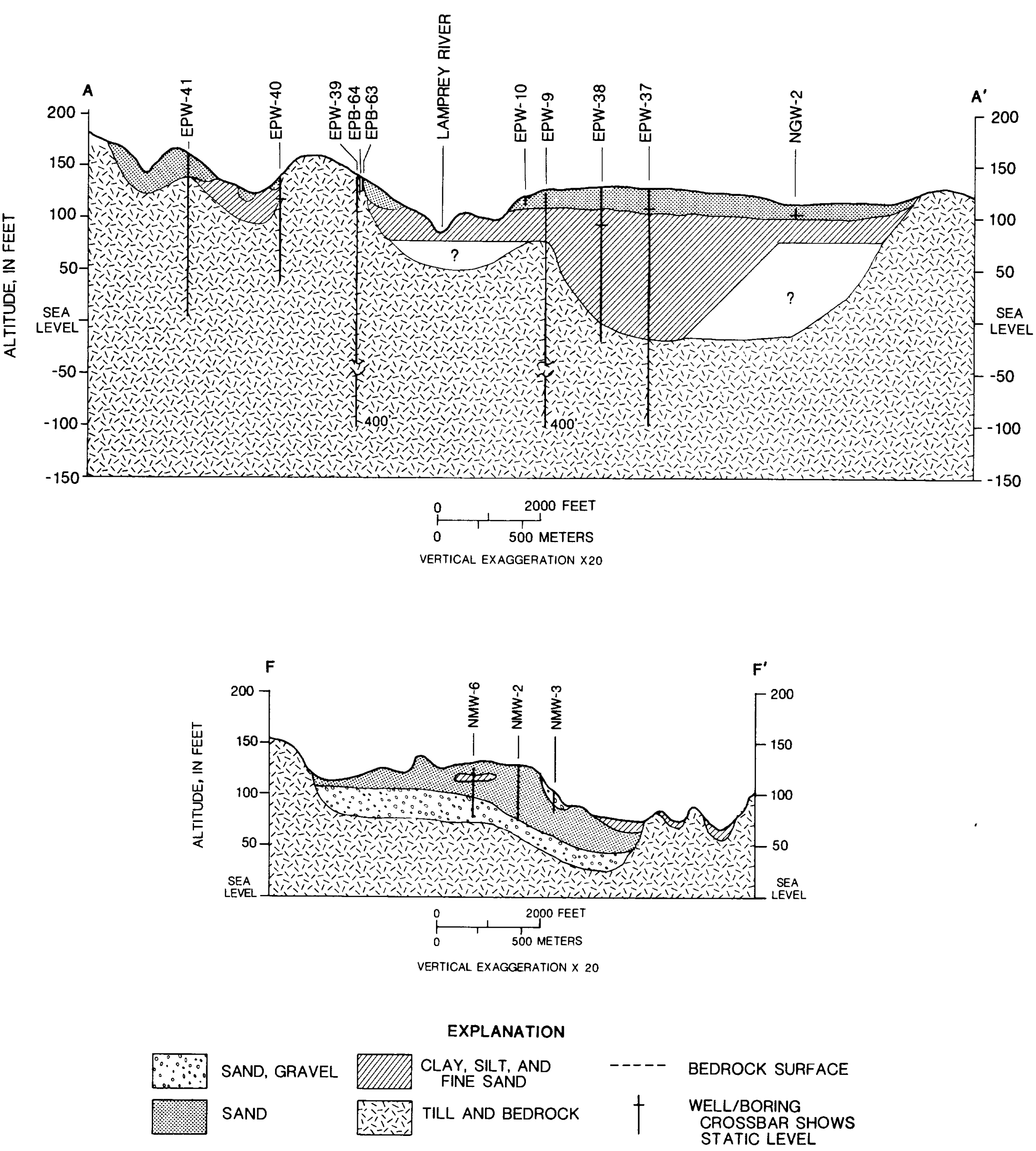


Figure 7.--Hydrogeologic sections of the Lamprey River valley in eastern Epping (A-A') and Newmarket Plains (F-F').

thickness of the water-table aquifer on the plains southeast of the river is limited to a few feet and, consequently, only small water supplies can be developed. Domestic supplies from dug or driven wells may not prove adequate during dry times. This sand extends over the lower slopes of the till hill at Camp Hedding, and perennial contact springs form in small ravines where the sand has been eroded. Dug wells in the sand within the camp community are generally adequate for domestic needs. However, recent domestic construction has used bedrock wells for water supply on the plain north to Wadley Falls. Saturated thicknesses and potential well yields in the sand and gravel of the tributary valleys west of the Lamprey River between Epping and Wadley Falls are estimated to be minimal.

Newmarket Plains

Sand and gravel beneath the Newmarket Plains, about 2 miles west of Newmarket, form a water-table aquifer that has the potential to yield moderately large ground-water supplies (pl. 1, fig. 7). The plain consists predominantly of ice-contact deposits and is probably a glaciomarine delta. This delta most likely formed contemporaneously with the deposition of marine and estuarine silts and clays to the south and east while ice remained to the northwest, an origin inferred from the presence of steeply dipping foreset beds in the northern and western parts of the deposit and by observations of silt and clay underlying and interfingering with sand and gravel in the southern and eastern parts of the deposit. An alternative theory (not supported here) for the origin of the plains is that the deposition of sand and gravel occurred as a kame plain prior to marine inundation, so that the silts and clays basically overlie the sands and gravels (Tuttle, 1952).

The deposit is generally 40 feet thick and is as much as 90 feet thick. Where exposed in the northern part of the deposit, about 20 feet of predominantly medium, moderately well sorted sand overlies sand and gravel. Bedrock surface elevations beneath the deposit are contoured by Hill (1979, p. 17).

The surface-water divide between the Lamprey and Piscassic River basins trends northeasterly across the plain. Ground water from beneath the plain drains northward to the Lamprey River and southward to the Piscassic River. The ground-water drainage divide has not been defined, may not be coincident with the surface-water divide, and probably shifts with time in response to pumpage from the Newmarket municipal well.

The saturated thickness of this aquifer ranges from about 10 to 80 feet. Most of the aquifer is at a higher elevation than potential stream sources of infiltration, so water recharges this aquifer only from direct infiltration of precipitation. The average annual recharge rate through sandy soil having a relatively flat land surface is estimated to be 0.8 [(Mgal/d)/mi^2] in the Lamprey River Basin. Thus, the average recharge to the 1-mi^2 plain is estimated to be 0.8\ Mgal/d. For the period August 1 to November 1, 1977, Hill (1979) determined that 5.5 inches (about 1 Mgal/d) of recharge occurred from direct precipitation to this aquifer. This larger amount reflects higher than average precipitation (about 160 percent) during this period.

WATER QUALITY

Ground Water

Ground water in the Lamprey River basin is generally of good chemical quality that is suitable for domestic uses. Most of it is clear and colorless, contains no suspended matter and practically no bacteria, and is low in dissolved solids concentration. Also, it is generally soft, 0 to 60 mg/L (milligrams per liter) of hardness, although water from bedrock is commonly moderately hard (61 to 120 mg/L). Chemical analyses for common constituents and nutrients were done on water from nine wells and one spring (fig. 8). Dissolved solids concentration ranged from 61 to 485 mg/L in the well samples, and was 33 mg/L in the spring sample. Total hardness ranged from 17 to 120 mg/L in the well samples and was 10 mg/L in the spring sample.

Several water-quality problems are present within the basin. Analyses of ground water by the New Hampshire Water Testing Laboratory indicate that iron and manganese may be present in concentrations greater than the limits for drinking water--0.3 and 0.05 mg/L, respectively (U.S. Environmental Protection Agency, 1976). In places, these excessive amounts of iron and manganese may restrict usefulness of the water. Although manganese was not analyzed, iron

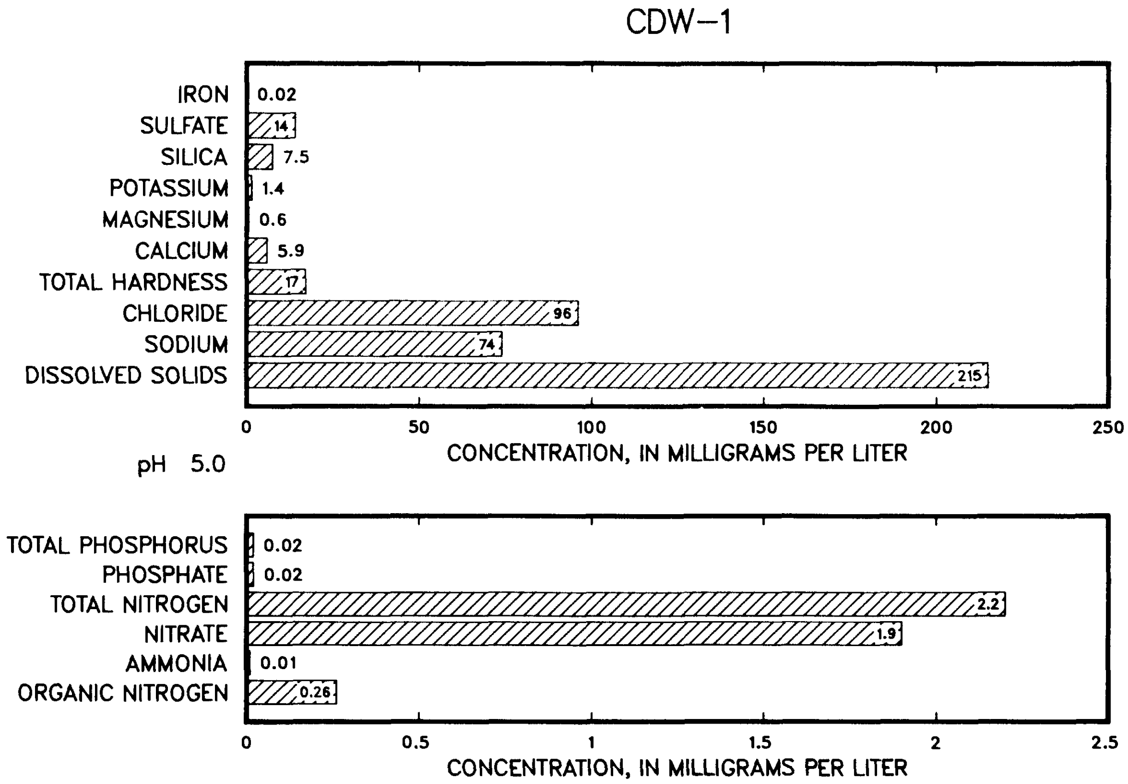


Figure 8.--Water samples from selected wells and a spring.

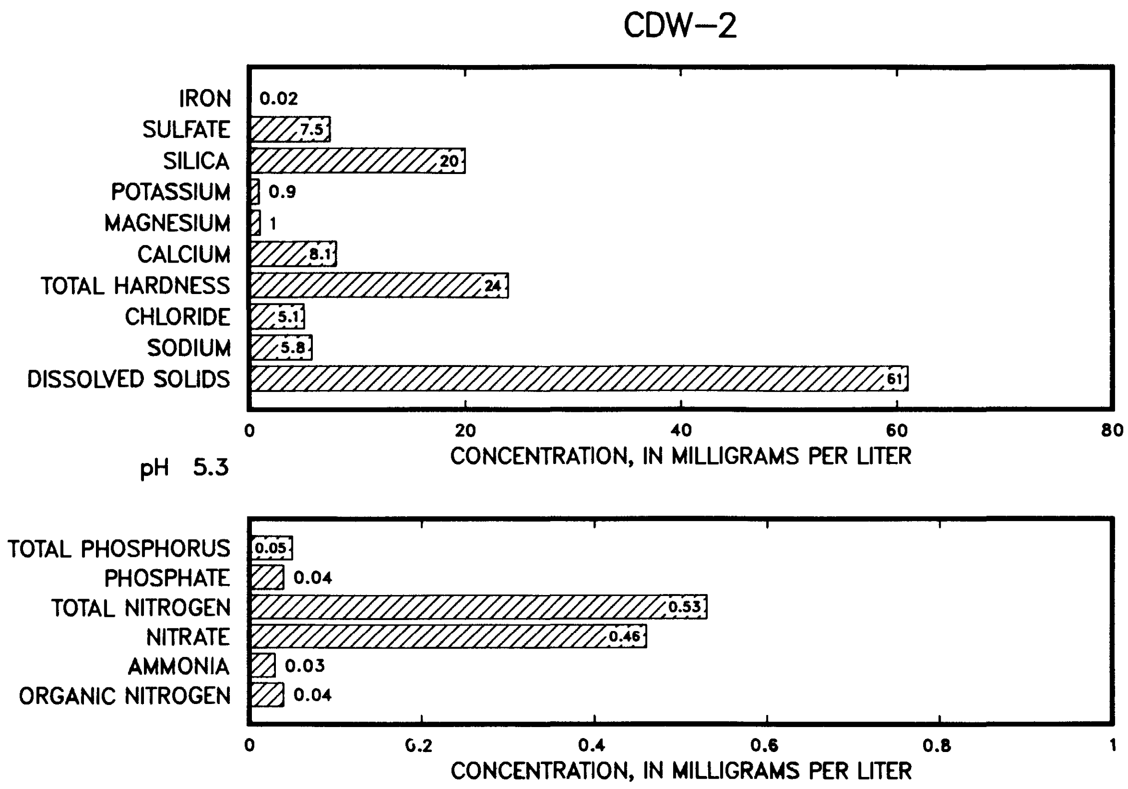


Figure 8.--(continued).

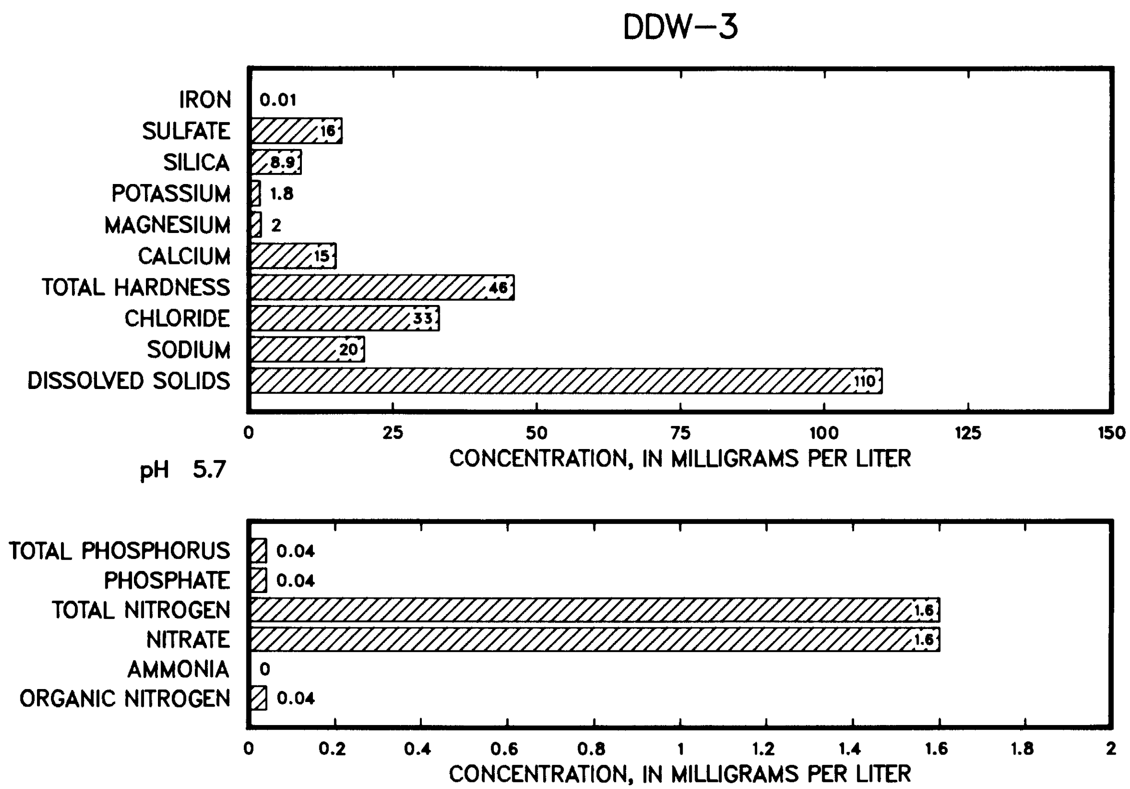


Figure 8.--(continued).

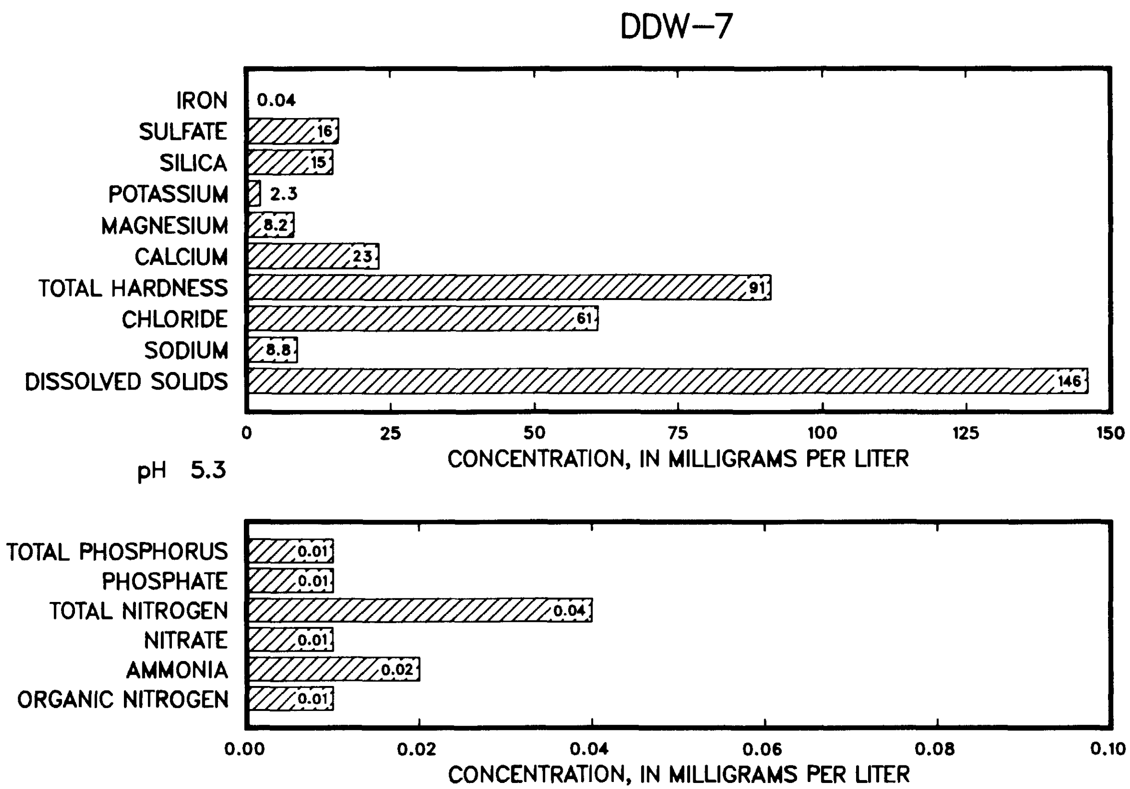


Figure 8.--(continued).

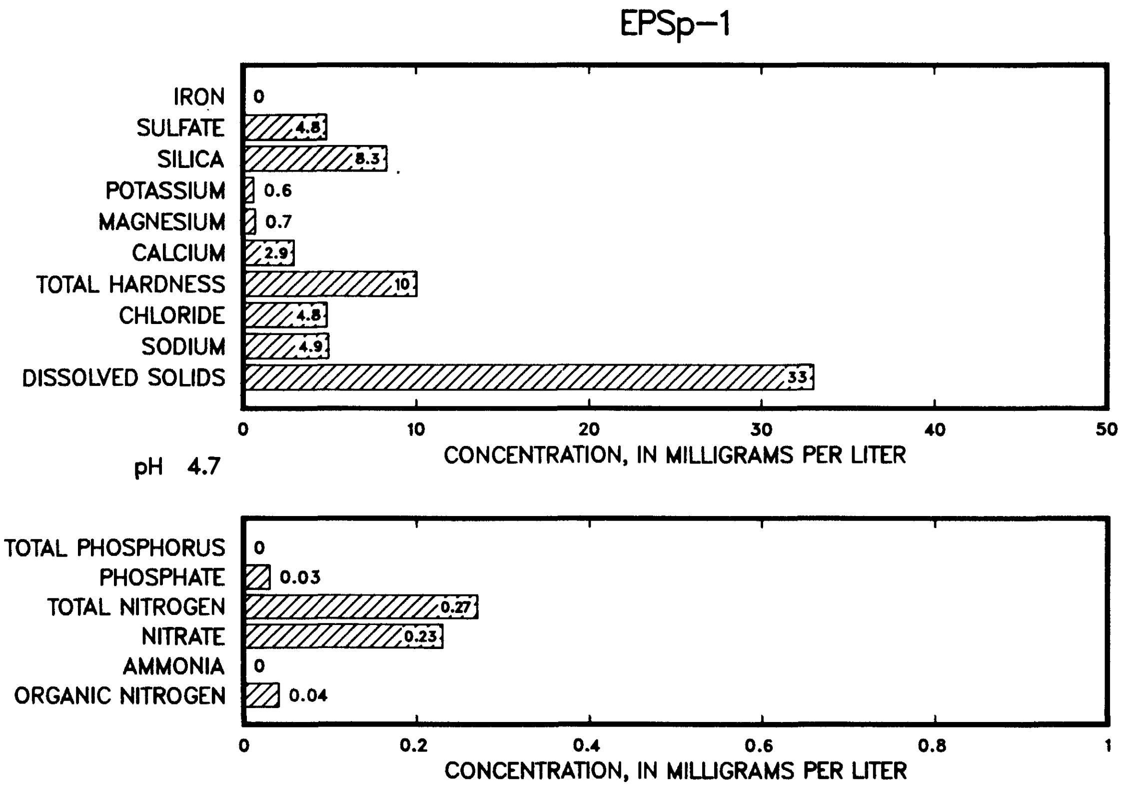


Figure 8.--(continued).

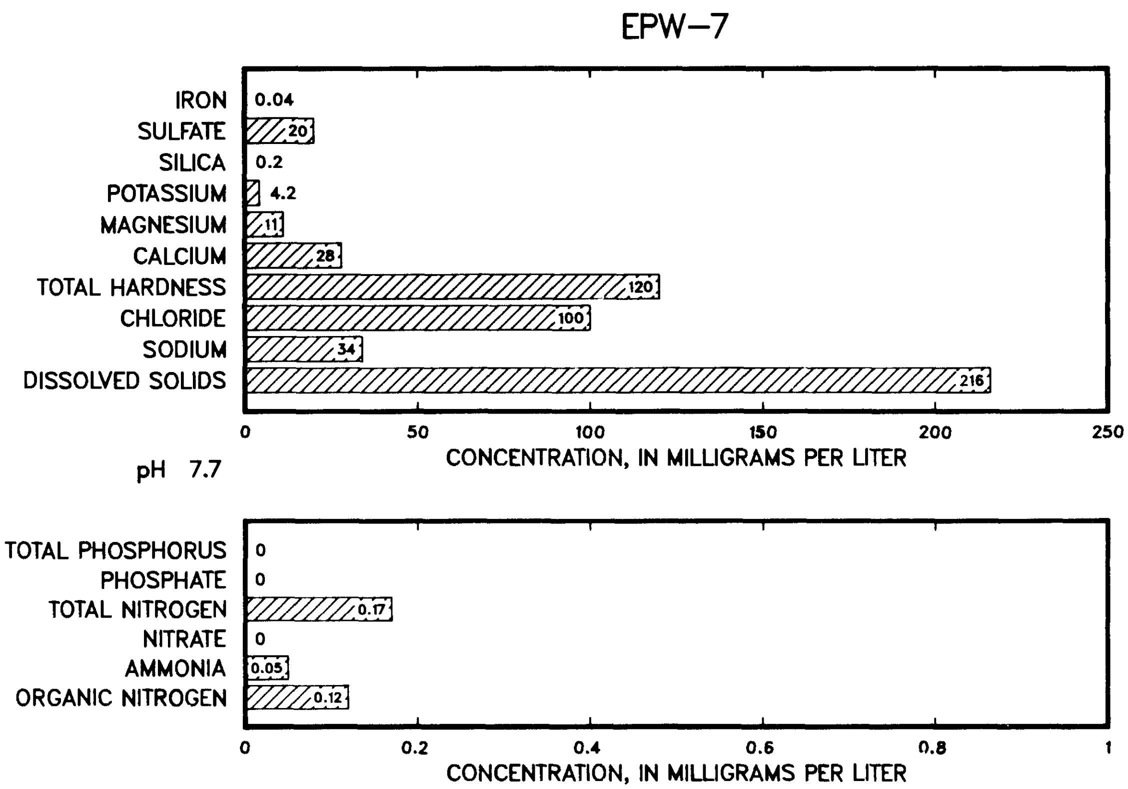


Figure 8.--(continued).

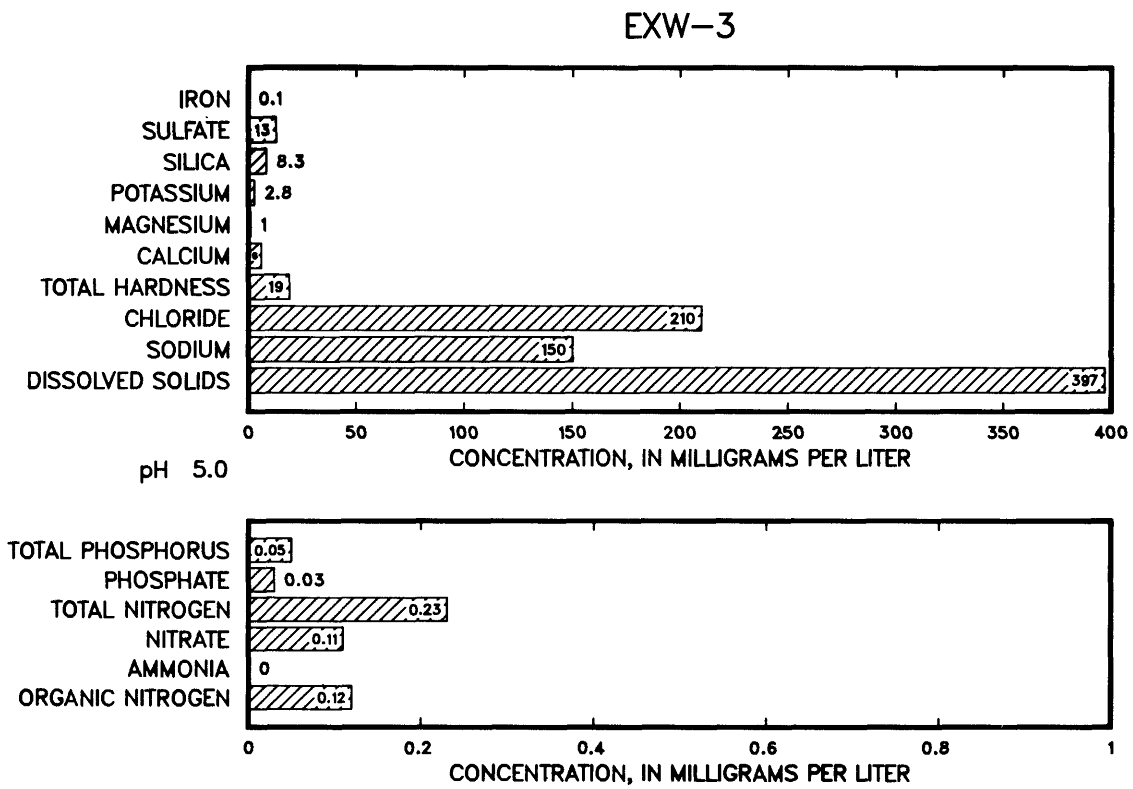


Figure 8.--(continued).

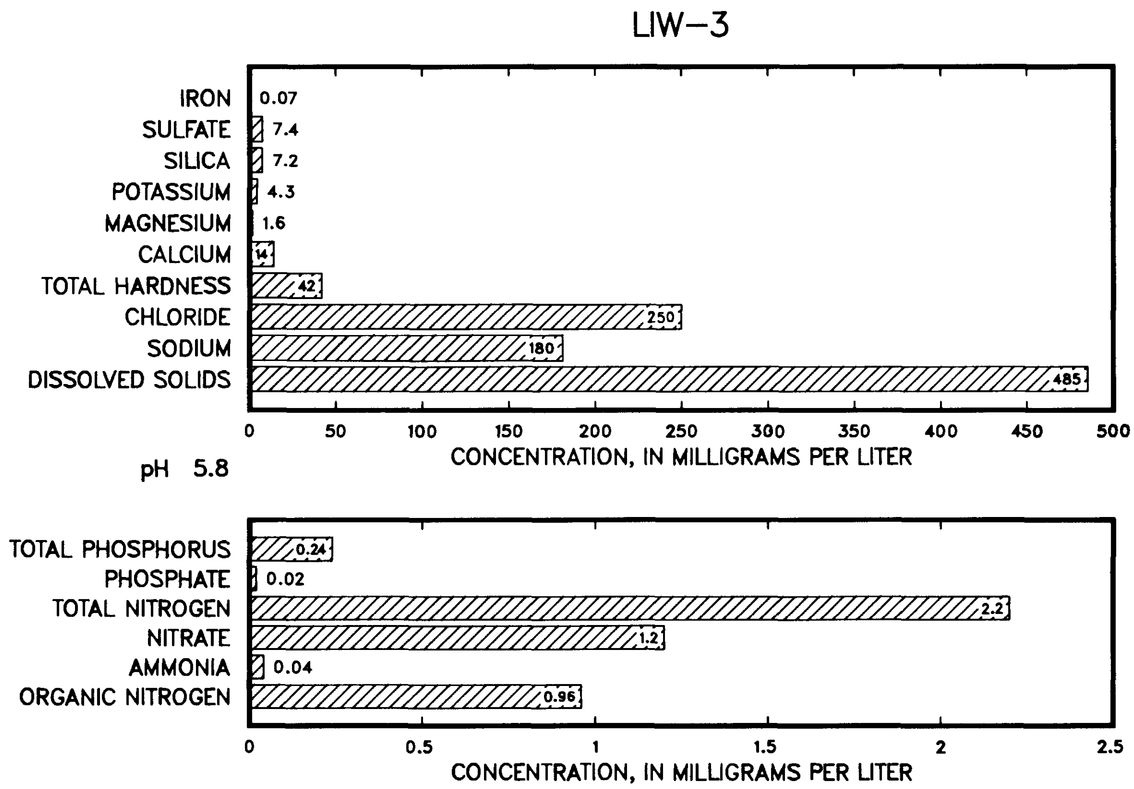


Figure 8.--(continued).

concentrations in nine samples were 0.04 mg/L or below and one sample contained 0.07 mg/L iron. Water in unconsolidated deposits is generally weakly acidic, and locally may be acidic enough to be slightly corrosive to metal plumbing. The pH in the 10 samples analyzed ranged from 4.7 to 7.7 and average 5.6.

Locally, the chemical quality of ground water may reflect land-use practices. Degradation of water quality may occur in unsewered residential and village areas, near waste-disposal sites, major highways, agricultural lands, and local roads that are treated with deicing chemicals in the winter. High chlorides in water analyses from wells close to roads were present in Candia 1, Deerfield 1, Epping 7, Exeter 3, and Lee 1.

Surface Water

Surface water in the Lamprey River basin in its natural condition is of the calcium-magnesium-sulfate-chloride type and is low in dissolved solids. The adopted use classification for the basin is B with the exception that the Piscassic River is classified A (table 3). Waters do not always meet the quality standards associated with these classifications, but quality is improving. In 1975, most reaches of both the Lamprey and Piscassic Rivers were classified C; downstream from Newmarket in tidewater the Lamprey was only class D (New Hampshire Water Supply and Pollution Control Commission, 1975). In 1979, the New England River Basins Commission estimated that only the tidewater reach and a 1.6-mile reach of the Lamprey River above Newmarket did not meet class B quality standards (New England River Basins Commission, 1979). The Commission expects that these reaches will meet the class B goal by 1984.

Effect of Induced Infiltration on Ground-Water Quality

Heavy pumpage of a shallow aquifer may induce recharge from surface-water reservoirs. The physical quality of water pumped from a well that is partially recharged by surface-water infiltration is not greatly affected by the physical quality of the surface water with the exception of temperature. Suspended sediment, organic matter, turbidity, taste, and odor associated with surface water are removed from percolating water during its movement through bottom sediments and aquifer materials (Johnston and Dickerman, 1974). Color, if present in the surface water, is generally reduced, although not entirely removed. The temperature follows a cyclical pattern governed by seasonal fluctuations of the surface-water temperatures and the time it takes the infiltrated water to reach the pumping well. The range of temperature fluctuation of the pumped water is less than that of the surface water, which reflects the relatively constant temperature of native ground water.

The chemical quality of pumped ground water reflects the chemistry of both the surface water and the native ground water. Some dissolved chemical constituents in the percolate may be altered or removed from solution by precipitation, adsorption, ion exchange, or other processes as it migrates through the aquifer (Johnston and Dickerman, 1974). Many chemical constituents retain their identity. Concentrations of these constituents will change, however, reflecting the mixing of the infiltrated water with native ground water.

SUMMARY AND CONCLUSIONS

Communities in the Lamprey River basin are experiencing the rapid population growth that is common to all communities in southeastern New Hampshire. The population of 15 towns in the basin increased about 40 percent from 1970 to 1980. This growth is expected to continue.

Future water demand, both municipal and private, will increase in response to population growth. By 2020, this demand may be 3 to 9 times greater than the present 3 Mgal/d pumpage.

Saturated sand and gravel deposits in the Lamprey and Piscassic River valleys and in the lowland area of Newmarket are the most productive or potentially productive stratified drift aquifers in the basin. Except for the aquifer at Newmarket Plains, induced infiltration of stream water would allow higher, but still modest, sustained yield to correctly placed wells. The aquifer in the vicinity of Deerfield Fairgrounds may yield at least 0.06 Mgal/d. The aquifer in northwest Raymond may yield 1.7 Mgal/d. A sustained withdrawal of 1 Mgal/d is probable in the west Epping area. The aquifer in central Epping may already be fully developed. Further exploration for a confined aquifer beneath estuarine deposits in eastern Epping is warranted.

Pumpage from the Newmarket Plains aquifer could be increased to an estimated 0.6 Mgal/d. Systematic exploration for highly fractured zones in bedrock may allow siting of wells with relatively high yields.

Ground water is generally of good chemical quality and suitable for domestic use. Because of recent improvements in stream quality, the effects of induced infiltration of surface water on the quality of ground water due to ground-water pumpage should be minimal.

Excessive concentrations of chloride and sodium in the ground water reflect highway deicing policies. Judicious land-use planning could offer protection to the few extensive sand and gravel aquifers that occur within this basin.

GLOSSARY

AQUIFER. A formation, group of formations, or part of a formation that contains enough saturated permeable material to yield significant quantities of water to wells and springs.

BRECCIATED. A rock structure marked by the presence of angular fragments.

DELTAIC DEPOSIT. A deposit of unconsolidated sediment sorted and stratified during the formation of the three components of a delta: Bottomset beds, foreset beds, and topset beds. The bottomset beds are flat-lying and generally the finest grained of the three. The foreset beds are well-sorted, cross-bedded, and make up the bulk of the delta. The flat-lying topset beds consist of channel and overbank flood deposits.

DRAWDOWN. The difference between nonpumping and pumping water level in a well.

EXTENSION FRACTURE. A fracture that develops perpendicular to the direction of greatest stress, and parallel to the direction of compression.

EVAPOTRANSPORATION. Loss of water from a land area through transpiration of plants and evaporation from the soil.

FLOW DURATION. The temporal distribution of stream flow expressed as how often a particular stream discharge is equaled or exceeded.

GROUND-WATER RESERVOIR. Parts of the stratified drift aquifer where ground water is accumulated under conditions that make it suitable for development and use, ie., an aquifer.

HYDRAULIC CONDUCTIVITY. The volume of water (at the existing kinematic viscosity) that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. Expressed herein as cubic foot of water per square foot of cross-sectional area per day. These values may be converted to gallons per day per square foot by multiplying by 7.48.

HYDRAULIC GRADIENT. The change in static head per unit of distance in a given direction. It is the slope of the water table.

LOW FLOW. Sustained or fair weather flow. In unregulated streams, this flow is composed largely of ground-water discharge.

NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD of 1929). A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Mean Sea Level."

PRIMARY POROSITY. Porosity which is due to the sediment or rock matrix.

SATURATED THICKNESS. The thickness of an aquifer below the water table. As measured for the stratified-drift aquifer in this report, it is the vertical distance between the water table and the bedrock surface and in places includes till present between the stratified drift and the bedrock surface.

SECONDARY POROSITY. Porosity which may be due to such phenomena as secondary solution or structurally controlled regional fracturing.

SILICIFICATION. The introduction of, or replacement by, silica, generally resulting in the formation of fine-grained quartz, chalcedony, or opal, which may both fill pores and replace existing minerals.

SPECIFIC YIELD. The ratio of (1) the volume of water which rock or soil, after being saturated will yield by gravity drainage to (2) the volume of the rock or soil; commonly expressed as a percentage.

STATIC WATER LEVEL. With respect to wells, the level of water maintained by natural pressure unaffected by pumping.

STRATIFIED DRIFT. Unconsolidated sediment that has been sorted by glacial meltwater and deposited in layers, or strata.

STRIKE. The direction or trend of a structural surface--for example, a bedding or fault plane, as it intersects the horizontal.

SUSPENDED LOAD. The part of the total stream load that is carried for a considerable period of time in suspension, free from contact with the stream bed; it consists mainly of mud, silt, and sand.

SUSTAINED YIELD. The amount of water that can be withdrawn from a ground-water basin without producing an undesired result.

TRANSMISSIVITY. The rate at which water (of the prevailing kinematic viscosity) is transmitted through a unit width of aquifer under a unit hydraulic gradient. It is equal to the product of hydraulic conductivity and saturated thickness. Expressed herein in cubic feet per day per foot or, more simply, feet squared per day. These values may be converted to gallons per day per foot by multiplying them by 7.48.

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APPENDIX

Table 1.--*Water-level measurements in selected wells*
[Water levels are given in feet below land-surface datum]

ROCKINGHAM COUNTY

CANDIA 1 (CDW-1)

Date	Water Level	Date	Water Level	Date	Water Level
1-12-78	3.21	12-29-78	2.85	11-30-79	4.02
2-9-78	3.43	1-29-79	2.72	12-28-79	3.96
3-15-78	3.17	2-26-79	2.83	1-29-80	3.42
4-20-78	2.99	3-27-79	3.30	2-29-80	3.59
5-26-78	2.76	4-26-79	3.56	3-28-80	3.98
6-23-78	3.01	5-29-79	3.13	4-27-80	3.96
7-20-78	4.46	6-29-79	3.96	5-29-80	3.21
8-25-78	5.92	7-27-79	4.59	6-28-80	4.22
9-28-78	6.71	8-31-79	4.53	7-29-80	5.52
10-30-78	5.51	9-28-79	4.69		
11-28-78	5.45	10-26-79	4.36		

CANDIA 2 (CDW-2)

Date	Water Level	Date	Water Level	Date	Water Level
1-27-78	2.00	12-29-78	2.79	11-30-79	4.81
2-28-78	3.61	1-29-79	2.43	12-28-79	6.67
3-22-78	2.09	2-26-79	2.50	1-29-80	5.60
4-20-78	1.98	3-27-79	2.55	2-29-80	4.92
5-26-78	1.32	4-26-79	3.34	3-28-80	4.81
6-23-78	1.99	5-29-79	2.49	4-27-80	4.17
7-20-78	5.33	6-29-79	2.51	5-29-80	4.91
8-25-78	7.31	7-27-79	3.82	6-28-80	5.33
9-28-78	8.71	8-31-79	5.00	7-29-80	6.20
10-30-78	8.13	9-28-79	5.42		
11-30-78	8.25	10-26-79	5.44		

CANDIA 3 (CDW-3)

Date	Water Level	Date	Water Level	Date	Water Level
1-7-78	3.8	12-29-78	17.10	11-30-79	13.02
2-9-78	5.3	1-29-79	4.31	12-28-79	13.51
3-15-78	6.7	2-26-79	4.56	1-29-80	8.77
4-20-78	5.22	3-27-79	4.88	2-29-80	8.19
5-26-78	4.98	4-26-79	4.61	3-28-80	8.33
6-23-78	5.37	5-29-79	3.55	4-27-80	7.71
7-20-78	6.93	6-29-79	3.59	5-29-80	6.03
8-25-78	8.91	7-27-79	8.09	6-28-80	7.08
9-28-78	9.78	8-31-79	10.92	7-29-80	8.11
10-30-78	15.54	9-28-79	12.21		
11-28-78	15.60	10-26-79	12.69		

DEERFIELD 2 (DDW-2)

Date	Water Level	Date	Water Level	Date	Water Level
1-12-78	3.6	12-29-78	11.00	11-30-79	8.33
2-6-78	4.2	1-29-79	5.8	12-28-79	9.01
3-15-78	5.9	2-26-79	6.52	1-29-80	7.17
4-19-78	5.95	3-27-79	7.01	2-29-80	7.82
5-26-78	4.04	4-26-79	5.23	3-28-80	8.63
6-24-78	5.09	5-29-79	4.05	4-27-80	7.88
7-20-78	7.82	6-29-79	5.74	5-29-80	6.47
8-25-78	9.55	7-27-79	6.02	6-28-80	6.99
9-28-78	10.89	8-31-79	6.42	7-29-80	7.51
10-30-78	Dry	9-28-79	8.62		
11-28-78	Dry	10-26-79	8.57		

DEERFIELD 3 (DDW-3)

Date	Water Level	Date	Water Level	Date	Water Level
1-13-78	7.50	12-29-78	28.00	12-28-79	22.81
2-27-78	10.30	1-29-79	15.65	1-29-80	16.57
3-15-78	13.70	3-27-79	10.42	2-29-80	17.32
4-19-78	13.24	4-26-79	8.24	3-28-80	17.10
5-26-78	11.01	5-29-79	6.84	4-27-80	16.30
6-24-78	12.87	6-29-79	7.03	5-29-80	13.35
7-20-78	16.57	7-27-79	9.21	6-28-80	15.22
8-25-78	20.84	8-31-79	15.33	7-29-80	17.39
9-28-78	22.91	9-28-79	21.50		
10-30-78	24.24	10-26-79	23.62		
11-28-78	24.21	11-30-79	23.89		

EPPING 3 (EPW-3)

Date	Water Level	Date	Water Level	Date	Water Level
3-14-78	12.9	1-29-79	9.77	12-28-79	13.62
4-20-78	13.35	2-26-79	10.55	1-29-80	10.11
5-26-78	11.64	3-27-79	11.03	2-29-80	10.89
6-23-78	12.72	4-26-79	11.75	3-28-80	11.24
7-20-78	13.54	5-29-79	10.23	4-27-80	10.89
8-24-78	15.03	6-29-79	11.52	5-29-80	10.09
9-27-78	Dry	7-27-79	11.99	6-28-80	11.31
10-30-78	13.58	8-31-79	12.13	7-19-80	12.13
11-17-78	13.57	9-28-79	12.16		
11-28-78	13.55	10-26-79	12.91		
12-29-78	9.18	11-30-79	13.07		

Table 1.--*Water-level measurements in selected wells (continued)*

EPPING 8 (EPW-8)

Date	Water Level	Date	Water Level	Date	Water Level
3-20-78	2.4	1-29-79	2.55	11-30-79	5.06
4-20-78	3.52	2-26-79	2.51	12-28-79	4.55
5-26-78	2.13	3-27-79	2.40	1-29-80	2.63
6-23-78	3.78	4-26-79	3.77	2-29-80	3.75
7-20-78	5.62	5-29-79	2.63	3-28-80	4.17
8-24-78	6.90	6-29-79	3.71	4-27-80	3.36
9-27-78	7.45	7-27-79	4.42	5-29-80	2.90
11-17-78	7.64	8-31-79	5.53	6-28-80	4.26
11-28-78	7.59	9-28-79	6.17	7-29-80	6.12
12-29-78	5.12	10-26-79	7.09		

EXETER 3 (EXW-3)

Date	Water Level	Date	Water Level	Date	Water Level
1-16-78	9.0	11-28-78	15.77	11-30-79	Dry
2-28-78	10.25	1-29-79	6.98	12-28-79	16.39
3-22-78	11.5	2-26-79	6.97	1-29-80	8.78
4-18-78	10.33	3-27-79	6.65	2-29-80	8.62
5-26-78	8.48	4-27-79	8.7	3-28-80	9.41
6-23-78	9.72	5-29-79	8.17	4-27-80	8.07
7-20-78	14.05	6-29-79	10.54	5-29-80	7.89
8-25-78	15.57	7-27-79	12.66	6-28-80	9.77
9-27-78	Dry	8-31-79	14.11	7-29-80	11.53
10-30-78	15.64	9-28-79	16.24		
11-17-78	15.78	10-26-79	Dry		

FREMONT 1 (FMW-1)

Date	Water Level	Date	Water Level	Date	Water Level
1-24-79	10.6	11-28-78	13.69	12-28-79	Dry
2-28-78	11.8	12-29-78	13.05	1-29-80	11.16
3-22-78	12.05	1-29-79	11.24	2-29-80	11.18
4-19-78	11.73	2-27-79	11.11	3-28-80	11.27
5-26-78	9.87	5-29-79	10.52	4-27-80	11.01
6-24-78	11.71	6-29-79	10.98	5-29-80	10.25
7-20-78	12.85	7-27-79	12.57	6-28-80	11.82
8-25-78	14.41	8-31-79	13.76	7-29-80	12.43
9-27-78	Dry	9-28-79	Dry		
10-30-78	13.90	10-26-79	Dry		
11-17-78	13.75	11-30-79	Dry		

STRAFFORD COUNTY

LEE 1 (LIW-1)

Date	Water Level	Date	Water Level	Date	Water Level
1-24-78	30.75	1-29-79	30.20	12-22-79	31.25
2-21-78	31.00	2-27-79	30.69	1-28-80	31.36
3-24-78	30.64	3-24-79	30.15	2-24-80	31.63
4-21-78	30.51	4-26-79	30.30	2-26-80	31.59
5-22-78	29.19	5-29-79	29.21	3-24-80	30.80

LEE 1 (LIW-1) (continued)

Date	Water Level	Date	Water Level	Date	Water Level
6-22-78	30.77	6-26-79	30.01	3-26-80	30.81
7-25-78	31.20	6-28-79	30.03	4-24-80	30.65
8-26-78	31.59	7-30-79	31.25	4-27-80	30.73
9-22-78	31.60	8-28-79	31.34	5-22-80	30.89
10-24-78	31.78	9-25-79	31.37	7-28-80	31.59
11-16-78	32.03	10-22-79	30.98		
11-27-78	31.63	11-24-79	30.98		
12-22-78	31.58	11-27-79	30.99		

LEE 30 (LIW-30)

Date	Water Level	Date	Water Level	Date	Water Level
1-9-78	11.75	11-28-78	Dry	11-30-79	Dry
2-3-78	12.20	12-29-78	12.89	12-28-79	17.00
3-13-78	14.00	1-29-79	11.94	1-29-80	13.28
4-18-78	11.33	3-27-79	12.19	2-29-80	13.39
5-26-78	10.89	4-26-79	12.21	3-28-80	13.62
6-23-78	11.67	5-29-79	11.80	4-27-80	11.28
7-20-78	16.85	6-29-79	12.31	5-29-80	10.35
8-25-78	Dry	7-27-79	14.29	6-28-80	11.22
9-27-78	Dry	8-31-79	15.90	7-29-80	12.36
10-30-78	17.58	9-28-79	16.78		
11-17-78	17.55	10-26-79	Dry		

LEE 31 (LIW-31)

Date	Water Level	Date	Water Level	Date	Water Level
1-18-78	3.26	12-29-78	5.76	12-28-79	10.71
2-17-78	4.71	1-29-79	2.8	1-29-80	7.73
3-13-78	6.59	2-26-79	3.15	2-29-80	6.30
4-18-78	6.01	3-27-79	3.96	3-28-80	5.71
5-26-78	3.97	4-26-79	4.18	4-27-80	4.82
6-23-78	5.89	5-29-79	3.52	5-29-80	3.07
7-20-78	8.76	6-29-79	4.19	6-28-80	4.09
8-25-78	10.07	7-27-79	5.38	7-29-80	6.13
9-27-78	11.21	8-31-79	7.97		
10-30-78	13.30	9-28-79	9.47		
11-17-78	13.59	10-26-79	9.82		
11-28-78	13.58	11-30-79	10.03		

NOTTINGHAM 2 (NXW-2)

Date	Water Level	Date	Water Level	Date	Water Level
12-30-77	5.90	6-23-78	7.57	12-29-78	15.29
1-26-78	7.23	7-20-78	9.88	1-29-79	13.01
2-25-78	8.40	8-25-78	11.50	2-26-79	13.35
3-25-78	9.45	9-28-78	12.31	3-27-79	10.39
4-18-78	9.01	10-30-78	15.01	4-26-79	8.72
5-26-78	6.32	11-28-78	15.49	5-29-79	6.36

Table 2.--*Miscellaneous low flow discharge measurements*

Site (Number on plate 1)	Drainage area (square miles)	September 12-13, 1977		September 6-8, 1978	
		Discharge (cubic feet per second)	Discharge (cubic feet per second per square mile)	Discharge (cubic feet per second)	Discharge (cubic foot per second per square mile)
Little River					
12	18.7	48.1	2.57	5.14	.27
13	.9	0	0	0	0
14	17.1	51.4	3.01	.93	.05
15	3.5	42.5	12.14	0	0
16	9.9	45.6	4.61	0	0
North River					
17	35.7	.06	.03	0	0
18	13.8	.01	.001	.05	.004
19	10.6	--	--	0	0
20	4.1	.01	.002	.01	.002
21	2.9	.01	.003	0	0
Lamprey River					
1	183.0	62	.34	10	.05
2	152.8	5.74	.04	5.16	.03
4	1.8	.02	.01	.10	.06
5	110.6	7.09	.06	9.66	.09
6	1.5	--	--	0	0
7	.5	--	--	0	0
8	33.8	.67	.02	1.34	.04
9	2.4	--	--	0	0
10	10.9	.09	.01	0	0
11	16.1	.16	.01	.94	.06
Piscassic River					
22	22.8	.25	.01	0	0
23	21.1	--	--	0	0
24	20.0	.06	.003	.16	.008
25	1.0	0	0	0	0
26	17.6	.12	.007	.05	.003
27	14.8	.11	.007	.47	.03
28	.7	0	0	.26	.37
29	11.0	--	--	0	0
30	10.1	.14	.01	0	0
31	8.6	--	--	0	0
32	8.1	--	--	0	0
33	7.0	--	--	0	0
34	5.2	.15	.03	.13	.02
35	2.9	.02	.007	0	0
36	.1	.04	.40	0	0
37	.1	0	0	0	0

Table 3--*Recommended use classifications and water-quality*[1]

[Remarks: M, not objectionable kinds or amounts; N, not less than 75% saturation; Q, not of unreasonable kind, quantity or duration; R, not in toxic concentrations or combinations; S, not to exceed 10 units in trout water; T, not to exceed 25 units in non-trout water.]

Class A: Potentially acceptable for public water supply after disinfection. No discharge of sewage or other wastes. Quality uniformly excellent.
Class B: Acceptable for bathing and recreation, fish habit, and public water supply after adequate treatment. No disposal of sewage or other wastes unless adequately treated. High aesthetic value.
Class C: Acceptable for recreational boating, fishing, and industrial water supply with or without treatment, depending on individual requirements. Third highest quality.
Class D: Aesthetically acceptable. Suitable for certain industrial purposes, power, and navigation. Lowest allowable quality.

	Class A	Class B	Class C	Class D
Dissolved oxygen	Not less than 75 % saturation	Not less than 75 % saturation	Not less than 5 ppm	Not less than 2 ppm
Coliform bacteria per 100 ml	Not more than 50	Not more than 240 in freshwater. Not more than 70 in saltwater or brackish water	Not specified	Not specified
pH	Natural	6.5-8.0	6.0-8.5	Not specified
Substances potentially toxic	None	R	R	R
Sludge deposits	None	M	M	M
Oil or grease	None	None	M	Q
Color	Not to exceed 15 units	Not in objectionable amounts	Not in objectionable amounts	Q
Turbidity	Not to exceed 5 units	S; T,	S; T	Q
Slick, odors, and surface-floating solids or duration	None	None	M	Not of unreasonable kind, quantity, amounts
Temperature	No artificial rise	Source[2]	Source[2]	Shall not exceed 90°F

[1]New Hampshire Water Supply and Pollution Control Commission, 1975.

[2]New Hampshire Fish and Game Department; New England Interstate Water Pollution Control; or National Technical Advisory Committee, U.S. Department of the Interior; whichever provides the most effective control.

Table 4.--*Records of selected wells and test wells*

Type of well: Dg, dug; Dn, driven; Dr, drilled; Wb, washed well. Use: D, domestic; I, industrial or commercial; O, observation; PS, public supply; T, test; U, unused

Remarks: B, reported in Bradley and Petersen, 1962; CA, chemical analysis (fig. 11);
O, observation well, water levels in table 1; L, log in table 5; DD, drawdown

Well No.	Site identification No.	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Diameter of well (inches)	Depth to bedrock (feet)	Type of well	Water-bearing material	Water level Depth	Water level Date	Use	Yield (gallons per minute)	Remarks
					ROCKINGHAM COUNTY									
					Brentwood									
BWW-20	430107071014201	New England Dragway	1977	120	15	--	--	Dg	Sand	--	- -	D	--	--
					Candia									
CDW-1	430414071165701	--	--	335	10.4	48	--	Dg	Gravel	3.2	1-12-78	O,U	--	CA; O
CDW-2	430334071163801	Clarence Blevens	1970	455	12	24	--	Dg	Till	2.0	1-27-78	O,U	--	CA; O
CDW-3	430257071172001	--	1978	475	18.5	42	--	Dg	Till	5.3	2- 9-78	O,U	--	O
CDW-4	430347071171801	Town of Candia	1972	495	600	6	25	Dr	Bedrock	--	--	I	30	--
CDW-5	430448071173701	K. Bell	1972	350	10	42	--	Dg	Gravel	7.5	3- -78	D	--	--
CDW-6	430544071192601	Fallon	1978	585	11.9	42	--	Dg	Till	9.2	4- -78	D	--	--
CDW-7	430335071164701	Leo's Auto Body	1978	455	12	36	--	Dg	Sand; gravel	1	5- -78	D	--	--
					Deerfield									
DDW-1	430603071144301	Deerfield Fair Assn.	1971	265	59	6	--	Dr	Sand; gravel	20.6	- -71	PS	50	CA
DDW-2	430837071162201	Maynard	1977	595	11.3	36	--	Dg	Till	3.6	1-12-78	O,U	--	O
DDW-3	430542071160401	Raymond Tucker	1972	545	31.2	36	--	Dg	Till	10.3	1- -78	O,U	--	CA; O
DDW-4	430608071135901	--	--	320	21.7	36	--	Dg	Gravel	14.5	8- -77	U	--	--
DDW-5	430511071140401	Deerfield Campground	1978	225	12	24	--	Dg	Sand; gravel	7	2- -78	I	--	--
DDW-6	430919071181401	--	1978	825	14.5	36	--	Dg	Till	8.3	4- -78	D	--	--
DDW-7	430752071141901	George B.White School	1955	450	208	6	20	Dr	Bedrock	--	- -	PS	50	CA

Table 4.--*Records of selected wells and test wells (continued)*

Well No.	Site identification No.	Owner or user	Year com-pleted	Altitude of land-surface datum (feet)	Depth (feet)	Diameter of well (inches)	Depth to bedrock (feet)	Type of well	Water-bearing mate-rial	Water level Depth	Water level Date	Use	Yield (gallons per minute)	Remarks
					ROCKINGHAM COUNTY (continued)									
					Epping									
EPW-1	430152071025701	R. C. Browne	1955	130	9.7	40	--	Dg	Sand	8.14	9-27-55	U	--	B
EPW-2	430147071050701	Town of Epping	1950	145	64	24	--	Dr	Sand; gravel	flowing	- -50	PS	150	L; B
EPW-3	430401071024301	J. T. Burley	1900	160	15.5	32	--	Dg	Till	12.39	12-20-55	O,U	--	B; O
EPW-6	430150071050601	Town of Epping	1976	150	60	8	60	Dr	Gravel, med. gray	5.6	2-12-76	PS	160	L
EPW-7	430128071050201	do.	1973	145	78	3	--	Dr	Sand	2.7	3-20-78	U	30	CA
EPW-8	430126071050401	do.	1973	145	78	3	--	Dr	Sand	2.5	3-20-78	O,U	60	O
EPW-9	430236071013901	Camp Hedding	1977	125	400	6	45	Dr	Bedrock	--	- -	D	3	--
EPW-10	430237071014601	do.	1977	130	15	36	--	Dg	Sand	3	7- -77	D	--	--
EPW-11	430238071034901	Pine & Pond Mobil Home	1968	160	250	6	13	Dr	Bedrock	--	- -	PS	100	--
EPW-13	430408071005201	Koles	1970	110	20	1.5	--	Dn	Sand	--	- -	D	--	
EPW-14	430134071070401	--	1978	170	12	48	--	Dg	Sand	2.5	5- -78	D	--	
EPW-15	430344071073701	Eleanor Rasp	1974	230	190	--	15	Dr	Bedrock	--	- -	D	4	
EPW-16	430330071072001	Robert Illsley	1965	285	170	--	58	Dr	Bedrock	25	11-4-65	D	4	
EPW-17	430309071061601	Morris Binette	1970	260	100	--	16	Dr	Bedrock	--	- -	D	8	
EPW-18	430304071055201	Town of Epping	1975	178	26	2.5	--	Wb	Gravel	0	5-28-75	T	10	L
EPW-19	430157071073801	do.	1978	150	37	2.5	--	Wb	Gravel	5.5	8-10-78	T	50	--
EPW-20	430158071074001	do.	1978	150	36	2.5	--	Wb	Gravel; silt; clay	6.1	8-2-78	T	50	L
EPW-21	430158071073601	do.	1978	152	36	2.5	--	Wb	Gravel; silt; clay	6.0	8-2-78	T	75	L
EPW-22	430209071074801	do.	1978	155	41	2.5	--	Wb	Gravel	--	- -	T	25	L
EPW-23	430212071073501	Frank Philbrick	1967	170	100	--	55	Dr	Bedrock	--	- -	D	15	--
EPW-24	430225071082501	Timothy Nary	1973	190	145	--	56	Dr	Bedrock	--	- -	D	10	--
EPW-25	430223071080901	Howard Phelps	1969	175	205	--	62	Dr	Bedrock	--	- -	D	30	--
EPW-26	430231071074101	Mike Sweeney	1971	150	270	--	25	Dr	Bedrock	25	9-27-71	D	15	--
EPW-27	430219071071501	Richard Forcier	1967	163	140	--	35	Dr	Bedrock	10	10-5-67	D	4	--

Table 4.--*Records of selected wells and test wells (continued)*

Well No.	Site identification No.	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Diameter of well (inches)	Depth to bedrock (feet)	Type of well	Water-bearing material	Water level Depth	Water level Date	Use	Yield (gallons per minute)	Remarks
		ROCKINGHAM COUNTY (continued)												
		Epping (continued)												
EPW-28	430148071050801	Town of Epping	1975	152	56	2.5	--	Wb	Sand; some clay	10.5	6-12-75	T	60	L
EPW-29	430221071054901	Lesley Byrnes	1965	190	208	--	102	Dr	Bedrock	30	5- 5-65	D	15	--
EPW-30	430217071054201	Theodore Lavoie	1965	185	104	--	16	Dr	Bedrock	24	6-18-65	D	20	--
EPW-31	430225071044701	Town of Epping	1980	115	34	2.5	--	Wb	Gravel	1.2	2-27-80	T	50	L
EPW-32	430316071044901	Elliot	1967	220	80	--	11	Dr	Bedrock	--	- -	D	4	--
EPW-33	430212071043701	Jack Lavoie	1971	145	175	--	36	Dr	Bedrock	--	- -	D	100	--
EPW-34	430207071033901	Morrison	1968	130	129	--	15	Dr	Bedrock	--	- -	D	20	--
EPW-35	430157071031001	Chester Croteau	1971	180	325	--	62	Dr	Bedrock	--	- -	D	4	--
EPW-36	430132071022901	Don Keack	1968	170	204	--	56	Dr	Bedrock	--	- -	D	6	--
EPW-37	430234071011101	Nathan Phillips	1965	130	230	--	145	Dr	Bedrock	20	9-27-65	D	12	--
EPW-38	430243071012101	Donald Smith	1965	130	147	--	131	Dr	Bedrock	35	9-29-65	D	100	--
EPW-39	430304071021401	Hall	1970	140	400	--	41	Dr	Bedrock	--	- -	D	1.5	--
EPW-40	430310071023401	Wilson & Hodge	1963	145	105	--	60	Dr	Bedrock	26	9- 3-63	D	20	--
EPW-41	430321071025601	Elizabeth Hartford	1957	155	150	--	15	Dr	Bedrock	--	- -	D	2.5	--
EPW-42	430353071033901	Sullivan	1967	190	190	--	15	Dr	Bedrock	--	- -	D	25	--
EPW-43	430434071041101	David Behm	1967	160	195	--	14	Dr	Bedrock	--	- -	D	50	--
EPW-45	430438071020701	Robert Grant	1974	110	370	--	24	Dr	Bedrock	--	- -	D	10	--
EPW-46	430207071074701	Patrick McCusker	1973	158	250	--	66	Dr	Bedrock	--	- -	D	3	
EPW-47	430125071040901	Town of Epping	1973	130	55	2.5	--	Wb	Sand	7.0	2-23-73	T	2.3	L
EPW-48	430149071050801	do.	1975	155	56	2.5	--	Wb	Sand	10.6	6-13-75	T	60	L
EPW-49	430226071045701	do.	1980	115	43	2.5	--	Wb	Gravel	1	2-26-80	T	5	L
EPW-50	430227071044901	do.	1980	115	31	2.5	--	Wb	Gravel	1.6	3- 3-80	T	50	L
EPW-51	430132071050901	do.	1979	150	78	2.5	--	Wb	Sand	6.3	12-18-79	T	60	--
EPW-52	430130071050901	do.	1979	150	78	2.5	--	Wb	Sand	6.25	12-19-79	T	60	--
EPW-53	430129071050901	do.	1979	150	82	2.5	--	Wb	Sand	6.2	12-20-79	T	60	--
EPW-54	430127071050901	do.	1979	150	71	2.5	--	Wb	Sand	5.75	1- 3-80	T	40	--

Table 4.--*Records of selected wells and test wells (continued)*

Well No.	Site identification No.	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Diameter of well (inches)	Depth to bedrock (feet)	Type of well	Water-bearing material	Water level Depth	Water level Date	Use	Yield (gallons per minute)	Remarks
ROCKINGHAM COUNTY (continued)														
Exeter														
EXW-3	430117070582301	Greer	1900	145	16.5	36	--	Dg	Sand	9.0	1-16-78	O,U	--	B; CA; O
										14.54	8- 5-55			
EXW-4	430117070592801	John Wentworth	1945	168	29.3	36	--	Dg	Till	21.69	8- 3-55	D	--	B
EXW-5	430110070592101	F. L. Wentworth	1928	170	170	6	100	Dr	Bedrock	--	- -	D	5.5	L; B
EXW-29	430134070582301	Davis	1958	110	7.7	48	--	Dg	Sand, silty	4.8	4- -78	D	--	--
Fremont														
FMW-1	430109071063101	Lewis Waterhouse	--	165	14.7	36	--	Dg	Till	10.6	1-24-78	O,U	--	O
FMW-2	430039071052801	Schreiber	--	170	50	--	3	Dr	Bedrock	--	- -	D	--	--
Newfields														
NGW-2	430227071003101	J. H. Proctor	1950	110	7.2	24	--	Dg	Sand	4.65	7-21-55	D	--	B
NGW-3	430237070580001	Harry Thompson	1900	140	21.5	36	--	Dg	Till	12.85	7-20-55	U	--	B
Newmarket														
NMW-1	430437070571701	R. M. Loiselle	1900	55	11.7	40	--	Dg	Sand	6.54	6-17-54	D	--	B
NMW-2	430458070582401	Harry Bergeron	1940	128	57	2	--	Dn	Sand	44	- -40	D	20	L; B
NMW-3	430454070581701	Charles W. Lang	1900	110	20.0	36	--	Dg	Sand; gravel	16.27	9-13-55	D	--	B
NMW-4	430459070571101	Town of Newmarket	1914	40	238	6	38	Dr	Bedrock	flowing	- -14	PS	84	L; B
NMW-6	430457070583601	do.	1974	125	48	24	--	Dr	Sand; gravel	10.8	6- 7-77	PS	200	DD about 24 feet; L

Table 4.--*Records of selected wells and test wells (continued)*

Well No.	Site identification No.	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Diameter of well (inches)	Depth to bedrock (feet)	Type of well	Water-bearing material	Water level Depth	Water level Date	Use	Yield (gallons per minute)	Remarks
ROCKINGHAM COUNTY (continued)														
Northwood														
NWW-2	431158071075001	C. E. Bateman	1960	500	16	36	--	Dg	Sand; gravel	10.08	10-16-79	D	--	--
NWW-4	431135071084801	H. A. Hardy	1965	570	110	6	15	Dr	Bedrock	15	- -66	D	12	--
NWW-5	431145071084801	do.	--	570	16.5	--	--	--	Sand; gravel	8.25	10-22-69	U	--	--
Nottingham														
NXW-2	431034071071001	Rourke	1830	370	19.5	36	--	Dg	Till	5.9	12-30-77	U	--	O
NXW-3	430722071061501	--	1977	260	300	6	25	Dr	Bedrock	--	- -	D	--	--
NXW-4	431035071071101	Rourke	1830	370	15.5	48	--	Dg	Till	9.7	12-30-77	D	--	--
NXW-5	431043071072101	R. Morris	1957	375	15.4	54	--	Dg	Bedrock	5.9	8- -77	D	--	CA
NXW-6	431012071061301	--	1977	330	8.8	42	--	Dg	Till	7.0	12- -77	D	--	--
NXW-7	430709071025901	Loy Lee Farms	1977	140	25	36	--	Dg	Till	15	8- -77	D	--	--
NXW-8	430720071024901	Yates	1972	150	110	6	65	Dr	Bedrock	--	- -	D	52	--
Raymond														
RBW-1	430227071104601	Raymond Water Dept.	1935	220	30	300	--	Dg	Sand; gravel	20	- -35	PS	--	--
RBW-2	430202071121001	do.	1964	200	59	18	--	Dr	Sand; gravel	13	- -80	PS	820	--
RBW-3	430131071093001	Pine Acres Campground	1960	210	7.7	36	--	Dg	Sand; gravel	4	6-30-77	PS	--	--
RBW-4	430133071092101	do.	1960	175	8.1	42	--	Dg	Sand; gravel	1.7	6-30-77	PS	--	--
RBW-5	430134071092001	do.	1960	175	8.2	42	--	Dg	Sand; gravel	1.8	6-30-77	PS	--	--
RBW-6	430332071131401	Leisure Village	1977	230	15	60	--	Dg	Sand	10	7--77	PS	--	--
RBW-7	430436071132801	Garland	1940	225	11.9	29	--	Dg	Gravel	10.3	1--78	D	--	--

Table 4.--*Records of selected wells and test wells (continued)*

Well No.	Site identification No.	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Diameter of well (inches)	Depth to bedrock (feet)	Type of well	Water-bearing material	Water level Depth	Water level Date	Use	Yield (gallons per minute)	Remarks
					STRAFFORD COUNTY									
					Durham									
DPW-8	430559070570501	Grover Smith	1900	75	16.5	36	--	Dg	Sand; gravel	13.92	10- 4-56	D	--	B
					Lee									
LIW-1	430723071004901	Brenda Nye	1900	190	32.8	40	--	Dg	Sand; gravel	31.45	11- 2-53	O,U	--	B,CA; O
LIW-2	430555071015001	W. Thurston	1932	153	19.3	24	--	Dg	Sand	18.98	11-17-53	U	--	B
LIW-3	430630070590101	E. Claridge	1860	100	15.0	36	--	Dg	Till	13.42	11-10-53	D	--	B
LIW-6	430605070593901	Carl Sanders	1900	112	21.5	36	--	Dg	Till	10.69	2-11-54	D	--	B
LIW-9	430721070591801	Herbert Palmer	1900	125	20.5	36	--	Dg	Sand	9.86	4-11-55	U	--	B
LIW-10	430719071004401	James B. Walker	1914	190	154	6	75	Dr	Bedrock	40	- -14	D	90	L; B
LIW-11	430727071003401	Fred True	1947	195	120	6	45	Dr	Bedrock	22	- -47	D	4	L; B
LIW-12	430527070584601	Wilber Wright	1949	80	96	6	25	Dr	Bedrock	22	- -49	D	4.5	L; B
LIW-28	430535071010001	--	1956	100	39	4	--	Dr	Sand;silt;clay	--	- -	T	--	L; B
LIW-30	430628070585801	Gingras	1860	103	17.7	36	--	Dg	Till	11.75	1- 9-78	O,U	--	O
LIW-31	430637070595101	--	--	85	16.6	36	--	Dg	Till	4.7	- -78	O,U	--	O
LIW-32	430623071021401	--	1977	190	--	--	--	Dr	Sand; gravel	--	- -	D	--	--
LIW-33	430648071004501	Libby	1877	95	18	36	--	Dg	Sand; gravel	--	- -	D	--	--
LIW-34	430556071002601	G. M. Main	1962	90	12	36	--	Dg	Sand	9.5	8- -77	D	--	--

Table 5.--*Drillers' logs of wells and test wells* [1]

	Thickness	Depth
ROCKINGHAM COUNTY		
Epping		
EPW-2* 430147071050701		
Fill	7	0 - 7
Clay	28	7 - 35
Sand	7	35 - 42
Clay	17	42 - 59
Sand, coarse; gravel, fine	5	59 - 64
EPW-6 430150071050601		
Fill (gravel, brown)	3	0 - 3
Clay, gray	54	3 - 57
Gravel, medium, gray	3	57 - 60
Refusal		at 60
EPW-18 430304071055201		
Clay, gray	21	0 - 21
Gravel, broken, brown	1	21 - 22
Gravel, coarse, brown, compact	4	22 - 26
EPW-20 430158071074001		
Topsoil	5	0 - 5
Gravel, brown, gray; silt	15	5 - 20
Silt, brown	10	20 - 30
Gravel, brown	5	30 - 35
Silt, red; clay, brown	6	35 - 41
EPW-21 430158071073601		
Topsoil	5	0 - 5
Gravel, brown, gray	25	5 - 30
Gravel, brown	5	30 - 35
Silt, red; clay, gray	7	35 - 42
EPW-22 430209071074801		
Gravel, brown	20	0 - 20
Gravel, red	10	20 - 30
Gravel, broken, sharp	5	30 - 35
Gravel, brown	11	35 - 46
EPW-28 430148071050801		
Sand, silty, brown	10	0 - 10
Clay, gray	40	10 - 50
Clay, gray; sand, medium, gray	5	50 - 55
Sand, medium, gray; hardpan	2	55 - 57
Refusal		at 57
EPW-31 430225071044701		
Topsoil	5	0 - 5
Gravel	5	5 - 10
Clay, gray	16	10 - 26
Gravel, brown; rock, sharp, black; clay traces	8	26 - 34
EPW-47 430125071040901		
Sand, brown	14	0 - 14
Clay, light gray	38	14 - 52
Sand, fine, light gray	3	52 - 55
EPW-48 430149071050801		
Sand, silty, brown	10	0 - 10
Clay, gray	40	10 - 50
Clay, gray; sand, medium, gray	5	50 - 55
Sand, medium, gray; hardpan	2	55 - 57
EPW-49 430226071045701		
Topsoil; clay, gray	5	0 - 5
Gravel, brown	5	5 - 10
Clay, gray	26	10 - 36
Gravel, broken, sharp; clay and silt, traces	7	36 - 43
EPW-50 430227071044901		
Topsoil	5	0 - 5
Gravel, brown	5	5 - 10
Clay, gray	16	10 - 26
Gravel, brown	5	26 - 31
Exeter		
EXW-5* 430110070592101		
Till	100	0 - 100
Bedrock	70	100 - 170
Newmarket		
NMW-2* 430458070582401		
Sand	57	0 - 57
NMW-4* 430459070571101		
Clay	30	0 - 30
Sand; rocks	8	30 - 38
Bedrock	200	38 - 238

Table 5.--*Drillers' logs of wells and test wells (continued)*

	Thick-ness	Depth
NMW-6* 430457070583601		
Fill	2.5	0 - 2.5
Clay, gray	7.5	2.5 - 10
Silt and sand, hard packed . .	10	10 - 20
Sand, medium, brown	5	20 - 25
Sand, medium, brown; gravel .	21	25 - 46
Sand, medium, brown	1.5	46 - 47.5
Till	0.5	47.5 - 48

STRAFFORD COUNTY
Lee

	Thick-ness	Depth
LIW-10* 430717071004801		
Sand; gravel	75	0 - 75
Bedrock	79	75 - 154
LIW-11* 430727071003401		
Sand; gravel	45	0 - 45
Bedrock	75	45 - 120
LIW-12* 430527070584601		
Clay	25	0 - 25
Bedrock	71	25 - 96
LIW-28* 430535071010001		
Sand, medium to coarse, brown	14	0 - 14
Sand, fine to medium, brown .	6	14 - 20
Silt, light gray; clay, light gray, some sand in streaks . .	10	20 - 30
Silt and clay, blue-gray, plastic; some sand streaks . .	9	30 - 39

*Bradley and Petersen, 1962

1 Thickness and depth given in feet.

Table 6.--*Records of selected borings*

[Remarks: L, log in table 7; P, pumping test failed; W, water level in feet below land surface; B, reported in Bradley and Petersen, 1962; N, no record of material; T, test pumpage remained turbid.]

Boring No.	Location No.	Year completed	Driller	Altitude above sea level (feet)	Depth (feet)	Water-bearing material	Remarks
			ROCKINGHAM COUNTY				
			Candia				
CDB-1	430425071164801	1959	NH Public Works	298	8	Gravel	L
CDB-2	430231071165301	1970	do.	428	20	Till	L
CDB-5	430202071152001	1970	do.	350	25	Till	L
CDB-10	430345071143201	1971	do.	208	25	Gravel	L
CDB-11	430343071144601	1971	do.	213	17	Gravel	L
			Deerfield				
DDB-1	430924071141901	1973	NH Public Works	419	18	Sand	L
			Epping				
EPA-4	430255071024601	1956	U.S. Geol. Survey	150	44	Sand	L; B
EPA-5	430415071005901	1956	do.	95	20	Sand, clay	L; B
EPB-1	430153071084301	1962	NH Public Works	146	12	Sand	L
EPB-2	430443071020901	1975	do.	95	22	Sand	L
EPB-3	430136071042801	1962	do.	142	46	Sand	L
EPB-4	430221071075101	1934	do.	134	7	Gravel	L
EPB-5	430212071041001	1950	do.	109	48	Silt, sand	L
EPB-6	430306071055801	1975	F. G. Sullivan	185	26	Gravel	L; W, 0
EPB-7	430153071084302	1962	NH Public Works	157	30	Sand	L
EPB-8	430153071084303	1962	do.	157	10	Sand	L
EPB-9	430153071084304	1962	do.	148	29	Sand	L
EPB-10	430153071084305	1962	do.	151	22	Sand	L
EPB-11	430153071084306	1962	do.	151	18	Sand, gravel	L
EPB-12	430134071064001	1978	Layne, Inc.	155	41	Gravel	L
EPB-13	430139071055601	1975	F. G. Sullivan	155	25	Gravel	L
EPB-14	430136071055401	1975	do.	155	17	Gravel	L
EPB-15	430132071054601	1978	Layne, Inc.	155	17	--	N
EPB-16	430135071054301	1978	do.	158	16	--	N
EPB-17	430135071053801	1975	F. G. Sullivan	158	31	Gravel	L
EPB-18	430136071053601	1975	do.	160	14	Clay	L
EPB-19	430129071053201	1978	Layne, Inc.	155	13	--	N
EPB-20	430130071053201	1978	do.	155	16	--	N
EPB-25	430124071045801	1973	do.	140	60	Clay	L; W, 10
EPB-26	430136071042802	1962	NH Public Works	140	34	Sand	L

Table 6.--*Records of selected borings* (continued)

Boring No.	Location No.	Year completed	Driller	Altitude above sea level (feet)	Depth (feet)	Water-bearing material	Remarks
			ROCKINGHAM COUNTY (continued)				
			Epping (continued)				
EPB-27	430136071042803	1962	NH Public Works	139	39	Sand	L
EPB-28	430136071042804	1962	do.	141	42	Sand	L
EPB-29	430136071042805	1962	do.	142	35	Sand	L
EPB-30	430136071042806	1962	do.	142	36	Sand	L
EPB-31	430136071042807	1962	do.	138	37	Sand	L
EPB-32	430136071042808	1962	do.	140	48	Sand	L
EPB-33	430136071042809	1962	do.	139	42	Sand	L
EPB-34	430136071042810	1962	do.	143	37	Sand	L
EPB-35	430126071041101	1973	Layne, Inc.	135	79	--	L; W, 8
EPB-38	430148071051501	1975	F. G. Sullivan	150	41	Sand, clay	L
EPB-39	430149071051101	1975	do.	150	57	Sand	L
EPB-41	430150071050301	1977	do.	155	74	Sand, gravel	L; P
EPB-42	430150071050101	1977	do.	155	66	Sand	L; P
EPB-43	430152071045801	1977	do.	160	74	Sand, gravel	L; P; W, 20
EPB-44	430142071050201	1977	do.	150	56	Sand, clay	L
EPB-45	430235071052701	1973	Layne, Inc.	120	10	--	L; W, 3
EPB-46	430233071052601	1973	do.	120	13	--	L; W, 3
EPB-47	430231071052601	1973	do.	118	14	--	L; W, 3
EPB-48	430224071045901	1980	do.	105	43	Gravel	L
EPB-51	430212071041002	1950	NH Public Works	109	49	Sand, gravel	L; W, 9
EPB-52	430212071041003	1950	do.	102	34	Sand	L; W, 2.5
EPB-53	430212071041004	1950	do.	102	39	Sand	L; W, 2
EPB-54	430212071041005	1950	do.	96	30	Sand	L
EPB-55	430212071041006	1950	do.	96	22	Sand	L
EPB-56	430212071041007	1950	do.	96	36	Silt	L
EPB-57	430219071033101	1978	Layne, Inc.	105	26	Gravel	L
EPB-58	430220071031301	1978	do.	100	47	Silt	L
EPB-59	430140071025001	1978	do.	122	19	Boulders	--
EPB-60	430308071015401	1978	do.	98	13	Boulders	--
EPB-61	430309071015601	1978	do.	100	10	Boulders	--
EPB-62	430309071015801	1978	do.	100	10	Boulders	--
EPB-63	430307071020801	1978	do.	145	14	Boulders	--
EPB-64	430309071020901	1978	do.	140	16	Boulders	--
EPB-65	430259071024301	1975	F. G. Sullivan	135	75	Sand	L
EPB-66	430331071024001	1978	Layne, Inc.	130	61	Gravel	L; T; W,6
EPB-67	430202071074401	1978	do.	170	42	Gravel	L; P; W, 8
			Newmarket				
NMB-1	430337070580001	1959	NH Public Works	70	27	Sand, silt	L

Table 6.--*Records of selected borings* (continued)

Boring No.	Location No.	Year completed	Driller	Altitude above sea level (feet)	Depth (feet)	Water-bearing material	Remarks
			ROCKINGHAM COUNTY (continued)				
			Nottingham				
NXB-1	430701071050301	1963	NH Public Works	203	17	Sand	L
NXB-2	430949071064001	1965	do.	286	10	Till	L
			Raymond				
RBB-1	430346071134101	1973	NH Public Works	206	48	Sand, gravel	L
RBB-2	430141071100701	1971	do.	181	31	Sand	L
RBB-3	430143071095501	1971	do.	178	28	Sand, gravel	L
RBB-4	430222071102601	1947	do.	170	10	Gravel	L
RBB-5	430229071120901	1962	do.	183	13	Sand, silty	L
			STRAFFORD COUNTY				
			Lee				
LIB-3	430708071020501	1937	NH Public Works	120	17	Sand	L

Table 7.--*Drillers' logs of borings* [1]

	Thickness	Depth
ROCKINGHAM COUNTY		
Candia		
CDB-1 430425071164801		
Gravel, boulders	8	0 - 8
Refusal		at 8
CDB-2 430231071165301		
Till, sandy; boulders	20	0 - 20
Refusal		at 20
CDB-5 430202071152001		
Topsoil	1	0 - 1
Till, sandy; boulders	24	1 - 25
Refusal		at 25
CDB-10 430345071143201		
Topsol	2	0 - 2
Sand; stones, small	12	2 - 14
Gravel	11	14 - 25
Refusal		at 25
CDB-11 430343071144601		
Gravel, boulders	12	0 - 12
Till, gravelly	5	12 - 17
Refusal		at 17
Deerfield		
DDB-1 430924071141901		
Sand, gravelly	18	0 - 18
Refusal		at 18
Epping		
EPA-4 430255071024601		
Sand, fine to medium, tan, uniform	25	0 - 25
Sand, fine, tan, uniform; pebbles near base	19	25 - 44
EPA-5 430415071005901		
Sand, medium to coarse, brown, micaceous	7.5	0 - 7.5
Sand, medium to coarse, rusty brown, micaceous	2.5	7.5 - 10
Silt and clay, gray; streaks of fine to coarse sand	10	10 - 20

	Thickness	Depth
EPB-1 430153071084301		
Stream water	1	0 - 1
Sand, silty, gravelly	11	1 - 12
Refusal		at 12
EPB-2 430443071020901		
Sand; stones	22	0 - 22
Refusal		at 22
EPB-3 430136071042801		
Fill (gravel)	4	0 - 4
Sand, fine	9	4 - 13
Clay	23	13 - 36
Sand, silty, gravelly	10	36 - 46
Refusal		at 46
EPB-4 430221071075101		
Gravel	4	0 - 4
Sand, gravel	3	4 - 7
Refusal.		at 7
EPB-5 430212071041001		
Silt; sand; gravel	13	0 - 13
Clay	19	13 - 32
Silt; sand; stones	7	32 - 39
Boulders	3	39 - 42
Clay; sand; stones	6	42 - 48
Refusal		at 48
EPB-6 430306071055801		
Clay, gray	21	0 - 21
Gravel, brown	5	21 - 26
Refusal		at 26
EPB-7 430153071084302		
Sand, silty, gravelly	10	0 - 10
Bedrock (cored)	20	10 - 30
EPB-8 430153071084303		
Sand, silty, gravelly	10	0 - 10
Refusal		at 10
EPB-9 430153071084304		
Stream water	1	0 - 1
Sand, silty, gravelly	9	1 - 10
Bedrock (cored)	20	10 - 30

Table 7.--*Drillers' logs of borings* (continued)

	Thick-ness	Depth
EPB-10 430153071084305		
Gravel, sandy	7	0 - 7
Sand	7	7 - 14
Sand, silty, gravelly	8	14 - 22
EPB-11 430153071084306		
Gravel, sandy	10	0 - 10
Sand, gravelly	8	10 - 18
EPB-12 430134071064001		
Silt, brown; gravel	20	0 - 20
Silt, gray; clay	21	20 - 41
EPB-13 430139071055601		
Sand, coarse; gravel	20	0 - 20
Gravel, coarse	5	20 - 25
Refusal		at 25
EPB-14 430136071055401		
Sand, medium; gravel; clay	10	0 - 10
Gravel, coarse; clay	7	10 - 17
Refusal		at 17
EPB-17 430135071053801		
Clay; broken rock	20	0 - 20
Hardpan	5	20 - 25
Gravel, coarse; clay	5	25 - 30
Broken rock	1	30 - 31
Refusal		at 31
EPB-18 430136071053601		
Clay; broken rock	14	0 - 14
Refusal		at 14
EPB-25 430124071045801		
Sand	15	0 - 15
Clay	20	15 - 35
Clay; streaks of fine sand	25	35 - 60
EPB-26 430136071042802		
Sand, fine; silt	10	0 - 10
Clay, soft	20	10 - 30
Sand, silty, gravelly	4	30 - 34
Refusal		at 34

	Thick-ness	Depth
EPB-27 430136071042803		
Sand, fine; silt, traces	8	0 - 8
Silt; clay	12	8 - 20
Clay, soft	12	20 - 32
Sand, silty, gravelly	8	32 - 40
Refusal		at 40
EPB-28 430136071042804		
Fill (gravel)	4	0 - 4
Sand, fine	5	4 - 9
Clay	23	9 - 32
Sand, silty, gravelly	10	32 - 42
Refusal		at 42
EPB-29 430136071042805		
Fill (gravel)	4	0 - 4
Sand, fine	6	4 - 10
Clay	17	10 - 27
Sand, silty, gravelly	8	27 - 35
Refusal		at 35
EPB-30 430136071042806		
Fill (gravel)	4	0 - 4
Sand, fine	8	4 - 12
Clay	16	12 - 28
Sand, silty, gravelly	8	28 - 36
Refusal		at 36
EPB-31 430136071042807		
Sand, fine; silt, trace	9	0 - 9
Clay	19	9 - 28
Sand, silty, gravelly	9	28 - 37
Refusal		at 37
EPB-32 430136071042808		
Sand, fine; silt, trace	11	0 - 11
Clay	21	11 - 32
Sand, silty; gravel	16	32 - 48
Refusal		at 48
EPB-33 430136071042809		
Fill (gravel)	4	0 - 4
Sand, fine	5	4 - 9
Clay	23	9 - 32
Sand, silty, gravelly	9	32 - 41
Refusal		at 41

Table 7.--*Drillers' logs of borings* (continued)

	Thickness	Depth
EPB-34 430136071042810		
Fill (gravel)	4	0 - 4
Sand, fine; silt, traces	7	4 - 11
Clay	20	11 - 31
Sand, silty, gravelly	6	31 - 37
Refusal		at 37
EPB-35 430126071041101		
Topsoil	3	0 - 3
Sand, brown	7	3 - 10
Sand, gray	10	10 - 20
Clay, sandy, light gray	12	20 - 32
Clay, light gray	47	32 - 79
EPB-38 430148071051501		
Sand, medium, brown; clay	10	0 - 10
Sand, coarse, brown; clay, gray	10	10 - 20
Clay, gray	15	20 - 35
Hardpan	6	35 - 41
Refusal		at 41
EPB-39 430149071051101		
Sand, silty, brown	10	0 - 10
Clay, gray	40	10 - 50
Clay, gray; sand, medium, gray	5	50 - 55
Sand, medium, gray; hardpan	2	55 - 57
Refusal		at 57
EPB-41 430150071050301		
Gravel, coarse, brown	10	0 - 10
Sand, coarse, brown; gravel	10	10 - 20
Clay, gray	35	20 - 55
Sand, silty, gray; clay	5	55 - 60
Sand, medium, gray; clay	5	60 - 65
Sand, medium, gray; gravel	9	65 - 74
Refusal		at 74
EPB-42 430150071050101		
Gravel, coarse, brown	10	0 - 10
Sand, coarse, brown; gravel	10	10 - 20
Clay, gray	15	20 - 35
Sand, silty, gray; clay	25	35 - 60
Clay, gray; sand, medium	5	60 - 65
Sand, medium, gray	1	65 - 66
Refusal		at 66
EPB-43 430152071045801		
Sand, coarse, brown; gravel	20	0 - 20
Clay, gray	30	20 - 50
Sand, silty, gray; clay	10	50 - 60
Sand, medium, gray; clay	5	60 - 65
Sand, medium, gray; gravel	9	65 - 74
Refusal		at 74
EPB-44 430142071050201		
Sand, medium, brown	10	0 - 10
Sand, silty, brown; clay, gray	10	10 - 20
Clay, gray	35	20 - 55
Clay, gray; sand, silty	1	55 - 56
Refusal		at 56
EPB-45 430235071052701		
Peat	1	0 - 1
Sand; gravel	5	1 - 6
Clay; broken stone (till)	4	6 - 10
EPB-46 430233071052601		
Peat	1	0 - 1
Sand; gravel	5	1 - 6
Clay; broken stone (till)	7	6 - 13
EPB-47 430231071052601		
Peat	1	0 - 1
Sand; gravel	5	1 - 6
Clay; broken stone (till)	8	6 - 14
EPB-48 430224071045901		
Topsoil	4	0 - 4
Clay, gray	36	4 - 40
Gravel, silty, gray	3	40 - 43
EPB-51 430212071041002		
Sand, fine, loose; silt	2	0 - 2
Sand, fine, compact; gravel	4	2 - 6
Sand, fine; silt; clay, trace; few stones	7	6 - 13

Table 7.--*Drillers' logs of borings* (continued)

	Thick-ness	Depth
EPB-51 (continued).		
Clay, soft	18	13 - 31
Silt; sand; stones	7	31 - 38
Boulders	2	38 - 40
Sand, fine to medium, sharp; gravel	5	40 - 45
Clay; sand; stones	3	45 - 48
Refusal		at 48
EPB-52 430212071041003		
Sand, fine; muck; leaves	3	0 - 3
Sand, fine; silt	4	3 - 7
Clay, blue, soft	18	7 - 25
Silt; sand; stones	5	25 - 30
Boulders	1	30 - 31
Silt; sand; stones	3	31 - 34
Refusal		at 34
EPB-53 430212071041004		
Sand, fine; muck; leaves	3	0 - 3
Sand, fine; silt, traces	4	3 - 7
Clay, blue, soft	18	7 - 25
Silt; sand; stones	9	25 - 34
Clay; sand; stones	5	34 - 39
Refusal		at 39
EPB-54 430212071041005		
Stream water	3	0 - 3
Clay, blue, soft	18	3 - 21
Silt; sand, sharp; stones	10	21 - 31
Silt; stone; clay, traces	2	31 - 33
Refusal		at 33
EPB-55 430212071041006		
Stream water	3	0 - 3
Clay, blue, soft	18	3 - 21
Silt; sand, sharp; stones	4	21 - 25
EPB-56 430212071041007		
Stream water	3	0 - 3
Clay, blue, soft	20	3 - 23
Sand, sharp; silt, traces; stones	12	23 - 35
Silt; clay, traces; stones	4	35 - 39
Refusal		at 39

	Thick-ness	Depth
EPB-57 430219071033101		
Gravel, brown; clay	20	0 - 20
Clay; gravel; hardpan	6	20 - 26
EPB-58 430220071031301		
Peat	10	0 - 10
Clay, blue	10	10 - 20
Silt, brown	5	20 - 25
Silt, brown; gravel, traces	10	25 - 35
Clay, gray; hardpan	12	35 - 47
EPB-65 430259071024301		
Sand, fine, brown	20	0 - 20
Sand, silty, brown; clay	15	20 - 35
Clay, gray; hardpan	25	35 - 60
Sand, coarse, gray; clay	15	60 - 75
Refusal		at 75
EPB-66 430331071024001 Water level - 6 feet		
Gravel, brown	20	0 - 20
Silt	10	20 - 30
Silt, gray; clay	10	30 - 40
Silt; gravel, fine	10	40 - 50
Silt; hardpan; clay; gravel	11	50 - 61
EPB-67 430202071074401		
Topsoil	3	0 - 3
Gravel, brown	22	3 - 25
Gravel, gray	5	25 - 30
Gravel, brown, sharp	5	30 - 35
Gravel, broken, sharp	7	35 - 42
Newmarket		
NMB-1 430337070580001		
Sand; silt; stone	27	0 - 27
Refusal		at 27
Nottingham		
NXB-1 430701071050301		
Gravel	5	0 - 5
Sand, silty; stones, small	5	5 - 10
Sand, fine	5	10 - 15
Till, silty	2	15 - 17
Refusal		at 17

Table 7.--*Drillers' logs of borings* (continued)

	Thick-ness	Depth
Nottingham (continued)		
NXB-2 430949071064001		
Till, sandy; boulders	10	0 - 10
Refusal		at 10
Raymond		
RBB-1 430346071134101		
Fill, (sand)	3	0 - 3
Sand; gravel	12	3 - 15
Sand, medium to coarse	11	15 - 26
Gravel, sandy	16	26 - 42
Till, sandy; boulders	6	42 - 48
Refusal		at 48
RBB-2 430141071100701		
Topsoil	1	0 - 1
Gravel	3	1 - 4
Sand, medium to coarse	6	4 - 10
Sand, fine	5	10 - 20
Sand, medium to coarse	6	20 - 26
Till, sandy; boulders	10	26 - 36
Refusal		at 36
RBB-3 430143071095501		
Muck	4	0 - 4
Gravel, sandy	13	4 - 17
Till, sandy; boulders	11	17 - 28
Refusal		at 28
RBB-4 430222071102601		
Rip rap	2	0 - 2
Sand, coarse	2	2 - 4
Gravel, fine	6	4 - 10
RBB-5 430229071120901		
Gravel, sandy	4	0 - 4
Sand, silty; stone	9	4 - 13
Refusal		at 13
STRAFFORD COUNTY		
Lee		
LIB-3 430708071020501		
Sand, loamy	7	0 - 7
Sand, fine, loose; clay, traces	1.7	7 - 8.7
Sand, coarse; gravel	5.6	8.7 - 14.3
Sand, hard, compact	2.7	14.3 - 17

[1] Thickness and depth given in feet.