TOWN OF FREEPORT
BEDROCK AQUIFER STUDY
BACKGROUND RESEARCH AND DATA COLLECTION

To

TOWN OF FREEPORT

By

Robert G. Gerber, Inc.
Consulting Civil Engineers and Geologists
17 West Street
Freeport, Maine 04032

May 1986

ROBERT G. GERBER, INC.
17 WEST STREET • FREEPORT, MAINE 04032
207-865-6138

9 May 1986

Mr. Dale Olmstead, Town Manager
Town of Freeport
Freeport, Maine 04032

Re: Transmittal of report on literature review and analysis of well questionnaire data for Freeport Bedrock Aquifer Study

Dear Mr. Olmstead:

We are pleased to present the second and third tasks of our Freeport Bedrock Aquifer Study. These tasks include a compilation of all of the water supply questionnaire data received, a compilation of the Dept. of Human Services well water quality data, and a discussion of the literature pertinent to the identification of high-yield bedrock aquifers. Statistical analyses and surficial and bedrock geologic maps constitute part of the work product. We should be completing the photolineament study within the next week.

In reducing the map prepared by the Greater Portland Council of Governments showing the well locations and ID numbers, we find that the legend and well numbers become illegible at the final reduced scale at which the report figures will be presented. We suggest, therefore, that GPCOG re-number the wells in a larger, more legible format, and also re-do the legend in a larger letter size format so that the final report maps will not detract from the overall quality of the report.

We are leaving one of the two required draft copies with you in the Town office and are dropping off the other copy plus blueprints of the full size plan maps at GPCOG. You should be receiving an invoice under separate cover soon for our Tasks 2 and 3.

Sincerely,

Robert G. Gerber, P.E.
& Certified Geologist

Enc: draft maps and report
cc: GPCOG

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BEDROCK AQUIFER STUDY PHASE 1 REPORT
BACKGROUND RESEARCH AND DATA COLLECTION

1.0 INTRODUCTION

This report summarizes our background research and data collection for the "Town of Freeport Bedrock Aquifer Study".

1.1 METHODS

The data presented in the following sections were obtained from the various sources listed in the bibliography and from our previous geological mapping in the Freeport area. The first portion of this report discusses the surficial and bedrock geology of the area as it relates to the hydraulic characteristics of the individual aquifer units. The latter portion of the report discusses the water source and the water quality information obtained from questionnaires, published literature, and water quality test data, respectively.

Several steps were involved in performing the background research and data collection for this study. The first step of data collection consisted of preparing and circulating water well questionnaires to all Freeport residents. Those questionnaires that were returned were transmitted to the Greater Portland Council of Governments (GPCOG), which plotted the corresponding well locations onto a project base map (Figure 1). Following this, geologists at Robert G. Gerber, Inc. (RGGI) established state plane grid coordinates of each plotted well using an enlarged U.S.G.S. map of the Freeport area. Data obtained from the questionnaires were tabulated by RGGI in a computerized data base and analyzed statistically. Concurrent with that process, RGGI made an independent search of Maine Geological Survey well information which was plotted, tabulated and analyzed.

Water quality data were obtained by RGGI from the files of the Maine Department of Human Services, Division of Health Engineering. We compiled test results on water samples taken in Freeport. Those test results which failed to meet state standards for safe drinking water were collected and included in a file separate from that of the questionnaire responses. RGGI conducted a literature search of pertinent bedrock and surficial geological data and created a project bibliography. The geological information gained from this literature was used by RGGI to prepare maps of the area and assign Geologic Unit Codes to each of the plotted wells on the project base map. RGGI prepared several tables and appendices which synthesize the information in a way that is useful and supports the discussion in this report.

The investigators involved in this project were Jim Hillier, who performed much of the data and literature research, Robert Gerber, who provided supervision and prepared the final report, and Steven Pinette, who compiled much of the data and prepared the maps. Jackie Cohen coordinated technical work performed by the GPCOG.

2.0 SURFICIAL GEOLOGY

The surficial deposits of the Town of Freeport are not so important as the bedrock as aquifers in terms of their potential to provide water for domestic use. Approximately one-third of the water supplies surveyed by questionnaire of Freeport residents are obtained from dug wells and springs in soil. While this is a significant fraction of the total sources, data indicate that these sources generally produce low yields and are more frequently contaminated. The conditions that usually should be present to provide a reliable dug well include a saturated soil depth of at least 5 to 10 feet, and a recharge area of 10 or more acres.

The soil cover material is very important, however, in determining the rate of recharge to the bedrock aquifer. Unless the bedrock is exposed, all precipitation must pass through soil to reach and recharge bedrock aquifers. The texture, compactness, and thickness of the soil directly determine the rate of recharge to or discharge from a bedrock aquifer.

In the following sections, the term "soil" is used rather loosely to include all surficial material. However, pedologists normally restrict the term "soil" to only the top several feet of the surficial material that has been weathered and has developed specific soil "horizons".

2.1 PREVIOUS WORK

Leavitt and Perkins (1934) were the first to investigate the surficial deposits of Maine in any systematic manner. The next useful soil mapping was that done by the Soil Conservation Service which published their soil survey in 1974. Although these pedological maps deal only with the upper several feet of the surficial units, we have found them useful in delineating areas of thin soil over bedrock, and areas of glaciomarine fine sands and clay-silt. Robert Gerber, John Rand and others (1975) prepared a report titled "Natural Resources Inventory for Freeport" for the Freeport Conservation Commission. As part of this report, maps of surficial geology and hydrology specific to Freeport were presented and discussed. The Surficial Geology map that was prepared for that report is presented as Figure 2, designating these units in terms of the soils' hydraulic characteristics. The U.S. Geological Survey published the results of a hydrological investigation by Glenn Prescott, Jr. (1976) titled "Ground-Water Favorability and Surficial Geology of the Windham - Freeport Area, Maine". Other surficial geology maps were published by the Maine Geological Survey and "Sand and Gravel Aquifer Maps" covering the area were published in 1979.

2.2 SURFICIAL DEPOSITS AND THEIR HYDRAULIC CHARACTERISTICS

For the purposes of this section we are interested primarily in differentiating the surficial units on the basis of horizontal and vertical hydraulic conductivities as well as on the basis of texture. Consequently, we have differentiated the deposits according to their average hydraulic conductivities.

All but two (swamp deposits and floodplain deposits) of the surficial deposits found in Freeport were formed during either the advance or retreat of the last major continental glaciation of Maine. An ice cap formed over northeastern North America--the Laurentide Advance of the Wisconsinan Stage of the Pleistocene Epoch--and expanded within Maine about 22,000 years ago. By 17,000 years ago, the ice sheet had reached its maximum extent (Georges Banks) and by 13,000 years ago, the ice had receded to the Maine coast. The weight of glacial loading had depressed the surface of the earth and the earth was slow to rebound during glacial melting. Fine sand, silt and clay were deposited on the land when it was under sea water which was temporarily as much as 240 feet above present sea level. Eventually the land rebounded so that Casco Bay had risen above present sea level by about 10,000 years ago. During the process of sea level lowering, small beaches developed at various levels on what are now upland hills and terraces. Wave action re-worked materials such as glacial till and left local sand and gravel deposits over the surface of bedrock or other underlying surficial units.

The following soil units are the primary units found in Freeport. We have assigned each surficial unit a unique "Geologic Unit Code" (GUC) for use in data base management. Refer to Table 1 for a summary of the Geologic Unit Code correlations.

2.2.1 Glacial Till (GUC 1)

Glacial till is identified as Geologic Unit Code 1. Geologic Unit Code is abbreviated as GUC throughout this report. Glacial till was deposited directly during the passage of the major ice advance or a smaller ice lobe advance during the period 22,000 to 13,000 years ago. As ice moved along the base of the glacier, it gouged out bedrock, ground it into material of different sizes, and mixed many materials together. These rock fragments, sand, silt, and clay were embedded under or within the ice and were plastered onto the land at various places, and then overridden and compacted by the weight of as much as several thousand feet of ice, or let down to the land surface when the glacier melted.

The percentage of silt and clay in a soil sample is one of the most important factors controlling permeability. Another major controlling factor is the density of the material. An additional very important factor is the presence of joints or fissure planes. Although we did not compile soil permeability test data on the tills occurring in the Freeport area as part of this study, we can infer their average properties by reference to other studies for which testing has been performed. We estimate that the hydraulic conductivity of the till in the study area to be between 10^{-5} and 10^{-7} cm/sec; however, a fissured clay-till may have a bulk permeability that is 10 to 100 times greater than an unfissured clay-till. We estimate the average effective porosity to be about 25 to 35%. The average recharge rate for the thick glacial till is approximately 10% of the average annual precipitation, or 0.23 gallons per minute (gpm) per acre. The average recharge rate for thin till (<5' thick) is approximately 15%, or 0.34 gpm per acre. This also represents the maximum rate that ground water can be passed on to underlying bedrock aquifers. Till, thin till, and exposed bedrock are combined in the Surficial Geology Map because till is relatively scarce in Freeport.

2.2.2 Glacial Ice-Contact Deposits (GUC 2)

Glacial ice-contact deposits are stratified coarse sand and gravel deposits formed against the edge of retreating glaciers. They are often found perched on hillsides. They may overlie marine clays or bedrock, and in turn may be overlain by thin outwash sands and marine clays. These coarse deposits are highly permeable. We estimate that they can accept and transmit 50% of average annual precipitation or 1.14 gpm per acre.

2.2.3 Glaciomarine Clay-silt (GUC 3)

During the time when the last glacier had retreated north of the Casco Bay region, but when the sea level was still elevated relative to the present day level, the silt and clay that was carried in the glacial meltwaters was settling to the ocean floor in much the same fashion that muds accumulate in the bays today. This particular Geologic Unit, known as the "Presumpscot Formation", overlies approximately 75% of Freeport.

The clay-silts have 80 to 100% silt and clay content. Where the soil lies below the permanent water table, it is a sticky soft blue-gray material referred to as "blue marine clay". Where it lies above the permanent water table, it is a stiff, fissured olive-colored soil that becomes brick-hard during droughts. Fine sand lenses may occur within the unit. Below the permanent water table, clay-silts, unlike some tills, will usually not be fissured. Therefore, the bulk permeability of the clay-silts will usually be ten times less than that of the lowest permeability till. Although the porosity of the clay-silts is high--about 50%--its specific yield is only about 3%.

We estimate that 5% of average annual precipitation will infiltrate through the thick clay-silt deposits, which represents about 0.11 gpm per acre. Because of their low permeability and specific yield, clay-silt deposits usually make very marginal sites for a dug wells, unless sand lenses are present.

2.2.4 Glacial Outwash Sand (GUC 4)

Glacial outwash sand deposits are rather uniform, stratified medium to fine sands with a variety of drainage conditions. They occur both under and above silty clay deposits. Outwash has a relatively high permeability, but is relatively thin in Freeport. The "Desert of Maine" is an area of glacial outwash that has been reworked by winds into an aeolian deposit. These deposits readily conduct water and form excellent aquifers for dug wells where sufficient recharge area is present and salt-water intrusion is not a problem. We estimate that they can accept and transmit 40% of average annual precipitation, or 0.91 gpm per acre.

3.0 BEDROCK GEOLOGY

3.1 INTRODUCTION

Intact masses of crystalline bedrock are essentially impermeable, prohibiting the passage of enough ground water to develop a successful household well. It is the "fracture porosity" caused by both the numerous openings along lamination partings and the less frequent openings on cross-cutting joints that render the bedrock first, capable of transmitting and releasing ground water for human use; and second, receptive to recharge by downward percolating rainfall and snow meltwater. Typical fracture apertures measure 10 to 100 microns across. A representative bedrock fracture porosity in the unweathered crystalline Maine rock is 0.1%. In other words, one-tenth of one percent of the bedrock mass consists of openings through which ground water can migrate. In areas of bedrock masses where the laminations in the schist or gneiss are tightly bonded and few cross-cutting joint fractures occur, little ground water will be available for the development of a successful bedrock well. Conversely, in areas of rock types where the rock parts readily along laminations and/or is closely broken by cross-cutting joints, the high fracture porosity will permit the development of high-yield bedrock wells. A representative bedrock fracture porosity of the latter rock mass in Maine is 1% to 10%.

While the greatest volume of bedrock ground water travels along laminations oriented parallel to the grain of the thinly-layered schists, the bedrock is also broken from place to place by "joints" which are planes of fracture which commonly occur as sharp, steeply-inclined cracks cutting across the laminated grain of the bedrock.

Since joint fractures commonly contain somewhat wider openings between their walls than the openings found along the narrow lamination partings in the layered rocks, bedrock wells which encounter joints may yield more ground water than those which encounter only lamination openings. However, because the non-fractured interval between joints is normally much greater than that between lamination partings in the Casco Bay area rocks, several times as much ground water in the bedrock aquifer as a whole may move northeast or southwest along the lamination partings than moves east or west along the cross-cutting joint fractures. Richard (1976) estimated that there are 30 to 40 times more lamination or foliation partings than joints per volume of rock at High Head in Harpswell located to the southeast of the study area. Modelling by Gerber and Rand (1980) with field verification in the Cape Elizabeth Formation in Wiscasset indicated that aquifer transmissivity was 5 to 10 times greater along the direction of the rock foliation than perpendicular to foliation in a rock that was not heavily jointed.

The major topographic elements of Freeport are controlled by the underlying bedrock structure, since the soil cover is thin throughout much of the town. This, coupled with the fact that about two-thirds of the Freeport wells for which we have well survey questionnaire data are drilled into bedrock, means that the bedrock geology of Freeport is very important in terms of the Town's present and future potable water supply.

The bedrock geology of the Town of Freeport has been mapped by Professor Arthur M. Hussey II of Bowdoin College and the Maine Geological Survey (Hussey, 1981). Professor Hussey identified two (2) different formations of metamorphic bedrock in the area. These metamorphic rocks were created by the transformation and recrystallization of originally-bedded deposits of mud, sand, and volcanic materials. The portion of Hussey's map that represents the structural geology of Freeport is presented in Figure 3.
Most of the bedrock in the northern and central portions of Freeport area is classed generally as "granofel-gneiss", a medium- to fine-grained metamorphic rock with limited foliation and lineation. Bedrock mapped in the southern and eastern portions of town are typically mapped as granofels or schist. "Schist" is defined as a strongly foliated, laminated rock type which splits readily into thin flakes or sheets due to the well-developed parallelism and relatively high content of platy minerals (such as mica). "Marble" is present as two (2) relatively thin units in the north-central portion of the study area.

As reflected by the strong north-northeast fabric of the islands and peninsulas of South Freeport, the trend of the bedrock layering or banding also is oriented northeasterly. Due to ancient mountain-building forces, the bedrock layers have been tilted to strongly dipping attitudes, so that laminations in the schists extend from the surface at steep angles (30-85 degrees from the horizontal) down to great depths. Much of the rain and snow meltwater that percolates downward into cracks and fractures at the surface of the layered bedrock then migrates as ground water along passageways created where the rock has split along its grains parallel to laminations or banding. The significance of the foliated, laminated, or banded character of the bedrock, therefore, is that the multitude of narrow partings along the bedrock layers contain and transport ground water which can be tapped and pumped from wells drilled into the bedrock. The bedrock mass which contains this recoverable ground water is referred to as the "bedrock aquifer".

It is important to note that "high-yield" bedrock aquifers would not normally rely on foliation planes for the high rates of ground water transmission. Rather, high-yield aquifers occur in zones of highly fractured rock. The large rock porosity occurs due to closely-spaced jointing or to faulting, often associated with rock weathering.

3.2 BEDROCK TYPES

The two bedrock formations found in Freeport are further divided into 7 lithologic units, all of which are enumerated for this study as potential bedrock aquifers. The bedrock units present in the study area are described as follows (modified after Hussey, 1981):

VASSALBORO FORMATION

Vassalboro SOv (GUC 5):

Medium dark gray salt-and pepper-textured quartz-plagioclase-biotite +/- hornblende granofels with sporadic thin interbeds of medium greenish gray hornblende-diopside calc-silicate granofels.

Vassalboro SOvl (GUC 6):

Diopside and hornblende-bearing marble, in places moderately sulfidic.

CUSHING FORMATION

Cushing EOc (GUC 7):

Non-rusty to slightly rusty-weathering light to medium gray quartz-plagioclase-biotite granofels; light gray quartz-plagioclase-muscovite-biotite schistose granofels locally with relict coarse fragmental structure; minor amphibole and calc-silicate granofels. Highly migmatized west of the Flying Point Fault.

Cushing EOca (GUC 8):

Amphibole; both fine- and even-grained, and coarse-grained.

Cushing EOct (GUC 9) Tory Hill Member:

Very rusty weathering muscovite-biotite-quartz-sillimanite-graphite schist

Cushing EOcl (GUC 10):

Fine-to coarse-grained calc-silicate granofels and skarn-like coarse grained rock.

Cushing EOcm (GUC 11) Merepoint Neck Member:

Very rusty weathering muscovite-biotite-quartz schist and quartz-plagioclase muscovite-biotite granofels. Rare feldspathic quartzite beds.

GRANITIC INTRUSIVES (no GUC assigned):

Numerous granitic intrusive rocks occur in the Freeport area. The largest of these include granite and pegmatite masses that may occupy several acres. Several abandoned quarries in granite and pegmatite can be found in Freeport. These felsic granitic rocks are relatively "tight" at depth and usually do not yield much water to bedrock wells. Mafic dikes and sills occur as thin tabular bodies throughout the area. These dikes, such as diabase dikes, may be highly fractured and provide a ready avenue for ground water movement. However, ground water passing through these dikes may be high in iron and manganese.

The differences in bedrock types which are used to discriminate between the two metamorphic rock formations relate predominantly to the mixture of minerals contained in the rock. The Vassalboro Formation is primarily composed of medium-textured quartz, plagioclase, biotite and hornblende. The predominant minerals in the Cushing Formation are quartz and plagioclase feldspar with relatively minor biotite mica. The Cushing Formation also contains beds or belts of thin-bedded or gneissic amphibolite, a layered rock made principally of the mineral hornblende, a dark-green to black silicate mineral having a relatively high iron content.

3.3 BEDROCK FRACTURES

Bedrock fractures are roughly planar openings in the rock through which ground water can migrate. The three types of fractures which are of consequence in evaluating the bedrock ground water regimes in the study area are partings along the bedding or foliation planes in the schists and gneiss, joints in all rock types, and faults in all rock types. While the greatest volume of bedrock ground water moves along steeply-inclined, north northeast-trending lamination partings, joints and faults may locally yield significant volumes to drilled wells. Joints are tensional fracture separations in the bedrock along which no relative movement has occurred. Faults are fractures along which the rock on one side of the fracture has moved relative to the rock on the other side of the fracture. Joint fractures in the Freeport area include very steeply-inclined cracks which cut almost directly across the north-northeast trend of the bedrock layering. They are commonly spaced on the order of <1 to 5' one from another. Relatively flat-lying (sub-horizontal) joints are also present, particularly in the granitic rocks. Much ground water flow may occur at shallow depths in those joints; however, these joints become more widely spaced and more closed with depth. Because of their high fracture porosity, joint zones may not only constitute important high-yield bedrock aquifers but also offer ready avenues for human or salt-water contamination.

Fault fractures occur in the bedrock at several locations in Freeport. Most are very minor cracks of short length along which the bedrock displacement is on the scales of inches. The faults mapped by Hussey (1981) are shown on Figure 3. Two major faults are mapped in the Freeport area: a pre-metamorphic thrust fault and the post-metamorphic Flying Point Fault. The older fault parallels U.S. Route 1 and separates the Vassalboro and Cushing Formations. The Flying Point Fault trends through Casco and Maquoit Bays locally traversing Flying Point where it was first observed. Major faults such as these can be important bedrock aquifers if the structural deformation caused by the fault movement was sufficiently intense to create a zone of bedrock crushing and fracturing in and adjacent to the plane of fault slippage, to create a zone of high fracture porosity.

3.4 TOPOGRAPHIC LINEAMENTS

Topographic lineaments are straight or gently-curved depressions or topographic "breaks" in the ground surface that may reflect trends or zones of closely-spaced fracturing in the underlying bedrock. Such zones may have sufficiently high fracture porosity to constitute important bedrock aquifers. Our viewing of the Freeport study area on satellite imagery, side-scan radar, and stereo-paired aerial photos has revealed numerous photo lineaments which may reflect zones where the bedrock is relatively closely fractured. (Our photo lineament analysis is preliminary at this stage and will be completed along with a map of potentially high yield bedrock zones in our next phase of work.)

4.0 GROUND WATER AND WELL SUPPLIES

A survey of the Freeport private water supplies was performed in conjunction with the Greater Portland Council of Governments. The process consisted of distributing well survey questionnaires to the residents, collecting and plotting the locations of responses, and compiling the resulting information into a data base.

The Town of Freeport mailed 1446 well questionnaires, one for each tax lot, to the property owners in the areas of Freeport not served by public water supply. A sample questionnaire is presented in Appendix C. No distinction was made with regard to developed and undeveloped parcels when distributing the questionnaires. There were a total of 269 respondents to the questionnaire--approximately 18% of the total number of questionnaires distributed. Twenty-seven of these were not useful, however, due to lack of information, leaving 242 questionnaires to be used in the study. The water source locations obtained from the survey were plotted by GPCOG on a base map at a scale of 1 inch equals 1,000 feet. Robert G. Gerber, Inc. entered all of the available data into the project data base that is presented in Appendix A.

Additional well data pertinent to Freeport were obtained by RGGI from the Maine Geological Survey. These data, originally compiled by Caswell and Lanctot (1978), and published in Ground Water Resource Maps of Cumberland County, included eighty (80) wells which were located in Freeport. Descriptive data of well depth, yield, and water level were included in this source of information. After reviewing the locations of these wells to prevent duplication of data, they were plotted on the project base map and included in the ground water data base.

Compilation of data from the two sources of Freeport well questionnaires and literature review have resulted in a data base of 322 wells which have been described by several parameters including state plane grid coordinates, ground elevation, Geologic Unit, type of well construction, yield, depth, and water level. The tabulated results of this compilation are presented in Appendix A. See Table 1 for an explanation of the Well Type code.

Of the wells and springs for which we received completed questionnaires, approximately 67% were drilled wells (artesian wells) into bedrock. The remaining water supplies were mostly dug wells. A bar graph indicating the relative percentages of the four water source types included in the questionnaire is presented in Figure 4. Although the information obtained from lay people in a survey such as this is obviously not so accurate as that which would be obtained from trained geologists, the information is nevertheless useful for many types of analysis. When handling this much data, a few errors will occur, such as in plotting of well locations, but the overall conclusions will not be affected.

4.1 ANALYSIS OF BEDROCK WELL DATA

4.1.1 Introduction

Appendix A summarizes the numerical data collected for this study of domestic water supplies in Freeport. The information summarized by Appendix A was derived primarily from Water Supply Questionnaires submitted by individual landowners, and was supplemented with other pertinent well data obtained from the Maine Geological Survey.

4.1.2 Bedrock Well Yield

Statistical analyses of bedrock well yields have been performed on the data compiled in Appendix A, including data both from questionnaire responses, and from supplemental bedrock well data obtained from the Maine Geological Survey. The graphic results of this analysis are presented in Figure 5.

Table 2 summarizes the statistics on bedrock well yield according to Geologic Unit Codes. The median yield is the best estimator for the "typical" well yield, since the mean is skewed by a few high yield wells. Although the majority of wells reported in this study yield less than 10 gallons per minute (gpm), numerous high yield bedrock wells are reported to yield over 10 gpm, including 28% of the total bedrock wells for which yields were reported. Of these wells, 16% yield over 25 gpm, seven (7) wells yield 50 gpm or greater, including one well that is reported to yield 100 gpm.

This information corresponds closely with well yield data analyses performed in other coastal Maine communities. Gerber and Rand, 1982, determined in a study of groundwater resources in nearby Harpswell that a median yield of 5 gpm was typical of that area with the exception of Orr's Island where yields were somewhat higher. Caswell (1978) reported in the Ground Water Handbook for the State of Maine that "Average yield from most of the bedrock in Maine is less than 10 gpm, and sufficient only for supplying dwellings and limited agricultural needs. Caswell goes on to say "Investigations to date suggest that the highest bedrock-well yields occur in the vicinity of mapped or inferred faults, in what are termed high-yield zones."

It is interesting to note on Table 2 that wells located in the small area of Geologic Unit Code 9 (Cushing Formation, Tory Hill member) have a significantly higher average yield than do wells in other areas of Freeport. Although only 6 wells are reported in the GUC 9 Area, the standard deviation of the yields is of the same order as the standard deviation in the other zones; therefore, the difference in the means is significant.

4.1.3 Bedrock Well Depths

A statistical analysis was performed on the well data base to determine typical bedrock well depth in Freeport. The graphic results of that analysis are presented in the bar graph of Figure 6. Table 2 summarizes well depth information according to Geologic Unit Code. Forty-seven percent (47.5%) of the total number of bedrock wells reporting depths were included in 100-200 feet depth range.

Typical mean well depths for all but GUC 9 wells are 174 to 207 feet which is similar to Harpswell and the Maine coast as a whole. Higher yield wells often go to shallower depths since the driller does not have to go so deep to get an adequate yield for the homeowner.

4.1.4 Bedrock Geologic Unit Codes

Each water source included in this study has been assigned a Geologic Unit Code (GUC). Drilled wells were assigned Geologic Unit Codes as determined by the bedrock formation from which they draw water. Descriptions of the Geologic Units that pertain to bedrock wells can be found in Sction 3.1. In order to determine the relative number of bedrock wells in each GUC in Freeport, a statistical analysis was performed. The results of this analysis is presented in the bar graph on Figure 6. Table 2 summarizes the statistics. These results indicate that Geologic Units 5 and 7 have by far the most wells. To illustrate the reason for this, we can refer to Figure 3 which shows the aerial extent of the bedrock Geologic Units in the Freeport area. From this map it is apparent that the relative frequency of a well in a particular Geologic Unit is more closely related to the size and location of the Geologic Unit rather than the hydrogeologic characteristic of the unit. In order to correlate bedrock unit code, i.e. bedrock type, with hydraulic characteristics, we must statistically analyze each group of wells in each bedrock Geologic Unit and correlate that information to well yield and depth.

4.1.5 Hydraulic Characteristics of Bedrock Geologic Units

In order to locate areas which demonstrate a potential as high yield bedrock aquifers, several statistical analyses have been performed: first, to establish what are typical cases of well type, well depth, and well yield; and second, to identify and define Geologic Units that may have an effect on the amount of water received by and transmitted through various types of bedrock. The third step of photo-lineament analysis will, in the following phase of work, identify zones in bedrock where much higher rates of ground water yield may occur. In developing the statistical data on well yields and geologic conditions, it has been possible to develop correlations between these data and determine, to a limited degree, hydraulic characteristics of the bedrock Geologic Units.

Table 2 presents statistical data relating to bedrock well yield and well depth which has been sorted by Geologic Unit Code, and analyzed for mean, standard deviation and median value. These statistics make it possible to determine and compare the average yield and depth of wells, that produce water from these specific bedrock types. It is apparent from studying the resulting data that a typical well located in Geologic Unit 5, has been drilled to a greater depth to yield an equivalent amount of water than was required in Geologic Unit 8. This has geographic significance in that Geologic Unit 5 of the Vassalboro Formation is located in the central, north, and west parts of Freeport while Geologic Unit 8 of the Cushing Formation is located only in the south and east portions of Freeport.

Ground water yield observed in Geologic Units 5, 7, and 8 is normal for Maine; however, Geologic Unit 9 has a mean and median that is several times higher than typical.

Geologic unit 9 represents the Tory Hill member of the Cushing bedrock formation. This rock tyupe is described as a very rusty muscovite-biotite-quartz-sillimanite-graphite schist. This type of rock may exhibit foliation more distinctly than the gneisses and granofels of other rock types in the area. The Tory Hill Formation is located adjacent to and paralleling a major thrust fault that trends to the northeast through central Freeport. This ancient fault zone marks the irregular contact between the Vassalboro and Cushing Formations. Preliminary photo linear analysis has identified a higher concentration of mappable linear features in GUC 9 than in other portions of Freeport. These combined data describing this particular Geologic Unit suggests that it may be a generalized zone worthy of further investigation as a high yield bedrock aquifer.

4.2 WATER QUALITY

4.2.1 Methods

Our water quality data obtained for this study were derived from files of water quality tests at the Maine Department of Human Services, and from water quality tests reported by the residents of Freeport in the questionnaires. Records maintained on file at the Dept. of Human Services document the results of tests performed from 1969 through 1985. Over this period, more than 1,500 tests requested by Freeport residents were performed and recorded. In order to expedite the review process, we tabulated data pertaining only to water quality test results which failed to meet State drinking water standards. By taking this approach, the number of test results worthy of evaluation was reduced to 211 or 14% of all samples tested. Of the 211 failing test results, 65 tests or about 31% pertained to drilled wells in bedrock. Since this is disproportionately low compared with the apparent ratio of drilled to other well types (67%), this may imply that bedrock ground water is of better overall quality than ground water from surficial aquifers. These data, which are most relevant to the Freeport Bedrock Aquifer Study, have been included in this report in Appendix B.

4.2.2 Discussion of Basic Water Quality Parameters

The important water quality parameters to consider in each of these data sources and their respective concentration levels which we believe indicate signs of deteriorated water quality are listed as follows:

Nitrate	>1 mg/l
Iron	>0.25 "
Chloride	>50 "
Copper	>0.01 "
Manganese	>0.05 "
Coliforms	>1 colony per plate

It is important to note that copper is usually derived from copper plumbing and not from the environment. Maximum contaminant levels for copper for secondary drinking water standards set by the Maine Department of Human Services are 1.0 mg/l. The Nitrate-N drinking water limit set by the Maine Department of Human Services, Division of Health Engineering, is 10 mg/l but concentrations in "contaminated" ground water are usually >1 mg/l. Nitrate and coliform concentrations in ground water are generally related to the amount of biological decomposition and septic wastes present in the environment. Concentration limits for manganese and iron are Secondary Drinking Water Standards (not health-related) set by the Maine Department of Human Services as 0.05 mg/l, and 0.25 mg/l, respectively. Iron and manganese concentrations are generally related to the decomposition of an iron- and manganese-rich sulfide mineral present in the bedrock. The secondary drinking water standard for chloride is 250 mg/l but chloride concentrations commonly correlate with sodium concentrations in the environment. Chloride concentrations in excess of 50 mg/l generally indicate salt water intrusion, road salt contamination, or sewage contamination. The associated sodium concentrations may exceed the recommended limit of 20 mg/l standard for sodium in public drinking water supplies.

4.2.3 Results from Health Engineering Laboratory Records

Of the 65 "failed" bedrock well water quality tests compiled from Health Engineering records, half were due to the presence of coliform bacteria. This relatively high number of coliform-contaminated samples may be due in part to a common error of contaminating the sample either by well construction or by sampling technique. The data obtained from the "failed" Freeport bedrock well water quality test results are summarized as follows:

Parameter	No. of Cases Showing Signs of deteriorated water quality	% of Failed Samples
Nitrate	11	16.7
Iron	14	21.2
Chloride	13	19.7
Copper	0	0
Manganese	17	25.8
Coliforms	33	50.0

As discussed above, iron and manganese are naturally-occurring elements in rock and, when measured in water quality tests, tend to reflect greater than usual fractions of minerals in the bedrock aquifer, and/or reflect stagnant ground water conditions that allowed the rock to be in contact with the ground water for a longer time than normal. Numerous high concentrations of iron and manganese indicate that bedrock types in some portions of Freeport contribute high concentrations of these minerals.

Nearly 20% of the tabulated tests failed on the basis of high chloride contents. Included in the data obtained from Health Engineering were results of tests performed for the Maine Department of Transportation (MDOT) on domestic water supplies located in Freeport. The intent of MDOT's testing program is to detect potential contamination of wells which are located near roads that receive applications of salt and are suspected of being contaminated by road salt. It is apparent from these data that chlorides have contaminated some water supplies in Freeport but that the percentage of affected wells is probably exaggerated here by the non-random way in which the data were included in the data base.

4.2.4 Results from Well Questionnaire

Of the 151 water quality tests described in questionnaire responses by the Freeport residents, 99 or approximately two-thirds of the cases related to wells drilled in bedrock. This ratio correlates with the ratio of drilled wells to other source types in Freeport which is also about two-thirds of the total. Of the 99 water tests reported for bedrock sources, 29 cases were reported where the water contained "excessive concentration" of some contaminant.

Parameter	No. of Cases with "Excessive Concentrations"	% of Total Samples
Nitrate	1	1.0
Iron	25	25.3
Chloride	1	1.0
Copper	0	0.0
Manganese	0	0.0
Coliforms	5	5.1

Six percent of the bedrock wells have nitrate or coliform levels which exceed Safe Drinking Water Standards. Since levels of these 2 parameters are related mainly to the amount of biological decomposition and septic wastes, roughly 6% of the bedrock wells surveyed in Freeport appear to be affected by biological wastes of some sort such as septic system effluent or manure.

High concentrations of iron were reported as the leading reason for low quality of domestic drinking water. A total of 25 of the 99 (25%) water supplies on which water tests were performed reported excessive iron concentrations. Iron content is related more frequently to inherent characteristics of bedrock than to human activity, although it can be released into the ground water in the vicinity of landfills, leachfields, and other waste disposal areas. Both of the bedrock formations mapped in Freeport (i.e., the Vassalboro and Cushing Formations) contain large fractions of iron-bearing minerals and are known to impart iron to ground water as detected by these tests. Further analysis of these data in the following phase of work will correlate water quality with Geologic Unit type in order to relate areas of high ground water yield with water quality.

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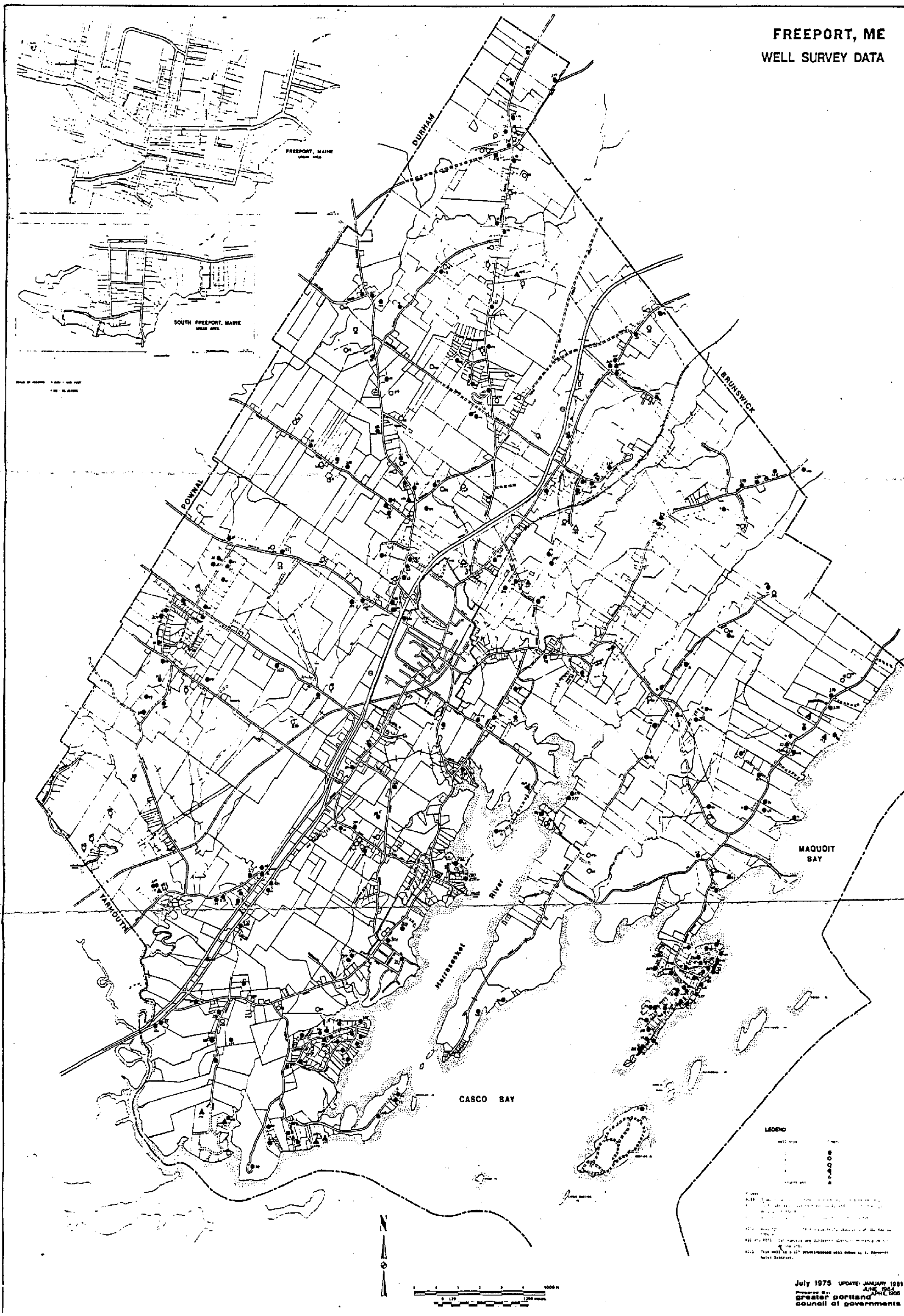
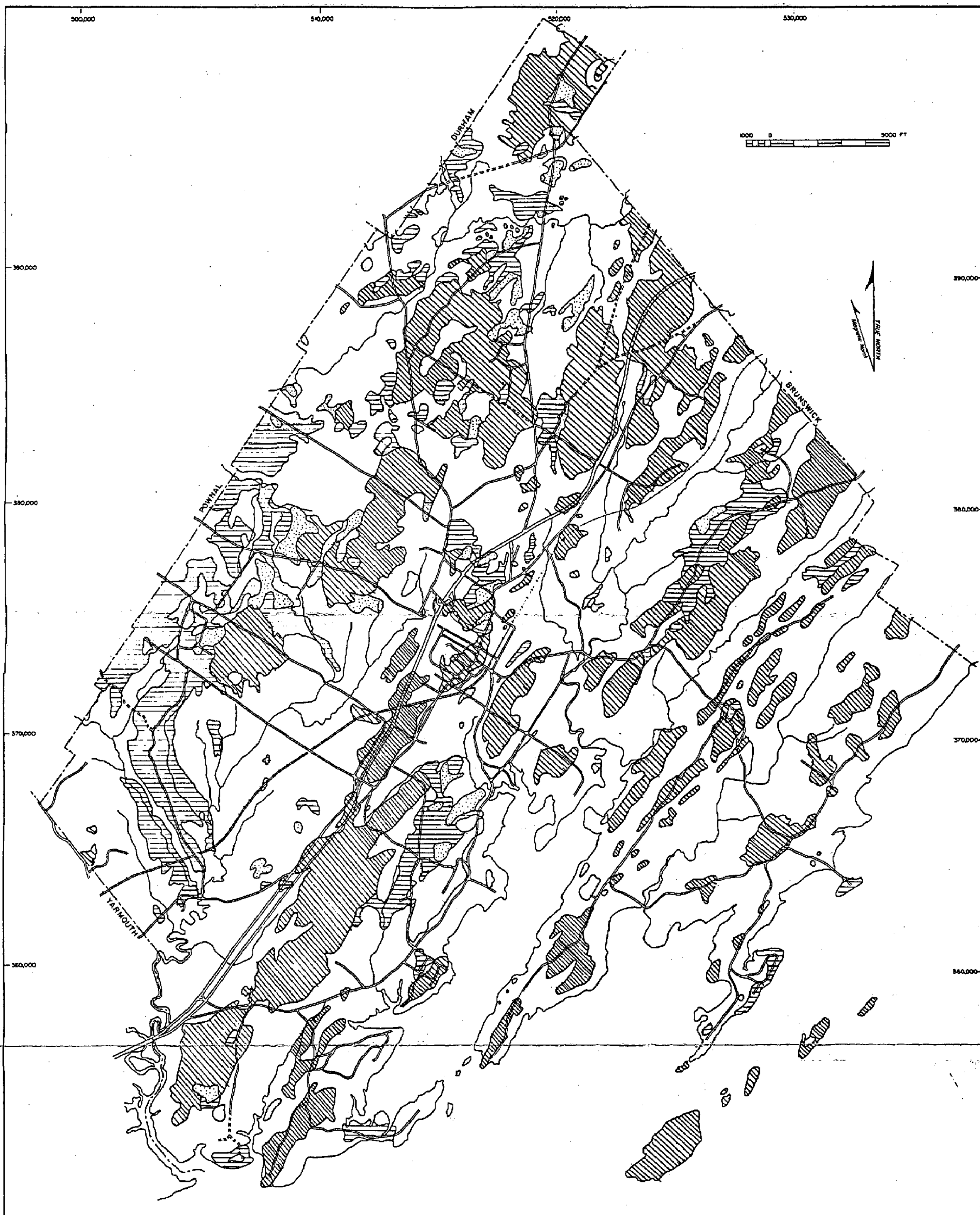

FREEPORT, ME
WELL SURVEY DATA
FREEPORT, MAINE
URBAN AREA
SOUTH FREEPORT, MAINE
URBAN AREA
DURHAM
BRUNSWICK
POWNAL
YARMOUTH
Harraseeket
River
MAQUOIT
BAY
CASCO BAY
LEGEND
N
July 1975 UPDATE: JANUARY 1981
JUNE 1984
APRIL 1986
Prepared By:
greater portland
council of governments



LEGEND

GEOLOGIC UNIT CODE	GRAPHIC SYMBOL	DESCRIPTION OF SURFICIAL (SOIL) UNITS	AVERAGE RECHARGE RATE INTO BEDROCK
1		Glacial till	0.23 GPM per acre
2		Glacial ice-contact	1.14 GPM per acre
3		Glaciomarine silt clay	0.11 GPM per acre
4		Glacial outwash sand	0.91 GPM per acre

SURFICIAL GEOLOGY

FOR THE

TOWN OF FREEPORT

FREEPORT BEDROCK AQUIFER STUDY

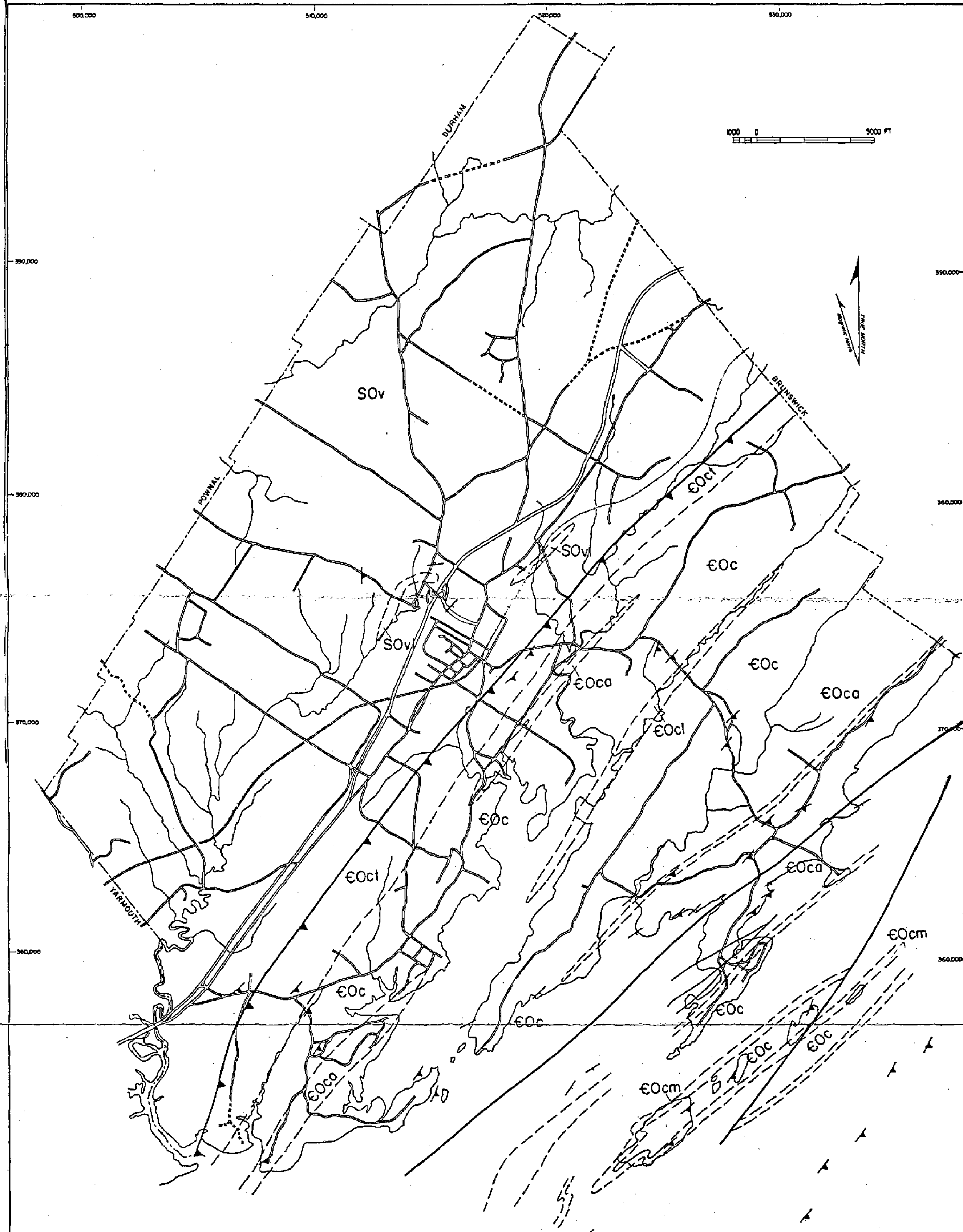
BY

ROBERT G. GERBER, INC.

CONSULTING CIVIL ENGINEERS AND GEOLOGISTS

FREEPORT, MAINE

DATE **MAY, 1986** | FIGURE **2**



LEGEND

GEOLOGIC UNIT CODE		BEDROCK FORMATION	ROCK TYPE
5	SOv	Vassalboro	Gray granofels
6	SOvl	Vassalboro	Marble
7	€Oc	Cushing	Non-rusty granofels
8	€Oca	Cushing	Amphibolite
9	€Oct	Cushing	Rusty schist
10	€Ocl	Cushing	Calc-silicate granofels

SYMBOLS

- Geologic contact
- High angle fault
- Thrust fault
- Foliation
- Bedding strike and dip

BEDROCK GEOLOGY

FOR THE

TOWN OF FREEPORT

FREEPORT BEDROCK AQUIFER STUDY

BY

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CONSULTING CIVIL ENGINEERS AND GEOLOGISTS
FREEPORT, MAINE

DATE | FIGURE

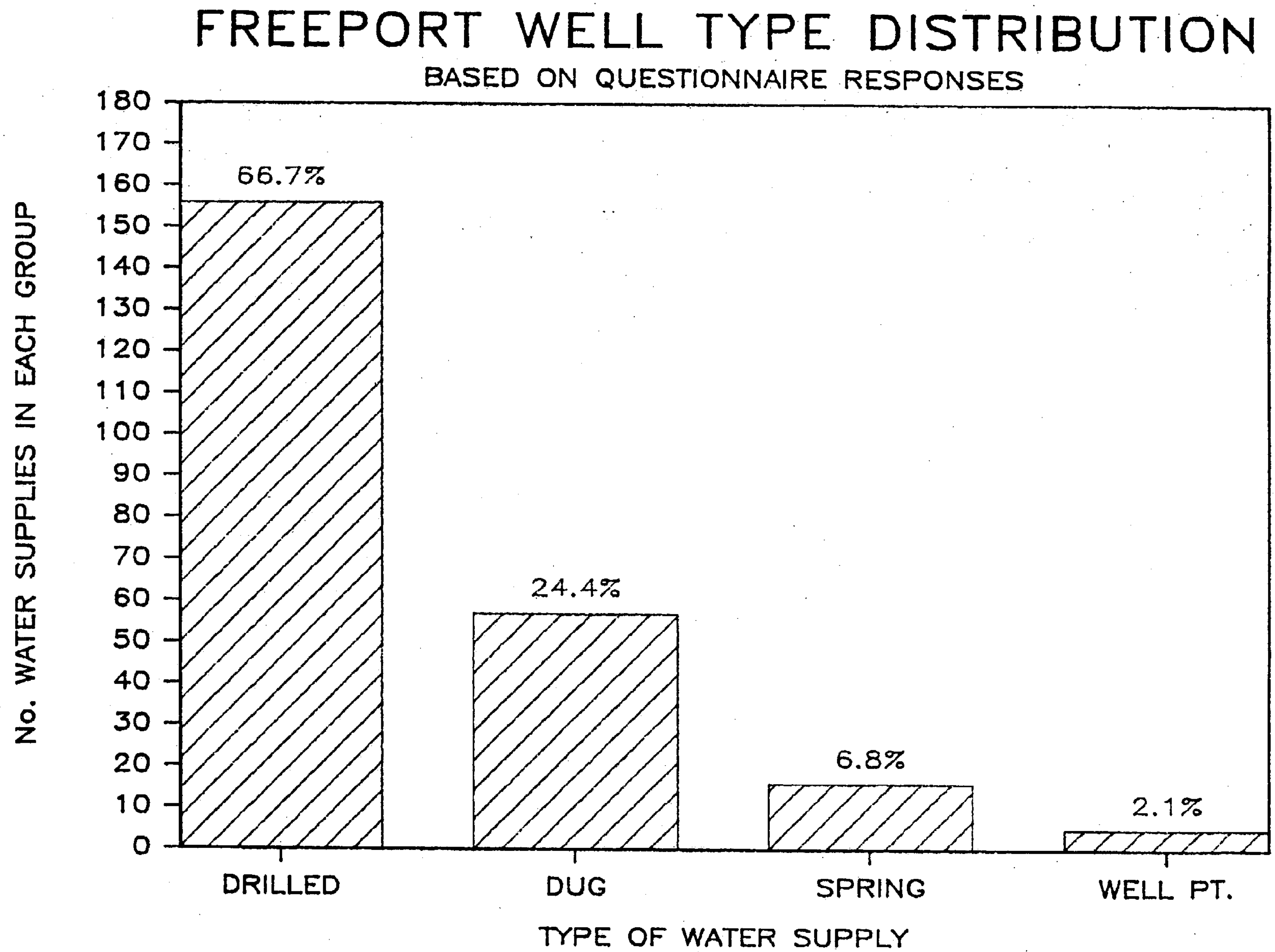

FREEPORT WELL TYPE DISTRIBUTION
BASED ON QUESTIONNAIRE RESPONSES
No. WATER SUPPLIES IN EACH GROUP
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
66.7%
24.4%
6.8%
2.1%
DRILLED
DUG
SPRING
WELL PT.
TYPE OF WATER SUPPLY

FIGURE 4

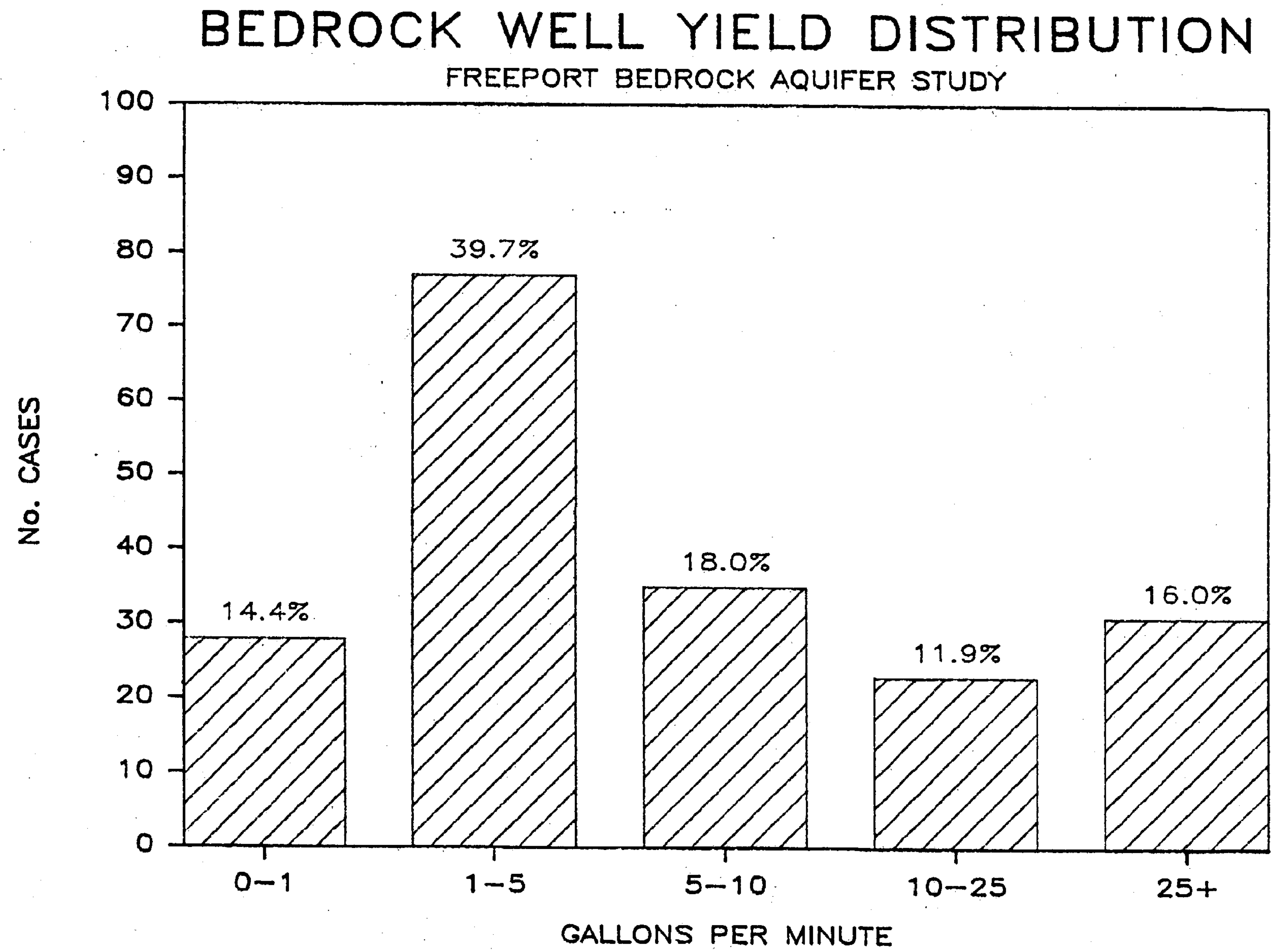

BEDROCK WELL YIELD DISTRIBUTION
FREEPORT BEDROCK AQUIFER STUDY
No. CASES
100
90
80
70
60
50
40
30
20
10
0
14.4%
39.7%
18.0%
11.9%
16.0%
0-1
1-5
5-10
10-25
25+
GALLONS PER MINUTE

FIGURE 5

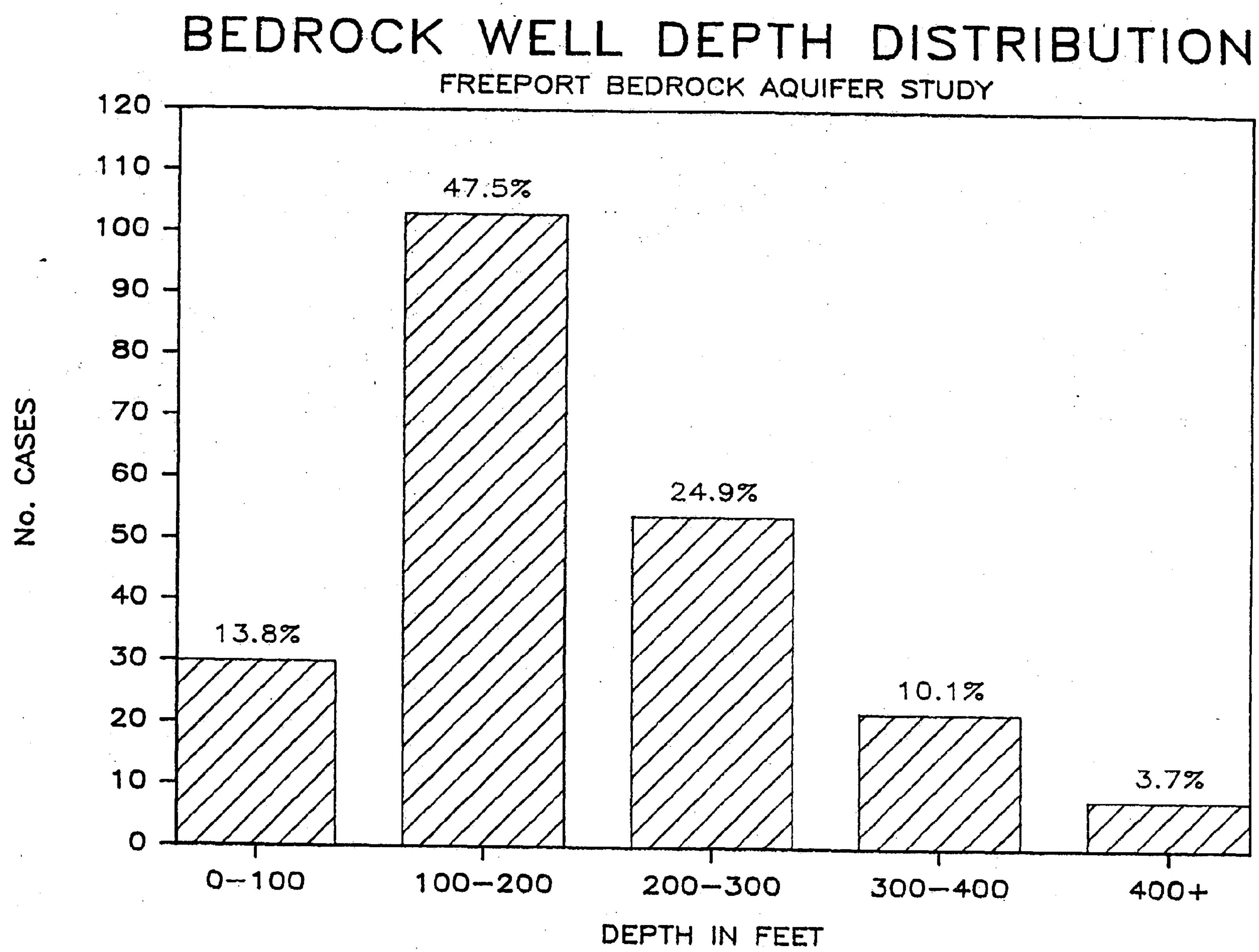
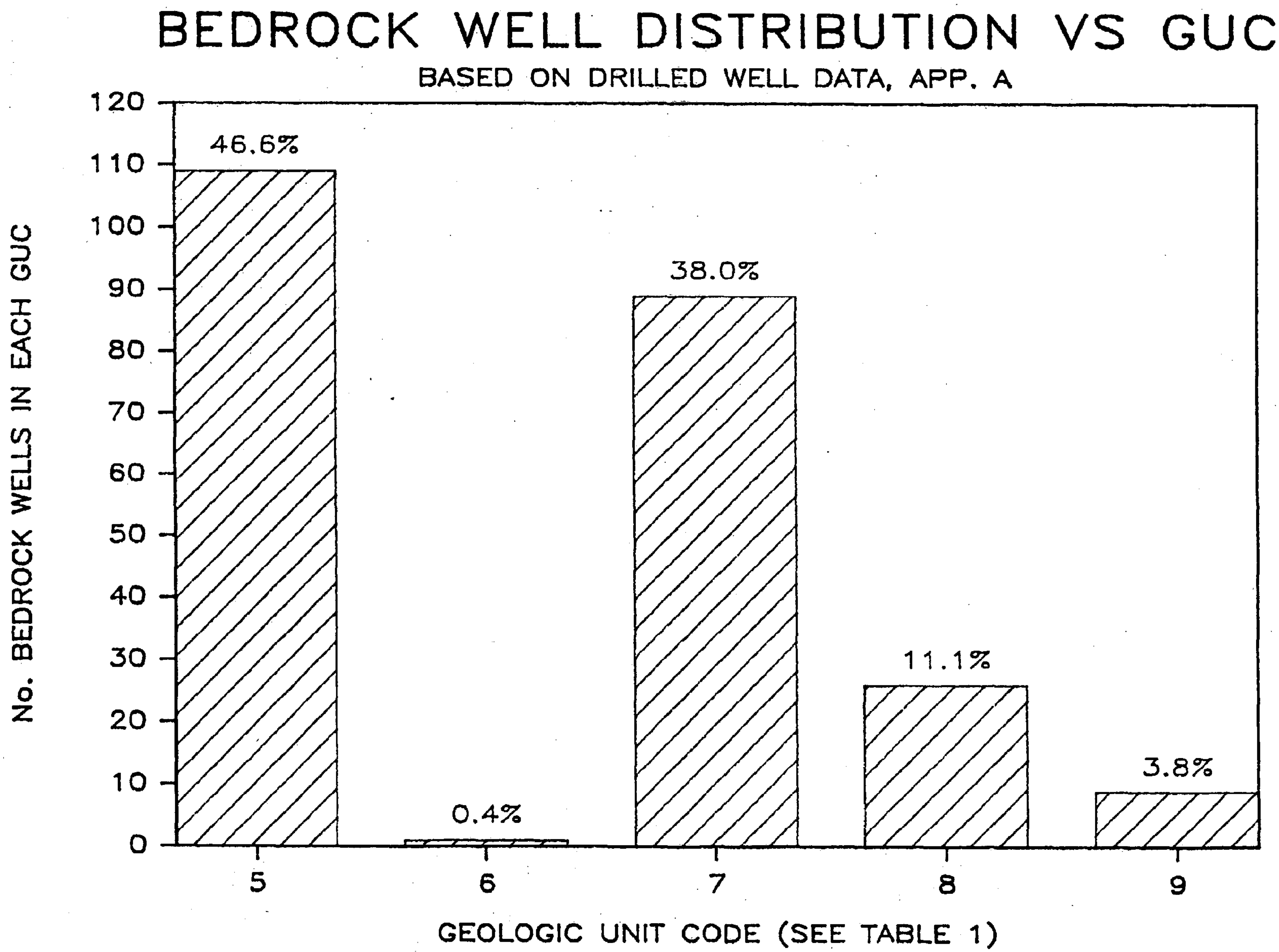

BEDROCK WELL DEPTH DISTRIBUTION
FREEPORT BEDROCK AQUIFER STUDY
No. CASES
0
10
20
30
40
50
60
70
80
90
100
110
120
13.8%
47.5%
24.9%
10.1%
3.7%
0-100
100-200
200-300
300-400
400+
DEPTH IN FEET

FIGURE 6



BEDROCK WELL DISTRIBUTION VS GUC
BASED ON DRILLED WELL DATA, APP. A
No. BEDROCK WELLS IN EACH GUC
0
10
20
30
40
50
60
70
80
90
100
110
120
46.6%
0.4%
38.0%
11.1%
3.8%
5
6
7
8
9
GEOLOGIC UNIT CODE (SEE TABLE 1)

FIGURE 7

TABLE 1

LEGEND FOR WELL TYPE AND GEOLOGIC UNIT CODE

Well Type Legend

1 drilled (artesian) well in bedrock
2 dug well in soil in which the ground water seldom or never overflows
3 spring developed in soil in which the ground water overflows the ground at least part of the year
4 spring developed in bedrock where the ground water flows out of the bedrock and overflows the ground surface during at least part of the year
5 well point (in soil)

Geologic Unit Codes

Soils (applied to dug wells, soil springs, and well points):

1 Glacial Till and thin soils and exposed Bedrock
2 Glacial Ice-Contact Deposits
3 Glaciomarine Clay-Silt
4 Glacial Outwash Sand

Bedrock units (applied to drilled wells):

5 Vassalboro SOv: Gneiss, thinly-bedded
6 Vassalboro SOvl: Marble
7 Cushing EOc: Schist and Gneiss with granofels
8 Cushing EOca: Amphibolite
9 Cushing EOct: Very rusty Schist
10 Cushing EOcl: Granofels and skarn-like rock
11 Cushing EOcm: Very rusty Schist and Granofels

TABLE 2

BEDROCK WELL YIELDS IN FREEPORT
AS A FUNCTION OF GEOLOGIC UNIT
CODE

GEOLOGIC UNIT CODE	STATISTIC	YIELD (gpm)	WELL DEPTH (feet)
GUC = 5	Median	4	
	Mean	10.8	207
	Std. Dev.	17.3	122
	No. Cases	97	103
GUC = 7	Median	3	
	Mean	10.7	174
	Std. Dev.	15.5	86
	No. Cases	74	81
GUC = 8	Median	5	
	Mean	10.7	175
	Std. Dev.	11.7	84
	No. Cases	20	27
GUC = 9	Median	32.5	
	Mean	24.9	144
	Std. Dev.	15.3	101
	No. Cases	6	8
COMBINED GUC = 7,8,9	Mean	11.5	172
	Std. Dev.	15.1	87
	No. Cases	100	116

APPENDIX A

APPENDIX A
FREEPORT 1986 WELL SURVEY DATA

WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GUC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
1	5A	5I	358400	528500	10	2	2	1950	1300	0	---	---	---	---	---	---	0		22	22	19	9	1985	---
2	21	45B	375000	514200	165	5	1	1980	350	1	---	---	---	---	---	RADON	0	4	265	210				
3	21	70A	380800	511700	185	3	2	1976	600	1							0	20	18	18	0			
4	23	35	364900	513000	147	3	2	1965	300	1							0	35	9		4			
5	19	24-5	369100	530500	70	7	1	1985	1000	1							0	10	225	25	10	7	1985	
6	28	11	356600	513400	45	8	1	1978	15	1							0		200					
7	18	92	379700	529700	150	7	1	1977	500	0							0	12	179	14	7		1977	
8	25	54C	355250	510050	70	7	1	1980	5280	1							0	2	250	230				
9	18	54	380900	523300	160	5	1	1980	30	0							0	2	248	20				
10	24	80	360700	528300	20	8	1	1971	250	0							1	3	98	46	15	8	1971	
11	19	30A	366800	530800	76	7	1	1966	100	1							0	1	197					
12	21	52A	380000	514500	215	5	1	1985	35	1							0	2	198	3	12		1985	
13	18	3	388300	526200	180	3	2	1957	100	1				1			0		25		20	7	1946	
14	19	55	381100	529100	98	7	1		1250	0							0	65	100	20	10		1985	
15	24	48	366100	521800	15	3	2	1961	3000	1							0		23	23	5	6	1961	
16	19	59D	370800	527700	110	7	1	1981	100	1							0	3	155	155	3			
17	54	19A	353700	526400	5	7	1	1974	30000	0							0	20	59	18	5		1974	
18	19	5	372400	535200	75	3	2	1911	100	0							0		30					
19	21	5A	386500	512400	160	3	2	1979	1500	1							0		20					
20	25	58B	352650	509200	84	7	1	1985	400	1				1			1	3	204	10				
21	5	88	359400	528600	28	5	1	1969	12	0							0	3	123	42	19	8	1969	
22	21	42D	376600	515200	165	6	1	1972	100	1							0							
23	17	34	386100	517500	260	5	1	1984	30	1						SAND	0	4	275	23	8	5	1985	
24	19	72	374500	529900	105	3	2	1965	150	0	1		1	1			1		18		0	2	1986	
25	22	51I	377300	506800	184	5	1	1982	100	1							0	5	150	48	22	2	1982	
26	26	20C	364800	504800	45	4	2	1971	200	0							0	1	14		8	2	1986	1971
27	5A	35H	356100	526200	10	7	1	1983	40	1	1						0	2	198	7	12	9	1983	
28	17	20	384500	520300	242	4	2	1968	200	0							0		12					
29	20	89	365700	519500	10	7	1		2200	0							0							
30	20	77	371900	520400	24	7	1		50	1							0							
31	21	59E	381600	515000	200	3	2	1969	125	1							0		16		4	4	1986	
32	21	59D	514700	381200	230	1	2	1973	125	1							0		16		3	4	1986	
33	21	88A	507300	378200	155	5	1	1972	80	1							0	7	109	100	10	7		
34	17	33G	519000	386800	198	5	1	1979	50	1				1			1	5	240	50	4	2	1979	
35	17	28C-5	518200	385000	255	5	1	1979	30	1							0		167		153	7	1985	
36	17	50	519100	391000	195	3	2	1978	300	0							0		15		6		1984	
37	5A	33	358100	526700	15	7	1	1978	400	1							0	19	97	14	12			
38	24	73	364100	529400	42	3	2	1859	70	1				1			1		26		10	9	1984	
39	23	79	357800	511500	15	3	2		1900	0							0		30					
40	17	47D	391700	519600	183	5	1	1985	400	1							0	7	300	60				
41	27	3H	356700	510800	95	7	1	1980	125	0							1	9	150	30	120		1980	
42	17	87A	389900	516800	238	5	1	1985	75	0							0	1	300	18	18	8	1985	
43	17	87	390100	317000	240	1	2	1968	100	1	1	1	1	1	1	1	0		32					1968
44	21	19-2	383700	518400	205	5	1	1985	1000	1							0	20	198	10	25	5	1985	
45	21	19-3	383800	518200	212	5	1	1985	1000	1						1	0	30	350	10	20	5	1985	
46	18	95A	379000	530600	155	1	2	1880	300	1				1			0		12					
47	21	13A	385200	514300	242	5	1	1973	175	0							0	1	298	4	1			
48	22	58	375300	506200	214	5	1	1978	100	1							0	6	211	18	6	12	1986	
49	17	61D	394100	525000	238	3	2	1975	1000	1							0		12		1			
50	22	7A	373700	504100	130	5	1	1973	20	1							0							

APPENDIX A
FREEPORT 1986 WELL SURVEY DATA

WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GUC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
51	5	57	360000	529700	20	7	1		15	0							0							
52	19	73	374200	530000	98	7	1		2200								0							
53	19	20A	369600	532700	84	7	1	1971	150	1				1			1		175					
54			360000	528900	30	8	1	1973	50	1							0	5	223	24	12	6		
55	21	90A	377800	509200	227	2	2	1961	50	1							0		12					
56	24	45B	364700	523800	80	1	2		15000	0							0		6					
57	21	15	384600	514500	203	3	2		300	1							0		11		4	1	1986	1984
58	5	61	363900	530100	18	8	1	1966		1							0	2	140	18				
59	22	15-1	372100	506300	250	5	1	1965	200	1							0	4	324					
60	24	56A	366200	523400	75	7	1	1977	100	1				1			1	20	125	8	11	7		
61	5	91A	359000	528200	30	5	1		81								0							
62	21	70B	381500	511400	202	3	2	1968	300	1							0		12		8			
63	5	62	359600	529500	15	7	1	1964	35								0		180	28	22	2	1984	
64	24	45	364000	523800	35	1	2	1950	675	0							0		6		2	8		
65	22	57-3	377100	506500	175	5	1	1983	250	1							0	1	648	55				
66	5	37	360700	529200	25	7	1	1968	75	1							0	5	200	47	30	12	1968	
67	5	94	359600	527600	15	8	1	1979	185	1	1						0		300					
68	5	128B	358900	527900	24	8	1	1984	30	1	1						0		180					1984
69	19	28	366700	531600	46	7	1	1943	100	1							0	14	175	15	20	10	1983	
70	21	42A	376500	514800	150	4	2	1961	40	1			1				1		25		8			
71	19	26	367100	531700	58	7	1	1974	35	1				1			1	3	297					
71A	19	26	366500	533100	22	7	1	1971										5	147					
72	017	079B+C	395100	518600	235	4	2	1969	200	1							0		14		5	9	1985	
73	5	43	360900	529600	25	7	1	1966	37	1							0	1	175					
74	21	49	380500	516900	140	8	2		10	1			1				0		20		11	11	1985	1975
75	17	15	385800	516400	264	1	2	1975	80	1														
76	18	2A	388200	526800	178	5	1	1983	30	0				1			0	8	100	20	13	6	1983	
77	27	9H	356600	512000	62	8	1	1978	200	1				1			0	1	223	5	4		1978	
78a	5	20a	359800	529300	25	7	1	1972	80	1							0	5	105	5	15		1972	
79	22	6	372900	504300	130	5	1	1947	100	0							0	10	110	20	3		1972	
80	19	69A	373000	528100	80	7	1	1983	200	1							1	10	132	14	50	5	1983	
81	5A	36	358100	526900	15	5	1	1979	350	1				1			1	35	110	30				
82	22	4	370700	503400	100	5	1	1965	40	0							0	20	130		70		1965	
83	21	4	388300	512200	170	3	2	1940	100	1							0	1	10		0	8		
84	22	58-5	376400	507000	182	5	1	1978	350	0							0	3	148	46	20	10	1978	
85	5A	15	356300	526300	10	7	1	1955	30	1				1			1	3	180					
86	21	46	379400	515500	170	3	2		200	1		1					0		20					
87	5	9	366900	529200	75	7	1	1969									0		95	32				
88	5A	71	356600	526700	10	7	1	1960	50	0							0	4	90	10	8		1960	
89	23	68A	363000	509100	118	5	1		30	1							0	30	120	8	5		1975	
90	27	4	356900	511800	55	7	1	1977	100	0							0	3	60	12	20	2	1984	
91	19	37	366400	529200	83	1	2	1949	100	1				1			0		16		8	8	1985	
92	17	64	395900	520200	262	1	2	1960	120	0							0		6		3			
93	25	43	509700	357800	50	3	2	1956	100	1				1			1		20		4	6	1957	
94	21	63A	379700	514300	205	5	1	1979	60								0	1	300	3	0	6	1979	
95	5A	35E	358700	527800	24	8	1	1969	300	1							0	2	196	31	10	8	1970	
96	23	31C	365400	514100	122	9	2	1966	150	1				1			0		25		7		1984	
97	22	4B	371300	503600	102	5	1	1976	400	1							0	3	248	86	65	9	1975	
98	22	7B-7	375100	504400	180	5	1	1980	50	1							1		300					
99	19	19	370000	532800	85	7	1	1950	300	1							0	6	300	4	16	8	1983	

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WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GWC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
100	17	93	388600	514000	170	5	1	1979	300	0							0	45	123	25	25	3	1979	
101	19	66	372000	527000	105	7	1	1979	20	1							0		185	18				
102	18	90A	381600	533300	115	7	1	1967	12	1							0	5	174	4			1968	
103	28	15	355600	512800	20	7	1	1958	300	1							0	10	126	14	20	3		
104	24	286	358300	509900	20	7	1	1981	1300	0							0							
105	18	5	387600	526300	180	3	2	1956	100	1							0	150	16					
106	5	112	360400	527000	20	8	1		40	1							0		80					1983
107	18	34A	382900	521200	235	1	2	1972	150	1							0		6		3	10	1985	
108	22	54	375500	505200	202	5	1	1973	110	1						RADON	0	1	219	30				1984
109	25	61C	352300	511500	8	4	5	1965	780	1							0	7	18		15		1965	
110	25	62A	352000	510600	15	7	1	1984	800	0							0	12	162	10				
111	17	92A	388400	514800	218	5	1	1976	100	1							0	18	120	20	12	1	1976	
112	19	9	370100	534800	38	7	1	1966	1400	1							0		207					
113	26	41	364000	508900	118	5	1		40								0							
114	21	47	379600	516200	153	5	1	1978	300	1						SULFER	1	1	350	35	30	8		
115	18	58	380400	521700	145	5	1	1953	100	1							0	10	85	9	17		1953	
116	20	65	371500	526500	116	3	3	1937	300	1				1			1		3		1			
117	5	79A	359800	528300	25	7	1	1959	40	1							0		60		21	7	1979	
118	21	15C	383500	514000	186	1	2	1960	100	1							0		20		5	6	1985	
119	21	73	381700	512100	190	5	1	1940	25	1							0		150					
120	20	52-15	372600	523400	145	7	1	1976	100	1				1			1							
121	21	5	387400	512800	158	3	2	1965	700	0							0		12					
122	20	21A	376500	520300	110	5	1	1968	30	1				1		SULFATE	1	55	425	11	5		1968	
123	20	68	371300	526700	110	7	1	1971	10	1				1			1	2	196	10				
124	5	45	360500	529800	20	7	1	1964	50	1							0	3	100					
125	28	9	356300	513200	40	7	1	1952	125	1				1			0	2	130	10	30	9	1984	1983
126	28	14C	356000	512600	22	8	1	1972	15	0							0	10	200					
127	27	9X	356400	512300	48	8	1	1978	250	1				1			1	7	250	6	225	6	1978	
128	26	31	362600	506900	70	5	1	1969	87	1							0	3	197	23			1969	
129	26	34	362500	507800	92	5	1	1977	115	1							0	50	295	1	50	1	1986	
130	23	43	365800	512400	178	5	4	1954	30	0							0		8		3	6		
131	20	93	371200	517100	130	9	1	1914	55	0							0							
132	24	28E	357800	508800	20	7	1	1984	500	1	1	1	1	1			0	30	179	58	0		1985	
133	24	75	363200	529500	25	8	1	1956	275	1							0	25	120	45	14		1956	
134	5	11	359700	529000	25	7	1	1970	40	1							0	20	122	26	22	5	1985	
135	26	13C-3	363000	504300	38																			
136	21	41	377300	517800	100	4	5	1950	900	1							0	50	20	20	4			
137	18	49E	384500	526300	200	1	2		100	1				1			0							
138	22	55	376000	505900	200	4	2	1890	200	1							0		12		5	9	1983	
139	17	77H	396000	520000	262	2	3	1960	300	1							0		11		4	6	1984	
140	17	55B	383300	519900	220	3	3		10	1							0		4		1			
141	5A	65	528100	358300	21	7	1	1955	70	0							1		200					
142	25	41B-12	353000	508300	23	7	1	1984	1000	1							0	8	205	60				
143	17	29	384300	519400	224	4	2	1968	130	1		1					0		18		8	6		
144	22	38	371500	511300	75	5	1	1982	100	1							0	2	300	67				
145	19	61	369000	526400	70	7	1	1982	300	0				1			1	28	140	5	12	7		
146	5	21	360100	529400	25	2	2	1957	100	0							0		20	20	15	9	1985	
147	22	4A	372100	504200	90	5	1	1979	225	1				1			1	2	322	52				
148	26	23	367800	503000	60	4	2	1977	350	1							0		6		2	7	1985	
149	5A	60	358800	528300	28	7	1	1951	500	1							0	5	100	35	20	7	1951	

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WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GUC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
150	5	67	359400	529200	20	3	2	1960	25	0							0		18					
151	25	15A	358900	508100	148	9	1	1960	300	1							0							
152	20	83	370600	520400	15	7	1	1976	800	1							0	1	347	90				
153	25	41B-8	351500	507500	20	4	2	1970	5300	1							0		10		6		1985	
154	19	24-1	368200	531400	85	8	1	1984	500	1							0	5	290	20	4	2	1984	
155	18	104	381500	532000	183	7	1	1980	200	1							0	1			35	8	1980	
156	17	33C	385500	518800	197	3	2	1982	700	1						ALGAE	0 56 ?		8	8	4	8	1985	
157	23	36	365200	513200	140	4	2		60	1	1						0		17					Y
158	24	68	364800	528700	80	7	1	1966	75	0						RADON	1	2	420					
159	28	22	356700	513000	58	8	1	1970	100	1							0	1	280					
160	21	37B	380000	519000	155	3	2	1963	33	1				1			0		14		2	4	1985	1965
161	27	9D	355500	510650	60	8	1	1969	15	1							1	30	162	8	0	7	1969	
162	22	64	377100	509500	198	3	3	1920	400	1									2					
163	5A	37	358100	527300	22	8	1	1974	200	1							0	10	100	10				
164	87	20	367600	521000	62					1														
165	21	49B	380600	517900	138	3	3	1959	200	0							0		12	6	3	7		
166	22	53B	374800	506100	218	5	1	1974	150								1	30	147	4	1	9	1974	
167	5A	66	358300	528400	10	7	1	1971	125	1							0	4	123	1	10		1971	
168	23	33	364900	513400	138	4	3	1925	300	1							0		6		2	7		
169	17	32B	358800	528300	202	3	3	1970	120	1				1			0		6		1			
170	22	12	371600	505300	100	3	3		300	1							0		4		0			
171	17	39	389500	520500	190	3	3	1975	550	0							0		9					
172	17	43	390200	518900	195	3	3	1620	450	1							0	5	6		6		1985	
173	23	32	364800	513500	140	8	1	1980	150	1				1			0	3	152	20	11	3	1980	
174	25	22D	356400	507500	77	9	4	1985	600	1				1			1	4	22	12	3	8	1985	
175	21	63C	379400	514400	182	5	1	1980		0							0		150					
176	21	55	380000	515400	175				300	1						COPPER								
177	27	8	356400	511700	58			1950	75	1							0							
178	25	41	353200	506200	65				600	0							0							
179	25	41B	352800	507300	23	9	1		1000								0		250					
180	20	24	376500	520900	115				175	1							0		74					
181	21	55B	381800	515000	185	5	1	1978	400	1	1						0	6	350		60			
182	25	25	357200	507100	100	1	2	1930	50	1			1				0		10					
183	19	20B	369400	532600	82	1	1	1972	60	1						RADON	1							
184	5	58	359100	529500	20	7	1	1984	15	1							0	4	198	18	22	7	1984	
185	25	71	354100	515100	8	7	1	1965		1							0	3	107					
186	27	3A	356700	511500	40	7	1	1978	25	1				1			1		165					
187	25	70	353900	515000	8	7	1		200	1				1			0		136					
188	26	4A	366300	501900	120	3	3	1700	600	1							0		12	12	3			
189	18	55	378800	523000	88	3	5		600	0							0		10		4			
190	20	53B	373700	524800	80	7	4	1935	100								0	4			2	2	1986	
191	19	16	370300	533500	78	8	1	1934	150	1						RADON	0	2	76	3	6	8	1934	
192	19	14A	370000	534400	40			1981	1000	0							0							
193	21	91	377300	511500	215	3	2	1974	100	1							0		12					
194	18	55A	379100	522500	118	3	2	1969	175	0							1	2	10	13	6		1985	1984
195	24	51	366500	521600	20	7	1	1967	2640								0	12	201	37	25	8	1967	
196	19	80	376300	531800	118	7	1	1984	500	1						RADON	0	5	97	5				
197	19	80A	386100	532000	99	3	2	1968	100	1	1						0	2	12		5			
198	25	61R	352000	811400	5		5	1965	800	1								6	18		15		1965	
199	25	61D	352200	511800	5		5	1965	800	1								6	18		15		1965	

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WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GUC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
200	22	10C	371000	504400	75	5	1	1981	18	1							0	25	173	45				
201	25	11	358100	505900	90	5	1		75	1							0							
202	19	15	370900	533700	120																			
203	5	73	359100	529100	20	7	4	1957	40	0							0	3	72					
204	27	7	357200	512400	30	7	1	1968	50	1							0	30	121	31	37	10	1968	
205	25	10B	356400	506600	118	9	1	1970	60	0							0							
206	26	58A	360000	506400	77	5	1	1982		1							0	80	373	46				
207	5	106	359900	526900	20	8	1		20	1							0		60					
208	5	60	359800	529500	20	7	1	1982	40								0	5	150	31				
209	5	55	360200	529700	20	7	1	1973	20	0							0	4	175	17	25			
210	21	76	383300	510200	175	4	2		200	1							0		12					1972
211	22	58-3	377000	507200	182	5	1	1983	150	1				1			0	1	300	55	20	7	1983	
212	21	42C	377100	515300	180	5	1		24								0							
213	26	33	362700	507200	90	5	1	1965	100	1								1	200					
214	20	21	376200	519900	105	5	1	1970	300	1							1	50	210		200	2	1986	
215	18	47A	381100	524000	180	5	1	1970	135	1							0	3	121	11				
216	5A	31	357500	526500	10	7	1	1968		0							0	3	112	12				
217	5A	10	356200	526100	10	7	1	1960	1000	1				1	1		1	6	50	15	20	9	1980	
218	19	21A	369300	533000	80	7	1	1970	50	1				1			1	30			10	1	1986	
219	18	39	372900	522600	170	5	1	1985	150	1							0	10	135	20				1985
220	25	20A	358200	508500	103	1	2	1958	60	1							0		18		10			
221	26	35	362900	507900	108	5	1			1							0	7	140	40				
222	5A	28	357100	526500	10	7	1	1954	200	1				1			0	3	55	6				
223	22	35	371800	511900	80	3	3		100								0							
224	17	43	389800	520200	185																			
225	23	28	366300	514100	125	9	1	1966	1500	1							0	37	45	45	1			
226	22	21	570300	510200	80	3	2	1912	800	1							0	50	12		0			
227	5	78	358700	528800	20	7	1	1983	110	1							0		165	20				
228	5	35	360300	528800	22	7	1	1970	40								0	3	113					
229A	26	13C	363200	504000	44	5	1	1973	224								0						1978	
229B	26	13C	363200	504000	42		1	1978	500									90	121		21			
230	5A	20	356900	526700	20	7	1	1975	30	1							0	4	90	14	4	5	1975	
231	22	18	371200	506800	100	5	1	1960	20	1							0		80		7	3	1986	
232	29	10	CAN'T	LOCATE			1	1961	1	0							0		200					
233	19	80	376800	532000	110	3	2	1930	1000	1	1							3	16		5			
234	22	7B-6	375300	504100	170	5	1	1981	40	1							0	2	373	6	9	10	1981	
235	25	41B-9	362000	515500	50	7	1	1969	3900	1							0	3	175	25	20	6	1985	
236	17	36A	358500	523100	176	3	2		600	1							0		15					
237	24	28H	388300	517800	35	7	1	1983		1							0	30	198	18	21	8	1983	
238	24	28	356700	518200	20	7	1	1978	150	1					1		0	5	148	10	12	11	1985	
239	24	43	363800	522400	62	1	2	1964	10	0							0	2	10	10	5	7	1985	
240	24	42	363800	522800	62	7	1	1961	100	1							0	2	240	20	22	7	1985	
241	24	37	363000	522300	62	7	1	1978	20	1							0	2	248	17	15	10	1985	
242			395300	519800	260	5	1											10	134	1				
243			395900	519700	270	5	1											5	50	0.5	13			
244			396500	520000	280	5	1											2.5	581	3.5				
245			398000	519900	290	5	1											3	65	7	10			
246			399300	520700	260	5	1											1	298	24	19			
247			398100	521900	240	5	1											0.5	373	6	48			
248			394900	519200	240	5	1											1	222	32	8			

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WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GUC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
249			392000	519300	180	5	1											4	222	11	15			
250			394600	520000	230	5	1											8	100	7	5			
251			388400	519100	210	5	1											20	133	63	7			
252			384800	519000	220	5	1											4	195	6				
253			380600	319100	160	5	1											6.25	178	25	8			
254			380500	385600	180	5	1											20	354	1	39			
255			380000	515200	200	5	1											0.5	100	10.5				
256			383000	514000	190	5	1											55	225	38	7			
257			386200	513600	220	5	1											0	400	5				
258			381500	512500	230	5	1											6	172	10				
259			382300	510900	180	5	1											0.9	442	8				
260			388900	513200	200	5	1											20	440	7	18			
261			385500	524800	220	5	1											0.75	287	3	33			
262			386000	524700	220	5	1											6	241	1				
263			387300	525700	220	5	1											1	305	3				
264			386000	524500	218	5	1											10	195	10				
265			386200	524700	220	5	1											0.5	303	2				
266			384600	526600	210	5	1											0.5	205	1	10			
267			380400	523100	140	5	1											9.5	124	9	19.5			
268			380700	523700	140	5	1											1	123	2				
269			381500	524500	160	5	1											1.5	248	6	20.5			
270			280600	530600	180	5	1											6	123	3	3			
271			380900	531200	200	5	1											4	239	50				
272			370600	531700	190	5	1											3.5	158	13	0			
273			370600	528600	90	7	1											35	121	7				
274			371700	534700	70	8	1												260	16	6			
275			371200	534200	80	7	1											2	172	5				
276			367400	523000	10	7	1											22	201	33				
277			367100	522800	20	7	1											12	201	32				
278			370600	519400	50	8	1											35	121	7				
279			370400	518600	70	7	1											2.4	340	23				
280			363600	518200	20	7	1											40	545	30	22			
281			364300	517700	20	7	1											4	160	21				
282			364300	517700	20	7	1											101	156	5.5				
283			368400	518000	25	8	1											30	52	7	14.5			
284			365800	513000	90	9	1											40	148					
285			367500	514900	130	9	1											3.5	196	1.5				
286			368400	512900	160	5	1											60	321	1				
287			369300	513700	150	5	1											20	220					
288			375500	514700	120	5	1											13	220	56				
289			375200	514700	110	5	1											1.5	220	64				
290			374800	515200	120	5	1											0.75	385		75			
291			377300	515400	180	5	1											34.5	221	24.7	12			
292			377300	515400	180	5	1											100	121	60				
293			375500	513300	140	5	1											15	147	32				
294			375600	512800	130	5	1											9.2	290	18				
295			377400	519300	130	5	1											1.1	246	19				
296			377600	521800	100	5	1											2.5	121	6				
297			377300	521900	50	5	1											6.2	103	9				
298			375600	521300	90	9	1											85	313	6.3				

APPENDIX A
FREEPORT 1986 WELL SURVEY DATA

WELL	TAX #	LOT #	N COORD	E COORD	GRD ELEV	GUC	WELL TYPE	YEAR 1ST USED	DISTANCE FROM RD	QUALITY TESTED?	BACTERIA	NITRATE	CHLORIDE	IRON	ORGANICS	OTHER	WATER FILTER	YIELD (GPM)	WELL DEPTH	CASING LENGTH	WATER LEVEL	MONTH MEASURED	YEAR MEASURED	YEAR DRY
299			379000	526800	170	7	1											0.75	302	5				
300			379300	526800	170	7	1											16	132	13				
301			373200	521600	30	8	1											31	167	6				
302			360000	515600	60	7	1											1.8	385	16	36			
303			361400	515300	40	7	1											10	114	28				
304			360800	514600	70	7	1											1	198	13	2.5			
305			357400	513400	20	8	1											1	237	12	37			
306			360100	513000	50	7	1											0	348	19				
307			360000	512900	40	7	1											6	208	34	7			
308			353200	514300	20	7	1											15	112	15	18			
309			374800	504200	160	5	1											8	114	23	15			
310			372700	509500	103	5	1											1.7	175	32	19			
311			377600	509700	210	5	1																	
312			363700	508900	110	5	1											4	100	7				
313			363600	508400	110	5	1											6	241	1				
314			363300	509300	110	5	1											4	348	11	31			
315			357200	504400	50	5	1											18	150					
316			357000	504100	30	5	1											9	100	46	16			
317			355500	506800	100	9	1											30	156	26	6			
318			357700	507000	110	5	1											3	403	18	12			
319			351000	508600	90	8	1											7	371	3	63			
320			352000	509400	70	8	1											3	175	12	20			
321			352400	510200	30	7	1											5	98	13	9			
322			361400	509800	90	5	1											3	197	53				

EXPLANATION OF COMPUTER PRINTOUT

Description of Well Tabulation Headings

WELL--unique well number assigned to the well; the Freeport bedrock wells are plotted according to this system

TAX #--tax map lot number on respective town tax map; left blank if not known

N COORD--Maine State Grid northern coordinate

E COORD--Maine State Grid eastern coordinate

GRD ELEV--estimated ground elevation at well, referenced to Mean Sea Level (NGVD)

GUC--geologic unit code (see Table 1)

WELL TYPE--type of well or spring (see Table 1); left blank if not known

YEAR 1ST USED--the year the well or spring was first used or developed for a water supply; left blank if not known

DISTANCE FROM RD--distance in feet between the nearest public road and the water supply; left blank if not known

QUALITY TESTED?--indication as to whether the water from the water supply has been tested by a laboratory; "1" if yes, left blank if not known

BACTERIA--indication as to whether the water contained excessive coliform bacteria according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

NITRATE--indication as to whether the water contained excessive nitrate nitrogen according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

CHLORIDE--indication as to whether the water contained excessive chloride according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

IRON--indication as to whether the water contained excessive iron according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

ORGANICS--indication as to whether the water contained excessive organics according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

OTHER--indication as to whether the water contained excessive other constituents according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

WATER FILTER--indication as to whether a water softener or other treatment system is used to treat the water; left blank if no or not known, "1" if yes

YIELD (GPM)--rated yield of the well in gallons per minute; left blank if not known

WELL DEPTH--total depth of well in feet; left blank if not known

CASING LENGTH--total length of well casing, or, if known, depth to bedrock in feet; left blank if not known

WATER LEVEL--distance from ground surface to static water level in feet; left blank if not known

MONTH MEASURED--month of the year in which the static water level is measured; left blank if not known

YEAR MEASURED--year in which the static water level is measured; left blank if not known

YEAR DRY--a year in which the well went dry; left blank if not known

APPENDIX A1

EXPLANATION OF COMPUTER PRINTOUT

Description of Well Tabulation Headings

WELL--unique well number assigned to the well; the Freeport bedrock wells are plotted according to this system

TAX #--tax map lot number on respective town tax map; left blank if not known

N COORD--Maine State Grid northern coordinate

E COORD--Maine State Grid eastern coordinate

GRD ELEV--estimated ground elevation at well, referenced to Mean Sea Level (NGVD)

GUC--geologic unit code (see Table 1)

WELL TYPE--type of well or spring (see Table 1); left blank if not known

YEAR 1ST USED--the year the well or spring was first used or developed for a water supply; left blank if not known

DISTANCE FROM RD--distance in feet between the nearest public road and the water supply; left blank if not known

QUALITY TESTED?--indication as to whether the water from the water supply has been tested by a laboratory; "1" if yes, left blank if not known

BACTERIA--indication as to whether the water contained excessive coliform bacteria according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

NITRATE--indication as to whether the water contained excessive nitrate nitrogen according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

CHLORIDE--indication as to whether the water contained excessive chloride according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

IRON--indication as to whether the water contained excessive iron according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

ORGANICS--indication as to whether the water contained excessive organics according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

OTHER--indication as to whether the water contained excessive other constituents according to recommended drinking water standards; left blank if no or not known, "1" if excessive level was reported

WATER FILTER--indication as to whether a water softener or other treatment system is used to treat the water; left blank if no or not known, "1" if yes

YIELD (GPM)--rated yield of the well in gallons per minute; left blank if not known

WELL DEPTH--total depth of well in feet; left blank if not known

CASING LENGTH--total length of well casing, or, if known, depth to bedrock in feet; left blank if not known

WATER LEVEL--distance from ground surface to static water level in feet; left blank if not known

MONTH MEASURED--month of the year in which the static water level is measured; left blank if not known

YEAR MEASURED--year in which the static water level is measured; left blank if not known

YEAR DRY--a year in which the well went dry; left blank if not known

APPENDIX B

FREEPORT AQUIFER STUDY. DATA OBTAINED FROM MAINE DEPT. OF HEALTH ENGINEERING

WELL TYPES: 1 = DRILLED, 2 = DUG, 3 = SPRING, 4 = OTHER

WELL No.	WELL TYPE	WELL DEPTH	YEAR 1ST	COLI FORMS	COL-OR	TUR-BID	pH	HARD NESS	CHLOR-IDES	NIT-RITES	NIT-RATES	COP-PER	IRON	MANG-ANESE	SOD-IUM
1	1	160	1976	TNTC						<.005	<.005				
2	1	273	1980	CG			6.5		21						
3	1	64	1930	0	5	14.00	6.9	89	14	<.005	<.005				
4	1	160	1958	2						0.03	6.2				
5	1	208	1975	TNTC						<.005	<.005				
6	1			TNTC			6.2		19	<.005	<.005		0.68	0.22	
7	1		1977	TNTC			6.7			<.005	12.1				
8	1	30	1959	0						<.005	42				
9	1	175	1964	TNTC						0	0				
10	1	30	1962	TNTC						<.005	<.005				
11	1	300	1982	TNTC						<.005	<.005				
12	1	350	1975	TNTC						<.005	<.005				
13	1	175	1964	TNTC						<.005	<.005				
14	1	30	1962	TNTC						<.005	<.005				
15	1	300	1982	TNTC						<.005	<.005				
16	1	350	1975	TNTC						<.005	<.005				
17	1			0	15	22.00	6.9	347	183	<.005	<.005	0.03	4.70	0.41	
18	1	248	1983	CG	0	0.60	7	98	28	0.02	1.65	0.00	0.19	0.09	11
19	1	300	1982	0				55	11	<.005	0.56				
20	1		1961	220						<.005	<.005				
21	1	400	1980	0	0	0.20	7.6		54	<.005	<.005				
22	1	51		600	100	1.50	7.2	123	135	0	0	24.00	0.00	0.10	0.1
23	1	188	1969	TNTC			7.4	20	40	<.005	<.005		1.80	0.16	
24	1	327	1976	0						<.005	<.005				
25	1	273	1981	0						<.005	<.005				
26	1	360	1978	TNTC				98	43	<.005	4.56				
27	1			TNTC						<.005	<.005				
28	1	200	1979	CG						0	0				
29	1	148	1970	0			7	28	68	0	0	0.22	0.20	0.48	
30	1	173		0			7.1	218	0	0	0	0.21	28.30	2.75	
31	1			0			7.2	207	69	0	0				
32	1	183	1984	0	10	2.00	7	502	239	0	3.07	0.50	0.60	0.27	
33	1	185	1978	0	5	4.30	7.1	117	82	0	0	0.01	0.95	0.53	24
34	1	365	1983	CG	10	0.25	6.8	182	26	<.005	3.7	0.17	0.25	0.05	8
35	1	80		0			6.9	228	34	<.005	<.005	0.40	0.05		
36	1	64		0	0	0.30	7.1	110	14	<.005	<.005	0.01	0.04	0.17	
37	1	230	1975	0			7.8	180	62	<.005	<.005	1.46	0.34	0.00	
38	1	623	1976	2						<.005	<.005				
39	1	95	1967	0	0	1.00		60		<.005	<.005		0.21		
40	1	136	1958	3	0	0.00		215	105	<.005	2.9				
41	1	160	1953	0	5	2.00				<.005	<.005		0.22	0.09	
42	1	200	1975	1						<.005	<.005				
43	1	300		0			6.6	99		<.005	<.005				
44	1	196	1972	0	0	0.00				<.005	<.005				
45	1	100	1976	10						<.005	<.005				
46	1	145	1954	0	0	0.00			70	<.005	1.7				
47	1	196	1974	0	0	0.00			10	<.005	<.005				
48	1	300	1976	0			6.6	99		<.005	<.005		0.29	0.53	
49	1	300	1976	8			6.5	117		<.005	<.005		0.30	0.62	
50	1	250		2				91	29	<.005	<.005				
51	1	376	1975	0	10	3.00	7.4	164	29	<.005	<.005		0.32	0.59	

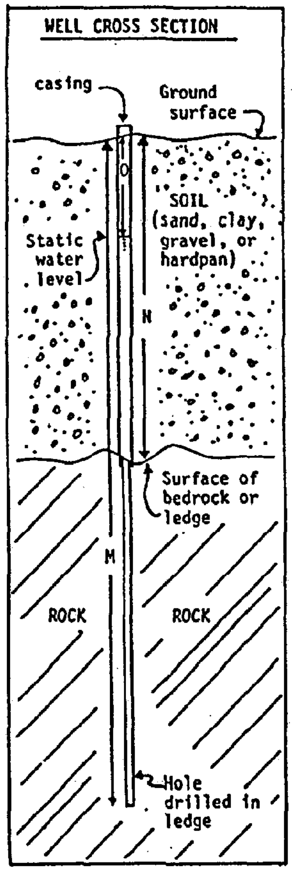
FREEPORT AQUIFER STUDY. DATA OBTAINED FROM MAINE DEPT. OF HEALTH ENGINEERING

WELL TYPES: 1 = DRILLED, 2 = DUG, 3 = SPRING, 4 = OTHER

WELL No.	WELL TYPE	WELL DEPTH	YEAR 1ST	COLIFORMS	COLOR	TURBID	pH	HARDNESS	CHLORIDES	NITRITES	NITRATES	COPPER	IRON	MANGANESE	SODIUM
52	1			0			6.6			<.005	<.005	1.60			
53	1		1971	0	0	0.00	7.5	91	14	<.005	<.005	1.40			
54	1	247	1973	24	15	1.00				<.005	<.005		0.27	0.28	
55	1		1951	0	5	2.00	7.2	227	290	<.005	<.005				
56	1		1974	0	5	3.00	6.1		11	<.005	<.005		0.75	0.04	4.3
57	1	100	1976	20	0			254	271	<.005	2.2				
58	1	240	1971	60						<.005	<.005				
59	1	65	1934	0	20	24.00				<.005	<.005		1.95	0.11	
60	1	100	1970	12						<.005	<.005				
61	1	110	1959	0	5			475	384	<.005	<.005				
62	1	75	1953	5			6.6	51		<.005	<.005		0.58	0.24	
63	1	260	1963	0	0	0.00	7.6	65		<.005	<.005				
64	1	110	1960	0	20	15.00	6.3	500	430	<.005	<.005				
65	1			0				179		<.005	<.005				
66	1			TNTC						<.005	<.005				

APPENDIX C

WATER SUPPLY QUESTIONNAIRE -- FREEPORT, MAINE, GROUND WATER STUDY



Less than half the Town of Freeport is served by public water supplies. The remainder of the Town residents must obtain their water supplies from individual wells, springs, or streams that are located on their own lots. With the rapid growth that has occurred in Freeport during the past few years, the demand on public water supplies has exceeded capacity and water is being purchased from Yarmouth. There are only two additional known gravel aquifers in Freeport that would be feasible to develop as public water supplies. One of these sources is presently being developed near the Webster Road. Additional sources for public water supplies must be found and the ability of property owners to develop a water supply that is of drinking water quality must be protected. The purpose of this study is to acquire information on the existing water supplies in the Town, particularly those artesian wells in bedrock, so that bedrock aquifers capable of yielding large quantities of water can be located and protected not only for the benefit of present users, but for future generations.

This questionnaire is being circulated by the Town of Freeport, with financial assistance provided by a grant from MAINE'S COASTAL PROGRAM, through funding provided by the U.S. Dept. of Commerce, Office of Coastal Zone Management, under the Coastal Zone Management Act of 1972, as amended. Town Manager Dale Olmstead is Project Manager of this study. Consultant Robert G. Gerber, Inc., will compile and analyze the questionnaire returns and prepare a report for the public on the results of the study. Greater Portland Council of Governments will also be assisting in the project.

Please fill out the questionnaire as completely as you can, leaving blank any questions for which you do not know the answer. To aid in your understanding of what some of the questions mean, at the left we have drawn a small cross section of a typical drilled well. The letters in the diagram correspond to some of the questions identified by the same letters in the right margin, opposite the questions. Please fill out separate forms for each well or spring on your property that is being now, or has been used in the past, as a water supply. Questions concerning the form or the study may be addressed to: Robert G. Gerber, Inc., 17 West Street, Freeport, Maine 04032, 207-865-6138. You may return the form directly to him by mail or drop it off at the Town Office. Please return by February 28th. Thank you.

Property Owner ____________ Freeport Tax Map Number (See mailing label) ________ A

Questionnaire Respondent ____________ Freeport Tax Map Lot # ________ B

North Coordinate (Please leave blank) ________ C

East Coordinate (Please leave blank) ________ D

Estimated Ground Elevation (Please leave blank) ________ E

Geologic Unit Code (Please leave blank) ________ F

Type of water supply? Answer "1" if drilled artesian well and supply name of well driller ____________ ; "2" if well dug by hand or backhoe; "3" if spring in soil; "4" if spring in ledge; "5" if well point; "6" if other, and describe ____________ ________ G

Year in which the water supply was first developed or used ________ H

Approximate distance, in feet, from nearest public road to water supply ________ I

Has the water supply been tested? ________ Enter "1" if excessive coliform bacteria; "2" if excessive nitrate-nitrogen; "3" if excessive chloride; "4" if excessive iron and/or manganese; "5" if gas, oil, or other organic chemicals were detected; "6" if other excessive constituents, and describe ____________ ________ J

Do you have a water softener or other type of treatment system? ________ K

How many gallons per minute is the water supply reported to produce? (Check with your well driller for this, if you know who he is) ________ L

What is the total depth of the well or spring, in feet, below ground? ________ M

What is the depth to ledge, or length of well casing, if a drilled artesian well? (Again, you could check with your well driller or look at the bill he gave you for drilling the well) ________ N

When the pump is off, how many feet below ground is the water level in your well? (This is called the "static level") ________ O

If you answered the previous question, in what month and year was the level measured? ________ P

In which years has your water supply run dry, if ever? ________ Q

Please indicate the approximate location of your well on the map that is printed on the back of this form. The lot lines are taken from the Freeport tax maps.