REPORT

HYDROGEOLOGIC INVESTIGATION
PROPOSED BROOME COUNTY
INDUSTRIAL PARK
CONKLIN, NEW YORK

BROOME COUNTY

INDUSTRIAL DEVELOPMENT AGENCY

BINGHAMTON, NEW YORK

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EXECUTIVE SUMMARY

O'Brien & Gere Engineers, Inc. has completed Phase I of a hydrogeologic investigation for the proposed Broome County Industrial Park in Conklin, New York. The purpose of the investigation was to evaluate the potential for contamination and development limitations of two abandoned landfills on the proposed industrial park site. Below is a summary of the findings, conclusions and recommendations of the hydrogeologic investigation.

Upper Landfill

The landfill is about 25 feet thick and is underlain by a low permeability glacial till material which significantly restricts the migration of landfill leachate into the groundwater.

It has been estimated that approximately 1.8 million gallons of leachate is generated annually by precipitation infiltrating the landfill surface and an additional 1,000 gallons of leachate is generated each year by groundwater flowing through the refuse.

The inorganic chemical analyses of the landfill leachate is typical of what is found in municipal refuse. However, the presence of various organic chemicals indicates that some industrial waste may be present.

Groundwater flow is in an east-northeast direction towards Carlin Creek at a low rate of approximately 8×10^{-5} ft/day (.03 ft/year).

Due to the low permeability of the subsurface materials, leachate seeps may develop during the wet periods of the year which may impact the water quality of Carlin Creek.

Although the landfill has slightly impacted the groundwater quality immediately adjacent to the landfill, the groundwater quality poses no threat to downgradient well users.

Recommendations: It is recommended that a low permeability soil cover be installed on the landfill to eliminate leachate seeps at an estimated cost of $430,000. In addition, continued groundwater monitoring is recommended.

Lower Landfill

The lower landfill is underlain by highly permeable sand and gravel which promotes rapid recharge of landfill leachate to the groundwater.

It has been estimated that approximately .9 million gallons of landfill leachate is generated by precipitation infiltrating the landfill surface and up to 150,000 gallons of leachate is generated by groundwater flowing through the refuse.

The chemical analyses of leachate is typical of what is found in municipal solid waste landfill leachate.

Groundwater flow is eastward towards Route 7 and the Susquehanna River at an estimated flow rate of 3 to 30 feet per day.

Some of the homeowner wells downgradient from the landfill contain iron, manganese and arsenic levels in excess of NYSDEC Class GA Groundwater Standards. The iron and manganese levels are believed to be attributed to the landfill, however, the source of the arsenic has not been clearly defined.

Recommendations: It is recommended that the homeowners water supplies be replaced by extending the Town of Conklins water supply system along Route 7 at an estimated cost of $300,000.

A low permeability soil cover is recommended to be installed on the landfill to minimize leachate generation at an estimated cost of $280,000.

Continued groundwater monitoring is recommended to evaluate long term impacts from the landfill at an estimated cost of $20,000.

Should building construction occur over the lower landfill additional geotechnical testing is recommended. The amount of testing is dependent on the type of structures to be constructed but could include: test borings, in-situ plate loading tests, and laboratory consolidation tests.

SECTION 1 - INTRODUCTION

1.01 Project Background

During June 1983 the Broome County Department of Planning submitted a proposal to the Broome County Legislature recommending that the County actively pursue the acquisition and development of a 619 acre trace of land (Figure 1) in the Town of Conklin for the purpose of creating a major industrial park. The site is located south of Powers Road, approximately one mile north of the Kirkwood Interchange. The ultimate goal of the proposed project is to create new jobs, broaden the County's tax base and promote additional growth in Broome County. The development of the project is to be undertaken by the Broome County Industrial Development Agency.

Included within the proposal was a Preliminary Environmental Assessment of the proposed industrial park. A major concern of the assessment was the potential impacts the project may have on local water supplies, including the Town of Conklin Well No. 3. In particular, two abandoned landfills are located on the proposed industrial park site. The impacts, if any, of these landfills on the viability of the project was determined by the BIDA to require further investigations. As a result the Broome County Industrial Development Agency requested that a hydrogeologic investigation be undertaken on the site of the proposed Industrial Park.

The proposed hydrogeologic investigation is to be conducted in two phases. The first phase is to include a determination of the hydrogeologic setting of and development limitations imposed by the two abandoned landfills on the site. The second phase is to provide determination of the hydrogeologic and geotechnical conditions of the entire site that would affect development of the industrial park. This report addresses only the objectives of the first phase of the hydrogeologic investigation.

1.02 Authorization and Scope

During July, 1983 the Broome County Industrial Development Agency (BIDA) authorized O'Brien & Gere Engineers, Inc. to perform Phase I of the hydrogeologic investigation at the proposed Broome County Industrial Park which includes the hydrogeologic investigation of the two abandoned landfills on site. The scope of work for the investigation is outlined in the Request for Proposal (RFP) dated June 24, 1983, and is described in detail in the proposal submitted by O'Brien & Gere Engineers, Inc. in July 1983. In general, the scope of work includes the following:

a. determination of the physical and chemical characteristics of waste deposited in the landfills, emphasizing the presence of toxic or hazardous materials and the build-up/migration of methane and volatile toxics.

b. determination of the existence of, or potential for, contamination of local groundwater and surface water by landfill leachate, and

c. recommendations and cost estimates for remedial action at the landfills, emphasizing the control of methane and volatile toxics and the prevention or elimination of groundwater and surface water contamination by landfill leachate (i.e., venting, physical containment, and/or removal measures).

The findings, conclusions and recommendations of the hydrogeologic investigation described above were submitted to the BIDA in a draft report during September, 1983. Recommendations of the report included: resampling the on-site wells and sampling the homeowner wells downgradient from the landfill sites. During November, 1983 the BIDA authorized O'Brien & Gere Engineers, Inc. to conduct this additional sampling, the results of which are incorporated into this report. In addition, the Broome County Health Department in conjunction with the State Health Department performed sampling and analyses of selected homeowner wells downgradient from the lower landfill.

1.03 Site Description

The two abandoned landfills on the proposed industrial park site shown on Figure 1 were operated by the Town of Conklin. The descriptions of the two sites as summarized in the Broome County Industrial Park Preliminary Environmental Assessment (Broome County Department of Planning 1983) follows:

1. The lower, or eastern-most landfill was operated from 1964 to 1969 and consists of three linear trenches situated adjacent to the D&H Railroad. Assuming an average depth of 30 feet for each trench, the lower landfill contains approximately 3,700,000 cubic feet of waste material. Preliminary indications are that the landfill contains municipal solid waste (MSW), although some industrial and chemical wastes may also be present. Chemical analysis of leachate flowing from the landfill to the adjacent off-site wetland indicates that purgeable volatile

halogenated organic compounds (VHO), petroleum-based compounds benzene, toluene, and xylene (BTX), and heavy metals were either undetectable or present in concentrations below the drinking water standards/guidelines set by the New York State Department of Health (NYSDOH).

2. The upper landfill was opened in 1969 by the Town of Conklin and closed in 1975 under a closure order issued by the New York State Department of Environmental Conservation (DEC). Most of the waste deposited in the landfill was placed in six unlined cells, with subsequent piling of waste material over the cells. The majority of the waste in the landfill is MSW, although there are unofficial reports that some industrial and chemical wastes were deposited there periodically. Assuming an average depth of 25 feet, the total filled volume of the landfill is approximately 6,875,000 cubic feet. Chemical analysis of leachate emanating from the sides of the landfill show that BTX were present in trace quantities below the minimum guidelines set by NYSDOH. VHO and heavy metals were either undetectable or below the minimum standards/guidelines set by NYSDOH.

SECTION 2 - FIELD INVESTIGATIONS

2.01 General

This section presents the methods and the procedures used during field investigations at the abandoned landfill sites which were conducted from July 27, 1983 through January 19, 1984. During this time the following tasks were completed:

1. Test boring completion and soil sampling.
2. Monitoring well installation and development.
3. In site permeability testing.
4. Geophysical Survey.
5. Elevation Survey of test borings/monitoring wells.
6. Static water level monitoring of completed wells.
7. Groundwater sampling.

2.02 Test Borings

A total of fifteen test borings were completed between July 27, 1983 and August 8, 1983 to evaluate the on-site subsurface hydrogeologic conditions. The locations of the borings are shown on Figure 12 All test borings were completed using a Central Mine Equipment (CME) model 55 drilling machine equipped with continuous flight hollow stem augers assembled in 5-foot sections. Samples of the encountered soils were collected at a minimum every five feet using ASTM method D1586 Split Barrel Sampling. As the test borings were completed within the fill area of each landfill, samples were collected continuously, from the land surface through the entire depth of the borehole.

Following the retrieval of the sampling device the soil samples were monitored for organic vapor content. This was accomplished by initially isolating the sample in a 1/2 pint jar covered with aluminum foil for a ten minute period, then analyzing the head space of the jar for organics using an organic vapor analyzer manufactured by HNU, which was calibrated for hexane, and/or an organic vapor analyzer manufactured by Dreager which was calibrated for trichloroethylene. In addition the test borings completed within the fill areas were monitored using a methane gas detector. Following completion of each borehole the samples were sealed in glass jars marked with the appropriate identification and delivered to O'Brien & Gere for later inspection and/or analyses.

The lithologic logs and well details shown in Appendix A, present the visual interpretations of each boring made by the O'Brien & Gere Engineers, Inc. geologists and the well specifications for each monitoring well. Appendix B includes a detailed description of the soil sampling methods and descriptions of the subsurface materials made by the drilling subcontractors, Parratt-Wolff, Inc.

2.03 Groundwater Monitoring Well Installation

Twelve of the fifteen test borings were completed into groundwater monitoring wells. These wells serve to establish a groundwater profile, provide information on the flow rate and direction of groundwater movement, and supply sampling points from which representative samples of the groundwater can be withdrawn. A map showing the location of the wells is included as Figure 2.

All groundwater monitoring wells were constructed of 2-inch ID flush joint threaded pvc well screen and riser pipe. The riser pipe on all wells was extended to the surface and a protective steel casing or curb box with a lock was installed on the riser pipe to prevent unauthorized entry. The method of installation was to lower the screen and casing assembly into the hollow stem auger to the selected screen depths. A washed Ottawa sand pack was then placed around the well screen and extended to a minimum of 2 foot above the top of the screen. A bentonite pellet seal was then placed on top of the sand pack to a minimum of one feet above the sand pack. The remaining annular space between the borehole wall and casing was then filled with a bentonite slurry grout to an elevation of approximately 2 feet below the existing ground surface. A bentonite/portland cement grout mix was then extended to the ground surface to ensure that surface water run-off will not enter the well via the borehole. Detailed designs of the wells are included in Appendix A.

Auger soil sampling equipment and miscellaneous tools used in the installation of the groundwater monitoring wells were thoroughly cleaned by rinsing with soap and water, rinsing a second time with an acetone solution and a third time with distilled water. This cleaning process was conducted to prevent cross contamination of the wells by the drilling equipment.

Following installation, the groundwater monitoring wells were developed using a centrifugal pump. In general this involved lowering a polypropylene hose of sufficient length to the bottom of the well and pumping the well to clear the finer grained sediments from around the well screen.

2.04 Methane Gas/Leachate Monitoring Well Installation

Three of the fifteen test borings were completed into monitoring wells to monitor for methane gas and to provide samples of the leachate for chemical analysis. Although the purpose of these wells was intended primarily for monitoring methane gas, the position of the water table within the landfill refuse at each site allowed the dual use of the wells for monitoring landfill leachate and gas monitoring.

The gas/leachate monitoring wells were installed by lowering a 2" ID pvc well screen into the hollow stem auger to the desired well depth. A washed Ottawa sand pack or pea gravel was then placed around the well screen. The well screen and packing material were extended to an elevation of about 2 feet below the ground surface. A surface casing and a bentonite/portland cement grout was then extended to the ground surface to restrict surface water infiltration and prevent the escape of methane gas through the annulus of the borehole. Detailed designs of the methane gas/leachate monitoring wells (Nos. 13-15) are included on Appendix A.

2.05 Well Elevation Survey

Following completion of the monitoring wells, an elevation survey was performed during August 1983 to determine locations ground elevations and top of casing elevations relative to an existing mean sea level datum. The datum that was used for establishing the elevations was taken from benchmark "y-12" on The Broome County Industrial Park Site Plan, which has an elevation of 866.481 ft above mean sea level. On August 16, 1983, water level measurements were taken at each of the monitoring wells to assess groundwater flow patterns. The monitoring well data is summarized in Table 1.

2.06 In-Situ Permeability Test

An in-situ permeability test was conducted on monitoring well No. 1 to determine the permeability of the subsurface materials beneath the upper landfill. The test was performed by evacuating a volume of water from the well and thus creating a potential hydraulic difference between the well and the surrounding aquifer. The rate of recovery of the water level in the well is then monitored which is a function of the hydraulic conductivity of the aquifer. Values for the hydraulic conductivity were then calculated using a digital computer program by Weyer and Howard-Brown (1982) that applies the use of Hvorsler's formulae.

2.07 Groundwater Quality Sampling

Groundwater quality samples were collected from all monitoring wells using a stainless steel bailer. Care was taken during the sampling procedure to assure that a representative sample was being collected. This involved calculating the volume contained in the well column and monitoring the volume of the water removed. Samples were collected following evacuation of three times the volume contained in the well. All samples were collected in properly prepared sample bottles, for example the samples analyzed for benzene, toluene and xylene (BTX) and volatile halogenated organics (VHO) were collected in head space free glass vials secured with a teflon cap. Following completion of the sample collection, all samples were placed on ice, and promptly transported to the

O'Brien & Gere laboratory in Syracuse, New York for analysis. A more detailed description of groundwater sampling methods applied at the site is included in Appendix C.

2.08 Geophysical Survey

A surface geophysical survey using electrical resistivity techniques was conducted between July 27 and July 30, 1983. The resistivity survey was used to delineate subsurface resistivity contrasts due to lithology, the presence or absence of groundwater, and the chemical quality of the groundwater. Although the survey identified subsurface hydrogeologic conditions that were closely correlated to the test boring logs, the survey was not able to delineate any prominent leachate plumes migrating from either of the landfill sites.

SECTION 3 - HYDROGEOLOGICAL INVESTIGATION

3.01 Geology

The Broome County Industrial Park is located within the Susquehanna section of the Glaciated Appalachian Plateau. This region is characterized by moderately sloping uplands and broad flat valley floors. The landscape has been sculptured by fluvial and glacial processes which have rounded the hill tops and partially filled the Susquehanna river valley with unconsolidated deposits.

The bedrock that underlies the site consists of fine grained sediments that were deposited in a shallow sea during the late Devonian age (approximately 350 million years ago). The sediments were consolidated through time into rock formations which are composed predominantly of gray, fine grained siltstone and shale. These rock types are comprised of layers that dip gently in a southerly direction at a rate of 10 to 40 feet per mile. Small planar openings commonly develop parallel and perpendicular to the layers. These openings or fractures provide the only significant void spaces in which groundwater can be transported through the bedrock. Because the fractures comprise only a small percentage of the total rock volume, the shale/siltstone bedrock is considered to be of low permeability where flow rates are slow and well yields are generally less than a few gallons per minute out of a common household well. Test boring logs and well records indicate that the bedrock underlies the unconsolidated deposits from a depth of 60 feet in the vicinity of the upper landfill and 114 feet beneath the lower landfill.

The unconsolidated deposits underlying the site are composed predominantly of sediments that were deposited by glaciers or glacial meltwaters several thousand years ago. The deposits vary in composition and include: glacial till, lacustrine deposits and outwash sand and gravel. The vertical and horizontal distribution of these deposits is shown on Figure 4.

Glacial till is the most wide spread unconsolidated deposit at the site. It extends from the land surface to the bedrock near the upper landfill and is overlain by other deposits in the vicinity of the lower landfill. The till is composed of a dense, unsorted mixture of silt, clay, sand, and rock fragments which were derived from the underlying siltstone and shale bedrock. Till thicknesses range from 60 feet beneath the upper landfill to 89 feet beneath the lower landfill site. Due to its high silt and clay content and unsorted nature and high density, the glacial till has a low permeability. The in-situ permeability test of Well No. 1 indicates that the glacial till at the site has a permeability of 1.4×10^{-7} cm/sec.

Lacustrine deposits present at the site identified as the silt and clay deposits on Figure 4,were deposited from lakes associated with glaciation. These deposits are variable in thickness and reach thicknesses of up to 32 feet in the vicinity of the upper landfill site and 45 feet in the vicinity of Route 7. Because of their fine grained texture, the lacustrine deposits are of low permeability and are generally unproductive aquifers.

Coarse grained materials that were deposited by glacial meltwaters are called outwash. The outwash deposit is composed of relatively well sorted sand and gravel with lesser amounts of silt. The outwash deposit at the lower landfill site forms a continuous layer of sand and gravel that extends from Well No. 6 to the Susquehanna River (Figure 4). The thickness ranges from 5 feet in Well 6 to 20 feet in Well 1002. Due to the coarse grained texture and well sorted nature of the sand and gravel, the outwash deposit has high permeability and forms a productive groundwater aquifer within the Susquehanna River Basin. Well records indicate that this outwash deposit is an important source of water supply to the local homeowners to the northeast of the lower landfill along Route 7 and to the Town of Conklin Well No. 3.

3.02 Groundwater Flow Conditions

Part of the precipitation falling on the land surface is transported as surface water runoff, some of it stays within the soils and is either transpired by plants or evaporated, and the remainder percolates through the ground as groundwater. Groundwater is usually considered to occur in two zones which include: (1) the zone of aeration where the pore spaces of the soil or rock are filled with both air and water and (2) the zone of saturation where the pore spaces become entirely filled with water, the top of which is called the water table.

Any groundwater that infiltrates through the refuse will percolate downward until it reaches the water table. Once the groundwater reaches the water table it enters the groundwater flow system where it flows under the influence of gravity down the slope of the water table until it reaches a point of discharge such as a spring, lake or stream. Generally, the slope of the water table is parallel to the slope of the land surface. A typical groundwater system is comprised of a small local system superimposed upon a larger regional system. In a local system, the groundwater discharges in a spring, small stream or pond, whereas in a regional flow system groundwater flows downgradient beneath the local streams then discharges into a major river or lake.

The depth to the water table at the site varies from 23.4 feet beneath the land surface of the upper landfill (at Well No. 2) to 11.7 feet below the land surface of the lower landfill at Well No. 7 Based on these water table depths and the depths of the refuse shown in the test boring logs, it is estimated that the water table is about 9 feet above the base of the refuse in the upper landfill and is 2 feet above the base of the refuse in the lower landfill. At the upper landfill site a portion of the groundwater may discharge into Carlin Creek, however the water table elevations shown on Figure 3 indicates the groundwater flowing from the upper landfill is predominantly in an eastward direction towards the Susquehanna River. The groundwater elevation map shows that the groundwater flow direction in the vicinity the lower landfill is also eastward towards the Susquehanna River and the flow direction is not influenced by the pumping of Town of Conklin's Well No. 3.

The velocity or rate of travel of uncontaminated groundwater can be approximated using Darcy's law in combination with the basic equation of hydraulics and a correction factor for porosity. The groundwater flow velocity equation is as follows:

$$V = \frac{K(dh/dL)}{7.5a}$$

where,

V = Velocity in feet per day

K = permeability, in gpd/square foot

dh/dL = water table gradient

a = porosity

To estimate the groundwater velocity of the glacial till beneath the upper landfill the permeability from the in-situ permeability test was calculated to be 1.4×10^{-7} cm/sec (.294 gpd/ft^2). This value in combination with the water table gradient of .070 (measured from the water elevation map - Figure 3) and a porosity value of .34 which is typical for glacial till (Todd, 1981) gives an estimated groundwater flow velocity for the upper landfill of 8.1×10^{-5} ft/day (.03 ft/year).

The water transmitting capacity or transmissivity of an aquifer is a measure of the rate at which water would flow through a vertical strip of specified width extending from the top to the bottom of the aquifer, assuming a unit hydraulic gradient. In published reports on the sand and gravel aquifers within the Susquehanna River Basin (Randall, 1977) transmissivity values for sand and gravel aquifers generally range from 10,000 gallons per day per foot (gpd/ft) to 100,000 gpd/ft. Pump test data on the Town of Conklin Well No. 1 indicates a higher local transmissivity of 130,000 gpd/ft. However, due to the close proximity of the Town of Conklin Well No. 1 to the Susquehanna River, the transmissivity value may be slightly high due to surface water recharge. As a result, the 10,000-100,000 gpd/ft range of transmissivity appears to be a more valid representation of the sand and gravel aquifer beneath the lower landfill. Additional pump test data would be needed to develop more refined transmissivity values for the sand and gravel aquifer beneath the lower landfill.

Dividing the transmissivity by the aquifer thickness (which is 13 feet in Well No. 8) gives an aquifer permeability range of 769 - 7692 gpd/ft^2. This value in combination with the water table gradient for the lower landfill of .010 and a porosity value of .25 which is typical for sand and gravel (Todd, 1981) gives an estimated groundwater flow velocity for the lower landfill ranging from 3 to 30 ft/day.

3.03 Water Budget

A water budget of a waste disposal area is a useful means of estimating the amount of recharge due to precipitation and predicting the amount of leachate that may be generated. The water budget of a particular area is a water balance between the income of water from precipitation and the outflow of water by evapotranspiration, runoff and percolation. In general the annual hydrogeologic budget of an area can be characterized by the following equation:

$$P = R/O + AET + ST + PERC$$

where P is the average precipitation, R/O the surface water runoff, AET the average evapotranspiration, ST the change in soil moisture storage and PERC the excess water that percolates the soils as groundwater recharge. Many of the parameters used for a hydrologic budget can be measured directly, such as precipitation, streamflow and evaporation. However, where long term data is not available, the water budget can be estimated from local climatological data and on-site hydrogeologic data through the use of the water balance method as originally developed by Thornthwaite (1957) and revised by Fenn (et al., 1975). The water budget data calculated for the upper and lower landfills are summarized in Tables 2 and 3.

The proposed Broome County Industrial Park is located in a humid temperate climate with a mean annual rainfall of 39 inches. The mean monthly precipitation and temperature data from the U.S. Weather

Bureau Station at the Broome County Airport were used in the water budget and are summarized in Tables 2 and 3.

Part of the precipitation that falls on the land surface will run off the site as overland flow before it has a chance to infiltrate the soils. The amount of surface water runoff will depend on several factors, including the intensity and duration of the storm, the antecedent soil moisture conditions, the slope of the land surface, and the permeability of the soil and type of vegetative cover. The water balance method calculates the surface runoff utilizing empirical runoff coefficients which are representative of actual on-site conditions. A runoff coefficient range of .18 - .22 was selected for the upper landfill which was representative of a heavy soil with an average slope of 2-7%. A runoff coefficient range of .05 - .10 was selected for the lower landfill which is representative of a sandy soil with an average slope of 2%. The lower runoff coefficient was used for the months that the soil moisture storage did not reach field capacity, whereas the higher coefficient was used when the soil moisture storage reached its field capacity. By applying the runoff coefficients to the monthly precipitation, a monthly estimate of the surface runoff is obtained and is summarized in Tables 2 and 3.

Evapotranspiration is the amount of available water present in the soil that is lost to the atmosphere as either evaporation from the soil or transpiration by plants. The water balance method calculates the potential evapotranspiration on the basis of monthly average temperature and latitude through the use of a series of tables. The actual evapotranspiration is then calculated based on the average monthly precipitation and the soil moisture availability. The data in Tables 2 and 3 indicate that 23 inches or 47% of the average annual precipitation returns to the atmosphere as evapotranspiration.

The amount of moisture that can be stored within the soils is dependent on the available water capacity of the soils and the depth of the root zone. Soil data from the USDA Soil Survey of Broome County (1971) indicate that the upper landfill site is underlain predominantly by Volusia soils that have an average available moisture capacity of 2.22 inches/ft or soil and an average root depth of 20 inches. The lower landfill is underlain by Chenango soils that have an average available moisture capacity of 1.8 inches/ft of soil and an average root depth of 35 inches. These values in combination with Thornthwaite's soil moisture retention tables were used to calculate the average monthly soil moisture storage values shown in Tables 2 and 3. The data shows that during the months of November through May, the soil moisture storage reaches its field capacity. The soil moisture storage decreases to a low during September when evapotranspiration rates are the highest.

Once the soil moisture storage reaches its field capacity, any excess water that infiltrates the soil becomes percolation that recharges the groundwater flow system. Percolation is simply the amount of the precipitation remaining following the water lost through surface runoff, evapotranspiration and soil moisture storage. The average monthly and annual percolation rates for the upper and lower landfills are summarized in Tables 2 and 3. The average annual percolation rate for the upper landfill is 10.5 inches, which is 27% of the precipitation. The average annual percolation for the lower landfill is 13.1 inches, which is 34% of the precipitation.

3.04 Leachate Generation

The amount of leachate generated at a sanitary landfill can be estimated from calculations on the amount of precipitation that percolates through the cover material, the amount of groundwater that flows through the refuse, and the areal extent of the fill area.

Based on the average annual percolation rate of 10.5 inches and the 6.3 acre estimated areal extent of the upper landfill, it is estimated that up to 1.8 million gallons of leachate per year is generated at the upper landfill by precipitation infiltrating the landfill surface. The test drilling program revealed that the water table beneath the upper landfill is 8.6 feet above the base of the refuse. This indicates that additional leachate is generated at the landfill from groundwater flowing through the refuse. Based on the groundwater flow velocity of 8.1×10^{-5} ft/day and the saturated cross sectional area of the refuse, it is estimated that up to an additional 1,000 gallons per year of leachate may be generated at the upper landfill by groundwater flowing through the refuse.

Based on the average annual percolation rate of 13.2 inches and the 2.5 acre areal extent of the lower landfill, it is estimated that up to 0.9 million gallons of leachate per year is generated at the lower landfill by precipitation infiltrating the landfill surface. The lower landfill is also partially buried beneath the water table, resulting in leachate generation from groundwater flowing through the refuse. From the groundwater flow velocity of 3 to 30 ft/day and the saturated cross sectional area of the refuse, it is estimated that an additional 15,000 - 150,000 gallons of leachate can be generated each year at the lower landfill by groundwater flowing through the refuse.

3.05 Groundwater/Leachate Analyses

All on-site monitoring wells identified on Figure 2 have been sampled in accordance with the groundwater sampling procedures outlined in Appendix C. Following completion of the sample collection all samples were placed on ice, and promptly transported to the O'Brien & Gere laboratory in Syracuse, New York where they were analyzed.

The laboratory analyses of groundwater and leachate samples are presented in Tables 4 and 5. To evaluate the potential for contamination the analyses are compared to: (1) New York State Class GA groundwater quality standards (Table 9); (2) upgradient groundwater quality; and (3) the range in background groundwater quality found in the various aquifers within the Susquehanna River Basin (Table 8). Class GA waters are defined as fresh groundwaters that can be used as a source of potable water and are found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock.

Upper Landfill

In as much as monitoring well 1 is located hydraulically upgradient to the upper landfill, the analyses of this well should be representative of the background groundwater quality adjacent to the upper landfill. The analysis of Well 1 indicates that the water quality is typical for the natural quality within a glacial till aquifer (Table 8), in that the water is of good drinking water quality, contains a moderate amount of dissolved solids, and is relatively low in iron content when compared to other aquifers. The water quality of Well 1 meets the New York State Class GA groundwater standards shown in Table 9.

Wells 14 and 16 were installed within the saturated refuse of the upper landfill, consequently, the analysis are indicative of the upper landfill. The inorganic analyses of these wells indicate that the leachate contains relatively high concentrations of sulfate, chloride, chromium, iron, manganese, mercury, and zinc. However, when these inorganic analyses are compared to the ranges of various constituents generally found in municipal sanitary landfills (Freeze and Cherry, 1980) (Table 10) the leachate analyses of the upper landfill is typical of what is found in municipal refuse. However, the relatively high concentrations of organic compounds such as benzene, methylene chloride, trichloroethylene and vinyl chloride indicate that some industrial waste may be present within the upper landfill.

The laboratory analyses of Well 2 is representative of the groundwater quality underlying the upper landfill. The analysis reveals that the groundwater quality beneath the landfill contains concentrations of iron, manganese and mercury in excess of Class GA groundwater standards. These analyses when compared to the leachate analyses reveal that the migration of much of the fill leachate has been restricted from entering the groundwater beneath the landfill.

The laboratory analyses for Wells 3, 4 and 11 in Tables 4 and 5 are indicative of the groundwater quality downgradient from the upper landfill site. The analyses indicate that the parameters in excess of Class GA standards include cadmium and manganese in Well 3, and manganese, benzene and vinyl chloride in Well 11. Due to the extremely low groundwater flow rates (.03 ft/year) beneath the upper landfill, it is expected that these elevated concentrations will be significantly reduced over a relatively short distance downgradient from the upper landfill.

Lower Landfill

The analysis of Well 6 (which is hydraulically upgradient to the lower landfill) should be representative of the background groundwater quality of the lower landfill. However, due to the presence of arsenic, iron, manganese and mercury it is apparent that the waste disposal practices of the lower landfill have had an impact on the groundwater quality of Well 6.

Wells 13 and 15 are screened within the leachate of the lower landfill. The analyses from these wells reveals that leachate contains relatively high concentrations of copper, iron, manganese, and mercury. However, the concentrations are typical for a landfill leachate as shown in Table 10. The relatively low organic concentrations indicate that the presence of industrial refuse is unlikely.

The groundwater quality beneath the lower landfill is represented by the analysis of Well 7. The analysis shows that arsenic, iron and manganese are in excess of Class GA groundwater standards.

Analyses for Wells 5, 8, 9, and 10 in Tables 4 and 5 are representative of the groundwater quality hydraulically downgradient from the lower landfill. The analyses reveal that the parameters in excess of Class GA groundwater standards include: arsenic in Well 8, iron in Well 8, and manganese in all four wells.

Homeowner Wells

The preliminary hydrogeologic investigation of the proposed industrial park site revealed that the lower landfill may have a potential impact on the groundwater quality of downgradient homeowner water supply wells. As a result, seventeen homeowner wells located east of the landfill along Route 7 were sampled during November 1983 to evaluate the impacts of the lower landfill of on downgradient private water supplies. The sampling of the homeowner wells was conducted by the BIDA and the analyses were performed by O'Brien & Gere (12 wells) and the New York State Department of Health (5 wells). The location of the homeowner wells sampled are shown on Figure 2 and the analyses are summarized in Tables 6 and 7.

Inorganic chemical analyses of the homeowner wells (Table 6) revealed that of the 17 wells sampled, arsenic was detected in three of the wells at levels exceeded the NYSDEC Class GA groundwater standard of .025 milligrams per liter. However, the arsenic levels detected in these three wells did not exceed the New York State Department of Health Drinking Water Standard of .05 milligrams per liter and, therefore, do not pose an immediate threat to public health. Due to the elevated arsenic levels, the three homeowner wells were resampled and analyzed by the NYSDOH during January, 1984. Although the second analyses showed lower levels of arsenic and were within the NYSDOH Drinking Water Standards the levels still exceeded the NYSDEC Class GA Groundwater Standards of .025 milligrams per liter.

The inorganic analyses of the 17 homeowner wells also indicated that the combined concentration of iron and manganese in 10 wells exceeded both the NYSDEC Class GA Groundwater Standard and NYSDOH Part 5 Drinking Water Standards of .5 milligrams per liter.

Organic analyses of homeowner wells (Table 7) shows that trace levels at trichloroethene were detected at the Lasky (9 ug/l) and Villano (4 ug/l) residences. Toluene was also found at trace levels (10 ug/l) at the Lasky residence. Although these organic concentrations exceed background levels, they are within NYSDOH guidelines of 50 ug/l for each parameter. The trichloroethene levels are also within the NYSDEC Class GA Standard of 10 ug/l. Toluene and trichloroethelene were detected within the groundwater at the upper and lower landfills. However, based on the on-site hydrogeologic conditions and the limited extent of the trichloroethene and toluene detected within the groundwater at each landfill, it is believed that the trace levels of organic chemicals detected within the homeowner wells are not attributed to the upper or lower landfills.

SECTION 4 - ENVIRONMENTAL IMPACTS

4.01 Groundwater Impacts

Upper Landfill

The groundwater quality analyses downgradient from the upper landfill have identified concentrations of manganese, cadmium, benzene and vinyl chloride in excess of Class GA groundwater quality standards. Previous studies concerning the attenuation of landfill leachate in the soils of New York State (Roberts, K.J., Olsen, G.W. and Sandrey, D.A., 1976) have revealed that soils such as the underlying till (which have permeabilities less than 10^{-3} cm/sec and silt and clay content greater than 25%) are favorable for the attenuation of contaminants from a landfill leachate. The soil properties and extremely low groundwater flow rates downgradient from the upper landfill are expected to effectively reduce the contaminant concentrations from the groundwater over a relatively short distance. As a result, it is anticipated that the groundwater flowing from upper landfill should not have a significant impact on downgradient groundwater or surface water supplies.

Lower Landfill

The groundwater downgradient from the lower landfill has been found to contain concentrations of arsenic iron and manganese in excess of Class GA groundwater quality standards. Because the lower landfill is situated in highly permeable soils where leachate attenuation is minimal and the groundwater flow rates are relatively high, the lower landfill has a potential for impacting the downgradient water supplies. The analyses of some of the downgradient homeowner wells along Conklin Road revealed that the groundwater quality exceeded Class 6A standards for manganese, iron and arsenic, indicating the lower landfill may have had an impact of downgradient water supplies. The impacts of each of these parameters are described below.

Arsenic - The U.S. Environmental Protection Agency (EPA) and the New York State Department of Health have adopted an arsenic standard of .060 mg/l in drinking water as posing a hazard to human health whereas the New York State DEC Class GA Standards for arsenic is .025 mg/l. NYSDEC Class GA Standards establish maximum contaminant levels in the groundwater from pollution sources whereas the NYSDOH Part 5 Standards establish maximum contaminant levels in drinking water at which may pose a threat to human health. Although the levels of arsenic detected in three of the homeowner wells exceeded the NYSDEC Class 6A groundwater standard of .025 mg/l, they did not exceed the Drinking Water Standard and therefore do not pose an immediate threat to drinking water supplies.

Arsenic can occur naturally within the groundwater in areas where phosphorite deposits or iron ore and coal bearing rock formations are present. Manmade sources of arsenic include: insecticides, herbicides, metallurgical additives, pharmaceuticals and fallout from the burning of coal. Because of geologic materials of the area do not contain phosphorous coal or iron ore bearing rocks, it is believed that that arsenic detected in the homeowner wells is attributable a manmade source. However, this investigation has not clearly defined the lower landfill as the source of arsenic due to the following facts: (1) leachate analyses of the lower landfill do not show any indication of either arsenic or any industrial waste being present; (2) only 1 of 4 on-site wells and 3 of 15 homeowner wells downgradient from the lower landfill have detected arsenic concentration in excess of NYSDEC Class GA Standards; (3) an arsenic contaminant plume has not been identified where high arsenic concentrations would occur near the source and gradually decrease downgradient and (4) arsenic was detected in on-site well No. 6 which is an upgradient well to the lower landfill. Based on this information, additional field investigated would be needed to define the source of arsenic in the homeowner wells.

Iron and Manganese - NYSDEC Class 6A Groundwater Standards and NYSDOH Part 5 Drinking Water Standards require that the combined concentration of iron and manganese in groundwater shall not exceed 0.5 mg/l. This standard has been established for water usage to avoid objectionable staining of plumbing fixtures.

Iron and manganese are common constituents of the rocks and soils within the area. Although the natural groundwater quality of the aquifers within the Susquehanna River Basin commonly contain iron concentrations exceeding the groundwater standards at levels up to 5 mg/l, the natural manganese concentrations within the groundwaters generally do not exceed the standard of 0.3 mg/l. (Hollyday, 1969). Previous analyses of the Town of Conklin's three municipal wells have shown iron concentrations up to 0.6 mg/l of iron and up to .5 mg/l of manganese. Iron and manganese are also the most common constituents within a landfill leachate. Studies have shown that iron concentrations within a leachate typically range from 1-1000 mg/l and manganese concentrations range from .01-100 mg/l (Table 10; Freeze and Cherry, 1980).

The analyses of the homeowner wells downgradient from the lower landfill have shown that of the 17 wells sampled, 7 wells exceeded the 0.3 mg/l standard for manganese and 5 wells exceeded the 0.3 mg/l standard for iron. Although the iron concentrations may be attributed in part to the natural groundwater quality, the manganese concentrations all exceeded the background levels of the area. Based on this information as well as: (1) elevated levels of manganese (7-15 mg/l) were detected within the lower landfill leachate; and (2) elevated levels of iron and manganese were detected in the on-site wells downgradient from the lower landfill, it is believed that the elevated manganese and iron concentrations detected in the homeowner wells is attributed to leachate from the lower landfill.

4.02 Surface Water Impacts

Groundwater flow data indicates that Carlin Creek may serve as a potential discharge point for groundwater flowing from the upper landfill. However, because the groundwater flow direction is predominantly eastward towards the Susquehanna River and the flow rate is relatively low (allowing considerable time for soil attenuation), it is expected that any groundwater discharging from the landfill into Carlin Creek should not have an impact of the surface water quality of Carlin Creek.

Section 3.04 of this report has revealed that up to 1.8 million gallons of leachate can be generated each year through precipitation infiltrating through the upper landfill. Because the upper landfill is underlain by extremely low permeable soils, a "bathtub effect" may be created where leachate will accumulate in the landfill and overflow at the lowest point in the form of leachate seeps. These leachate seeps have a potential for flowing over the land surface and having an impact on the surface water quality of Carlin Creek.

The nearest potential groundwater discharge point from the lower landfill is the Susquehanna River. Due to the relatively low concentrations of the manganese and mercury in the groundwater flowing from the lower landfill and the relatively high flows of the Susquehanna River, it is expected that the lower landfill does not have a significant impact on the surface water quality of the Susquehanna River. Inasmuch as the lower landfill in underlain by permeable soils, there is not a potential for the development of leachate seeps at the lower landfill.

4.03 Settlement

The amount of settlement that occurs at the upper and lower landfills depends on what type of refuse was disposed of at each site and how thoroughly the waste was compacted. Settlement generally varies from 10 percent to 25 percent within six months to two years. It was found that in landfills in New York, about 90 percent of the total settlement occurs in the first two to five years. The remaining 10 percent may be over a long period of time (American Public Works Association, 1970). There may be even further subsistence from expulsion of entrapped waters, particularly in water logged silty soils, as with the soils within the upper landfill. In addition, landfills that have refuse buried below the water table may settle more and at a faster rate than dry landfills because of accelerated decomposition and leaching action.

As a result there are no reliable guidelines as to how much or over what period settling might be expected.

Because the upper landfill has been inactive for more than eight years and the lower landfill has been inactive for more than fourteen years, it is expected that most of the settlement has already taken place at each landfill. However, because of each of the landfills are partially below the groundwater table where further decomposition will take place, additional settlement can be expected. Although it is technically feasible to construct buildings over landfills which would not be affected by differential settlement, high cost of geotechnical testing and foundation engineering is usually required. The additional geotechnical testing may include: test borings to define thickness and composition of refuse, in-situ plate load tests to determine ultimate bearing capacity and laboratory consolidation tests of the refuse. The results of these tests will be compared to the loads of the anticipated structure to determine what engineering remedial measures will be needed. Some engineering considerations may include: mat foundations, spread footings, pile foundations, increased landfill cover thickness, soil stabilizers, and gas venting systems.

4.04 Decomposition/Gas Production

Decomposition of landfills depends on many factors, including permeability of cover material, moisture content of the refuse and degree of compaction. Gases produced as a by-product during the decomposition of the refuse and are principally composed of methane and carbon dioxide. Studies of landfills (American Public Works Association, 1970) indicate that the greatest amount of gas is produced from refuse that is about one-half to two years old. However, the studies have also shown that if the refuse is buried below the water table, or if surface water percolates through the refuse, gas production can occur over a longer period of time.

The methane gas monitoring of the upper and lower landfills revealed that methane gas levels were well below combustible levels, indicating that decomposition of the landfill presently is not a problem. However, the high water table and surface water infiltration may increase gas production. Therefore, continued methane gas monitoring is recommended to evaluate gas production at the landfill sites. In addition, gas venting is recommended where low permeability covers are placed over each landfill.

SECTION 5 - REMEDIAL ALTERNATIVES

The previous section of this report has identified that the only significant impacts the two landfills may have on the proposed industrial park include: (1) the development of leachate seeps at the upper landfill may have negative impacts on the water quality of Carlin Creek; and (2) leachate from the lower landfill has most likely elevated manganese and iron levels and may have elevated arsenic levels in some homeowner wells downgradient from the landfill. Based on these existing and potential environmental impacts, the following remedial alternatives may be considered.

5.01 Recommended Remedial Measures

Replace Existing Homeowner Water Supplies

Due to the impacts of the lower landfill on downgradient homeowner water supply wells, replacement of the impacted homeowner water supplies is recommended. The most cost-effective method of replacing the homeowner water supplies would be to extend the Town of Conklins water supply system from Carlin Road, south along Route 7 and tie into the impacted homes. It is estimated that approximately 5,000 feet of water main and 20 connections to homes would be needed. The estimated cost for this remedial alternative is $300,000.

Groundwater Monitoring

The purpose of a groundwater monitoring system is to provide an early warning system to evaluate the potential for future contamination of downgradient water supply wells or surface waters. New York State

Department of Environmental Conservation recommends that a monitoring system include the following:

1. A minimum of three groundwater monitoring wells, one well located upgradient and at least two wells located downgradient from the solid waste fill area.

2. Baseline water quality conditions should be established by collecting at least two samples from each of the wells and analyze for drinking water parameters, indicator parameters and site specific constituents.

3. Routine water sampling and analyses should be conducted at least on a quarterly basis. The analyses should include indicator parameters such as: chlorides, specific conductivity, total organic carbon (TOC), total iron, total dissolved solids and site specific parameters.

The first two elements of the groundwater monitoring program described above have been completed for this investigation. The routine sampling and analyses should be considered in order to (1) monitor the potential for contamination of Carlin Creek from the upper landfill; and (2) evaluate the potential for contamination of downgradient homeowner wells from the lower landfill. The routine analyses should include the indicator parameters listed above as well as site specific parameters such as arsenic, manganese, mercury, toluene, methylene chloride, and vinyl chloride.

Installation of Landfill Cover - To minimize the amount of leachate generated from precipitation infiltrating the refuse, installation of a low permeability cover may be needed at the upper and lower landfills. A low permeability cover would minimize the development of leachate seeps in the upper landfill and significantly reduce the amount of leachate that is entering the groundwater at the liner landfill.

NYSDEC Part 360 regulations requirements for a closed sanitary landfill include a minimum of 18 inches of final cover material with a hydraulic conductivity of 10^{-5} cm/sec and a graded at a minimum slope of 2 percent. In addition, a gas venting system may be needed to minimize the potential problem associated with methane gas build-up beneath a low permeable cover. The in-situ permeability test of the glacial till material indicated a permeability of 1.4×10^{-7} cm/sec. As a result, the on-site material should be suitable as cover material.

The estimated cost for installing a low permeability cover is $430,000 for the upper landfill and $280,000 for the lower landfill. These estimates include the costs for installing the cover using the on-site till, the gas venting system, topsoil and seeding, grading, safety procedures and engineering costs. These costs are preliminary and based on very limited data on the landfills. The costs may need to be adjusted once the areal extent of fill areas are more defined, a more detailed topographic survey is performed, the thickness of the existing cover material is better defined, and the determination is made on whether local till is suitable to be used as a cover material.

5.02 Other Remedial Alternatives

Based on the magnitude and extent of the existing problems associated with the upper and lower landfills, the remedial alternatives discussed above should provide sufficient measures of minimizing the potential for surface and groundwater contamination. In addition, these remedial alternatives are expected to minimize the long term potential for contamination from the landfills. However, should future monitoring identify a greater extent of contamination, one or more of the following remedial measures may have to be considered for implementation.

Define Sources of Arsenic - This alternative should include a hydrogeologic investigation to determine whether the arsenic detected within the homeowner wells is attributed to either the lower landfill or other sources. The investigation would include drilling test borings, installing monitoring wells, and analyzing soil and groundwater samples. The estimated cost for this investigation is $30,000.

Installation of groundwater cutoff wall and clay cap - This remedial alternative would include installing a clay cap and soil/bentonite wall around the landfill to encapsulate the site, to prevent leachate generation and restrict leachate migration. The estimated cost for this would be $1.5 million for the upper landfill and $2.0 million for the lower landfill.

Off-site Disposal - This alternative includes the excavation of the refuse material from the site, and hauling to a local landfill for disposal. Assuming the waste is not classified as hazardous, and a local landfill would except such a large volume of wastes, it is estimated it could cost up to $4.2 million for off-site disposal for the upper landfill and $2.5 million for the off-site disposal of the lower landfill. However, it is unlikely that such a large volume of wastes would be accepted at the existing Broome County landfill.

Leachate Collection and Treatment - This alternative would include a clay cap to minimize leachate generation as well as a leachate collection trench and treatment system. The capital costs for such a system could range from $900,000 for the lower landfill to $1.1 million for the upper landfill. These costs do not include operation and maintenance costs which are dependent on the lifetime of the system.

It should be noted that the cost estimates discussed above are preliminary and based on very limited data for each landfill site. The costs may need to be adjusted once the following conditions for each landfill are better defined; the topography of the fill surface, the thickness of the existing cover material, the areal extent of the fills, the groundwater flow conditions, and the suitability of the on-site till as a cover material.

SECTION 6 - CONCLUSIONS AND RECOMMENDATIONS

6.01 Conclusions

Based on the investigations described in the report the following conclusions are presented.

Upper Landfill

1. The upper landfill site is underlain by low permeability glacial till. The groundwater beneath the landfill may be discharged locally into Carlin Creek however the predominant groundwater flow is eastward towards the Susquehanna River at a rate of approximately 8×10^{-5} ft/day (.03 ft/year).
2. The laboratory analyses of leachate of the upper fill contains relatively high concentrations of sulfate chloride, chromium, iron, manganese, mercury and zinc in excess of, which is not uncommon for a municipal landfill leachate. The low permeability and high silt and clay content of the underlying glacial till appears to have significantly restricted the migration of these constituents into the groundwater as evidenced by the much lower chemical concentrations within the groundwater beneath the landfill.
3. The groundwater downgradient from the upper landfill contains concentrations of cadmium, manganese, benzene, and vinyl chloride in excess of NYSDEC Class GA groundwater standards. However, due to the low groundwater flow rates (.03 ft/year) and high silt and clay content of the glacial till, the groundwater quality from the upper landfill should not have a significant impact on downgradient groundwater or surface water supplies.

4. It has been estimated that up to 1.8 million gallons per year of landfill leachate may be generated through precipitation infiltrating the fill surface and only 1,000 gallons per year of leachate may be generated by groundwater flowing through the base of the refuse. Due to low permeability of the underlying glacial till, this leachate may tend to accumulate in the landfill and overflow at the lowest point as a landfill seeps. These seeps may be transported as surface runoff and have a potential impact on water quality of Carlin Creek.

5. In order to minimize the amount of leachate that would be generated by precipitation infiltrating the landfill surface, a low permeability should be installed.

6. Methane gas monitoring of the upper landfill indicated that methane gas concentrations were below combustible levels. As a result, methane gas generation does not pose any adverse environmental impacts at the present time. However because the refuse is partially buried below the water table, future gas generation can be anticipated.

7. Because the upper landfill has been inactive for more than eight years, it is expected that most of the landfill settlement has already occurred. However, due to the high water table within the landfill further decomposition and settlement can be expected.

Lower Landfill

1. The lower landfill is underlain by a highly permeable sand and gravel which promotes recharge of leachate to the underlying groundwater. The groundwater flow in the vicinity of the lower

landfill is in an eastward direction towards the Susquehanna River at an estimated rate of 3 to 30 feet per day (1,100-11,000 feet per year).

2. The leachate of the lower landfill contains relatively high concentrations of copper, iron, manganese and mercury, but is typical of municipal landfill leachate.

3. The chemical analyses of 17 homeowner wells downgradient from the lower landfill revealed that NYSDEC Class GA Groundwater Standards were exceeded for arsenic in 3 wells, manganese in 7 wells and iron in 5 wells. Because the arsenic levels did not exceed the NYSDOH Drinking Water Standards, they do not pose an immediate threat to public health. Although the iron and manganese levels can be attributed to the lower landfill, the source of the arsenic levels has not been clearly defined.

4. It has been estimated that up to 0.9 million gallons of landfill leachate per year may be generated by precipitation infiltrating the landfill surface and up to 15,000 - 150,000 gallons of leachate may be generated by groundwater flowing through the base of the landfill. Due to the high permeability of the underlying sand and gravel, this leachate will tend to recharge the groundwater rather than be discharged at the surface as landfill seeps.

5. A low permeability cover would be needed to minimize the amount of leachate generated by rainfall infiltration.

6. Methane gas monitoring of the lower landfill revealed that at the present time methane gas generation does not pose any adverse environmental impacts on the proposed project.

7. The lower landfill site has been inactive for over fourteen years indicating that most of the landfill settlement has occurred. However, because the water table is above the base of the fill, additional settlement can be expected.

6.02 Recommendations

1. It is recommended that a low permeability soil cover be installed on the upper and lower landfills to minimize the amount of leachate generation. The estimated cost for installing a low permeability soil cover is $430,000 for the upper landfill and $280,000 for the lower landfill. The following work items are recommended to minimize the cost of the cover installation: drill test borings to define the thickness and extent of existing cover material, conduct topographic and magnetometer surveys and aerial photo evaluations to define areal extent of landfills, conduct permeability tests of on-site till to evaluate suitability as a cover material.
2. Due to the impacts of the lower landfill on the downgradient homeowner wells, it is recommended that the homeowner water supplies be replaced. This can be accomplished most cost effectively by extending the Town of Conklin's water system from Carlin Road south along Route 7 for a distance of approximately 5,000 feet. The estimated cost for this remedial measure is $300,000.
3. Because of the engineering problems associated with differential settlement and methane gas generation, it is recommended that the two landfills not be constructed upon. However, should a strong need develop to build on either of the landfills, additional geotechnical testing is recommended. This testing is dependent on

the types of structures anticipated to be constructed but may include: test borings to define nature and extent of refuse, in-situ pate loading tests, and laboratory compaction tests.

4. Groundwater monitoring is recommended to continue in order: 1) monitor the potential for contamination of Carlin Creek from the upper landfill and 2) evaluate the contamination of the homeowner wells from the lower landfill. Water sampling and analyses should be conducted at least on a quarterly basis for one year on the three monitoring wells downgradient from the upper landfill, the four on-site monitoring wells downgradient from the lower landfill, and ten impacted homeowner wells downgradient from the lower landfill. The analyses should include indicator parameters of landfill leachate such as : pH, chlorides, specific conductivity, total organic carbon (TOC), total iron, and total dissolved solids. In addition, the analyses should include site specific parameters such as arsenic, manganese, mercury, toluene, methylene chloride, and vinyl chloride. The estimated cost for this groundwater monitoring is $20,000.

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Tables

O'BRIEN & GERE

TABLE 1

MONITORING WELL DATA

Well No.	Grade Elevation	Top of Steel Casing Elevation	Top of PVC Casing Elevation	Well Depth Below Grade	Groundwater Elevations 8/16/83	Groundwater Elevations 11/9/83
1	944.4	947.41	947.30	60	937.34	933.79
2	914.8	916.16	915.93	45	891.37	890.56
3	885.8	889.20	889.11	20	881.21	879.57
4	890.9	893.58	893.42	20	881.85	881.80
5	860.31	860.31	860.24	33.5	853.25	852.17
6	868.8	868.82	868.59	17.9	861.97	860.57
7	865.2	868.37	868.27	25	853.54	852.02
8	860.2	860.24	860.08	18	853.34	851.60
9	861.3	864.21	864.11	18	853.31	851.66
10	863.8	863.76	863.47	18	853.69	851.76
11	896.2	898.97	898.82	30.5	882.31	881.82
12	898.6	901.62	901.51	16	dry	dry
13	865.7	868.62	868.55	15	853.94	
14	914.8	917.25	917.14	15	908.45	
15	873.8	876.62	876.49	18	859.76	

TABLE 2

WATER BUDGET DATA FOR UPPER LANDFILL

WATER BUDGET FOR YEAR = 1

PREC	PE	CR	RO	INF	I-PE	NGE	ST	DELST	AE	PERC
January 8.6	0.0	.22	1.9	6.7	6.7	0.0	9.4	0.0	0.0	6.7
February 5.7	0.0	.22	1.3	4.5	4.5	0.0	9.4	0.0	0.0	4.5
March 7.3	0.0	.22	1.6	5.7	5.7	0.0	9.4	0.0	0.0	5.7
April 8.1	3.6	.22	1.8	6.3	2.7	0.0	9.4	0.0	3.6	2.7
May 9.7	6.3	.22	2.1	7.6	1.3	0.0	9.4	0.0	6.3	1.3
June 9.1	9.4	.18	1.6	7.5	-1.9	-1.9	7.7	-1.7	9.0	0.0
July 9.7	12.8	.18	1.8	8.0	-4.8	-6.7	4.5	-3.2	8.1	0.0
August 9.2	11.6	.18	1.7	7.5	-4.1	-10.8	3.1	-1.4	6.5	0.0
September 7.7	8.0	.18	1.4	6.3	-1.8	-12.6	2.7	-.3	6.3	0.0
October 7.6	4.7	.18	1.4	6.2	1.6	0.0	4.3	1.6	4.7	0.0
November 7.9	1.3	.18	1.4	6.5	5.2	0.0	9.4	5.1	1.3	0.1
December 7.0	0.0	.22	1.5	5.4	5.4	0.0	9.4	0.0	0.0	5.4

VARIABLE SYMBOLS

Precipitation (mm) - PREC

Potential Evapotranspiration (mm) - PE

Runoff Coefficient - CRO

Runoff (mm) - RO

Infiltration (mm) - INF

Accumulated Pot. Water Loss (mm) - NGE

Storage (mm) - ST

Change in Storage (mm) - DELST

Actual Evapotranspiration (mm) - AE

Percolation (mm) - PERC

DATA SUMMARY

Site Latitude (Deg)
42.00

Root Depth (in), (cm)
20.00 0.00

Holding Capacity (in/ft), (mm/m)
2.22 0.00

Dry Season Runoff Coefficient
.18

Wet Season Runoff Coefficient
.22

Average Seasonal Runoff Coefficient
.20

Average Precipitation for 1 Year (cm)
8.134

Total Precipitation for Year 1 (cm)
97.612

Total Pot. Evapotranspiration (cm)
57.783

Total Infiltration (cm)
78.185

Total Storage (cm)
86.045

Total Change in Storage (cm)
0.000

Total Actual Evapotranspiration (cm)
45.679

Total Percolation (cm)
26.332

TABLE 3

WATER BUDGET DATA FOR LOWER LANDFILL

WATER BUDGET FOR YEAR = 1

PREC	PE	CR	RO	INF	I-PE	NGE	ST	DELST	AE	PERC
January 8.6	0.0	.10	0.9	7.8	7.8	0.0	13.3	0.0	0.0	7.8
February 5.7	0.0	.10	0.6	5.1	5.1	0.0	13.3	0.0	0.0	5.1
March 7.3	0.0	.10	0.7	6.6	6.6	0.0	13.3	0.0	0.0	6.6
April 8.1	3.6	.10	0.8	7.3	3.6	0.0	13.3	0.0	3.6	3.6
May 9.7	6.3	.10	1.0	8.8	2.4	0.0	13.3	0.0	6.3	2.4
June 9.1	9.4	.05	0.5	8.7	-.7	-.7	12.4	-.9	9.4	0.0
July 9.7	12.8	.05	0.5	9.2	-3.6	-4.3	8.3	-4.0	10.2	0.0
August 9.2	11.6	.05	0.5	8.7	-2.9	-7.2	6.1	-2.3	8.5	0.0
September 7.7	8.0	.05	0.4	7.3	-.8	-8.0	5.6	-.4	7.4	0.0
October 7.6	4.7	.05	0.4	7.2	2.5	0.0	8.2	2.5	4.7	0.0
November 7.9	1.3	.05	0.4	7.5	6.2	0.0	13.3	5.2	1.3	1.0
December 7.0	0.0	.10	0.7	6.3	6.3	0.0	13.3	0.0	0.0	6.3

VARIABLE SYMBOLS

Precipitation (mm) - PREC
Potential Evapotranspiration (mm) - PE
Runoff Coefficient - CRO
Runoff (mm) - RO
Infiltration (mm) - INF
Accumulated Pot. Water Loss (mm) - NGE
Storage (mm) - ST
Change in Storage (mm) - DELST
Actual Evapotranspiration (mm) - AE
Percolation (mm) - PERC

DATA SUMMARY

Site Latitude (Deg)
42.00
Root Depth (in), (cm)
35.00 0.00
Holding Capacity (in/ft), (mm/m)
1.80 0.00
Dry Season Runoff Coefficient
.05
Wet Season Runoff Coefficient
.10
Average Seasonal Runoff Coefficient
.08
Average Precipitation for 1 Year (cm)
8.134
Total Precipitation for Year 1 (cm)
97.612
Total Pot. Evapotranspiration (cm)
57.783
Total Infiltration (cm)
90.410
Total Storage (cm)
133.952
Total Change in Storage (cm)
0.000
Total Actual Evapotranspiration (cm)
51.361
Total Percolation (cm)
32.875

TABLE 4

BROOME COUNTY INDUSTRIAL PARKS
INORGANIC DATA
ON-SITE WELLS

WELL	SAMPLE	DATE	TYPE	AL	AS	BA	CD	CR	CU	FE	PB	MN	HG	NI	SE	NA	ZN	CA	MG	HARD	TALK	PH	SPCOND
1	4385	08/05/83		<.1	<.01		<.01	<.01	.01	1.8	<.01	.18	<.5	<.01		18.	<.01					7.8	330.
1	4890	11/09/83		<.1	<.01	<.1	<.01	<.01	<.01	<.01	<.01	.02	<.5	<.01	<.01	14.	<.01	44.	11.	160.	132.	8.3	319.
2	4386	08/05/83		<.1	<.01		<.01	<.01	.01	<.01	<.01	.31	<.5	<.01		10.	.07					7.5	310.
2	4891	11/09/83		<.1	.06	.6	<.01	<.01	.03	.38	<.01	1.9	4.6	<.01	<.01	43.	.05	56.	11.	190.	174.	7.6	420.
2		1/19/84			.01																		
3	4387	08/05/83		<.1	<.01		.015	<.01	.02	<.01	<.01	.40	<.5	<.01		7.0	.05					6.7	200.
3	4892	11/09/83		<.1	.02	.1	<.01	<.01	<.01	<.01	<.01	1.3	<.5	<.01	<.01	6.2	<.01	30.	6.7	100.	61.	7.8	212.
3		1/19/84			<.01																		
4	4388	08/05/83		<.1	<.01		<.01	<.01	<.01	.05	<.01	.33	<.5	<.01		11.	<.01					7.0	160.
4	4893	11/09/83		<.1	<.01	.1	<.01	<.01	<.01	.01	<.01	<.01	6.7	<.01	<.01	5.6	.02	21.	5.1	73.	42.	8.2	160.
5	4389	08/05/83		<.1	.02		<.01	<.01	.12	<.01	<.01	1.4	<.5	<.01		13.	<.01					7.1	190.
5	4894	11/09/83		<.1	.01	.2	<.01	<.01	<.01	.02	<.01	1.9	3.9	<.01	<.01	6.7	.03	24.	3.7	75.	<1.	8.3	161.
6	4895	11/09/83		<.1	.08	.3	<.01	<.01	.01	38.	<.01	4.1	2.2	<.01	<.01	4.5	.06	11.	3.0	40.	19.	6.6	115.
6	62892	08/08/83		<.1	<.01		<.01	<.01	.01	2.4	<.01	2.8	<.5	<.01		11.	.01					5.9	140.
6		1/19/84			.01																		
7	4390	08/05/83		<.1	<.01		<.01	<.01	.05	<.01	<.01	4.1	<.5	<.01		5.0	.02					6.2	90.
7	4896	11/09/83		<.1	.07	.2	<.01	<.01	.01	7.8	<.01	4.3	<.5	<.01	<.01	3.8	.03	11.	1.9	35.	19.	7.1	94.4
7		1/19/84			.01																		
8	4391	08/05/83		<.1	<.01		<.01	<.01	.05	<.01	<.01	4.4	<.5	<.01		5.0	.02					6.2	90.
8	4897	11/09/83		<.1	.08	.3	<.01	<.01	<.01	10.	<.01	4.8	<.5	<.01	<.01	3.6	.04	8.6	1.7	28.	14.	7.1	84.3
8		1/19/84			.01																		
9	4392	08/05/83		<.1	<.01		<.01	<.01	.18	<.01	<.01	1.7	<.5	<.01		9.0	.02					6.2	90.
9	4898	11/09/83		<.1	<.01	.2	<.01	<.01	<.01	.03	<.01	2.0	<.5	<.01	<.01	3.7	.02	12.	2.2	39.	16.	7.0	100.
10	4393	08/05/83		<.1	<.01		<.01	<.01	.34	<.01	<.01	3.3	<.5	<.01		11.	.02					6.8	100.
10	4899	11/09/83		<.1	<.01	.2	<.01	<.01	<.01	.07	<.01	2.3	<.5	<.01	<.01	4.4	.02	14.	3.0	47.	19.	7.5	106.
11	4900	11/09/83		<.1	.06	.3	<.01	<.01	.02	2.2	<.01	11.	<.5	<.01	<.01	22.	.03	160.	39.	560.	350.	7.7	995.
11	62893	08/08/83		<.1	<.01		<.01	<.01	.26	<.01	<.01	4.4	.6	<.01	14.6	21.	<.01					7.1	750.
11		1/19/84			<.01																		

LEACHATE ANALYSES

WELL	SAMPLE	DATE	TYPE	AL	AS	BA	CD	CR	CU	FE	PB	MN	HG	NI	SE	NA	ZN	CA	MG	HARD	TALK	PH	SPCOND
13	62894	08/08/83	1	.1	<.01		<.01	<.01	2.4	3.6	<.01	16.	<.5	<.01		43.	.03					6.8	430.
13	63217	08/20/83	1	<.1	<.01		<.01	1.9	2.5	.84	<.01	15.	25.	<.01		14.	.01					6.6	272.
14	62895	08/08/83	1	.4	<.01		<.01	.05	.20	190.	<.01	110.		.49		650.	23.					6.0	10342.
14	63218	08/19/83	1	.4	<.01		.03	.65	.2	640.	<.01	120.	5.	.43		680.	16.					5.9	11458.
15	62896	08/08/83	1	.2	<.01		<.01	<.01	.78	<.01	<.01	7.2	<.5	<.01		45.	.08					6.8	330.
15	63220	08/20/83	1	<.1						.03		15.		<.01		16.	.11						
16	63219	08/20/83	1	<.1	<.01		<.01	.55	.3	4.3	<.01	.80	2.	.07		560.	.20					7.7	4586.

TABLE 4

BROOME COUNTY INDUSTRIAL PARKS
INORGANIC DATA
ON-SITE WELLS

WELL	SAMPLE	DATE	TDS	SO4	CL	NO3N	CN	PHENOL	TOC	AG
1	4385	08/05/83	210.	9.	12.	<.01	<.05			<.01
1	4890	11/09/83	190.	8.	2.	<.01	<.5	<.001	8.	<.01
2	4386	08/05/83	240.	65.	18.	<.01	.07			<.01
2	4891	11/09/83	300.	<1.	8.	<.01	<.5	.02	390.	<.01
3	4387	08/05/83	180.	27.	23.	<.01	<.05			<.01
3	4892	11/09/83	150.	3.	1.	.03	<.5	<.001	59.	<.01
4	4388	08/05/83	170.	81.	15.	.15	<.05			<.01
4	4893	11/09/83	90.	12.	1.	.05	<.5	<.001	1.	<.01
5	4389	08/05/83	200.	31.	23.	.14	<.05			.01
5	4894	11/09/83	110.	11.	4.	<.01	<.5	<.001	14.	<.01
6	4895	11/09/83	100.	5.	4.	.02	<.5	<.001	19.	<.01
6	62892	08/08/83	220.	34.	27.	<.01	<.05			<.01
7	4390	08/05/83	90.	71.	13.	.02	<.05			<.01
7	4896	11/09/83	110.	11.	4.	.02	<.5	<.001	4.	<.01
8	4391	08/05/83	100.	35.	16.	.08	<.05			<.01
8	4897	11/09/83	80.	12.	3.	.02	<.5	<.001	4.	<.01
9	4392	08/05/83	120.	100.	21.	.05	<.05			<.01
9	4898	11/09/83	100.	16.	3.	.01	<.5	<.001	2.	<.01
10	4393	08/05/83	170.	23.	26.	.08	<.05			.01
10	4899	11/09/83	120.	37.	4.	<.01	<.5	<.001	3.	<.01
11	4900	11/09/83	740.	1.	43.	<.01	<.5	.07	280.	<.01
11	62893	08/08/83	360.	72.	47.	<.01	<.05			.01

LEACHATE ANALYSES

WELL	SAMPLE	DATE	TDS	SO4	CL	NO3N	CN	PHENOL	TOC	AG
13	62894	08/08/83	310.	41.	27.	<.01	<.05			<.01
13	63217	08/20/83	230.	13.0	90.	3.6	<.05			<.01
14	62895	08/08/83	13750.	890.	840.	.18	.5			.03
14	63218	08/19/83	15900.	814.0	860.	.4	.14			<.01
15	62896	08/08/83	280.	113.	47.	.10	<.05			.03
15	63220	08/20/83								
16	63219	08/20/83	2660.	11.0	760.	.3	<.1			<.01

TABLE 5
BROOME COUNTY INDUSTRIAL PARK
ORGANIC ANALYSES OF ON-SITE WELLS
1983

	Well 1		Well 2		Well 3		Well 4		Well 5		Well 6		Well 7		Well 8		Well 9		Well 10		Well 11		Well 13		Well 14		Well 15		Well 16	
	8/5	11/10	8/5	11/10	8/5	11/10	8/5	11/9	8/5	11/9	8/5	11/9	8/5	11/9	8/5	11/9	8/5	11/9	8/5	11/9	8/5	11/9	8/8	8/20	8/8	8/19	8/8	8/20	8/20	8/20
Benzene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	3	2	<1	40	27	<1	<1		7
a-Trifluorotoluene		<1		2		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Toluene	<1	<1	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	110	17	13	1100	1200	<1	<1		8
Ethylbenzene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	8	5	34	59	<1	<1		<1
1-Chlorocyclohexene-1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
p-Xylene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		4								
m-Xylene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Chlorobenzene	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	6	2	<1	<1	<1	<1	<1		<1
o-Xylene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Isopropylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Styrene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
p-Bromofluorobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
n-Propylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
o-Chlorotoluene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
tert-Butylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Bromobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
sec-Butylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
1,3,5-Trimethylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
1,2,4-Trimethylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
p-Cymene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
p-Dichlorobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Cyclopropylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
n-Butylbenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
m-Dichlorobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
2,3-Benzofuran		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
o-Dichlorobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Hexachloro-1,3-butadiene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
1,2,4-Trichlorobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Naphthalene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
1,2,3-Trichlorobenzene		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1		<1								
Chloromethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	2	<1	<1		<1
Bromomethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	2	<1	<1			<1	<1		<1
Vinyl Chloride	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	16	<1	<1	<1	36	25	<1	<1		<1
Chloroethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	5	18	<1	<1	19	15	<1	<1		<1
Methylene chloride	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	2	32	<1	2	1600	2100	2	4		4
1,1-Dichloroethene	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1		<1	<1	<1	<1	<1	<1	<1		<1
1,1-Dichloroethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	26	150	<1	<1	62	80	<1	<1		<1
t-1,2-Dichloroethene	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	8	10	<1	<1		<1
Chloroform	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
1,2-Dichloroethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	3	<1	<1	6	10	<1	<1		<1
1,1,1-Trichloroethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	8	<1	2	<1	<1	<1	<1	<1		<1
Carbon tetrachloride	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
Bromodichloromethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
1,2-Dichloropropane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	40	<1	<1	150	350	15	20		<1
t-1,3-Dichloropropene	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
Trichloroethene	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	23	23	<1	<1		<1
Dibromochloromethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
1,1,2-Trichloroethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
c-1,3-Dichloropropene	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
2-Chloroethylvinyl ether	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10	<10		<10
Bromoform	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10	<10		<10
1,1,2,2-Tetrachloroethane	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1
Tetrachloroethene	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1

TABLE 6

BROOME COUNTY INDUSTRIAL PARKS
INORGANIC DATA
HOMEOWNER WELLS

DATE	HOME	SAMPLE	AL	AS	BA	CD	CR	CU	FE	PB	MN	HG	NI	SE	NA	ZN	CA	MG	HARD	TALK	PH	SPCOND	TDS
11/14/83	1	71229	<.1	<.01	.3	<.01	<.01	<.01	2.1	<.01	1.5	<.5	<.01	<.01	10.	.02	19.	4.3	65.	70.	7.3	158.	130.
11/14/83	2 2	71230	<.1	.04 .033	.2	<.01	<.01	<.01	<.01	<.01	.06	<.5	<.01	<.01	130.	.01	7.9	1.4	25.	270.	8.8	524.	340.
11/14/83	3	71231	<.1	<.01	.1	<.01	<.01	.10	<.01	<.01	.14	<.5	<.01	<.01	40.	.02	30.	6.5	100.	46.	6.3	426.	260.
11/14/83	4	71232	<.1	<.01	<.1	<.01	<.01	.01	<.01	<.01	1.1	<.5	<.01	<.01	26.	.03	53.	5.8	160.	174.	8.8	379.	250.
11/14/83	5	71233	<.1	.02	.2	<.01	<.01	<.01	.03	<.01	.45	<.5	<.01	<.01	14.	.01	34.	5.4	110.	122.	8.9	223.	180.
11/14/83	7 7	71235	<.1	.03 .010	.1	<.01	<.01	<.01	.04	<.01	.54	<.5	<.01	<.01	11.	.02	33.	5.4	105.	114.	7.7	236.	140.
11/14/83	8	71236	<.1	.01	.4	<.01	<.01	<.01	.01	<.01	.13	<.5	<.01	<.01	23.	.06	27.	5.0	88.	120.	8.0	248.	140.
11/14/83	9 9	71237	<.1	.11 .033	.1	<.01	<.01	.01	.04	<.01	.42	<.5	<.01	<.01	75.	.03	27.	4.8	87.	224.	7.9	399.	270.
11/14/83	10	71238	<.1	<.01	.1	<.01	<.01	.33	<.01	<.01	<.01	<.5	<.01	<.01	65.	.03	26.	6.3	91.	44.	6.3	517.	320.
11/14/83	11	71239	<.1	<.01	<.1	<.01	<.01	.01	<.01	<.01	1.0	<.5	<.01	<.01	27.	.01	44.	5.1	130.	162.	7.7	348.	220.
11/15/83	6	71234	<.1	<.01	<.1	<.01	<.01	.12	<.01	<.01	.01	<.5	<.01	<.01	6.2	.03	12.	3.0	42.	16.	5.9	112.	80.
11/15/83	12	71240	<.1	<.01	.1	<.01	<.01	.23	<.01	<.01	<.01	<.5	<.01	<.01	69.	.26	26.	4.7	88.	40.	6.2	539.	320.
11/15/83	13	50315	<.05	.023	.5	<.002	<.01	<.05	.44	<.01	.27	<.4	<.05	<.01	53.	.14			88.	190.	7.6	386.	206.
11/15/83	14	50316	<.05	<.01	<.5	<.002	<.01	<.05	6.6	<.01	1.9	<.4	<.05	<.01	12.	.09			129.	107.	7.0	281.	204.
11/15/83	15	50317	<.05	<.01	<.5	<.002	<.01	<.05	8.4	<.01	.22	<.4	<.05	<.01	5.8	<.05			57.	38.	6.5	142.	87.
11/15/83	16	50318	<.05	<.01	<.5	<.002	<.01	<.05	<.02	<.01	.08	<.4	<.05	<.01	55.	<.05			1.	105.	7.5	256.	162.
11/15/83	17	50319	<.05	<.01	<.5	<.002	<.01	<.1	.66	<.01	.20	<.4	<.05	<.01	4.7	<.05			43.	23.	6.6	118.	71.

BROOME COUNTY INDUSTRIAL PARKS
INORGANIC DATA
HOMEOWNER WELLS

DATE	HOME	SAMPLE	SO4	CL	NO3N	CN	PHENOL	TOC	AG
11/14/83	1	71229	14.	6.	<.01	<.05	<.001	6.	<.01
11/14/83	2	71230	<1.	29.	<.01	<.05	<.001	14.	<.01
11/14/83	3	71231	30.	65.	4.7	<.05	<.001	8.	<.01
11/14/83	4	71232	14.	23.	<.01	<.05	<.001	10.	<.01
11/14/83	5	71233	7.	8.	<.01	<.05	<.001	7.	<.01
11/14/83	7	71235	12.	8.	<.01	<.05	<.001	8.	<.01
11/14/83	8	71236	4.	7.	<.01	<.05	<.001	9.	<.01
11/14/83	9	71237	3.	27.	<.01	<.05	<.001	11.	<.01
11/14/83	10	71238	25.	116.	5.0	<.05	<.001	8.	<.01
11/14/83	11	71239	12.	14.	<.01	<.05	<.001	9.	<.01
11/15/83	6	71234	11.	17.	1.13	<.05	<.001	4.	<.01
11/15/83	12	71240	37.	114.	4.6	<.05	<.001	6.	<.01
11/15/83	13	50315	2.2	14.					<.02
11/15/83	14	50316	20.	13.					<.02
11/15/83	15	50317	15.	11.					<.02
11/15/83	16	50318	20.	5.6					<.02
11/15/83	17	50319	18.	8.5					<.02

TABLE 7
BROOME COUNTY INDUSTRIAL PARK
ORGANIC ANALYSES OF HOMEOWNER WELLS

WELL NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
OWNER	D. Eckelberger	G. Tamkins	R. Edminster	M. Smith	D. Kernan	J. Villano	O. Desimone	A. Dahteria	R. Johnson	A. Allen	J. Hoover	R. Gleason	D. Hamm	Town Hall	R. Rowse	T. Butchko	S. Lasky
DATE	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/9/83	11/15/84	11/15/84	11/15/84	11/15/84	11/15/84
Benzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
a-Trifluorotoluene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Toluene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	10
Ethylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1-Chlorocyclohexene-1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
p-Xylene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
m-Xylene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chlorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
o-Xylene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Isopropylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Styrene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
p-Bromofluorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
n-Propylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
o-Chlorotoluene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
p-Chlorotoluene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
tert-Butylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bromobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
sec-Butylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,3,5-Trimethlbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,2,4-Trimethylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
p-Cymene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
p-Dichlorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cyclopropylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
n-Butylbenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
m-Dichlorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
2,3-Benzofuran	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
o-Dichlorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Hexachloro-1,3-butadiene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,2,4-Trichlorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Naphthalene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,2,3-Trichlorobenzene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chloromethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bromomethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Vinyl Chloride	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chloroethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Methylene chloride	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,1-Dichloroethene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,1-Dichloroethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
t-1,2-Dichloroethene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Chloroform	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	2	< 1	< 1	< 1
1,2-Dichloroethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,1,1-Trichloroethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Carbon tetrachloride	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bromodichloromethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,2-Dichloropropane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
t-1,3-Dichloropropene	< 1	< 1	< 1	< 1	< 1	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Trichloroethene	< 1	< 1	< 1	< 1	< 1	4	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	9
Dibromochloromethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
c-1,3-Dichloropropene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
2-Chloroethylvinyl ether	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromoform	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2,2-Tetrachloroethane	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Tetrachloroethene	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1

TABLE 8

Groundwater Quality Within the Aquifers of the Susquehanna River Basin in New York State
(values in mg/l) (from Hollyday, 1969)

	Glacial Till and Bedrock			Lacustrine Deposits			Outwash Deposits		
*	G	M	P	G	M	P	G	M	P
Temperature	48	50	52	50	52	53	47	50	53
Silica	6.7	8.3	9.6	2.0	7.8	15	6.8	7.4	8.8
Iron	.08	.30	.65	.21	1.0	1.8	.03	.06	.15
Manganese	.01	.03	.05		.02		0	.01	.05
Calcium	29	41	51		30		45	50	74
Magnesium	3.8	8.3	9.7		9.0		6.0	12	19
Sodium	4.8	11	64		7.6		6.6	8.9	13
Potassium	.5	1.5	2.3		.5		1.1	1.4	1.6
Bicarbonate	140	170	250		130		150	180	230
Sulfate	3.6	12	27		15		25	31	50
Chloride	4.0	16	58		3.0		7.8	13	22
Fluoride	.1	.1	.2		.1		.05	.1	.2
Nitrate	.09	.18	.53		0		.24	1.0	2.1
Dissolved Solids	160	200	310		140		190	240	330
Calcium and Magnesium	54	90	140		120		150	200	220
Alkalinity	110	150	190		110	130	130	150	170
pH	7.3	7.7	8.1		7.5		7.4	7.6	7.8
Color	0	2	10		1		1	2	5

*Values tabulated are taken from a frequency distribution of reported chemical analysis of well water.
Good (G), medium (M) and poor (P) refer to values equaled or exceeded for 75, 50 and 25 percent of available analyses, respectively.

TABLE 9

New York State Department of Environmental Conservation
Class GA Groundwater Standards
(suitable as a potable water supply)

Parameter	Maximum Allowable Concentration
Arsenic (As)	.025 mg/l
Barium (Ba)	1.0 mg/l
Cadmium (Cd)	.01 mg/l
Chloride (Cl)	250 mg/l
Chromium (Cr)	.05 mg/l
Copper (Cu)	1.0 mg/l
Cyanide (CN)	.2 mg/l
Fluoride (F)	1.5 mg/l
Foaming Agents	.5 mg/l
Iron (Fe)	.3 mg/l
Lead (Pb)	.05 mg/l
Manganese (Mn)	.3 mg/l
Mercury (Hg)	.002 mg/l
Nitrate (N)	10.0 mg/l
Phenols	-
Selenium (Se)	.01 mg/l
Silver (As)	.05 mg/l
Sulfate (SO_4)	250 mg/l
Zinc (Zn)	5 mg/l
pH Range	6.5 - 8.5
Chlordane	3.0 mg/l
Endrin	.2 ug/l
Heptachlor	.1 ug/l
Lindane	4.0 ug/l
Methoxychlor	100 ug/l
Toxaphene	5.0 ug/l
2,4-Dichlorophenoxyacetic Acid	100 ug/l
2,4,5-Trichlorophenoxyproploric Acid	10.0 ug/l
Vinyl Chloride	5.0 ug/l
Benzene	not detectable
Chloroform	100 ug/l
Trichloroethylene	10 ug/l

TABLE 10

Representative Ranges for Various Inorganic Constituents in Leachate from Sanitary Landfills

Parameter	Representative Range (mg/l)
K^+	200 - 1000
Na^+	200 - 1200
Ca^{2+}	100 - 3000
Mg^+	100 - 1500
Cl^-	300 - 3000
SO_4^{2-}	10 - 1000
Alkalinity	500 - 10,000
Fe (total)	1 - 1000
Mn	0.01 - 100
Cu	10
Ni	0.01 - 1
Zn	0.1 - 100
Pb	5
Hg	0.2
NO_3^-	0.1 - 10
NH_4^+	10 - 1000
P as PO_4	1 - 100
Ogranic nitrogen	10 - 1000
Total dissolved organic carbon	200 - 30,000
COD (chemical oxidation demand)	1000 - 90,000
Total dissolved solids	5000 - 40,000
pH	4 - 8

Sources: Griffin et al., 1976; Leckie et al., 1975.

Figures

O'BRIEN & GERE

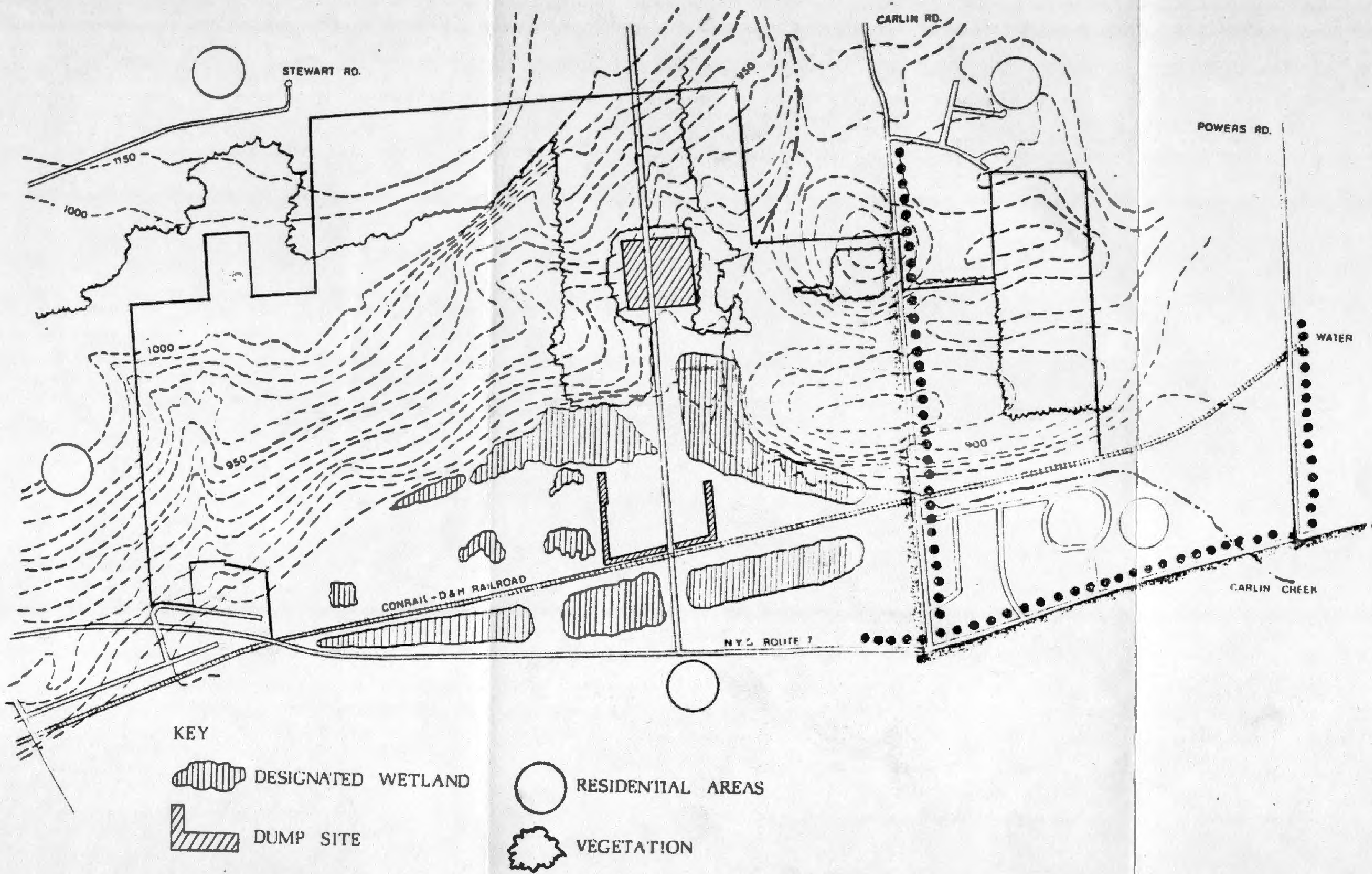


FIGURE I

NOTE: MAP BY BROOME COUNTY DEPARTMENT OF PLANNING

BROOME COUNTY
INDUSTRIAL DEVELOPEMENT
AGENCY

SITE PLAN

O'BRIEN & GERE
O'Brien & Gere Engineers, Inc.

FIGURE 2

LEGEND

- GROUNDWATER MONITORING WELL
- LEACHATE / METHANE GAS MONITORING WELL
- WELLS BY OTHERS
- LITHOLOGIC CROSS SECTION LINE
- AREAL EXTENT OF LAND FILLS
- (5) HOMEOWNER WELL

BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY

MONITORING WELL LOCATION MAP

SCALE IN FEET

1" = 200' 200 0 200 400

O'BRIEN & GERE

FIGURE 3

LEGEND

- GROUNDWATER MONITORING WELL
- LEACHATE / METHANE GAS MONITORING WELL
- WELLS BY OTHERS
- LITHOLOGIC CROSS SECTION LINE
- AREAL EXTENT OF LAND FILLS
- (5) HOMEOWNER WELL
- WATER ELEVATION CONTOURS
- GROUND WATER FLOW DIRECTION

BROOME COUNTY INDUSTRIAL DEVELOPMENT AGENCY

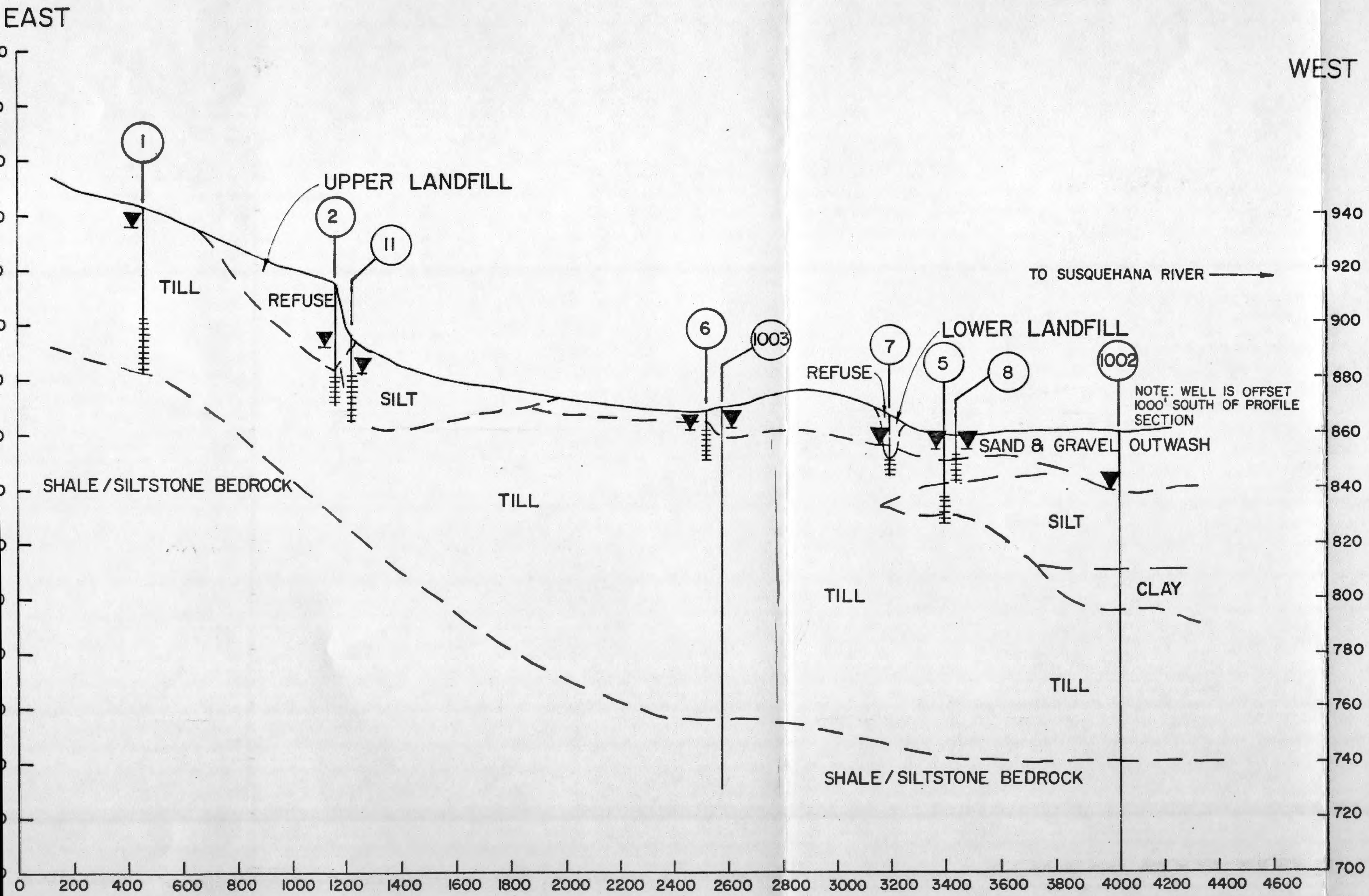
GROUND WATER ELEVATION MAP

SCALE IN FEET

1" = 200' — 200 0 200 400

O'BRIEN & GERE

FIGURE 4



LEGEND

5 GROUNDWATER MONITORING WELL

GROUNDWATER MONITORING WELL SCREEN INTERVAL

▼ GROUNDWATER ELEVATION

NOTE: GROUNDWATER WELL 1002 & 1003 ARE FROM RANDALL 1972

BROOME COUNTY INDUSTRIAL DEVELOPEMENT AGENCY

SITE CROSS SECTION

O'BRIEN & GERE

Appendices

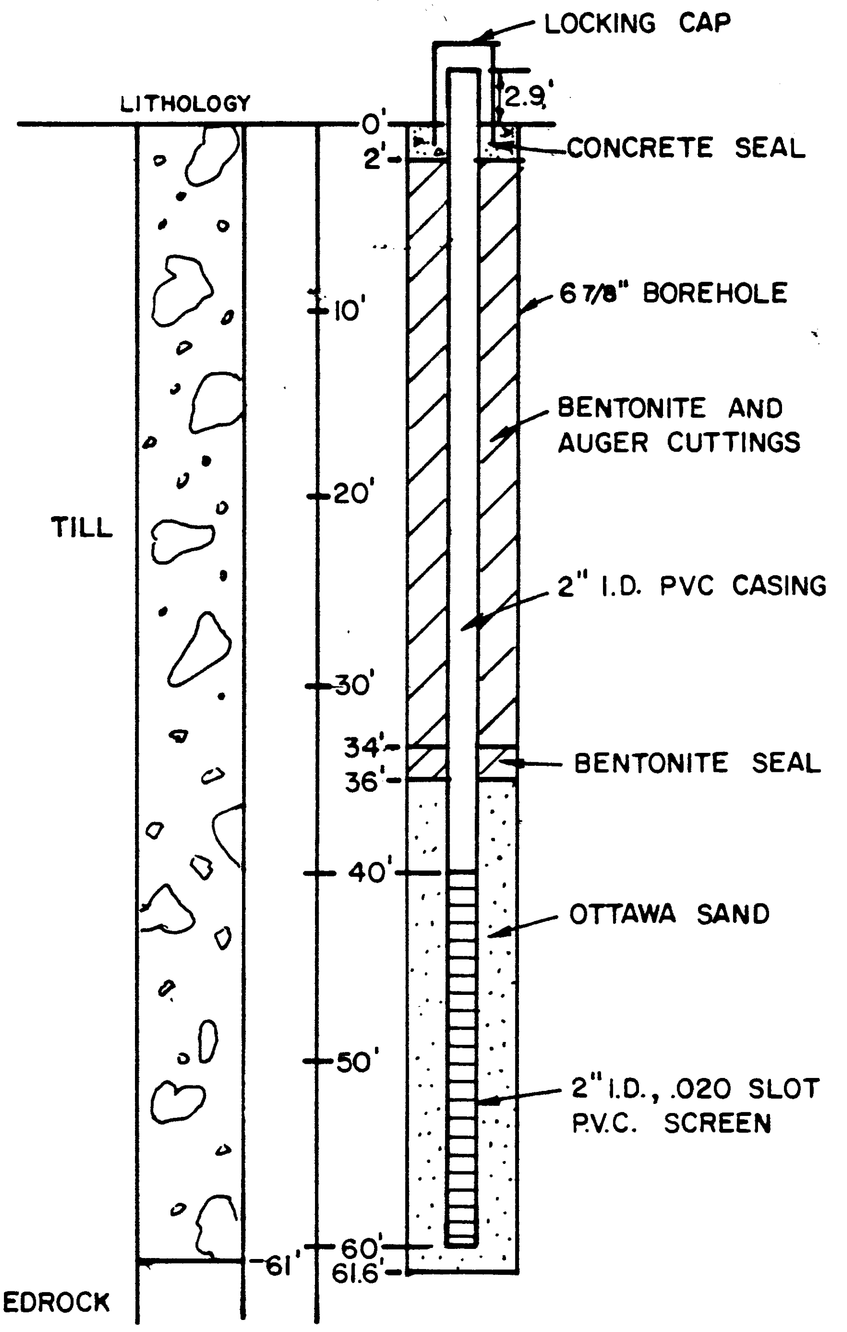
O'BRIEN & GERE

APPENDIX A

LITHOLOGIC LOGS AND MONITORING WELLS DETAILS

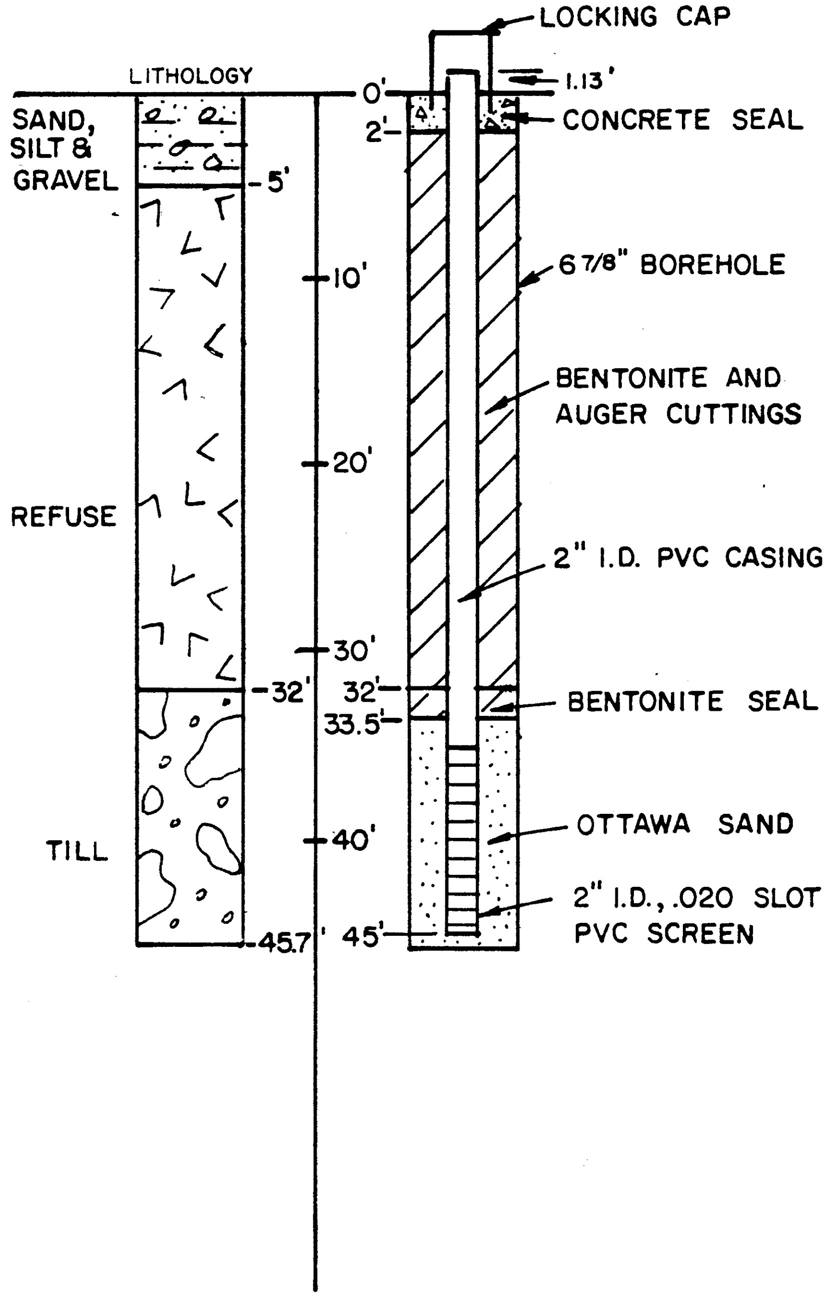
WELL I
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DETH	ELEV.	DESCRIPTION
0-2	944.4-939.4	Silt, brown, moist, little sand and gravel, very stiff
5-7	939.4-937.4	Silt, brown, moist, little sand, trace gravel, trace clay, hard
10-12	934.4-932.4	Same as above
15-17	929.4-927.4	Silt, brown, moist, little clay and sand, trace gravel, hard
20-22	924.4-922.4	Silt, gray, moist, little clay, sand and gravel, very stiff to hard
25-27	919.4-917.4	Same as above
30-32	914.4-912.2	Same as above
35-37	909.4-	Silt, wet, hard, trace sand and clay, hard
40-42	904.4-883.4	Silt, gray, moist to wet little clay, sand and gravel, very stiff
45-47	899.4-897.4	Same as above
50-52	894.4-892.4	Same as above
55-57	889.4-887.4	Same as above
60-61	884.4-882.4	Same as above
61-61.6	883.4-	Silt, stone, gray, dry, hard



WELL 2
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

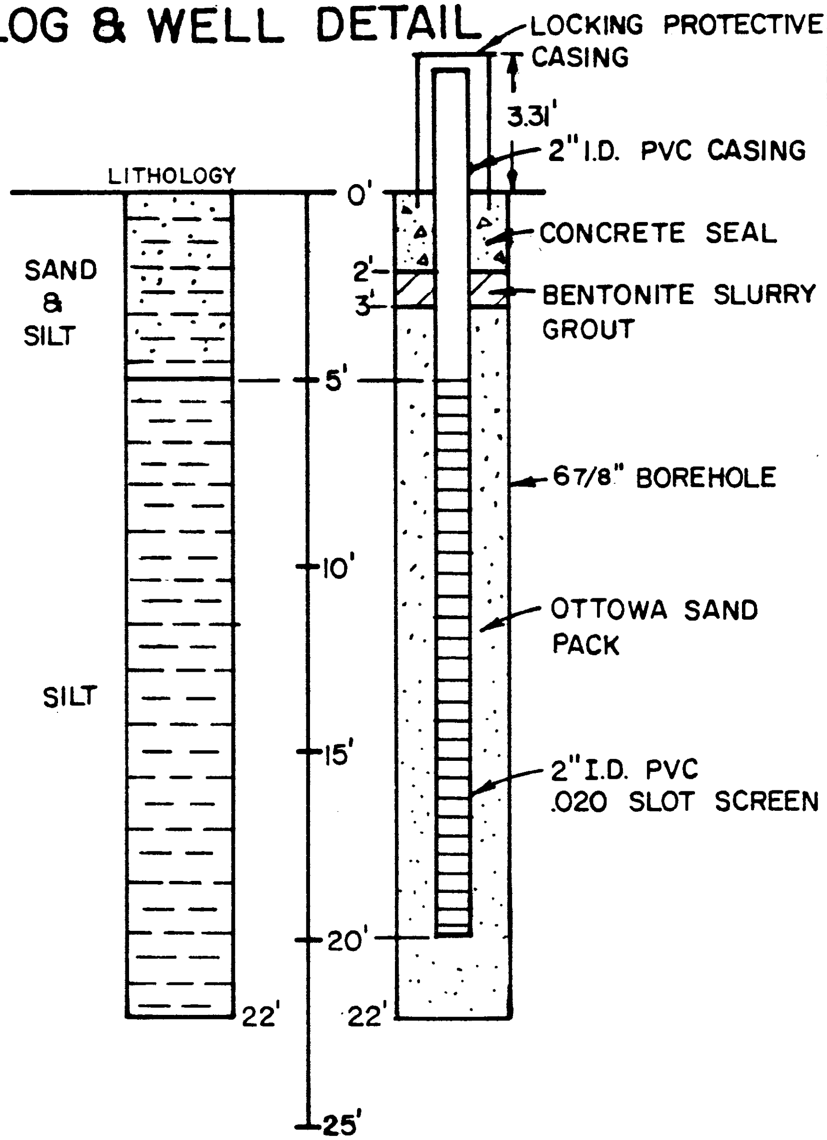
DEPTH	ELEV.	DESCRIPTION
0-5	914.8 909.8	Sand, gravel & silt, brown moist, medium dense
5-12	909.8- 902.8	Refuse, gray-brown, wet
12-26	902.8- 888.8	Refuse, gray-brown, wet, some sand, silt & gravel medium dense
26-30	888.8- 884.8	Silt & clay gray, wet little sand & gravel medium dense
30-32	884.8- 882.8	Silt, clay, gray, wet some refuse, little sand & gravel medium dense
32-45.7	882.8- 869.1	Silt, clay, gray, wet, some sand & gravel Still to hard
45.7	869.1	Refusal



WELL 3

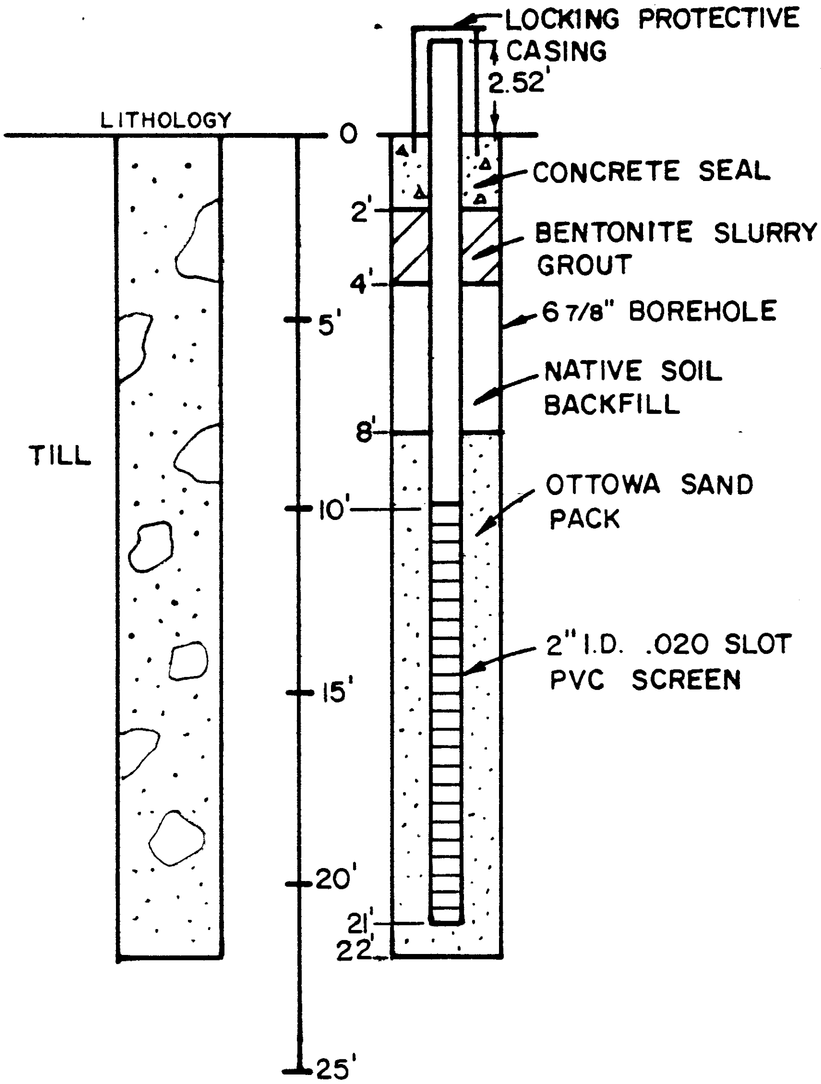
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-1	885.8-883.8	Silt, brown, moist, little fine sand, stiff
5-7	880.8-878.8	Silt, brown, moist, very stiff, some rounded pebbles and angular shale gravel, little, fine sand, trace clay, stiff
10-12	875.8-873.8	Silt, gray, wet, varred, stiff, some clay, very stiff
15-17	870.8-868.8	Silt, gray, wet varred, stiff, little clay, stiff
20-22	865.8-863.8	Silt, grey, wet, varred stiff, little clay, stiff



WELL 4
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	890.9-888.9	Silt, brown moist some gravel, trace clay, stiff
5-7	885.9-883.9	Silt, gray, wet, some clay, little gravel, stiff
10-12	880.9-878.9	Silt, brown, moist, some gravel, little sand, medium dense
15-17	875.9-873.9	Silt, brown, wet, some sand and gravel, little clay
20-22	870.9-868.9	Silt, brown-gray, wet, little clay, little gravel, stiff



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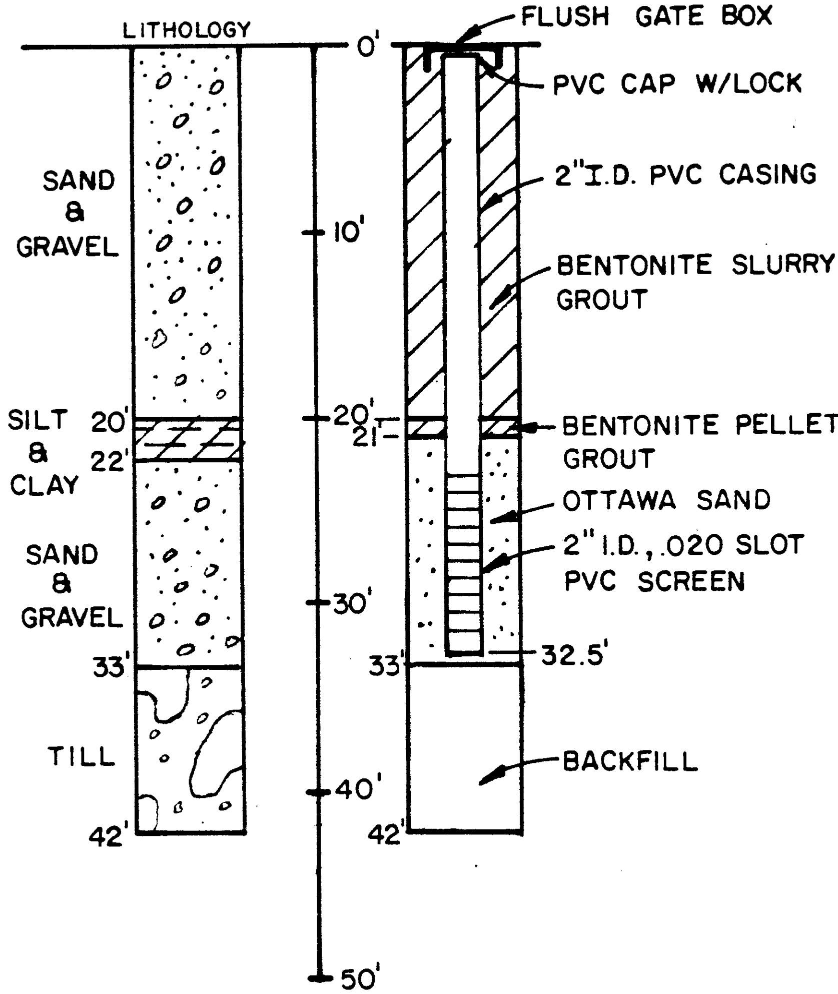
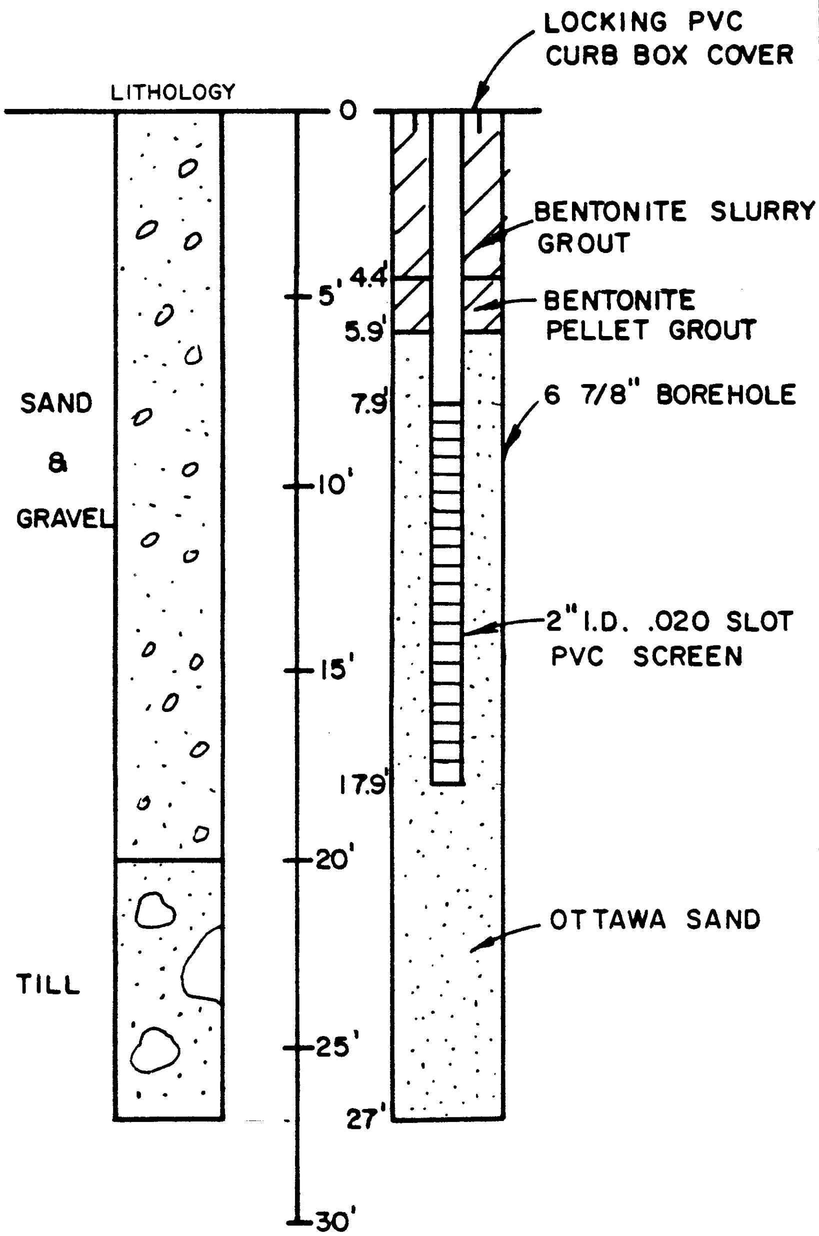
WELL 5
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	860.31-858.31	Gravel, brown, dry, little sand, loose
5-7	855.31-853.31	Sand and gravel, brown, dry, little silt, very dense
10-12	850.31-848.31	Gravel and sand, gray, wet, some silt, dense
15-16	845.31-844.31	Same as above
16-17	844.31-843.31	Sand and gravel, brown, wet, medium dense
20-22	840.31-838.31	Silt, brown, wet, little clay lenses, stiff
25-27	835.31-833.31	Silt, brown, wet, some sand, little gravel, medium dense
30-32	830.31-828.31	Silt, gray, moist, some sand and gravel, stiff
35-37	825.31-823.31	Silt, gray moist, little sand and gravel
40-42		Silt, gray, moist, some sand and gravel



WELL 6
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	868.82-866.82	Sand and gravel, brown, dry, medium dense
5-7	863.82-861.82	Sand, brown moist, some silt, little gravel, medium dense
10-12	858.82-856.82	Gravel and sand, gray, wet, little silt, dense
15-17	853.82-851.82	Same as above
20-22	848.82-846.82	Gravel and gray, wet, some silt very dense
25-27	843.82-851.82	Same as above



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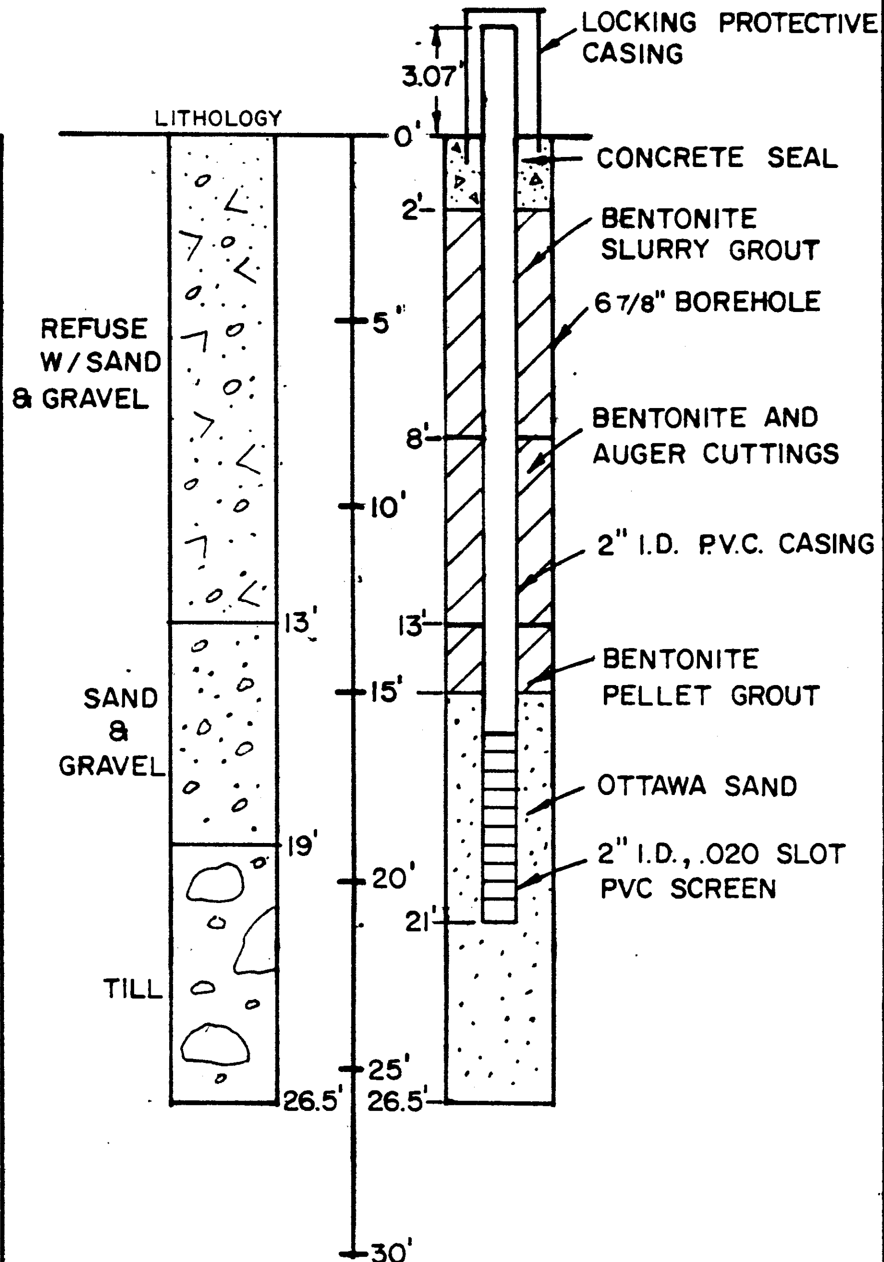
WELL 7
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	865.2-863.2	Gravel, brown, moist, some sand and silt, dense
4-6	861.2-859.2	Refuse, black, wet, little sand, silt and gravel
6-8	859.2-857.2	Gravel, brown, wet, some refuse, little sand and silt, medium dense
8-10	857.2-	Same as above
10-12	855.2-853.2	Same as above
12-14	853.2-851.2	Same as above
14-16	851.2-849.2	Gravel, brown wet, little silt and sand, trace clay, very dense
16-18	849.2-847.2	Same as above
20-22	845.2-843.2	Silt and sand, brown, dry, little gravel, very dense
25-26.5	840.2-838.2	Silt and sand, brown, dry to wet, little gravel, very dense



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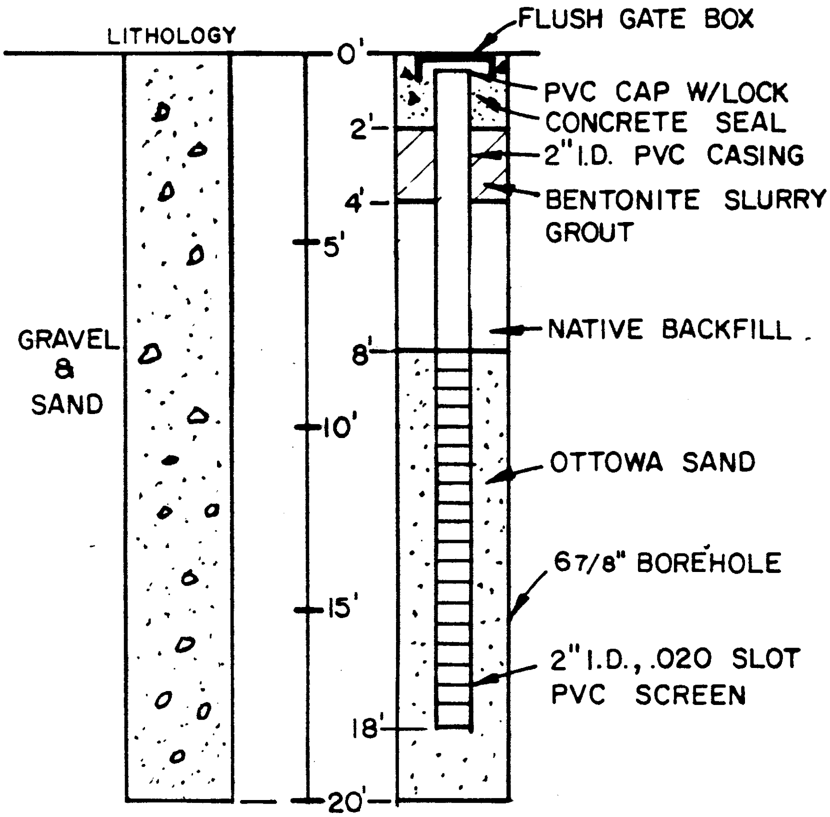
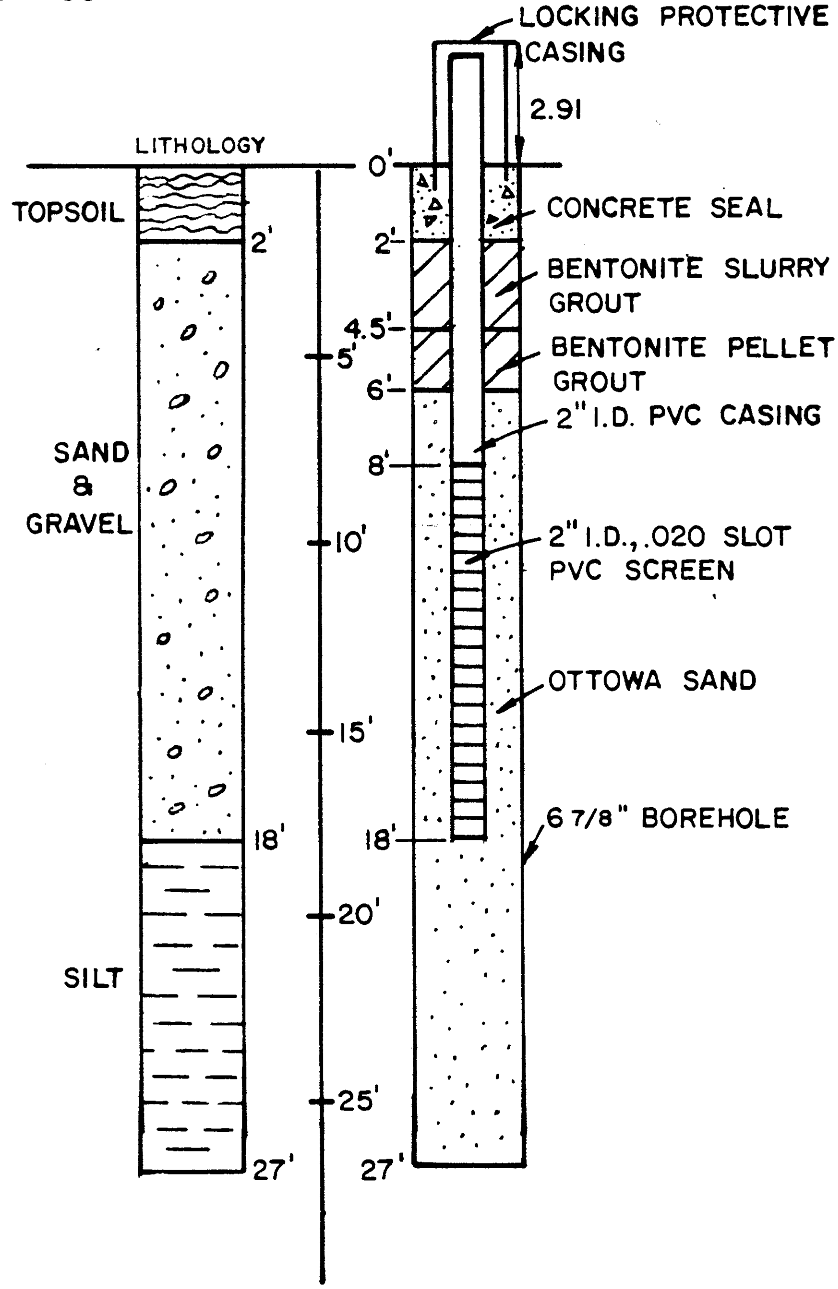
WELL 8
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-18	860.24 842.24	No Samples - same as Well #5
18-19	842.24 841.24	Gravel, brown, wet, little sand and silt, medium dense
19-20	841.24 840.24	Silt, brown, wet, trace sand & clay, stiff



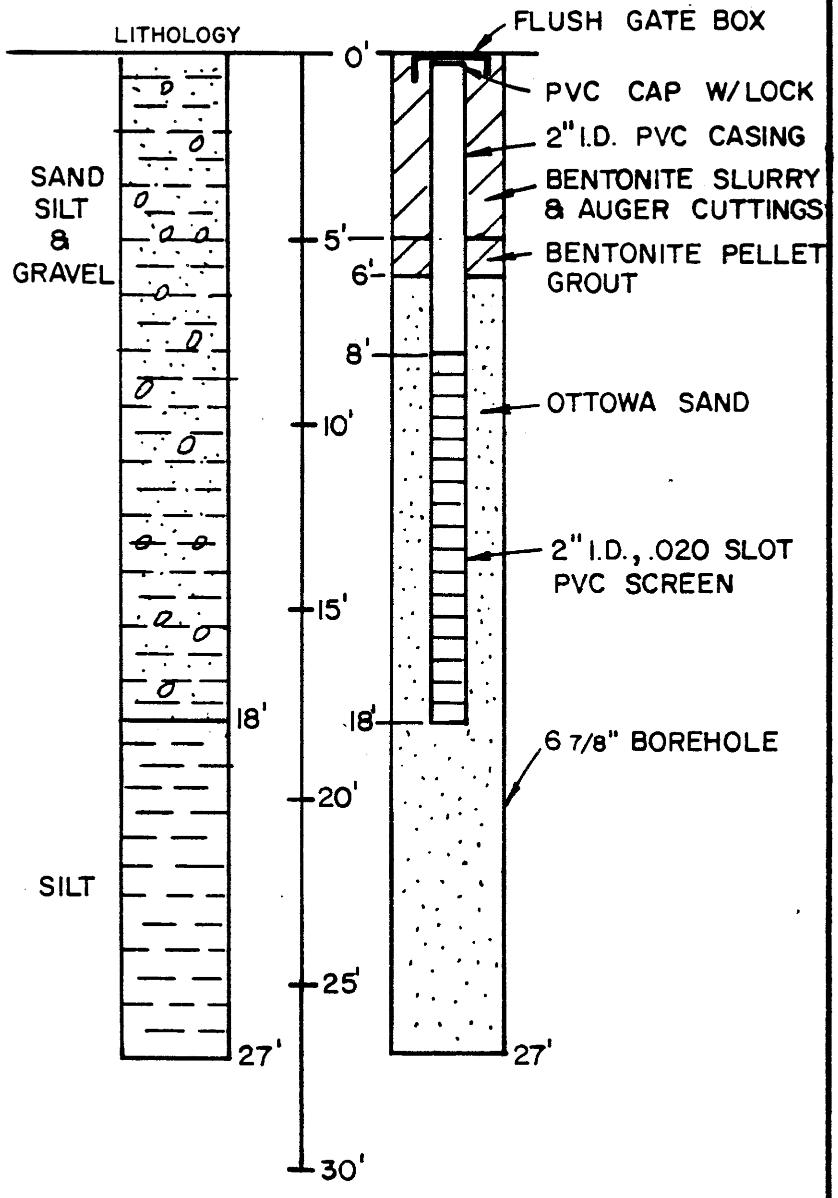
WELL 9
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	861.3-	Gravel, brown dry, some sand, little silt, loose
5-7	856.3-	Gravel & Sand, brown, dry to wet, little silt, very dense
10-12	851.3- 849.3	Coarse sand, brown, wet, some gravel dense
15-17	846.3- 844.3	Same as above
20-22	841.3 839.3	Silt, brown, wet, some sand, little stiff
25-27	836.3- 834.3	Silt, Brown, wet, little sand, trace gravel, stiff



WELL 10
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	863.76-	Silt, brown, dry, little sand and gravel, medium stiff
5-7	858.76- 856.76	Same as above
10-11	853.76- 852.76	Sand, brown, wet, little silt, medium dense
11-12	852.76- 851.76	Sand, brown, wet, some gravel, little silt, medium dense
15-17	848.76- 846.76	Same as above
20-22	843.76- 841.76	Silt, brown, wet, trace fine sand, stiff
25-27	838.76- 846.76	Silt, brown, wet, very stiff



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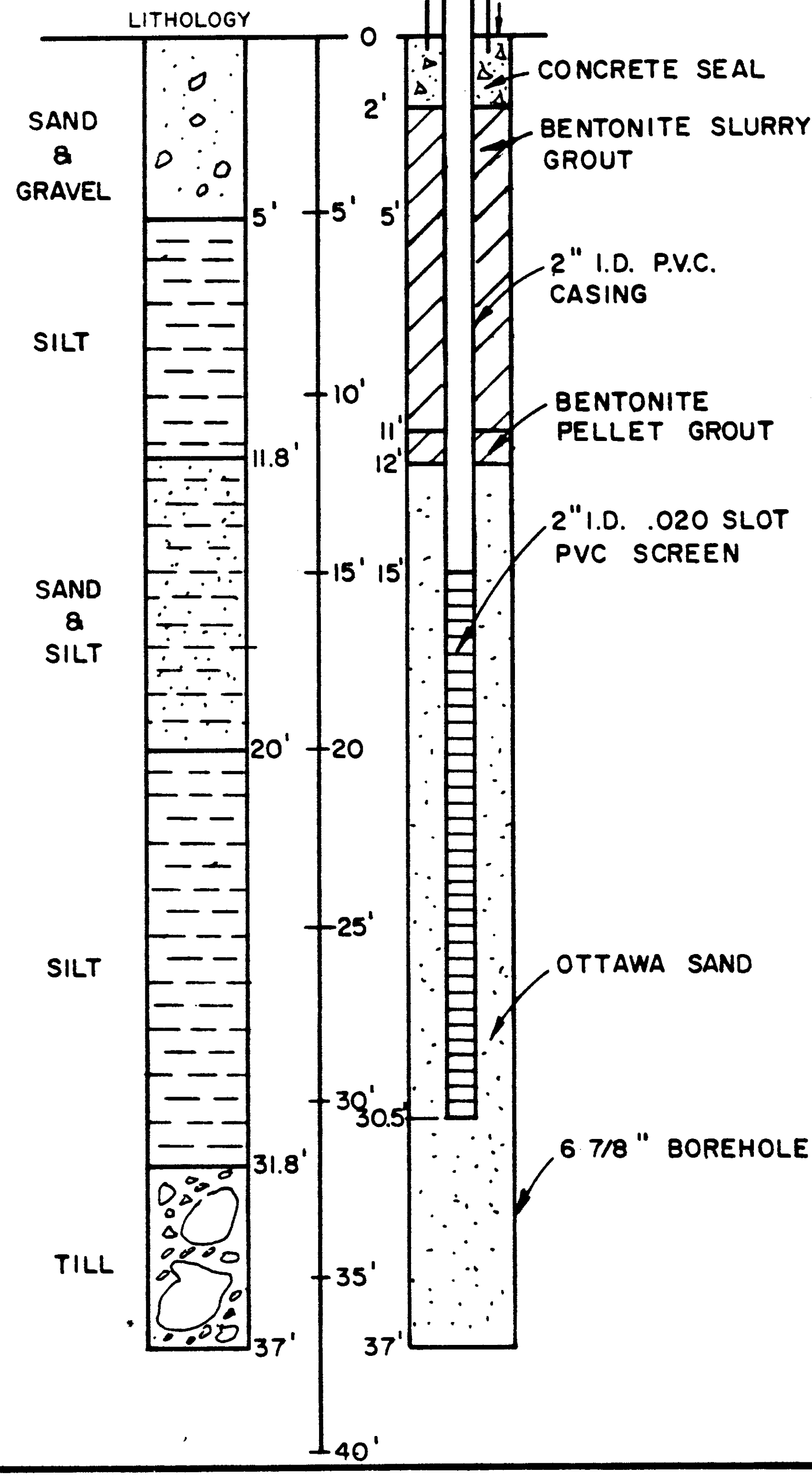
WELL 11
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	896.2-894.2	Sand, brown, dry, some gravel, medium dense
2-4	894.2-892.2	Gravel, brown, dry, some sand, little silt, medium dense
5-7	891.2-889.2	Silt, gray, moist, little clay, stiff
7-8	889.2-888.2	Same as above
8-9	888.2-887.2	Silt, brown, moist, some sand, little clay and gravel, stiff
10-12	886.2-884.2	Same as above
15-17	881.2-879.2	Sand, brown, wet, some silt, medium dense
20-22	876.2-874.2	Silt, gray, wet, little clay, trace sand, stiff
25-27	871.2-879.2	Silt, gray, wet, very stiff
30-31.8	866.2-864.4	Same as above
31.8-32	864.4-864.2	Sand, gray, wet, some silt, medium dense
35-37	861.2-859.2	Same as above



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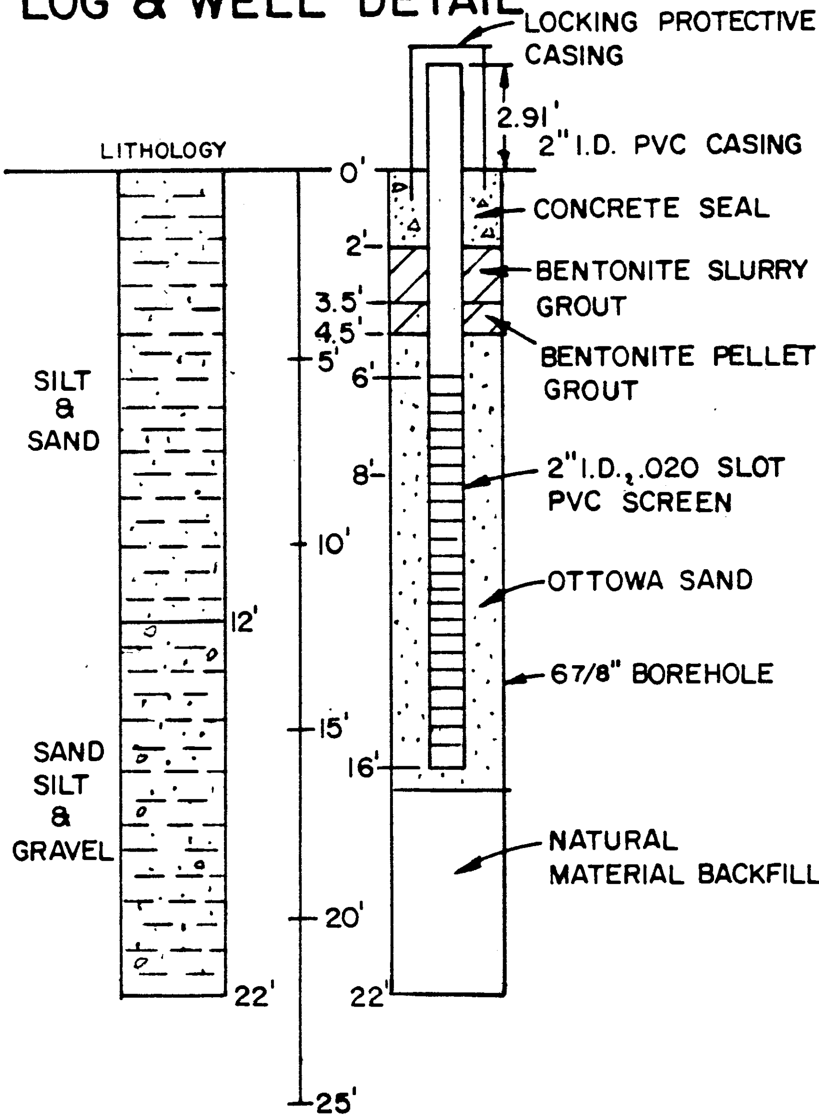
WELL 12

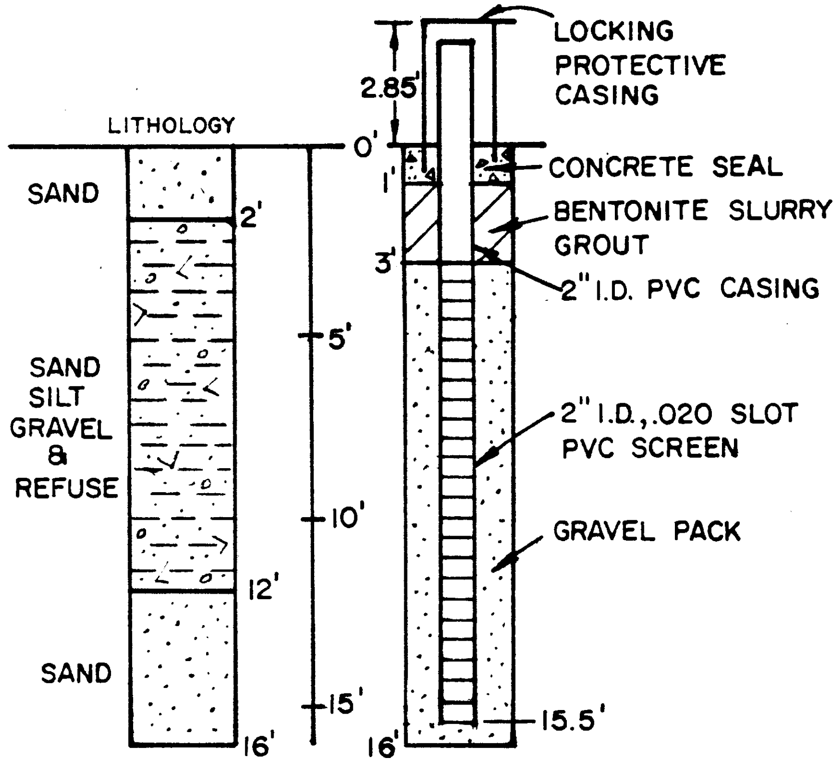
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	898.6-896.6	Silt, brown, dry, trace sand and gravel, stiff
5-7	893.6-891.6	Silt, brown, dry, some sand and gravel, hard
10-11	888.6-887.6	Silt, brown, wet, some sand, trace clay, medium stiff
11-12	887.6-886.6	Sand, brown, wet, some silt and gravel, medium dense
15-17	883.6-881.6	Sand, wet, brown, some gravel, medium dense
20-22	878.6-877.6	Same as above



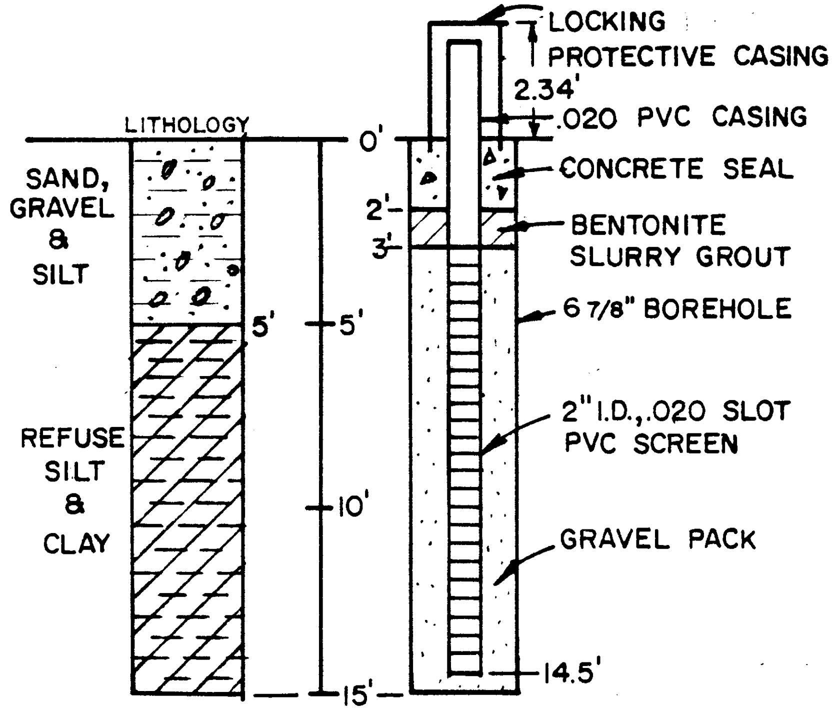
WELL 13
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	865.7-863.7	Sand, brown, dry, little silt, trace gravel, medium dense
2-4	863.7-861.7	Sand, brown moist, trace refuse and silt, loose
4-6	861.7-859.7	Sand, brown, moist, little silt, gravel and refuse, loose
6-8	859.7-857.7	Same as above
8-10	857.7-855.7	Sand, brown gray, wet, little silt, trace gravel and refuse, medium dense
10-12	855.7-853.7	Same as above
12-14	853.7-851.7	Sand, gray, wet, little gravel and silt, medium dense
14-16	851.7-849.7	Same as above



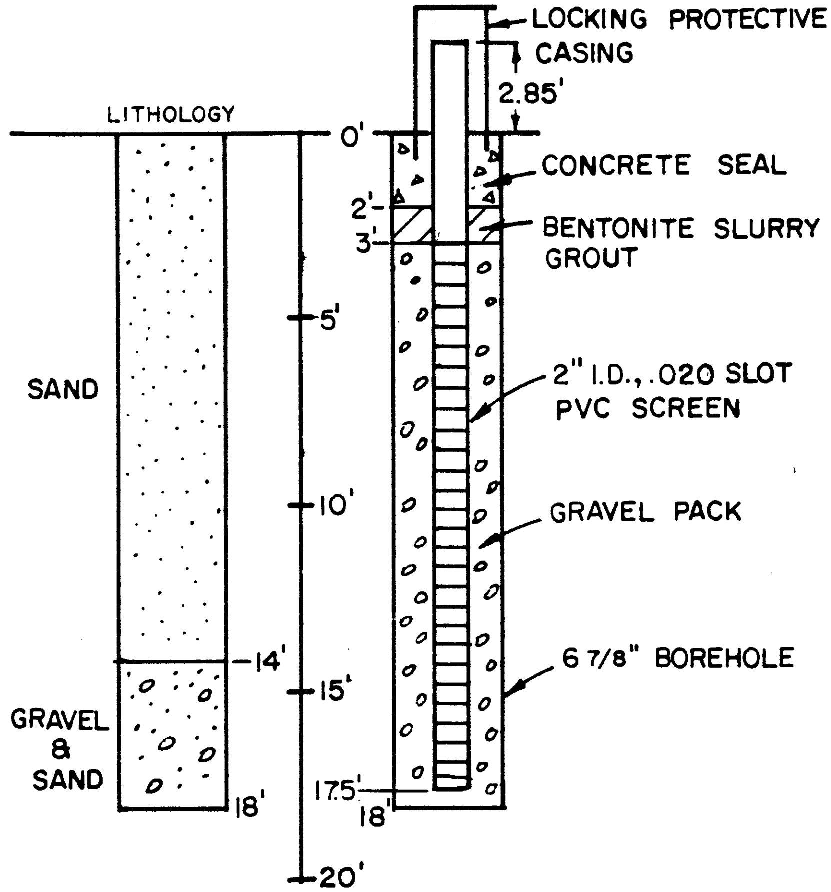
WELL 14
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-5	914.8-912.8	Sand, gravel and silt, brown, moist, medium dense
5-12	909.8-902.8	Refuse, gray-brown, wet
12-15	902.8-899.8	Refuse, gray-brown, wet, some sand, silt and gravel, medium dense



WELL 15
BROOME COUNTY
INDUSTRIAL DEVELOPEMENT AGENCY
LITHOLOGIC LOG & WELL DETAIL

DEPTH	ELEV.	DESCRIPTION
0-2	873.8-871.8	Sand, brown, dry, little silt and gravel loose
2-4	871.8-869.8	Sand, brown, dry, little silt and gravel, medium dense
4-6	869.8-867.8	Same as above
6-8	867.8-865.8	Same as above
8-10	865.8-863.8	Sand, brown, moist, little silt and gravel, medium dense
10-12	863.8-861.8	Same as above
12-14	861.8-859.8	Same as above
14-16	859.8-857.8	Gravel and sand, gray, wet, trace silt, very dense
16-18	857.8-855.8	Same as above



APPENDIX B

TEST BORING LOGS

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TELEPHONE AREA CODE 315/437-1429

A BRIEF DESCRIPTION OF THE UNIFIED SOIL SYSTEM

The Unified Classification System is an engineering soil classification that is an outgrowth of the Air-Field classification developed by Casagrande.

The system incorporates the textural characteristics of a soil into the engineering classification. All soils are classified into fifteen groups, each group being designated by two letters. These letters are as follows: G—gravel, S—sand, M—Non plastic or low plasticity fines, C—plastic fines, Pt—peat, humus and swamp soils, O—organic, W—well graded, P—poorly graded, L—low liquid limit, H—high liquid limit.

GW and SW Groups
These groups comprise well graded gravelly and sandy soils which contain less than 5% of non plastic fines passing a #200 sieve. Fines which are present must not noticeably change the strength characteristics of the coarse grain fraction and must not interfere with its free draining characteristics. In areas subject to frost action the material should not contain more than about 3% of soil grains smaller than .02 millimeters in size.

GP and SP Groups
These groups are poorly graded gravels and sands containing less than 5% non plastic fines. They may consist of uniform gravels, uniform sands, or non uniform mixtures of very coarse material and very fine sand with intermediate sizes lacking. Materials of this latter type are sometimes referred to as skip graded, cap graded, or step graded.

GM and SM Groups
In general, these groups include gravels or sands which contain more than 12% of fines having little or no plasticity. The plasticity index and liquid limit of a soil in either of these groups plot below the "A" line on a plasticity chart. Gradation is not important and both low grade and poorly graded materials are included. Some sands and gravels in these groups may have a binder composed of natural cementing agents so proportioned that the mixture shows negligible swelling or shrinkage. Thus, the dry strength is provided by a small amount of soil binder or dry cementation of calcareous materials or iron oxide. A fine fraction of non cemented materials may be composed of silts or rock flour types having little or no plasticity, and the mixture will exhibit no dry strength.

GC and SC Groups
These groups comprise gravelly or sandy soils with more than 12% of fines which exhibit either low or high plasticity. The plasticity index and liquid limit of a soil in either of these groups plot above the "A" line on the plasticity chart. Gradation of these materials is not important. Plasticity of the binder fraction has more influence on the behavior of the soils than does the variation in gradation. A fine fraction is generally composed of clays.

ML and MH Groups
These groups include predominantly silty materials and micaceous or diatomaceous soils. An arbitrary division between the two groups has been established with a liquid limit of 50. Soils in these groups are sandy silts, clayey silts or organic silts with relatively low plasticity. Also included are loessial soils and rock flours. Micaceous and diatomaceous soils generally fall within the MH group, but may extend into the ML group when their liquid limit is less than 50. The same is true for certain types of kaolin clays and some illite clays having relatively low plasticity.

CL and CH Groups
The CL and CH groups embrace clays with low and high liquid limits respectively. They are primarily inorganic clays. Low plasticity clays are classified as CL and are usually lean clays, sandy clays, and silty clays. The medium plasticity and high plasticity clays are classified as CH. These include fat clays, gumbo clays, certain volcanic clays and bentonite.

OL and OH Groups
The soils in these groups are characterized by the presence of organic matter including organic silts and clays. They have a plasticity range that corresponds with the ML and MH groups.

Pt Group
Highly organic soils which are very compressible have undesirable construction characteristics and are classified in one group with the symbol Pt. Peat, humus and swamp soils with a highly organic texture are typical of the group. Particles of leaves, grass, branches of bushes and other fibrous vegetable matter are common components of these soils.

Borderline Classification
Soils in the GW, SW, GP and SP groups are non plastic materials having less than 5% passing the #200 sieve, while GM, SM, GC, and SC soils have more than 12% passing the #200 sieve. When these coarse grain materials contain between 5% and 12% of fines they are classified as borderline, and are designated by the dual symbol such as GW-GM. Similarly coarse grain soils which have less than 5% passing the #200 sieve, but which are not free draining or in which the fine fraction exhibits plasticity are also classed as borderline and are given a dual symbol. Still another type of borderline classification occurs when a liquid limit of a fine grain soil is less than 29 and the plasticity index lies in the range of four to seven. These limits are indicated by the shaded area on the plasticity chart.

Silty and Clayey
In the Unified System, these terms are used to describe soils whose Atterberg limits plot below and above the "A" line on the plasticity chart. The adjectives silty and clayey are used to describe soils whose limits plot close to the "A" line.

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% of material is LARGER than No. 200 sieve size)	GRAVELS (More than 50% of coarse fraction is LARGER than the No. 4 sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel - sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel - sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amt. of fines)	GM	Silty gravels, gravel - sand - silt mixtures.
			GC	Clayey gravels, gravel - sand - clay mixtures.
	SANDS (More than 50% of coarse fraction is SMALLER than the No. 4 sieve size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amt. of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS (More than 50% of material is SMALLER than No. 200 sieve size)	SILTS AND CLAYS (Liquid limit LESS than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (Liquid limit GREATER than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

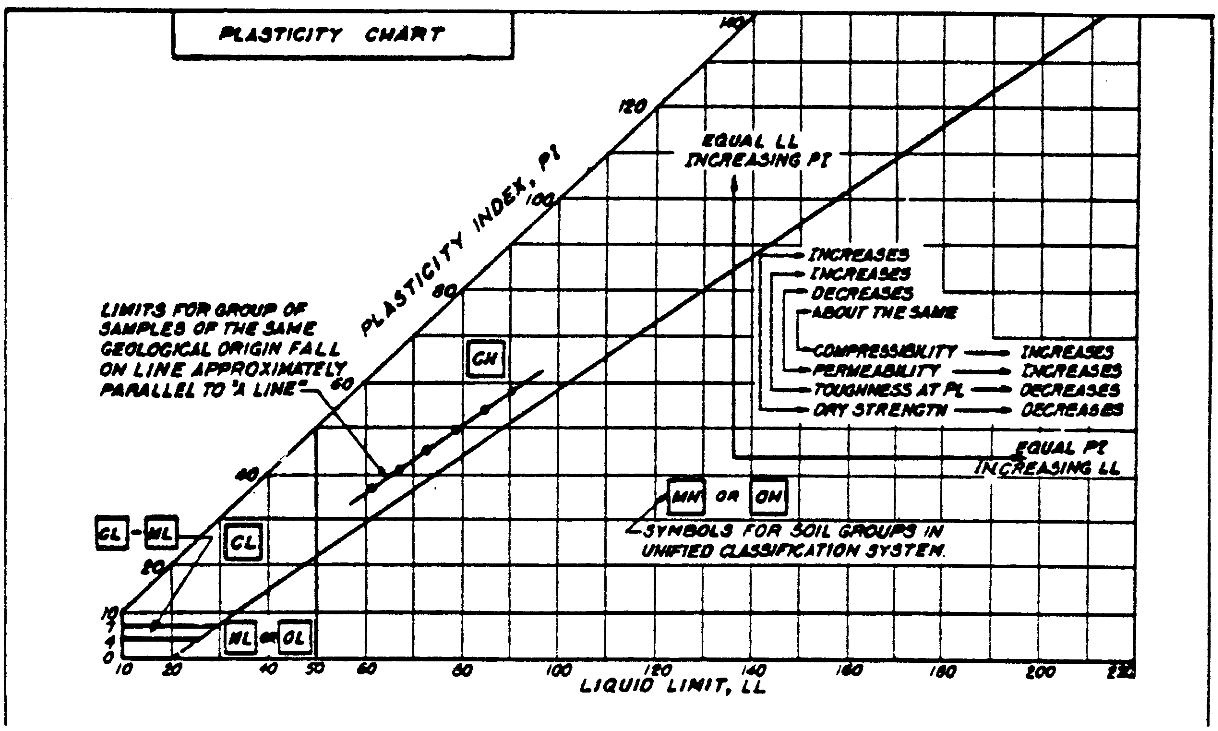
BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

No. 200   No. 40   No. 10   No. 4   ¾ in.   3 in.   (12 in.)

U.S STANDARD SIEVE SIZE



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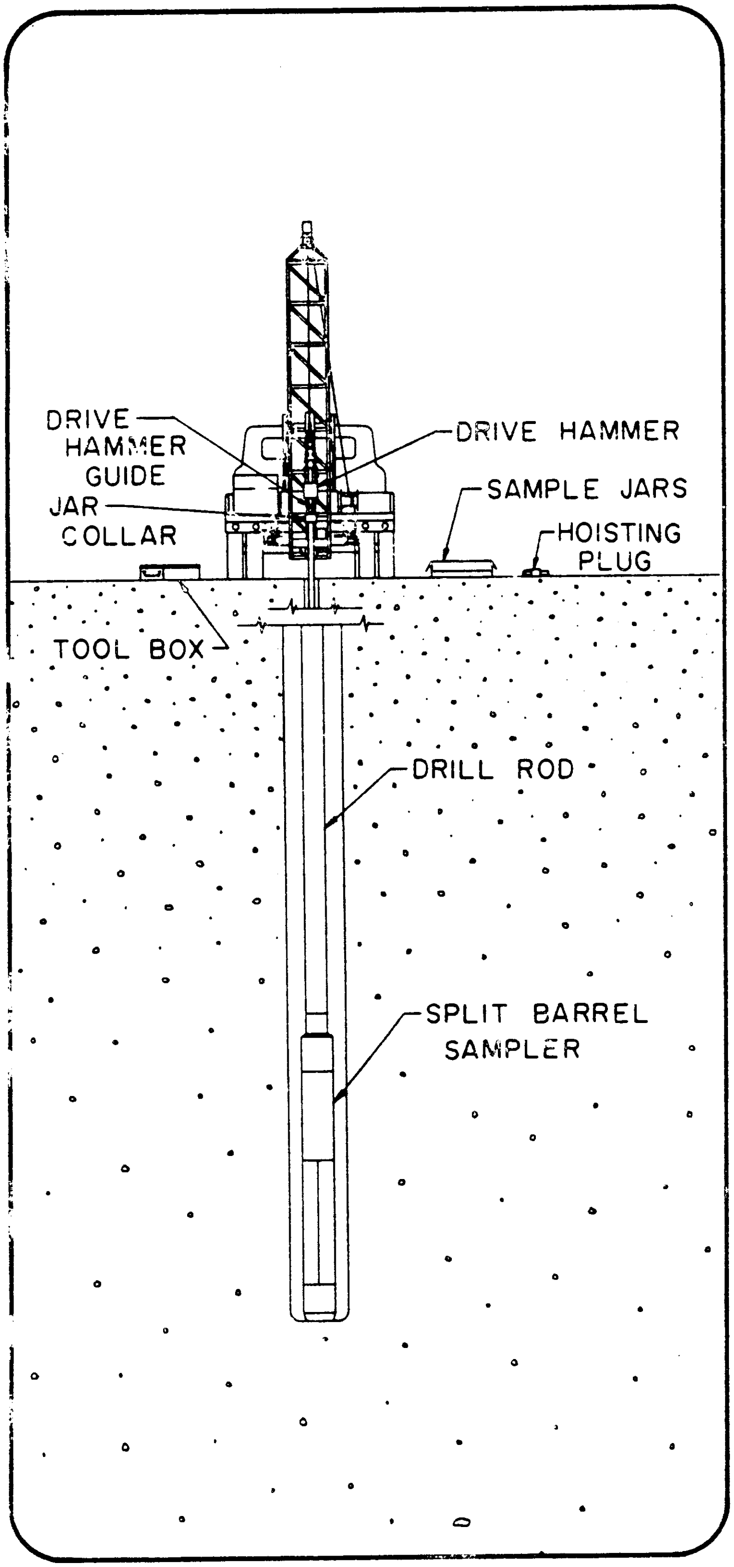

Split barrel sampling

The following excerpts are from "Standard Method for penetration test and split-barrel sampling of soils."[1] (ASTM designation: D-1586-67 AASHO Designation: T-206-70.)

1. Scope

1.1 This method describes a procedure for using a split-barrel sampler to obtain respresentative samples of soil for identification purposes and other laboratory tests, and to obtain a measure of the resistance of the soil to penetration of the sampler.

2. Apparatus

2.1 Drilling Equipment – Any drilling equipment shall be acceptable that provides a reasonably clean hole before insertion of the sampler to ensure that the penetration test is performed on undisturbed soil, and that will permit the driving of the sampler to obtain the sample and penetration record in accordance with the procedure described in 3. Procedure. To avoid "whips" under the blows of the hammer, it is recommended that the drill rod have stiffness equal to or greater than the A-rod. An "A" rod is a hollow drill rod or "steel" having an outside diameter of 1-5/8 in. or 41.2 mm and an inside diameter of 1-1/8 in. or 28.5 mm, through which the rotary motion of drilling is transferred from the drilling motor to the cutting bit. A stiffer drill rod is suggested for holes deeper than 50 ft (15m). The hole shall be limited in diameter to between 2-1/4 and 6 in. (57.2 and 152mm).

2.2 Split-Barrel Sampler – The sampler shall be constructed with the dimensions indicated (in Fig. 1.) The drive shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The coupling head shall have four 1/2-in. (12.7-mm) (minimum diameter) vent ports and shall contain a ball check valve. If sizes other than the 2-in. (50.8-mm) sampler are permitted, the size shall be conspicuously noted on all penetration records.

2.3 Drive Weight Assembly – The assembly shall consist of a 140-lb (63.5-kg) weight, a driving head, and a guide permitting a free fall of 30 in. (0.76 m). Special precautions shall be taken to ensure that the energy of the falling weight is not reduced by friction between the drive weight and the guides.

2.4 Accessory Equipment – Labels, data sheets, sample jars, paraffin, and other necessary supplies should accompany the sampling equipment.

SOIL SAMPLING METHODS

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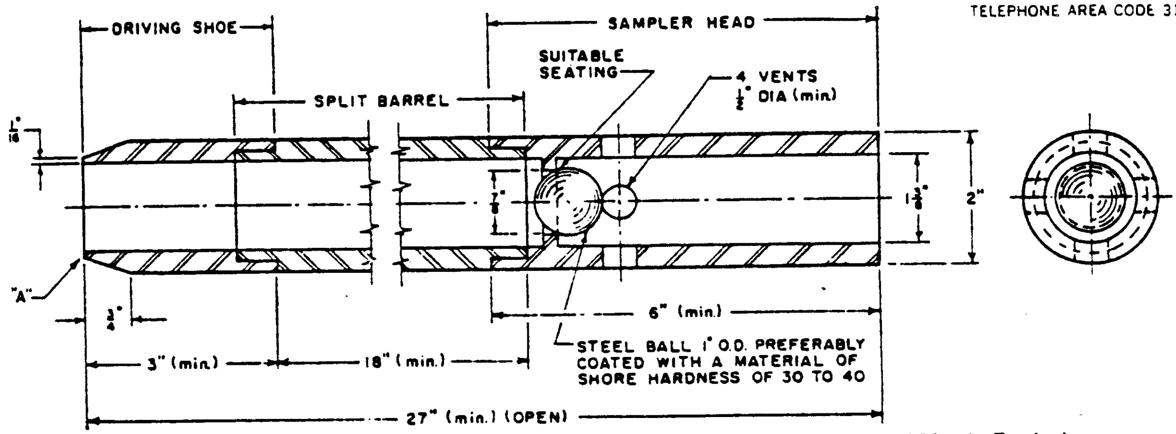

Table of Metric Equivalents.

In.	Mm	Cm	In.	Mm	Cm
1/16 (16 gage)	1.5	. . .	2	. . .	5.08
1/2	12.7	. . .	3	. . .	7.62
3/4	19.0	1.90	6	. . .	15.24
7/8	22.2	2.22	18	. . .	45.72
1-3/8	34.9	3.49	27	68.58	
1-1/2	38.1	3.81			

Fig. 1 — Standard Split Barrel Sampler Assembly

Note 1 — Split barrel may be 1-1/2 in. inside diameter provided it contains a liner of 16-gage wall thickness.

Note 2 — Core retainers in the driving shoe to prevent loss of sample are permitted.

Note 3 — The corners at A may be slightly rounded.

3. Procedure

3.1 Clear out the hole to sampling elevation using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts withdraw the drill bit slowly to prevent loosening of the soil around the hole. Maintain the water level in the hole at or above ground water level.

3.2 In no case shall a bottom-discharge bit be permitted. (Side-discharge bits are permissible.) The process of jetting through an open-tube sampler and then sampling when the desired depth is reached shall not be permitted. Where casing is used, it may not be driven below sampling elevation. Record any loss of circulation or excess pressure in drilling fluid during advancing of holes.

3.3 With the sampler resting on the bottom of the hole, drive the sampler with blows from the 140-lb (63.5 kg) hammer falling 30 in. (0.76 m) until either 18 in. (0.45 m) have been penetrated or 100 blows have been applied.

3.4 Repeat this operation at intervals not longer than 5 ft (1.5 m) in homogeneous strata and at every change of strata.

3.5 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fractions thereof. The first 6 in. (0.15 m) is considered to be a seating drive. The number of blows required for the second and third 6 in. (0.15 m) of penetration added is termed the penetration resistance, N. If the sampler is driven less than 18 in. (0.45 m), the penetration resistance is that for the last 1 ft (0.30 m) of penetration (if less than 1 ft (0.30 m) is penetrated, the logs shall state the number of blows and the fraction of 1 ft (0.30 m) penetrated).

3.6 Bring the sampler to the surface and open. Describe carefully typical samples of soils recovered as to composition, structure, consistency, color, and condition; then put into jars without ramming. Seal them with wax or hermetically seal to prevent evaporation of the soil moisture. Affix labels to the jar or make notations on the covers (or both) bearing job designation, boring number, sample number, depth penetration record, and length of recovery. Protect samples against extreme temperature changes.

4. Report

4.1 Data obtained in borings shall be recorded in the field and shall include the following:

4.1.1 Name and location of job,
4.1.2 Date of boring — start, finish,
4.1.3 Boring number and coordinate, if available,
4.1.4 Surface elevation, if available,
4.1.5 Sample number and depth,
4.1.6 Method of advancing sampler, penetration and recovery lengths,
4.1.7 Type and size of sampler,
4.1.8 Description of soil,
4.1.9 Thickness of layer,
4.1.10 Depth to water surface; to loss of water; to artesian head; time at which reading was made,
4.1.11 Type and make of machine,
4.1.12 Size of casing, depth of cased hole,
4.1.13 Number of blows per 6 in. (0.15 m)
4.1.14 Names of crewmen, and
4.1.15 Weather, remarks.

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-18 on Soil and Rock for Engineering Purposes. A list of members may be found in the ASTM Year Book.

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parratt wolff inc
FISHER RD., EAST SYRACUSE, N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

GENERAL NOTES

1. The soil logs, notes and other test data shown are the results of interpretations made by representatives of Parratt-Wolff Inc. from personal observations made during the exploration period of samples of subsurface materials recovered during exploration and records of exploration as prepared by the drill operator.

2. Explanation of the classifications and terms:

a. Bedrock - Natural solid mineral matter occurring in great thickness and extent in its natural location. It is classified according to geological type and structure (joints, bedding, etc.) and described as solid, weathered, broken, fragmented or decomposed depending on its condition.

b. Soils - Sediments or other unconsolidated accumulations of particles produced by the physical and chemical disintegration of rocks and which may or may not contain organic matter.

PENETRATION RESISTANCE

COHESIONLESS SOILS		COHESIVE SOILS	
Blows Per Ft.	Relative Density	Blows Per Ft.	Consistency
0 to 4	Very Loose	0 to 2	Very Soft
4 to 10	Loose	2 to 4	Soft
10 to 30	Medium	4 to 8	Medium
30 to 50	Dense	8 to 15	Stiff
Over 50	Very Dense	15 to 30	Very Stiff
		Over 30	Hard

Size Component Terms

Boulder	Larger than 8 inches
Cobble or Small Stone . .	8 inches to 3 inches
Gravel - coarse	3 inches to 3/4 inch
medium	3/4 inch to 4.76 mm
Sand - coarse	4.76 mm to 2.00 mm (#10 sieve)
medium	2.00 mm to 0.42 mm (#40 sieve)
fine	0.42 mm to 0.074 mm (#200 sieve)
Silt and Clay	Finer than 0.074 mm

Proportion by Weight

Major component is shown with all letters capitalized.

Minor component percentage terms of total sample are:

and . . .	40 to 50 percent
some . . .	20 to 40 percent
little . . .	10 to 20 percent
trace . . .	1 to 10 percent

c. Gradation Terms - The terms coarse, medium and fine are used to describe gradation of Sands and Gravel.

d. The terms used to describe the various soil components and proportions are arrived at by visual estimates of the recovered soil samples. Other terms are used when the recovered samples are not truly representative of the natural materials, such as, soil containing numerous cobbles and boulders which cannot be sampled, thinly stratified soils, organic soils, and fills.

e. Ground Water - The measurement was made during exploration work or immediately after completion, unless otherwise noted. The depth recorded is influenced by exploration methods, the soil type and weather conditions during exploration. Where no water was found it is so indicated. It is anticipated that the ground water will rise during periods of wet weather. In addition, perched ground water above the water levels indicated (or above the bottom of the hole where no ground water is indicated) may be encountered at changes in soil strata or top of rock.

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT Broome County Industrial Park
LOCATION Conklin, New York

HOLE NO. B-1-83-494
SURF. EL.

DATE STARTED 7/27/83 DATE COMPLETED 7/28/83

JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 35.0' (See Note)
BEFORE CASING REMOVED 10.5' (12 Hours)
AFTER CASING REMOVED 11.8'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 2
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		3/9		Brown dry very stiff SILT, little fine gravel, trace fine to medium sand	
	2.0'			10/19	19		
5.0							5.0'
	5.0'-	2		51/44		Brown dry hard SILT, little fine to coarse sand, trace fine to coarse gravel, trace clay	
	7.0'			16/10	60		
10.0	10.0'-	3		34/35			
	12.0'			22/29	57		
15.0							15.0'
	15.0'-	4		20/22		Brown moist hard SILT, little clay, little fine to coarse sand, trace fine gravel	
	17.0'			24/25	46		
20.0	20.0'-	5		12/14			
	22.0'			20/25	34		
25.0							25.0'
	25.0'-	6		9/11		Gray moist very stiff to hard SILT, little clay, little fine to coarse sand, little fine to medium gravel	
	27.0'			18/50	29		
30.0	30.0'-	7		7/9			
	32.0'			15/16	24		
35.0 ▼							35.0'
WL	35.0'-	8		12/24		Gray wet hard SILT, trace fine to coarse sand	
	37.0'			22/24	46		
40.0							

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT / LOCATION: Broome County Industrial Park, Conklin, New York

HOLE NO. B-1-83-494

SURF. EL.

DATE STARTED 7/27/83 DATE COMPLETED 7/28/83

JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 35.0' (See Note)
BEFORE CASING REMOVED 10.5' (12 Hours)
AFTER CASING REMOVED 11.8'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 2 OF 2
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	40.0'-	9		9/11		Gray moist very stiff SILT, little clay, little fine to coarse sand, little fine gravel	
	42.0'			18/18	29		
45.0							45.0'
	45.0'-	10		25/12		Gray moist very stiff SILT, trace fine to coarse sand, trace clay	
	47.0'			14/19	26		
50.0							50.0'
	50.0'-	11		9/21		Gray wet to moist hard SILT, little clay, little fine to coarse sand, little fine gravel	
	52.0'			24/25	45		
55.0							
	55.0'-	12		17/23			
	57.0'			27/27	50		
60.0							
	60.0'-	13		13/34			61.0'
	61.6'			100/100-.1		Gray moist hard silty sandy weathered SHALE	
						Bottom of Boring	61.6'
65.0						Notes: Installed observation well to 60.0' on completion of boring. Driller noted wet seams below 40.0'.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT Broome County Industrial Park
LOCATION Conklin, New York

HOLE NO. B-2-83-495

SURF. EL.

DATE STARTED 7/28/83 DATE COMPLETED 7/29/83

JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 4.0'

BEFORE CASING REMOVED 16.0'

AFTER CASING REMOVED 5.0'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 2
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		5/10		Brown moist medium dense fine to coarse	
	2.0'			15/12	25	SAND, fine to coarse GRAVEL and SILT	
	2.0'-	2		5/8			
WL ▼	4.0'			8/12	16		
5.0	4.0'-	3		12/12			5.0'
	6.0'			21/13	33	REFUSE	
	6.0'-	4		15/17			
	8.0'			10/13	27		
	8.0'-	5		15/10			
10.0	10.0'			11/12	21		
	10.0'-	6		8/2			
	12.0'			4/4	6		
	12.0'-	7		16/8			
	14.0'			10/5	18		
15.0	14.0'-	8		8/10			
	16.0'			10/20	20		
	16.0'-	9		21/23			
	18.0'			19/30	42		
	18.0'	10		75-.0'			
20.0							
	20.0'-	11		18/12			
	22.0'			10/35	22		
	22.0'-	12		20/50-			
	22.9'			.4'			
25.0	24.0'-	13		24/17			
	26.0'			47/15	64		
	26.0'-	14		4/3			
	28.0'			7/16	10		
	28.0'-	15		13/14			
30.0	30.0'			14/16	28		
	30.0'-	16		12/14			
	32.0'			16/20	30		32.0'
	32.0'-	17		8/9		Gray wet very stiff to hard SILT, some	
	34.0'			10/12	19	clay, some fine to coarse sand	
35.0							
	35.0'-	18		12/18			
	37.0'			20/17	38		
							39.0'
40.0							

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT Broome County Industrial Park
LOCATION Conklin, New York
DATE STARTED 7/28/83 DATE COMPLETED 7/29/83

HOLE NO. B-2-83-495
SURF. EL.
JOB NO. 8396
GROUND WATER DEPTH
WHILE DRILLING 4.0'
BEFORE CASING REMOVED 16.0'
AFTER CASING REMOVED 5.0'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 2 OF 2
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	40.0'-	19		21/26		Gray dry hard SILT and SHALE GRAVEL	
	41.5'			32	58		
45.0							
	45.0'-	19		32/50-		Bottom of Boring	45.3'
	45.8'			.3'			
50.0						Note: Installed observation well to 45.0' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT Broome County Industrial Park
LOCATION Conklin, New York

HOLE NO. B-3-83-496
SURF. EL.

DATE STARTED 7/29/83 DATE COMPLETED 7/29/83

JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING Wet
BEFORE CASING REMOVED Wet
AFTER CASING REMOVED Wet

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		2/3		Brown dry moist fine SAND, little silt	
	2.0'			4/6	7		1.5'
						Brown dry stiff SILT, little fine sand	
5.0							5.0'
	5.0'-	2		6/10		Brown moist to wet very stiff SILT, little fine sand, little shale gravel, trace clay	
	7.0'			9/10	19		
10.0							10.0'
	10.0'-	3		3/5		Gray wet stiff SILT	
	12.0'			5/5	10		
15.0							
	15.0'-	4		3/5			
	17.0'			4/5	9		
20.0							
	20.0'-	5		4/4			
	22.0'			4/4	8		
						Bottom of Boring	22.0'
25.0						Note: Installed observation well to 20.0' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y 13057

PROJECT: Broome County Industrial Park

LOCATION: Conklin, New York

DATE STARTED: 7/29/83 DATE COMPLETED: 8/1/83

HOLE NO. B-4-83-497

SURF. EL.

JOB NO. 8396

GROUND WATER DEPTH WHILE DRILLING

BEFORE CASING REMOVED 13.6' (72 Hours)

AFTER CASING REMOVED 13.6'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-2.0'	1		3/5 8/8	13	Brown dry stiff SILT, little fine to coarse sand, trace fine gravel	4.0'
5.0	5.0'-7.0'	2		9/13 1/3	14	Gray-brown wet stiff SILT, some fine to coarse sand, little fine gravel, trace clay	11.0'
10.0	10'-11'	3A		2/5			
	11'-12'	3B		13/15	18	Brown wet medium dense fine to coarse SAND and fine to medium GRAVEL, some silt	
WL							
15.0	15.0'-17.0'	4		9/11 18/20	29		20.0'
20.0	20.0'-22.0'	5		4/4 5/8	9	Brown-gray wet stiff SILT	22.0'
						Bottom of Boring	
25.0						Note: Installed observation well to 20.0' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park
LOCATION: Conklin, New York
DATE STARTED: 8/1/83
DATE COMPLETED: 8/1/83

HOLE NO. B-5-83-498
SURF. EL.
JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 7.0'
BEFORE CASING REMOVED 8.7'
AFTER CASING REMOVED 7.6'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 2
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		3/3		Brown dry loose fine to coarse GRAVEL, little fine to coarse sand, little silt	
	2.0'			6/6	9		
5.0							5.0'
	5.0'-	2		9/29		Brown dry very dense fine to coarse SAND and fine to coarse GRAVEL, little silt	
WL	7.0'			40/40	69		
10.0							10.0'
	10.0'-	3		40/21		Gray wet dense coarse to fine SAND and fine to coarse GRAVEL, some silt	
	12.0'			18/25	39		
15.0							
	15'-16'	4A		15/12			16.0'
	16'-17'	4B		14/13	26	Brown wet medium dense fine to coarse SAND and fine to coarse GRAVEL, little silt	18.0'
20.0						Brown wet stiff SILT, trace clay lenses	
	20.0'-	5		5/7			
	22.0'			8/8	15		
25.0							25.0'
	25.0'-	6		4/5		Brown wet medium dense fine to coarse SAND and fine to medium GRAVEL, little silt	
	27.0'			8/9	13		26.5'
30.0						Gray wet stiff SILT	
	30-30.5'	7A		6/14			30.5'
	30.5-32'	7B		18/20	32	Gray wet dense fine to coarse SAND, SILT and fine to medium GRAVEL	
35.0							35.0'
	35.0'-	8		20/27		Gray moist very dense fine to coarse SAND, some fine to medium gravel, little silt	
	37.0'			63/92	90		
40.0							

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT Broome County Industrial Park
LOCATION Conklin, New York
DATE STARTED 8/1/83 DATE COMPLETED 8/1/83

HOLE NO. B-5-83-498
SURF. EL.
JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 7.0'
BEFORE CASING REMOVED 8.7'
AFTER CASING REMOVED 7.6'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	40.0'-	9		64/47		Gray moist very dense fine to coarse	
	42.0'			46/48	93	SAND, some fine to medium gravel,	
						little silt	
						Bottom of Boring	42.0'
45.0							
						Note: Installed observation well to 33.5' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park
LOCATION: Conklin, New York
DATE STARTED: 8/2/83
DATE COMPLETED: 8/2/83

HOLE NO. B-6-83-499
SURF. EL.
JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 7.7'
BEFORE CASING REMOVED 8.4'
AFTER CASING REMOVED 8.2'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		4/6		Brown dry medium dense fine to medium GRAVEL, little fine to coarse sand, little silt	
	2.0'			6/7	12		
5.0							5.0'
	5.0'-	2		3/5		Brown moist medium dense fine to coarse SAND, some silt, some fine to medium gravel	
WL ▼	7.0'			7/7	12		9.0'
10.0						Gray wet dense to very dense fine to coarse GRAVEL, some fine to coarse sand little silt	
	10.0'-	3		9/25			
	12.0'			26/21	51		
15.0							
	15.0'-	4		20/47			
	17.0'			27/49	74		
20.0							
	20.0'-	5		27/27			
	22.0'			28/27	55		
25.0							
	25.0'-	6		36/41			
	27.0'			42/37	83		
						Bottom of Boring	27.0'
30.0						Note: Installed observation well to 17.9' on completion of boring.	

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park

LOCATION: Conklin, New York

DATE STARTED: 8/2/83 DATE COMPLETED: 8/2/83

HOLE NO. B-7

SURF. EL.

JOB NO. 8396

GROUND WATER DEPTH WHILE DRILLING 13.0'

BEFORE CASING REMOVED 21.4'

AFTER CASING REMOVED 13.4'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		6/13		Brown moist dense fine GRAVEL, little fine to coarse sand, trace silt	
	2.0'			22/22	35		
	2.0'-	2	No	10/5			
	4.0'		Rec	5/2	10		4.0'
5.0	4.0'-	3		4/6		REFUSE	
	6.0'			6/15	12		6.0'
	6.0'-	4		15/9		Brown wet medium dense fine GRAVEL, little fine to coarse sand, little silt, little refuse	
	8.0'			7/16	16		
	8.0'-	5		4/6			
10.0	10.0'			8/7	14		
	10.0'-	6		56/3			
	12.0'			3/6	6		
WL ▼	12.0'-	7		7/8			13.0'
	14.0'			20/21	28	Brown wet very dense fine to coarse GRAVEL, little silt, little fine to coarse sand, trace clay	
15.0	14.0'-	8		32/33			
	16.0'			32/34	65		
	16.0'-	9		34/42			
	18.0'			44/61			
							19.0'
20.0						Brown dry very dense fine to coarse SAND, some silt, little fine gravel	
	20.0'-	10		21/42			
	22.0'			56/69	98		
25.0							25.0'
	25.0'-	11		31/41		Brown dry to wet very dense fine to coarse SAND, some silt, little fine gravel	
	26.5'			84	125		
						Bottom of Boring	26.5'
30.0						Note: Installed observation well to 21.0' on completion of boring.	

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park
LOCATION: Conklin, New York
DATE STARTED: 8/2/83   DATE COMPLETED: 8/2/83

HOLE NO. B-8-83-501
SURF. EL.
JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 7.0'
BEFORE CASING REMOVED 9.4'
AFTER CASING REMOVED 4.6'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
						Brown dry fine to coarse GRAVEL, little fine to coarse sand, little silt	
5.0							5.0'
WL ▼						Brown dry fine to coarse SAND, little silt, little fine gravel	
10.0							10.0'
						Brown wet fine GRAVEL, little fine to coarse sand, trace silt	
15.0							
	18.0'-	1		15/10			19.0'
20.0	20.0'			8/9	18	Brown wet very stiff SILT, little clay, trace fine sand	
						Bottom of Boring	20.0'
						Note: Installed observation well to 18.0' on completion of boring.	

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park
LOCATION: Conklin, New York
DATE STARTED: 8/3/83 DATE COMPLETED: 8/3/83

HOLE NO. B-9-83-502
SURF. EL.
JOB NO. 8396
GROUND WATER DEPTH
WHILE DRILLING 9.0'
BEFORE CASING REMOVED 8.0'
AFTER CASING REMOVED 6.3'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		1/3		Brown dry loose fine to coarse GRAVEL, little fine to coarse sand, little silt	
	2.0'			5/7	8		3.0'
5.0						Brown dry to wet very dense to dense fine to coarse GRAVEL and fine to coarse SAND, little silt	
	5.0'-	2		21/34			
	7.0'			33/47	67		
WL ▼ 10.0							
	10.0'-	3		15/21			
	12.0'			19/19	40		
15.0							
	15.0'-	4		31/22			
	17.0'			15/12	37		18.0'
20.0						Brown wet stiff SILT, trace fine sand	
	20.0'-	5		5/7			
	22.0'			9/10	16		
25.0							25.0'
	25.0'-	6		4/5		Brown wet stiff SILT and fine to coarse SAND, trace fine gravel	26.0'
	27.0'			5/6	10	Gray wet stiff SILT, trace fine sand	
						Bottom of Boring	27.0'
30.0						Note: Installed observation well to 18.5' on completion of boring.	

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT / LOCATION: Broome County Industrial Park, Conklin, New York

HOLE NO. B-10-83-503

SURF. EL.

DATE STARTED 8/3/83 DATE COMPLETED 8/3/83

JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 8.5'
BEFORE CASING REMOVED 17.3'
AFTER CASING REMOVED 8.8'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		2/2		Brown dry medium stiff SILT, trace fine to medium sand, trace roots	
	2.0'			3/5	5		2.5'
5.0						Brown dry very dense fine to medium GRAVEL and fine to coarse SAND, little silt	
	5.0'-	2		18/31			
	7.0'			36/43	67		
WL ▼							8.5'
10.0						Brown wet medium dense fine to coarse SAND, little silt	
	10-11'	3A		6/6			11.0'
	11-12'	3B		10/12	16	Gray wet medium dense to dense fine to coarse SAND and fine to coarse GRAVEL, little silt	
15.0							
	15.0'-	4		20/22			
	17.0'			26/21	48		18.0'
20.0						Brown wet very stiff SILT, trace fine sand, trace clay lenses	
	20.0'-	5		7/7			
	22.0'			9/7	16		
25.0							25.0'
	25.0'-	6		3/3		Brown wet very stiff SILT, trace fine sand	
	27.0'			5/6	8	Bottom of Boring	27.0'
30.0						Note: Installed observation well to 18.3' on completion of boring.	

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT Broome County Industrial Park
LOCATION Conklin, New York
DATE STARTED 8/3/83 DATE COMPLETED 8/4/83

HOLE NO. B-11-83-504
SURF. EL.
JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 13.5'
BEFORE CASING REMOVED 19.7'
AFTER CASING REMOVED 9.7'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		8/9		Brown dry medium dense fine to coarse	
	2.0'			10/8	19	SAND, some fine to medium gravel, little	
	2.0'-	2		9/9		silt	2.0'
	4.0'			22/12	31	Brown dry to moist medium dense fine to	
5.0						medium GRAVEL, little fine to coarse	
	5.0'-	3		4/5		sand, little silt, little wood	5.0'
	7.0'			4/5	9	Gray wet stiff SILT, some fine to coarse	
	7.0'-	4		3/2		sand, little clay, trace organic matter	7.8'
	9.0'			4/8	6	Brown wet stiff SILT, some fine to	
10.0						coarse sand, some fine gravel, trace	
	10.0'-	5		4/5		clay	11.8'
	12.0'			6/6	11	Gray wet medium dense fine SAND, some	
WL ▼						silt	
15.0							15.0'
	15.0'-	6		16/26		Brown wet dense fine GRAVEL, little silt,	
	17.0'			19/19	45	little fine to coarse sand, trace clay	
20.0							20.0'
	20.0'-	7		6/8		Gray wet very stiff SILT, trace clay	
	22.0'			10/10	18	lenses, trace fine sand	
25.0							25.0'
	25.0'-	8		3/4		Gray wet stiff SILT, little clay, trace	
	27.0'			5/5	9	fine sand	
30.0							
	30.0'-	9		2/6			
	32.0'			8/12	14		31.5'
						Gray wet medium dense fine to coarse	
						SAND, some silt, little fine gravel	
35.0							
	35.0'-	10		9/12			
	37.0'			18/23	30		
						Bottom of Boring	37.0'
						Note: Installed observation well to	
40.0						30.5' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park
LOCATION: Conklin, New York
DATE STARTED: 8/4/83   DATE COMPLETED: 8/4/83

HOLE NO. B-12-83-505
SURF. EL.
JOB NO. 8396
GROUND WATER DEPTH WHILE DRILLING 16.0'
BEFORE CASING REMOVED 15.8'
AFTER CASING REMOVED 8.3'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		2/4		Brown dry stiff SILT, trace fine to coarse sand, trace fine gravel	
	2.0'			6/6	10		
5.0							5.0'
	5.0'-	2		10/15		Brown dry hard SILT, fine to coarse GRAVEL and fine to coarse SAND	
	7.0'			20/21	35		8.5'
10.0						Brown wet medium stiff SILT, some fine to medium sand, trace clay	
	10-11'	3A		2/3			11.0'
	11-12'	3B		8/12	11	Brown wet medium dense fine to coarse SAND, some fine to coarse gravel, some silt	
15.0							15.0'
WL	15.0'-	4		11/15		Brown wet medium dense to dense fine to coarse SAND and fine to coarse GRAVEL, little silt	
	17.0'			16/19	31		
20.0							
	20.0'-	5		14/12			
	22.0'			14/16	26		
						Bottom of Boring	22.0'
25.0						Note: Installed observation well to 16.0' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park

LOCATION: Conklin, New York

DATE STARTED: 8/5/83 DATE COMPLETED: 8/5/83

HOLE NO. B-13-83-506

SURF. EL.

JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 12.0'

BEFORE CASING REMOVED 12.2'

AFTER CASING REMOVED 4.5'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		4/10		Brown dry medium dense fine to coarse	
	2.0'			16/10	26	SAND, little silt, trace fine gravel	2.0'
	2.0'-	2		2/2		Brown moist loose fine to coarse SAND,	
	4.0'			2/2	4	little silt, little refuse	4.0'
5.0	4.0'-	3		2/3		Brown moist loose fine to coarse SAND,	
	6.0'			2/3	5	little silt, little fine gravel, little	
	6.0'-	4		3/5		refuse	
	8.0'			4/4	9		8.0'
	8.0'-	5		6/6		Brown wet medium dense fine to coarse	
10.0	10.0'			6/10	12	SAND, little silt, trace fine gravel,	
	10.0'-	6		26/12		trace refuse	
WL ▼	12.0'			9/9	21		12.0'
	12.0'-	7		16/13		Gray wet medium dense to dense fine to	
	14.0'			20/26	33	coarse SAND, little fine gravel, little	
15.0	14.0'-	8		18/17		silt	
	16.0'			28/27	45		
						Bottom of Boring	16.0'
						Note: Installed observation well to	
20.0						15.0' on completion of boring.	

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TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT: Broome County Industrial Park
LOCATION: Conklin, New York
DATE STARTED: 8/5/83
DATE COMPLETED: 8/8/83

HOLE NO. B-14-83-507
SURF. EL.
JOB NO. 8396

GROUND WATER DEPTH
WHILE DRILLING 6.5'
BEFORE CASING REMOVED 6.5'
AFTER CASING REMOVED 4.2'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1
File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
						Augered to 15.0'	
5.0							
WL ▼							
10.0							
15.0							
						Bottom of Boring	15.0'
						Note: Installed observation well to 15.0' on completion of boring.	

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FISHER ROAD
EAST SYRACUSE, N.Y. 13057

TEST BORING LOG

PROJECT Broome County Industrial Park

LOCATION Conklin, New York

HOLE NO. B-15-83-508

SURF. EL.

DATE STARTED 8/8/83 DATE COMPLETED 8/8/83

JOB NO. 8396

GROUND WATER DEPTH

WHILE DRILLING 14.0'

BEFORE CASING REMOVED 14.0'

AFTER CASING REMOVED 14.5'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

File #2773.002

DRILLER'S FIELD LOG

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
	0.0'-	1		1/1		Brown dry very loose fine to coarse	
	2.0'			1/2	2	SAND, little silt, little fine gravel,	
	2.0'-	2		1/2		trace wood	3.0'
	4.0'			4/6	6	Brown dry medium dense fine to coarse	
5.0	4.0'-	3		6/7		SAND, little fine gravel, trace silt	
	6.0'			4/9	11		
	6.0'-	4		10/6			
	8.0'			5/4	11		8.0'
	8.0'-	5		6/7		Brown moist medium dense fine to coarse	
10.0	10.0'			5/5	12	SAND, little silt, little fine gravel	
	10.0'-	6		6/4			
	12.0'			6/4	10		
	12.0'-	7		7/13			
WL ▼	14.0'			14/11	27		14.0'
15.0	14.0'-	8		28/100-		Gray wet very dense fine GRAVEL, some	
	14.7'			.2'		fine to coarse sand, trace silt	
	16.0'-	9		29/100-			
	16.9'			.4'		Bottom of Boring	18.0'
20.0							
						Note: Installed observation well to 18.0' on completion of boring.	

APPENDIX C

GROUNDWATER SAMPLING PROTOCL

GROUNDWATER SAMPLING PROCEDURES

General

Some general procedures must be adhered to during all well developing and sampling operations. Safety glasses or goggles must be worn at all times during well development or sampling to prevent splashing of potentially contaminated water into the eyes. Respirators must be worn if a distinct chemical odor is observed. Sampling of wells must be discontinued during precipitation periods (rain or snow).

Groundwater Well Development

Prior to obtaining groundwater samples for laboratory analysis, all monitoring wells must be developed as described in the following paragraphs:

To obtain representative samples of groundwater from a groundwater monitoring well, all fine grained material and sediments that have settled in or around the well during installation should first be removed from the well (well development). This is accomplished by air surging, pumping or bailing groundwater from the well until its yields sediment-free water.

The main precaution taken during well development is the use of new equipment and accessories for developing each well to avoid cross contamination of the wells (i.e. during air surging, new lengths of polypropylene tubing and hose are required for each well; during pumping, new polypropylene tubing is required for each well and bailing, a new bailer (and rope) is required for each well).

NOTE: Wells must be allowed to stabilize after development a minimum of 10 days prior to sampling.

Procedures

Use of the following procedures for the sampling of groundwater observation wells is dependent upon the depth of the well to be sampled. To obtain representative groundwater samples from wells installed to a depth greater than 25 feet, the bailing procedure should be used. To obtain representative groundwater samples from wells installed to a depth less than 25 feet, the bailing procedure or the pumping procedure can be used. Each of these procedures is explained in detail below.

A. Sampling Procedures (BAILER)

1. Identify the well and record the location on the Groundwater Sampling Field Log.

2. Cut a slit in one side of the plastic sheet and slip it over and around the well, creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of 10 feet by 10 feet. Do not kick, transfer, drop, or in any way let soils or other materials fall onto this sheet unless it comes from inside the well. Do not place meters, tools,

equipment, etc. on the sheet unless they have been cleaned first with a clean rag.

3. Put on a new pair of disposable gloves.

4. Clean the well cap with a clean rag, and remove the well cap and plug placing both on the plastic sheet.

5. Clean the first ten feet of the steel 100 foot tape with a hexane soaked rag, rinse with distilled water and measure the depth to the water table. Record this information on the Groundwater Sampling Field Log (Attached).

6. Compute the volume of water in the well using the formulae and information provided on the Groundwater Sampling Field Log. Record this volume on the Groundwater Field Log.

7. Attach enough polypropylene rope to a bailer to reach the bottom of the well and lower the bailer slowly into the well, making certain to submerge it only far enough to fill it completely.

8. Pull the bailer out of the well keeping the polypropylene rope on the plastic sheet. Empty the groundwater from the bailer into a new glass quart container and observe its appearance. Return the glass quart to its proper transport container. Note: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the groundwater only.

9. Record the physical appearance of the groundwater on the Groundwater Sampling Field Log.

10. Lower the bailer to the bottom of the well and agitate the bailer up and down to resuspend any material settled in the well.

11. Initiate bailing the well from the well bottom making certain to keep the polypropylene rope on the plastic sheet. All groundwater should be dumped from the bailer into a graduated pail to measure the quantity of water removed from the well.

12. Continue bailing the well from the bottom until three times the volume of groundwater in the well has been removed, or until the well is bailed dry. If the well is bailed dry, allow sufficient time (several hours to overnight) for the well to recover before proceeding with Step 13. Record this information on the Groundwater Sampling Field Log.

13. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling. Always fill the containers labeled purgeable priority pollutant or BTX analysis first.

14. Initiate sampling by lowering the bailer slowly into the well making certain to submerge it only far enough to fill it completely. Minimize agitation of the water in the well. Fill each sample container following the instructions listed on Attachment A - Sample Containerization Procedures. Return each sample bottle to its proper transport container.

15. If the sample bottles cannot be filled quickly, keep them cool with their caps on until they are filled. Each sample bottle for purgeable priority pollutant or BTX analysis should be filled from one bailer, then securely capped. NOTE: Samples must not be allowed to freeze.

16. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

17. After the last sample has been collected, record the date and time, empty one bailer of water from the surface of the water in the well into the 200 ml flask, measure and record the pH, and measure and record the conductivity of the groundwater following the procedures outlined in the equipment operation manuals. Record this information on the Groundwater Sampling Field Log. The 200 ml flask must then be rinsed with hexane and distilled water prior to reuse.

18. Replace the well plug and lock the well protection assembly before leaving the well location.

19. Place the bailer, polyproplyene rope, gloves, rags and plastic sheeting into a plastic bag. The plastic bag should then be buried on-site at a preselected location.

B. Sampling Procedures (Pump)

1. Identify the well and record the location on the Groundwater Sampling Field Log.

2. Cut a slit in one side of the plastic sheet and slip it over and around the well creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of 10 feet by 10 feet. Do not kick, transfer, drop, or in any way let soils or other materials fall onto this sheet unless it comes from inside the well. Do not place meters, tools, equipment, etc. on the sheet unless they have been cleaned first with a clean rag.

3. Put on a new pair of disposable gloves.

4. Clean the well cap with a clean rag and remove the well cap and plug, placing both on the plastic sheet.

5. Clean the first ten feet of the steel 100 foot tape with a hexane soaked rag, rinse with distilled water and measure the depth to

the water table. Record this information on the Groundwater Sampling Field Log.

6. Compute the volume of water in the well using the formulae and information provided on the Groundwater Sampling Field Log. Record this volume on the Field Log.

7. Prepare the peristaltic pump for operation. Replace the short length of flexible silicone tubing in the pump head between each sampling location.

8. Attach a new length of polypropylene tubing to the flexible silicone tubing at the pump head. This polypropylene tubing must be long enough to reach the well bottom. Note: The suction lift of the peristaltic pump is approximately 25 feet.

9. Start the pump and lower the suction end of the tubing into the well until the surface of the water is contacted. Remove approximately one half quart of this water from the surface of the well water into a new glass quart bottle. Observe the appearance of this water. Return this quart bottle to its proper transport container. Note: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the groundwater only.

10. Record the physical appearance of the groundwater on the Groundwater Sampling Field Log.

11. Initiate pumping from the well into a graduated pail until three times the volume of water in the well has been removed or until the well is pumped dry. The suction end of the tubing should be raised and lowered in the well during pumping to ensure that water is entering the well from the entire length of the screened well casing. If the well is pumped dry, allow sufficient time (several hours to overnight) for the well to recover before proceeding. Record this information on the Groundwater Sampling Field Log.

12. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling bottles to allow for convenient filling. Always fill the bottles labeled purgeable priority pollutant or BTX analysis first.

13. Continue pumping the well with the suction end of the tubing now at a level just below the surface of the water in the well. Fill each sample container following the instructions listed on Attachment A - Sample Containerization Procedures. Return each sampling bottle to its proper transport container.

14. If the sample bottles cannot be filled quickly, keep them cool with their caps on until they are filled. NOTE: Samples must not be allowed to freeze.

15. Record the physical appearance of the groundwater observed during sampling on the Groundwater Sampling Field Log.

16. After the last sample has been collected, record the date and time and pump from the surface of the water in the well into the 200 ml flask, filling it approximately halfway. Measure and record the pH and conductivity of the groundwater following the procedures outlines in the equipment operation manuals. Record this information on the Groundwater Sampling Field Log. The 200 ml flask must then be rinsed with hexane and distilled water prior to reuse.

17. Replace the well plug and lock the well protection assembly before leaving the well location.

18. Place the polypropylene tubing, silicone pump head tubing, gloves, rags and plastic sheet into a plastic bag. The plastic bag should then be buried on-site at a preselected location.

GROUNDWATER SAMPLING PROCEDURES

I. Materials

1. Disposable Latex Gloves
2. Plastic Sheeting - (10 ft. by 10 ft. minimum)
3. Bailers - (top filling) 1 - 1½ inch O.D. aluminum, natural cork plugs
4. Polypropylene Rope
5. Distilled Water
6. Hexane Solvent
7. Disposable Rags
8. 100 Ft. Steel Tape
9. Peristaltic Pump With Accessories
10. Polypropylene Tubing (¼ - ½ inch)
11. Insulated Transport Containers
12. Graduated Pail
13. Conductivity Meter
14. pH Meter
15. Dual Carbon Respirators with Organic Vapor Filters
16. Safety Glasses or Goggles
17. Appropriate Sampling Containers
18. 200 ml Flask

SAMPLE CONTAINERIZATION PROCEDURES

Lab Analysis	Container Description	Number of Containers	Collection Instructions
1. Purgeable Priority	40 ml Vial	3	1. The sample vial consists of 3 parts: a glass bottle, a teflonfaced septum, and a screw cap. 2. Remove the cap and septum, handling the septum by the edges only. 3. Carefully fill the vial to overflowing a slight crown of water remaining on top. 4. Slide the septum, teflon side (slippery side) down, onto the vial. 5. Replace the cap and tighten. 6. Invert the sample and lightly tap the cap on a solid surface. The absence of trapped air indicates a successful seal. If bubbles are present, open the bottle, add a few additional drops of sample and reseal the bottle as above. Continue until no trapped air is present. 7. Keep the samples refrigerated or on ice.
2. PCBs, Pesticides	glass gallon	1	Fill gallon bottle then cap.
3. Metals	glass quart with preservative added	1	Fill quart bottle then cap
4. Acid/Base Neutral Priority Pollutants	glass gallon	1	Fill gallon bottle then cap. Keep the sample refrigerated or on ice.
5. Cyanide	plastic quart with preservative added	1	Fill quart bottle then cap. Keep the sample refrigerated or on ice.
6. Phenols	plastic quart	1	Fill quart bottle then cap.