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GEOLOGIC REPORT

MIDDLESEX MUNICIPAL LANDFILL SITE

MIDDLESEX, NEW JERSEY

Bechtel National, Inc.
Advanced Technology Division

MARCH 1984

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MARCH 1984

Bechtel Job 14501

Prepared for

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By

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ABSTRACT

This is a report on geologic and hydrologic investigations of the former Municipal Landfill, Middlesex, New Jersey, conducted during 1982 and 1983 by Bechtel National, Inc. for the United States Department of Energy, Oak Ridge Operations Office.

The investigations were designed to assess the feasibility of stabilizing the radioactive contamination present on site. The investigations were conducted in two phases: Phase 1 consisted of permeability tests; Phase 2 consisted of tests to ascertain the extent of hydraulic interconnection between various stratigraphic units.

The investigations revealed that a complete separation of bedrock and overburden did not exist and that the clay present could not be relied upon to confine vertical migration of contaminants over the long term.

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1.0 INTRODUCTION

The Middlesex Landfill, in Middlesex, New Jersey is an inactive municipal disposal site containing low-level radiologically contaminated domestic and industrial refuse (Figure 1). A study of the geologic and hydrogeologic conditions at the site was performed during 1981, 1982 and 1983 by Bechtel, Oak Ridge, Tennessee under contract to the U.S. Department of Energy. Several previous Environmental and Engineering studies have been conducted at the Middlesex Landfill (Refs. 1-6). These reports contain information concerning site history and remedial action options. This information is not included in the present report except where it contributes to the understanding of the hydrogeology of the site.

2.0 PURPOSE AND SCOPE

The program was designed to define the geologic and hydrogeologic conditions at the Middlesex Landfill site and to assess the feasibility of stabilizing the refuse on-site. The program consisted of two phases; phase one included drilling 15 exploratory drill holes, conducting permeability tests, installing observation wells, and evaluating data; phase two involved installing five observation wells, three of which are near wells installed during phase one, and conducting permeability tests to ascertain the extent of hydraulic interconnection between various stratigraphic units. The work completed during both phases, and discussions of the results and conclusions are presented below. Figure 2 shows the locations of all boreholes.

3.0 SITE GEOLOGY

3.1 Site Topography

The Middlesex Landfill Site is located adjacent to Bound Brook and has a relief of about 18 feet. The land surface slopes approximately 3 percent from the southwest towards Bound Brook. Based on the topography it would be suspected that surface water would drain to the northeast. The landfill materials fill a gully that previously lead through the site to Bound Brook. The stream channel was moved as a result of the landfill activity (Figure 1). Natural ground vegetation now covers the landfill materials. The waste materials that are reported to be radiologically contaminated are located in the western portion of the landfill site (Figure 1).

3.2 Site Stratigraphy

Three types of materials identified at the site are considered important to this study: overburden; weathered bedrock; and bedrock. The overburden consists of landfill and the underlying in-place sedimentary units. The landfill materials, which were not defined during this study, range in thickness from zero to about 20 feet. The sedimentary units have been divided into two units: the upper, which consists of a gray and brown silty, sandy clay with a high organic content probably representing original ground surface, and a lower unit, which consists of a red-brown clayey, silty, fine-to medium-grained sand. The thickness of the overburden ranges from 11 to 34 feet.

The weathered bedrock materials are predominantly clay-sized particles that are the result of weathering of the upper several feet of shale bedrock, described below. This weathered shale is a reddish-brown, soft to very soft clay, containing sand-sized fragments of less weathered shale. The clay grades downward into a weak, friable, severely weathered shale with little or no clay characteristics, at which depth, the unit is considered bedrock. The weathered bedrock ranges in thickness from two to four feet except at one location. Weathered bedrock (12 feet) was thickest in boring 83-18 (Figure 2). The upper six feet of clay at this location is sandy and contains abundant, less weathered rock fragments. A two-foot thick, stiff to very stiff, reddish-brown clay layer with occasional green clay lenses underlies the sandy clay. The lower four feet of weathered material is a clayey shale.

The bedrock consists of the Triassic Brunswick Shale Formation. It is a red-brown moderately soft, highly fractured rock. The formation is horizontally bedded and becomes harder with depth. The degree of open fracturing decreases with depth. The stratigraphic relationship of the landfill materials to the weathered bedrock is shown on Figure 3.

4.0 PROGRAM DESIGN

4.1 Phase One

Fifteen exploratory holes were drilled during phase one to determine the site stratigraphy, permeabilities of the various units, and intervals for

selected hydrologic monitoring. Phase one also provided a system of observation wells (Appendix B) to determine the occurrence, movement, and quality of groundwater at the site. Locations of the holes are shown on Figure 2, and their depths and collar elevations are provided on drill logs in Appendix A.

Eight of the fifteen exploratory holes (81-1; 81-3; 81-5; 81-8A; 81-10; 81-13; 81-15; 81-17) were drilled at sites adjacent to and within the landfill area. Soil samples were collected in the sedimentary units beneath the landfill, and bedrock was continuously cored. Tests to determine permeability of the bedrock were conducted, after which the holes were completed as observation wells open to the bedrock. Additional permeability tests were conducted after the wells were installed.

The remaining seven observation wells (81-2A; 81-4; 81-6; 81-9; 81-11; 81-14; 81-16), which were installed adjacent to seven of the bedrock observation wells, are open to the overburden. Permeability tests were conducted in the completed wells. Water-level measurements and water samples from these paired observation wells were used to evaluate both vertical and lateral changes in groundwater movement and quality.

The data collected during phase one were analyzed with respect to in situ stabilization of wastes at the landfill site. The data analyzed included core logs, water-level measurements, water-chemical quality, and permeability tests.

The core logs indicate that a clay layer, which is in-place weathered bedrock, separates the overburden from the unweathered bedrock. Water levels, which were measured in both the overburden and the bedrock observation wells, suggest the existence of two aquifers separated by the clay. Hydrographs for each well pair were constructed (Figures 4A-4H), and contour maps of the water surfaces in both the overburden and bedrock were prepared (Figures 5A-5P). Water chemistry data between well pairs are graphically displayed (Figures 6A and 6B) to provide a clearer understanding of the degree of separation between the two aquifers.

4.2 Phase Two

The phase-two investigation defined the hydraulic characteristics of the clay that separates the overburden materials from the bedrock.

One additional exploratory hole was drilled at each of three phase-one observation-well pairs (83-18; 83-21; 83-22; Figure 2). In each new boring, constant-head (permeability) tests were performed in both the overburden and in the bedrock. The adjacent phase-one observation wells were monitored for changes in water levels during these tests.

Variable-head (permeability) tests were performed in the clay. The exploratory holes were completed as observation wells in the bedrock.

Two additional wells (83-19A and 83-20) were installed on the southwestern perimeter of the landfill as shown in Figure 2. One well was screened in overburden and the other in bedrock to supply additional groundwater data. Observation-well installation logs are presented in Appendix B.

5.0 HYDROLOGY

5.1 Phase One

5.1.1 Permeability Testing

Permeabilities were determined using constant- and variable-head test methods. Constant-head tests were conducted in the bedrock before observation wells were installed, and variable-head tests were conducted in both bedrock and overburden observation wells after installation. The constant-head method involves using a single pneumatic packer to isolate the zone being tested, as described in Designation E-18 of the U.S. Bureau of Reclamation Earth Manual. Sixteen of these tests were performed. Bedrock permeabilities ranged from 45 to 1300 feet per year, with a mean value of 340 feet per year. The permeability of the bedrock is secondary (fracture type) and generally decreases with depth.

The variable-head test method was used to determine overburden and bedrock permeabilities after the observation wells were installed. The tests were conducted as described in the Department of the Navy Design Manual, DM-7. The method assumes that an instantaneous slug of water is injected into the well. This assumption was valid in all cases except in well 81-2A, where the infiltration rate exceeded the water injection rate.

The permeability values from the variable-head tests in the bedrock range from 50 to 1800 feet per year with a mean value of 550 feet per year. These values are in good agreement with the results of the constant-head tests. The large variability in tests results is indicative of fracture-type permeability.

The permeability values from variable-head tests in the overburden range from 50 to 260 feet per year, with a mean value of 120 feet per year. This indicates that, except for localized higher permeability zones, such as encountered in well 81-2A discussed below, the overburden has a lower permeability than the bedrock. The permeability values from the phase-one field investigation are summarized on Table 1.1.

Well 81-2A is screened in the sedimentary units that overlie the clay. Although the permeability of this material could not be accurately measured by the test procedure used, the high infiltration rate indicates a permeability of at least 3000 feet per year.

5.1.2 Observation-Well Monitoring

All phase-one boreholes were completed as observation wells and a groundwater sampling and water-level monitoring program was established. The program entailed periodically measuring water-level elevations and sampling the groundwater for chemical analysis. As these data became available, they were analyzed and assessed to determine the feasibility of in situ stabilization.

5.2 Phase-One Interpretations

Phase-one data suggest that two aquifers may be present at the Middlesex site. Water-level data and chemical analyses of water samples from the two aquifers, however, do not confirm continuous hydrologic separation. Because data presented below are inconclusive, phase two was developed.

As described in Section 4.1, water-level data (Table 1.3) were used to develop hydrographs for each well pair (Figures 4A through 4H) and contour maps of water-level elevations (Figures 5A through 5P). Bar graphs depicting the difference in water quality between the overburden and bedrock are presented in Figure 6A and 6B. Based on evaluation of the hydrographs for well pairs 81-3 and 81-4, 81-5 and 81-6, 81-10 and 81-11, and 81-15 and 81-16, there appears to be a potential separation of the two units, which suggests two aquifers exist. However, the hydrographs for well pairs, 81-1 and 81-2, 81-8A and 81-9, and 81-13 and 81-14 indicate that the two units may not be separated and that the direction of vertical flow between the two units reverses over time.

Contour maps of water levels in each unit show that water in the overburden generally discharges towards Bound Brook. Water in the bedrock usually discharges to the northwest with Bound Brook serving as the apparent recharge boundary. However, during certain months, the groundwater gradient changes direction and water in the bedrock discharges to the brook. There are insufficient data to fully understand this characteristic, but the fact that water in the two units sometimes discharged in different directions is evidence that there may be some degree of separation.

The water-quality data indicate that with the exception of well pair 81-5 and 81-6, the overburden contains poorer quality water than the bedrock. Water-quality data for well pair 81-5 and 81-6 indicate that there may be hydraulic interconnection between the two units. Although the difference in chemistry could indicate separation, the two units may be interconnected and contamination in the bedrock masked by dilution from Bound Brook or by cation exchange with fine-grained materials.

Because the phase-one data are inconsistent, it was not possible to confirm whether an effective hydrologic barrier exists between the landfill and unweathered bedrock. The phase-two investigation was developed to better define the hydrologic characteristics of the intervening clay layer.

5.3 Phase Two

5.3.1 Permeability Testing

Two types of permeability tests were conducted during phase two to determine the character of the clay between the overburden and bedrock aquifers. Constant-head permeability tests were used in both the overburden and unweathered shale and variable-head tests in the clay layer. Drilling procedures are described in Section 7.

5.3.1.1 Constant-head Tests in the Overburden

Constant-head tests were performed in the overburden in three holes (83-18, 83-21, and 83-22). These tests were conducted when the top of the clay layer was encountered. A six-inch diameter steel casing was lowered into each hole to temporarily seal-off the overburden. The cased hole was washed and four-inch diameter, slotted PVC casing with an end cap was lowered to the bottom of the hole. The lower four feet of the PVC was slotted in the field with approximately 64 slots, each of which is 1/16-inch wide and 3 1/2-inches long. The six-inch steel casing was then raised four or five feet, exposing the slotted PVC to the overburden aquifer. The PVC was removed before the hole was advanced into bedrock.

The annular space between the six-inch steel and the four-inch PVC was sealed by using four to five rubber glands. A temporary seal was installed in the annular space between the borehole wall and the six-inch steel casing. At boring 83-18, this seal was made by packing the annulus with empty cement bags, followed by adding approximately six inches of wetted, tamped bentonite. At borings 83-21 and 83-22, the hole was sealed by creating a 30-inch diameter excavation around the six-inch steel casing to a depth of six- to twelve-inches and filling the excavation with a bentonite-and-cement slurry. The slurry was thin enough to infiltrate the surrounding landfill material. The seal was allowed to set for about 16 hours.

The pump-in test was performed with the four-inch PVC in place, and the six-inch casing raised and sealed as described above. A one-inch PVC pipe and screen was placed inside the four-inch PVC casing to measure water levels during the test.

Figures 7 through 9 illustrate the arrangement of pump-in test wells and observation wells for each test. Water was injected at either the maximum flow rate determined by the pump capacity or by the water-take rate of the hole (the pump capacity at 83-18 and the water-take rate at 83-21 and 83-22). Water levels in the two adjacent observation wells were monitored while pumping water into the test well. During the early part of each test, the observation well in the overburden was monitored by using a steel tape or an M-scope. Water levels in the bedrock observation well were monitored using an audible alarm set to detect a rise in water level of 0.01 foot or more. During the latter portion of the tests, all readings were done with an M-scope or a steel tape. The tests were run for 3-1/2 to 3-3/4 hours in boreholes 83-21 and 83-22 and for 2-3/4 hours in borehole 83-18. Water-level recovery was monitored in the observation wells after pumping had stopped.

Water levels in the observation wells in the bedrock were unaffected by pumping into the overburden at all three test sites. While this condition suggests that the clay layer is acting as a barrier, the relatively high permeability of the overburden (landfill materials and lower sedimentary units) would not permit a substantial pressure head to develop. Such a pressure head is needed to affect the bedrock hydrologic

conditions. Without a sufficient head, the test results are inconclusive. The constant-head test at well 83-18 is a typical example. Testing in the overburden lasted 2-3/4 hours. Approximately 17 gallons per minute were pumped into the well. The water-level response in the adjacent overburden observation well (81-9) was negligible. During a retest, 40 gallons per minute, the maximum output of the pump, was pumped into the well for 16 minutes. The water level in well 81-9, which is less than five feet away (Figure 7), rose 0.07 foot, which is also negligible.

Data from test wells 83-18, 83-21, and 83-22 were used to calculate an approximate permeability of the overburden. The permeabilities range between 3,600 and 40,000 feet per year. The permeability values are summarized in Table 2.1.

5.3.1.2 Variable-Head Testing in Clay Layer

Variable-head permeability tests were conducted in the clay. A permanent steel casing was installed to the top of the clay layer (Section 6.2). The hole was then advanced in two-foot intervals into the clay layer. At each interval, samples were collected using Shelby tube or split-spoon samplers and a variable-head permeability test was performed. A temporary, four-inch steel casing was used as a stand pipe for the tests. In some instances, the four-inch casing was advanced after each Shelby tube sample was taken. In other cases, the casing was left in one position for several tests. The test results are summarized in Table 2.2.

The permeabilities were calculated under the assumption that the vertical permeability (K_v) equals horizontal permeability (K_h), although as a general rule, K_v is considered to be at least one tenth of K_h . The K_v -equals- K_h assumption was used because the clay layer is the result of the in-place weathering of the shale bedrock. Commonly, the weathering process destroys the rock structure, which can leave vertical pathways for water migration.

Permeabilities in the clay ranged from values too low to measure with the variable-head test method (less than six feet per year) to approximately 70 feet per year. The well-construction method required the penetration of the upper one- to two-feet of clay with the permanent steel casing prior to performing any variable-head tests. This uppermost two feet is the most severely weathered portion of the formation and may be less permeable than other parts of the formation. Therefore, the permeability of the clay layer, when taken as a whole, may be somewhat lower than the permeabilities indicated by the test results.

5.3.1.3 Constant-Head Testing in the Bedrock

After completion of permeability testing in the clay layer, the exploratory holes were drilled to their final depths in the unweathered bedrock, and observation wells were installed. Well installation procedures are described in Section 7.2. The completed observation wells were cleaned and developed by pumping clean water into the well. After development, constant-head tests were performed in the bedrock portion of the holes. A Moyno pump was used to pump water under pressure into the one-inch PVC casing. The tests were performed for 3-1/2 to 3-3/4 hours.

The water levels in the adjacent observation wells in the bedrock were monitored with a steel tape or M-scope; the adjacent overburden well was equipped with the audible alarm described earlier. During the latter part of each test, both wells were monitored with a steel tape or M-scope. Water-level recovery was monitored at the conclusion of pumping in both the overburden and bedrock observation wells.

At test site 83-18 (Figure 7), water was pumped into the well at four gallons per minute, which caused the water level in bedrock observation well 81-8A to rise approximately five feet. The water level in overburden well 81-9, rose 0.04 foot in one test and 0.015 foot in a retest. This small rise is probably due to either changes in barometric pressure or the imprecision of the measuring devices and is considered negligible.

Pumping five gallons per minute into bedrock well 83-21 (Figure 8) caused a 1.8-foot rise in water level in the bedrock observation well 81-5. There was no observed effect in the overburden at well 81-6.

Pumping 0.4 gallons per minute into well 83-22 (Figure 9) caused the water level in the bedrock observation well 81-10 to rise 0.17 feet, and the water level in the overburden observation well 81-11 to rise 0.02 feet. While the 0.17-foot rise is probably a valid response, the 0.02-foot rise is not. The data from the overburden test at the same site (Section 5.3.1.1) indicate that a 0.04 gallons per minute pumping rate in the bedrock could not affect the water-levels in the relatively higher permeability overburden. Permeabilities of the bedrock were calculated using bedrock pump-test data and are listed in Table 2.1.

5.3.2 Ground-Water Monitoring

All of the observation wells were measured on July 13, 1983.

Ground-water levels in the overburden were above the bottom of the landfill in several locations and one- to three-feet below the bottom of the landfill in others. The water-level elevations are given on Table 2.3.

5.4 Comparison of Overburden and Bedrock Groundwater Levels

Groundwater contour maps for both the overburden and bedrock were constructed using July 13, 1983, data (Figures 10a and 10b). The overburden groundwater contour map (Figure 10a) indicates a general direction of flow toward the north and east, probably discharging into Bound Brook. The bedrock groundwater contour map (Figure 10b) indicates a direction similar to that of the overburden. The directions of groundwater flow in the two units are similar but not exactly the same, which concurs with phase-one findings.

Groundwater contour maps for both phase one and phase two indicate that water-surface elevations in the overburden are about one- foot higher than the levels in the bedrock. However, comparison of elevations for each well pair indicate that the water-level differences are usually less than one foot. Local differences of two- to four-feet have been measured at certain times. These differences could be the result of localized perched groundwater conditions and not due to two completely separate aquifers. The perched conditions could result from the clay and other low permeable layers within the sedimentary units of the overburden.

6.0 CONCLUSIONS

The two- to twelve-foot thick clay layer forms only a partial hydraulic separation between the overburden and the bedrock. The relatively high permeability of the clay layer (6 to 70 feet per year) and the similar characteristics of the groundwater levels in the bedrock and overburden are primary evidence that a complete separation of the aquifers does not exist. Therefore, the use of the clay as a long-term confining layer to vertical migration of contaminants should not be relied upon.

The relatively high permeabilities recorded in the clay are probably the result of the incomplete in-place decomposition of the shale bedrock. Decomposition that has not taken place at a constant rate can lead to the development of an unevenly distributed clay layer with resultant permeable pathways through to the rock. However, by reworking and redistributing the existing decomposed material, a relatively impermeable layer can probably be developed.

7.0 DRILLING

7.1 Phase One

The drilling contractor, Layne-New York Co., Inc., of Linden, New Jersey, used a Mobile B-60 and a Mobile B-80 drill rig. To assist with drilling the observation wells, which did not require soil sampling, a third rig, a Bucyrus-Erie 20W, was mobilized on December 14.

The exploratory holes were generally advanced using an eight-inch hollow-stem flight auger. Soil sampling commenced when natural geologic materials were encountered beneath landfill deposits. Initially both disturbed and undisturbed soils sampling was attempted. However, because the noncohesive sandy soils encountered were not suitable for undisturbed sampling, only disturbed samples of the soil (using a two-inch diameter split-spoon drive sampler) were taken. When auger refusal was reached, the hollow-stem augers were removed and a temporary six-inch casing was installed to prevent caving and water loss in the overburden. Bedrock was cored using standard NX diamond coring techniques. Constant-head permeability tests were conducted in the bedrock. Upon completion of coring and permeability testing, the hole was reamed to six inches, and an observation well was installed.

7.2 Phase Two

The drilling contractor during phase two was Testwell-Craig Test Boring Company, Inc., of Mays Landing, New Jersey. All of the drilling, except Boring 83-20, was done with a Mobile B-61 truck mounted drill rig. Boring 83-20 was drilled with a Mobil B-50 truck mounted drill rig.

Phase-two drilling procedures were slightly modified from those used during phase one. Phase-one activities indicated that a possible barrier to groundwater movement existed, and water-quality data indicated that higher concentrations of total dissolved solids existed in the overburden than in the bedrock. Drilling modifications were made primarily to assure no cross-contamination in drill holes would occur.

After the overburden permeability test was completed (Section 5.3.1.1), the four-inch PVC pipe was withdrawn from the borehole and the six-inch steel casing was driven to the top of clay. The inside of the six-inch casing was cleaned out using rotary drilling methods and then the borehole was advanced one- to two-feet into the clay layer. To assure a good seal at the clay/overburden interface, two cubic feet of heavy cement grout was tremied to the bottom of the six-inch steel casing. The casing was raised three- to four-feet to allow the heavy grout to move into the permeable material just above the weathered bedrock. The casing was then pushed into the clay layer. The annular space between the six-inch casing and the borehole wall was grouted to the ground surface. This casing was left undisturbed for several days before drilling continued. The hole was then advanced to its final depth in the unweathered shale.

8.0 OBSERVATION-WELL CONSTRUCTION

8.1 Phase One

Seventeen observation wells were installed during the phase-one investigations. Observation-well installation logs are presented in Appendix B. Generally, a three-foot screened section of two-inch diameter schedule 80 PVC with 0.04 inch slots was installed in the bottom of each hole on a riser string of two-inch diameter schedule 80, threaded-joint PVC pipe. The annular space between the six-inch hole and the two-inch PVC pipe was filled to several feet above the screened section with coarse sand (referred to as #2 well gravel). A bentonite seal consisting of one- to two-feet of bentonite tablets was placed on

top of the gravel pack. The hole was then grouted to the surface and the temporary casing removed. When constructing observation wells in the soil zone, the temporary casing was withdrawn simultaneously as the gravel pack and bentonite seal were being placed to prevent caving of the hole and binding of the well casing inside the temporary casing. The temporary casing in well 81-5 could not be removed above a depth of 20 feet. However, because this temporary casing is above the well screen and monitored zone, the casing will not affect functioning of the well.

To protect the observation wells from damage, a surface-protection system was installed at each well. This system consisted of placing a six-inch diameter steel casing with locking cap over the PVC riser pipe and then placing a 24-inch diameter steel casing around the six-inch casing. After both casings were in place, the 24-inch casing was completely filled with concrete and the six-inch casing was filled with concrete to within two- to three-inches of the top of the PVC riser pipe.

A variable-head test was performed in each completed well to test its operability (Section 5.1.1). In addition to determining if the observation well was operating properly, the rate of decline of the water was used to calculate the permeability of the material open to the gravel pack.

8.2 Phase Two

An observation well was installed at each of the phase-two test locations. The wells consisted of one-inch diameter schedule 80 PVC pipe with a screened section 4.6 feet long. The screen was also one-inch

diameter Schedule 80 PVC with 0.020 machine cut slots. A five-foot sump was placed below the screened section. The screen was placed at the same elevation as the screened section of the 1981 bedrock observation well as shown on Figures 7 through 9. A filter pack was placed in the well annulus surrounding the screened section and extending at least five feet above the screen. About one foot of tamped bentonite pellets was placed above the filter sand. Above the bentonite seal, a bentonite-cement slurry was tremied into the annulus to ground surface. After placement of this surface seal, the temporary casing was removed from the hole. The completed wells were allowed to stand undisturbed for several days before pumping tests were performed (Section 5.2.1.3). At the conclusion of pumping tests, a surface casing extension with a lockable threaded cap was welded onto the six-inch casing. Observation-well installation logs are presented in Appendix B.

9.0 METHANE AND TOXIC GAS

9.1 Phase One

During phase one, gas detection devices provided by Layne-New York indicated high levels of gas at several well sites during drilling and, at one point, gas emanating from well 81-8A was ignited during welding of casing. The fire was quenched with an extinguisher. Layne-New York safety personnel assessed the situation, and it was agreed that the gases should be sampled and analyzed. This function was performed by Eberline, Inc. The analyses indicated that the predominant gas was methane and that there were not sufficient quantities of harmful gases to cause a serious health hazard. Threaded-joint casing was used to eliminate the

further need for welding and reduce the possibility of fire. The work was completed without further gas-related problems.

9.2 Phase Two

During the drilling of boring 83-19A and 83-18, methane was detected in concentrations above the lower explosive limit at the collar of each boring. At the time of detection, drilling had not penetrated beyond the overburden. The presence of methane was again a problem during the welding of surface casing in the boreholes. Sparks from the welding ignited the methane.

During the drilling of boring 83-18, a chlorinated-solvent form of toxic gas was detected at the collar of the boring. Drilling personnel were instructed not to allow skin contact with the sludge auger cuttings. Laboratory chemical analyses were conducted on samples from hole 83-22. Although no toxic gases were detected from this hole, other priority pollutants were. They include numerous metals, cyanide, volatile organics, and pesticides/herbicides.

10.0 RADIOLOGICAL MONITORING

Eberline, Inc. health physicists were present during both phase-one and phase-two field activities. They monitored earth materials for radioactivity which included sampling and analyzing subsurface materials and downhole logging of the boreholes with a gamma particle detection system. According to preliminary results from Eberline, no harmful levels of radioactivity were detected.

TABLES

TABLE 1.1

SUMMARY OF PHASE-ONE FIELD PERMEABILITY MEASUREMENTS

Hole No.	Elevation of Test Section Feet, MSL		Test Method	Material Tested	Permeability Feet/Year
81-1	17.03 to	6.03	Constant head	Bedrock	180
81-1	10.03 to	4.03	Variable head	Bedrock	50
81-2A	35.56 to	29.06	Variable head	Overburden/Sand & Clay	3000+*
81-3	11.84 to	4.54	Variable head	Bedrock	930
81-4	29.92 to	24.92	Variable head	Overburden/Gravel & Clay	50
81-5	14.6 to	4.6	Constant head	Bedrock	1100
81-5	4.6 to	-5.4	Constant head	Bedrock	240
81-5	- 5.4 to	-15.4	Constant head	Bedrock	140
81-5	-15.4 to	-30.9	Constant head	Bedrock	95
81-5	-19.9 to	-30.9	Variable head	Bedrock	200
81-6	34.61 to	28.11	Variable head	Overburden/Clayey Sand	260
81-8A	10.7 to	-0.3	Constant head	Bedrock	130
81-8A	7.2 to	-1.3	Variable head	Bedrock	430
81-9	29.96 to	23.96	Variable head	Overburden/Clayey Sand	180
81-10	15.94 to	5.94	Constant head	Bedrock	320
81-10	5.94 to	-4.06	Constant head	Bedrock	250
81-10	- 4.06 to	-14.06	Constant head	Bedrock	200
81-10	-14.06 to	-29.06	Constant head	Bedrock	45
81-10	-23.76 to	-30.56	Variable head	Bedrock	55
81-11	31.5 to	25.7	Variable head	Overburden/Sandy Clay	70
81-13	15.88 to	5.28	Constant head	Bedrock	45
81-13	13.58 to	5.28	Variable head	Bedrock	540
81-14	32.45 to	25.45	Variable head	Overburden/Sand & Clay	55
81-15	11.96 to	1.96	Constant head	Bedrock	400
81-15	7.46 to	1.96	Variable head	Bedrock	360
81-16	31.66 to	25.66	Variable head	Overburden/Landfill	12
81-17	10.65 to	0.65	Constant head	Bedrock	240
81-17	0.65 to	-9.35	Constant head	Bedrock	470
81-17	- 9.35 to	-19.35	Constant head	Bedrock	1300
81-17	-19.35 to	-34.35	Constant head	Bedrock	300
81-17	-25.35 to	-34.35	Variable head	Bedrock	1800

*Estimated from unsuccessful attempt to run variable head test.

TABLE 1.2

PHASE-ONE PRETESTING WATER LEVEL MEASUREMENTS

<u>Well No.</u>	<u>Elevation of Water Level Feet, MSL</u>	<u>Date Measured</u>	<u>Material Monitored</u>
81-1	32.5	12-23-81	Bedrock
81-2A	33.1	12-24-81	Overburden/Sand & Clay
81-3	32.7	12-24-81	Bedrock
81-4	31.7	12-24-81	Overburden/Gravel & Clay
81-5	32.6	12-24-81	Bedrock
81-6	35.0	12-18-81	Overburden/Clayey Sand
81-8A	33.2	12-18-81	Bedrock
81-9	32.9	12-18-81	Overburden/Clayey Sand
81-10	32.0	12-24-81	Bedrock
81-11	32.2	12-18-81	Overburden/Sandy Clay
81-13	33.0	12-18-81	Bedrock
81-14	33.4	12-18-81	Overburden/Clay & Sand
81-15	33.0	12-18-81	Bedrock
81-16	33.8	12-18-81	Overburden/Landfill
81-17	32.6	12-24-81	Bedrock

TABLE 1.3

MIDDLESEX LANDFILL WATER LEVELS

PHASE ONE

(Elevation in feet)

<u>Well</u> <u>No.</u>	<u>2/24/82</u>	<u>4/13/82</u>	<u>6/23/83</u>	<u>8/31/82</u>	<u>9/22/82</u>	<u>10/28/82</u>	<u>11/24/82</u>	<u>12/15/82</u>
1*	31.93	32.93	33.63	31.83	31.03	31.60	31.03	31.03
2	32.46	32.76	33.66	32.26	32.00	32.06	31.36	31.36
3*	29.24	30.94	30.54	30.54	29.54	29.84	29.84	29.94
4	29.42	32.62	32.62	30.92	30.72	31.22	32.82	30.92
5*	40.20	33.40	30.00	31.40	28.10	28.00	29.10	28.10
6	39.71	35.91	34.41	33.40	33.10	32.41	42.71**	33.10
8A*	36.70	32.90	32.90	31.30	30.70	31.30	30.80	30.70
9	38.76	32.26	32.36	31.86	30.46	30.76	31.57	30.46
10*	30.04	31.74	32.09	25.90	30.44	30.44	30.44	30.44
11	30.40	30.30	31.10	25.60	29.00	29.30	29.30	29.40
13*	37.68	30.58	30.68	31.08	29.38	29.38	29.38	28.38
14	30.95	30.55	30.05	30.95	28.55	29.45	29.45	28.45
15*	26.76	32.56	32.76	31.06	30.96	31.26	30.96	30.26
16	20.36	33.46	33.46	31.06	31.86	32.06	31.66	31.16
17*	20.43	32.80	32.95	31.65	31.65	21.65**	32.05	31.95

*Bedrock wells

**Value questioned

TABLE 2.1

OVERBURDEN AND BEDROCK PERMEABILITIES FROM PHASE-TWO CONSTANT-HEAD TESTS

<u>Well No.</u>	<u>Test Interval Feet Below Ground Surface</u>	<u>Material</u>	<u>Permeability Feet/Year</u>
83-18	Above 25.4	Overburden/Sand & Landfill	11,000 to 40,000
83-18	40-50	Fractured Bedrock	332
83-21	Above 17.1	Overburden/Sand & Silt & Landfill	3,600 to 9,800
83-2	56.25 - 78.8	Fractured Bedrock	370
83-22	Above 13.7	Overburden/Sand & Silt & Clay & Landfill	7,900 to 17,700
83-22	55.8 - 76.3	Bedrock	23

TABLE 2.2

CLAY LAYER PERMEABILITIES FROM PHASE-TWO VARIABLE-HEAD TESTS

<u>Well No.</u>	<u>Test Interval Feet Below Ground Surface</u>	<u>Material</u>	<u>Permeability Feet/Year</u>
83-18	29.45 - 30.20	Clay	6
83-18	29.45 - 33.20	Clay	6
83-21	19.70 - 21.70	Clay	63
83-21	21.70 - 23.70	Clay	68
83-21	23.70 - 24.60	Clay	31
83-22	15.50 - 17.25	Clay & overburden	209*
83-22	16.50 - 18.00	Clay	62
83-22	16.50 - 18.50	Clay & bedrock	45

* Permeability value represents hydrologic interconnection with sedimentary units in the overburden.

TABLE 2.3

PHASE-TWO WATER-LEVEL MEASUREMENTS

<u>Well No.</u>	<u>Elevation of Water Level</u>	<u>Date Measured</u>	<u>Material Monitored</u>
(Feet, MSL)			
81-1	35.17	7/13/83	Bedrock
81-2A	36.13	7/13/83	Overburden/Sand & Clay
81-3	33.23	7/13/83	Bedrock
81-4	32.67	7/13/83	Overburden/Gravel & Clay
81-5	34.55	7/13/83	Bedrock
81-6	35.67	7/13/83	Overburden/Clayey Sand
81-8A	34.64	7/13/83	Bedrock
81-9	34.02	7/13/83	Overburden/Clayey Sand
81-10	32.57	7/13/83	Bedrock
81-11	31.52	7/13/83	Overburden/Sandy Clay
81-13	33.45	7/13/83	Bedrock
81-14	32.89	7/13/83	Overburden/Clay & Sand
81-15	34.39	7/13/83	Bedrock
81-16	33.61	7/13/83	Overburden/Landfill
81-17	34.01	7/13/83	Bedrock
83-18	34.76	7/13/83	Bedrock
81-19A	35.32	7/13/83	Bedrock
83-20	35.95	7/13/83	Overburden/Sand
83-21	34.68	7/13/83	Bedrock
83-22	32.47	7/13/83	Bedrock

NOTE: Water elevation of Bound Brook near 81-17 on 7/13/83 was 31.2 feet MSL.

FIGURES

EXPLANATION

- ~50 Topographic contour interval = 1 foot.
- Approximate location of radiologically contaminated waste.

SOURCE: Ford Bacon and Davis Utah Inc. (1979).
Environmental Analysis at the Middlesex
Municipal Landfill Site, Middlesex,
New Jersey.

BECHTEL SAN FRANCISCO			
FUSRAP MIDDLESEX LANDFILL			
LOCATION AND TOPOGRAPHY OF MIDDLESEX LANDFILL SITE			
	JOB No.	DRAWING No.	REV.
	14501	FIGURE 1	0

EXPLANATION

- 83-18
- DRILL HOLE LOCATION
- OVERBURDEN MATERIALS – Landfill, deposited waste.
- SEDIMENTARY UNITS – Alluvial, sandy clays and clayey sands and gravels.
- WEATHERED SHALE – Clay layer separating the overburden from competent bedrock.
- BEDROCK – Shale, moderately soft and fractured, becoming more competent with depth.

Note: Boreholes not shown to true depth.

<div> <div> <div>BECHTEL</div> <div>SAN FRANCISCO</div> </div> <div> <div>FUSRAP</div> <div>MIDDLESEX LANDFILL</div> </div> <div> <div>FENCE DIAGRAM SHOWING THE RELATIONSHIP BETWEEN THE LANDFILL MATERIALS & THE WEATHERED SHALE</div> </div> </div>			
JOB No.		DRAWING No.	
14501		FIGURE 3	
			REV.
			○

△ OBSERVATION WELL 4 (OVERBURDEN)
○ OBSERVATION WELL 3 (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS

FIGURE 4B

* * VALUE QUESTIONED

△ OBSERVATION WELL 6 (OVERBURDEN)
○ OBSERVATION WELL 5 (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS

FIGURE 4C

- △ OBSERVATION WELL 9 (OVERBURDEN)
○ OBSERVATION WELL 8A (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS

FIGURE 4D

△ OBSERVATION WELL 11 (OVERBURDEN)
○ OBSERVATION WELL 10 (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS

FIGURE 4E

△ OBSERVATION WELL 14 (OVERBURDEN)
○ OBSERVATION WELL 13 (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS

FIGURE 4F

△ OBSERVATION WELL 16 (OVERBURDEN)
○ OBSERVATION WELL 15 (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS
FIGURE 4G

** VALUE QUESTIONED

○ OBSERVATION WELL 17 (BEDROCK)

MIDDLESEX LANDFILL
HYDROGRAPH OF OBSERVATION WELLS

FIGURE 4H

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 2-24-82		
JOB No. 14501	DRAWING No. FIGURE 5A	REV. O

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 2-24-82		
JOB No.	DRAWING No.	REV.
14501	FIGURE 5B	0

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 4-13-82		
JOB NO.	DRAWING NO.	REV.
14501	FIGURE 5C	0

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BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 4-13-82		
JOB No. 14501	DRAWING No. FIGURE 5D	REV. O

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 6-23-82		
JOB NO. 14501	DRAWING NO. FIGURE 5E	REV. O

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BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 6-23-82		
JOB No. 14501	DRAWING No. FIGURE 5F	REV. O

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 8-31-82		
JOB No. 14501	DRAWING No. FIGURE 5G	REV. 0

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 8-31-82		
JOB No. 14501	DRAWING No. FIGURE 5H	REV. O

BECHTEL SAN FRANCISCO	
FUSRAP MIDDLESEX LANDFILL			
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 9-22-82			
JOB No. 14501	DRAWING No. FIGURE 5.1		
REV.

EXPLANATION

- 81-1 WELL INSTALLED DURING PHASE-ONE
32.06 ACTIVITIES WITH WATER SURFACE ELEVATION
- 30 — GROUNDWATER CONTOURS, ELEVATION IN FEET

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 9-22-82		
JOB NO. 14501	DRAWING NO. FIGURE 5J	REV. 0

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 10-28-82		
JOB No. 14501	DRAWING No. FIGURE 5K	REV. 0

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 10-28-82		
JOB NO. 14501	DRAWING NO. FIGURE 5L	REV. 0

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 11-24-82		
JOB NO.	DRAWING NO.	REV.
14501	FIGURE 5M	O

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 11-24-82		
JOB No. 14501	DRAWING No. FIGURE 5N	REV. O

JOB No.	DRAWING No.
14501	FIGURE 5.0
REV.	0
BECHTEL SAN FRANCISCO FUSRAP MIDDLESEX LANDFILL WATER LEVEL ELEVATIONS IN THE OVERBURDEN 12-15-82

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
WATER LEVEL ELEVATIONS IN THE BEDROCK 12-15-82		
JOB No. 14501	DRAWING No. FIGURE 5P	REV. 0

EXPLANATION

- Chloride *mg/l*
- Sulfate *mg/l*
- Total Dissolved Solids *mg/l*
- Hardness *mg/l*

BECHTEL SAN FRANCISCO			
FUSRAP MIDDLESEX LANDFILL			
GROUNDWATER CHEMISTRY 4-13-82			
	JOB No.	DRAWING No.	REV.
	14501	FIGURE 6A	0

EXPLANATION

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
GROUNDWATER CHEMISTRY 6-23-82		
	JOB No. 14501	DRAWING No. FIGURE 6B
		REV. ○

SCALE: VERTICAL 1" = 10'
HORIZONTAL NOT TO SCALE

PLAN VIEW

BECHTEL SAN FRANCISCO		
FUSRAP MIDDLESEX LANDFILL		
BORING 83-18 PUMP-IN TESTS		
JOB No.	DRAWING No.	REV.
14501	FIGURE 7	○

SCALE: VERTICAL 1" = 10'
HORIZONTAL NOT TO SCALE

EXPLANATION

- PUMP-IN INTERVAL
- OBSERVED INTERVAL

PLAN VIEW

BECHTEL SAN FRANCISCO			
FUSRAP MIDDLESEX LANDFILL			
BORING 83-21 PUMP-IN TESTS
JOB No.	DRAWING No.	REV.
	14501	FIGURE 8	0

BECHTEL SAN FRANCISCO			
FUSRAP MIDDLESEX LANDFILL			
BORING 83-22 PUMP-IN TESTS			
BECHTEL	JOB No.	DRAWING No.	REV.
	14501	FIGURE 9	0

BECHTEL SAN FRANCISCO			
FUSRAP MIDDLESEX LANDFILL			
WATER LEVEL ELEVATIONS IN THE OVERBURDEN 7-13-83			
	JOB No.	DRAWING No.	REV.
	14501	FIGURE 10A	0

EXPLANATION

- 81-1 WELL INSTALLED DURING PHASE-ONE
- 35.17 ACTIVITIES WITH WATER SURFACE ELEVATION
- 83-19 WELL INSTALLED DURING PHASE-TWO
- 35.32 ACTIVITIES WITH WATER SURFACE ELEVATION
- 35 GROUNDWATER CONTOURS, ELEVATION IN FEET

BECHTEL
SAN FRANCISCO

FUSRAP
MIDDLESEX LANDFILL

WATER LEVEL ELEVATIONS
IN THE BEDROCK 7-13-83

JOB No.	DRAWING No.	REV.
14501	FIGURE 10B	0

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5. Ford, Bacon & Davis Utah, Inc., "Environmental Analysis of the Middlesex Municipal Landfill Site, Middlesex, New Jersey", EW-76-C-13-1658 Salt Lake City, Utah, July 1979.
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APPENDIX A

DRILL LOGS

GEOLOGIC DRILL LOG				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 2	HOLE NO. 81-1				
SITE MIDDLESEX LANDFILL			COORDINATES +451.5 351.9 R			ANGLE FROM HORIZ. Vertical		BEARING ---				
BEGIN 11/18/81	COMPLETED 11/23/81	DRILLER Layne	DRILL MAKE AND MODEL Mobile B61		HOLE SIZE 8"/NX	OVERBURDEN (FT.) 27	ROCK (FT.) 20	TOTAL DEPTH 47'				
CORE RECOVERY (FT./%) 10.6/71		CORE BOXES 1	SAMPLES 5	EL. TOP OF CASING 52.8'	GROUND EL. 51.03'	DEPTH/EL. GROUND WATER 18.5'/32.5'		DEPTH/EL. TOP OF ROCK 27'/24.0'				
SAMPLE HAMMER WEIGHT/FALL 140 lbs./30"		CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log			LOGGED BY: R. Talmage							
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN "	SAMPLER RECOVERY CORE RECOVERY "	SAMPLER BLOWS PERCENT CORE RECOVERY "	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
							51.0'	0			0.0': SHALE: Red, fragments on ground surface.	8" flight auger drilled to 30.0'.
SS	24"		29					1			0.0-26.8': SAND: Red-brown, brown, to gray, very fine to medium grained (coarse at base), occasionally some clay, silty, occasional pebbles.	
								5			3.0': Brown, very fine to fine grained, some clay.	
								10			8.0': Red-brown, less silty, no clay.	
ST	30"							2			10.0': Gray, loose, medium grained, occasional pebbles.	
								15				
SS			6-5-4					3			19.0': Brown, very fine to fine grained, clay fraction.	
								20				
SS			8-3-6					4			25.0': Coarse, pebbly.	Water level on 11/24/81 at 20.9'.
ST	17.5"						24.2'	5			26.8-28.8': CLAY: Red-brown, stiff, weathered.	Refusal at 26'; bent lip of tube.
							22.2'				28.8-45.0': SHALE: Red-brown, moderately hard, horizontal bedding, occasional soft clay beds, weathered and fractured near top, becoming harder with depth.	Possibly some caving with core loss.
NX Core	5.0	2.0	40					30				
								35				

SS - SPLIT SPOON; ST - SHELBY TUBE;
 D - DENNISON; P - PITCHER; O - OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-1

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 2 OF 2	HOLE NO. 81-1
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
NX Core	60"	52"		87					35			35.0': Occasional sandy beds.		
	60"	51.5"		86				40	43.0': Solution pits to 1" in size.					
							6.0'	45			B.O.H. = 45'			

SS - SPLIT SPOON; ST - SHELBY TUBE;
D - DENNISON; P - PITCHER; O - OTHER

SITE

MIDDLESEX LANDFILL

HOLE NO.

81-1

GEOLOGIC DRILL LOG				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-2A						
SITE MIDDLESEX LANDFILL			COORDINATES				ANGLE FROM HORIZ. Vertical	BEARING ---						
BEGIN 11/30/81	COMPLETED 11/30/81	DRILLER Layne - T. Molliton	DRILL MAKE AND MODEL Mobile B61	HOLE SIZE 6-3/4	OVERBURDEN (FT.) 22.5	ROCK (FT.) 0	TOTAL DEPTH 22.5							
CORE RECOVERY (FT./%) ---		CORE BOXES ---	SAMPLES ---	EL. TOP OF CASING 49.8'	GROUND EL. 51.56'	DEPTH/EL. GROUND WATER 22.5'/29.1'		DEPTH/EL. TOP OF ROCK 22.5'						
SAMPLE HAMMER WEIGHT/FALL ---		CASING LEFT IN HOLE: DIA./LENGTH 2" PVC/22.9'			LOGGED BY: A. Atkinson									
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS "N" PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.		
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES								
							51.6'	0			Hole drilled as observation well only. See geologic log of adjacent hole 81-1 for geologic details. Cuttings indicate tan to gray, fine-grained sand with traces of red clay at bottom of hole.	8" flight auger to 22.5'. 6-3/4" casing to 21'. (temporary)		
							29.1'	22.5					B.O.H. = 22.5'	
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER													SITE MIDDLESEX LANDFILL	HOLE NO. 81-2A

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
										FUSRAP		14501		1 OF 2		81-3	
SITE					COORDINATES					ANGLE FROM HORIZ.					BEARING		
MIDDLESEX LANDFILL					+184.6 147.7 R					Vertical					---		
BEGIN		COMPLETED		DRILLER		DRILL MAKE AND MODEL		HOLE SIZE		OVERBURDEN (FT.)		ROCK (FT.)		TOTAL DEPTH			
11/9/81		11/11/81		Layne		Mobile B61		8" / NX		21		22		43'			
CORE RECOVERY (FT. / %)				CORE BOXES		SAMPLES		EL. TOP OF CASING		GROUND EL.		DEPTH / EL. GROUND WATER		DEPTH / EL. TOP OF ROCK			
124 / 83				1		3		49.6'		47.54'		14.8' / 32.7'		21' / 26.5			
SAMPLE HAMMER WEIGHT / FALL					CASING LEFT IN HOLE: DIA. / LENGTH					LOGGED BY:							
					See Observation Well Log					R. Talmage							
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.			
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES										
									47.5'	0			0.0-15.5': LANDFILL: Predominately commercial and domestic waste.	8" flight auger drilled to 28.0'.			
SS				No Recovery					32.0'	15			15.5-21.0': GRAVEL: Red-brown, pea size, sandy (medium-grained).	Water level on 11/12/81 at 14.7'.			
SS				No Recovery					26.5'	20			21.0-29.0': CLAY: Red-brown, stiff, silty, possibly is weathered rock.	Water level on 11/10/81 at 17-1/2'.			
SS				No Recovery						25							
NX Core	5.0	4.2		84					18.5'	30			29.0-38.0': SHALE: Dark red-brown, locally fissile, generally moderately hard, minor (<1/2") beds containing clay and rock fragments, bedding approximately horizontal, occasional incipient fractures at about 45°.	Refusal at bottom.			
										35							

SS = SPLIT SPOON; ST = SHELBY TUBE;
 D = DENNISON; P = PITCHER; O = OTHER

SITE
 MIDDLESEX LANDFILL

HOLE NO.
 81-3

GEOLOGIC DRILL LOG							PROJECT		JOB NO.	SHEET NO.	HOLE NO.		
							FUSRAP		14501	2 OF 2	81-3		
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER SLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
NX Core	5.0	3.4	68					4.5'	35			36.0': Greater variation in hardness. 37.5': Sandy lenses.	Some sand washed in around 6" casing.
	5.0	4.8	96						40		38.0-43.0': <u>SILTSTONE</u> : Red-brown, massive, minor high angle fractures, shaly, hard, occasional pits - possibly loss of gypsum, some pits filled with white gypsum or calcite.		
									43			B.O.H. = 43'	

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE

MIDDLESEX LANDFILL

HOLE NO.

81-3

GEOLOGIC DRILL LOG				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-4				
SITE MIDDLESEX LANDFILL			COORDINATES +192.6 151.5 R			ANGLE FROM HORIZ. Vertical		BEARING ---				
BEGIN 11/13/81	COMPLETED 11/17/81	DRILLER Layne	DRILL MAKE AND MODEL Mobile B61		HOLE SIZE 8"	OVERBURDEN (FT.) ---	ROCK (FT.)	TOTAL DEPTH 22.0'				
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING 48.7'	GROUND EL. 47.42'	DEPTH/EL. GROUND WATER 15.2'/32.2'		DEPTH/EL. TOP OF ROCK				
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log			LOGGED BY:						
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN O.P.M.	PRESSURE P.S.I.	TIME IN MINUTES					
								47.4'	0		Hole drilled as observation well only. See geologic log of adjacent hole 81-3 for geologic details.	8" flight auger drilled to 22'
								25.4'	22			

SS = SPLIT SPOON; ST = SHELBY TUBE;
 D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-4

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 of 3	HOLE NO. 81-5	
SITE MIDDLESEX LANDFILL					COORDINATES +379.9 23.7 L					ANGLE FROM HORIZ. Vertical		BEARING ---			
BEGIN 12/1/81		COMPLETED 12/22/81		DRILLER Layne - T. Molliton		DRILL MAKE AND MODEL Mobile B61		HOLE SIZE 8"		OVERBURDEN (FT.) 26.0		ROCK (FT.) 50.5		TOTAL DEPTH 76.5'	
CORE RECOVERY (FT./%) 42.9/85				CORE BOXES 3		SAMPLES 3		EL. TOP OF CASING 47.4'		GROUND EL. 45.60'		DEPTH/EL. GROUND WATER 13.0'/32.6'		DEPTH/EL. TOP OF ROCK 26.0'/19.6'	
SAMPLE HAMMER WEIGHT/FALL 140 lbs./30"				CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log				LOGGED BY: A. Atkinson							
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.		
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES								
								45.6'	0	0		0.0-12.5': <u>LANDFILL</u> : Predominantly commercial and domestic waste. Approximate Contact 12.5-17.5': <u>SAND</u> : Red-brown to gray, silty, clayey, medium-grained. Approximate Contact 17.5-76.5': <u>SHALE</u> : Red-brown, weathered at top, moderately soft, occasional gray streaks, moderately to highly fractured, occasional solution pits, black coatings on open joints and fracture surfaces common. 17.5-22.5': Decomposed. 26.0': Moderately weathered. 32.5': 60° joint with black coating. 47.3': 60° joint.	Sandia sample No. 81-5-0. Sandia sample No. 81-5-2-1/2. Sandia sample No. 81-5-5. Sandia sample No. 81-5-7-1/2.		
SS	18"	11"	8-6-8				33.1'	5	0						
								15	1-SS						
SS	18"	7"	5-11-12				28.1'	20	2-SS						
								25	3-SS						
SS	9"	5"	56	50/3"				30	4-SS						
								35	5-SS						
NX Core	0.5	0.5	100												
	5.0	1.0	20												
	2.5	1.8	72												

SS = SPLIT SPOON; ST = SHELBY TUBE;
 D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-5

GEOLOGIC DRILL LOG							PROJECT	JOB NO.	SHEET NO.	HOLE NO.		
							FUSRAP - Middlesex Landfill	14501	2 OF 3	81-5		
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
	4.0	3.0	75									LP = 0.3' Partial AP = 0.2' Circula- tion Returns
	3.0	2.8		13.6	20	5						LP = 0.5' AP = 0.2'
	5.0	4.8	96									LP = 0.6' AP = 0.3'
	5.0	4.7	94	5.0	30	5						LP = 0.3' AP = 0.2'
	10.0	9.8	98	3.2	30	5						LP = 0.8' AP = 0.4'
	10.0	9.5	95									LP = 0.8' AP = 0.3'
	5.5	5.5	100	3.8	30	5						LP = 1.2' AP = 0.3'

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP - Middlesex Landfill	14501	3 OF 3	81-5

H&CF 19-2

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-6
SITE MIDDLESEX LANDFILL					COORDINATES +375.6 28.4 L					ANGLE FROM HORIZ. Vertical		BEARING ---		
BEGUN 12/17/81	COMPLETED 12/18/81	DRILLER Layne - J. Debres			DRILL MAKE AND MODEL Bucyrus-Erie 20W		HOLE SIZE 6"	OVERBURDEN (FT.) 17	ROCK (FT.) ---	TOTAL DEPTH 17'				
CORE RECOVERY (FT./%) ---		CORE BOXES ---	SAMPLES ---	EL. TOP OF CASING 46.9'	GROUND EL. 45.11	DEPTH/EL. GROUND WATER 10.0'/35.1'			DEPTH/EL. TOP OF ROCK ---					
SAMPLE HAMMER WEIGHT/FALL ---			CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log				LOGGED BY: A. Atkinson							
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE SLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
								45.1'	0			Hole drilled as observation well only. See geologic log of adjacent hole 81-5 for geologic details.		
								28.1'	15					
									20			B.O.H. = 17.0'		
									25					
									30					
									35					

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-6

GEOLOGIC DRILL LOG										PROJECT		JOB NO.	SHEET NO.	HOLE NO.
										FUSRAP		14501	1 OF 2	81-8A
SITE					COORDINATES					ANGLE FROM HORIZ.		BEARING		
MIDDLESEX LANDFILL					+682 57.9 L					Vertical		---		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL		HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH				
12/2/81		Layne-Jackson			Mobile B80		8"/NX	34.2	17.8	52.0'				
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK						
13.2/74		1	2	52.5'	50.70'	17.5'/33.2'		34.2'/16.5'						
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE: DIA./LENGTH			LOGGED BY:								
140 lbs./30"			Observation Well			A. Atkinson								
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
								50.7'	0			0.0-25.0': LANDFILL: Predominantly commercial and domestic waste.	8" flight auger drilled to 33.0'. Water level on 12/4/81 at 10.5'. Water level on 12/10/81 at 12'. Water level on 12/11/81 at 16'. Water level on 12/15/81 at 18'.	
									5					
									10					
									15					
									20					
									25			25.0-26.0': SAND: Gray, medium-grained.		
SS	18"	11"		12-13-12				25.7'						
								24.7'				26.0-52.0': SHALE: Red-brown.		
												26.0-26.5': Decomposed.		
												30.0': Weathered.		
												34.2': Weak, highly fragmented, occasional solution pits, occasional gray-green streaks.		
									30					
5-7/8" Tricone													5-7/8" rock bit from 33.0-34.2'.	
NX														

SS = SPLIT SPOON; ST = SHELBY TUBE;
O = DENNISON; P = PITCHER; Q = OTHER

MIDDLESEX LANDFILL

HOLE NO.
81-8A

GEOLOGIC DRILL LOG										PROJECT		JOB NO.	SHEET NO.	HOLE NO.
										FUSRAP - Middlesex Landfill		14501	2 OF 2	81-BA
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
NX Core	3.8	2.7	71						35			Longest core piece ("LP") = 0.2'. Average core piece ("AP") < 0.1'. LP = 0.3' AP = 0.1' LP = 0.2' AP < 0.1' 5-7/8" rock bit from 51-52'.		
	5.0	4.5	90					40						
	6.0	4.5	75	1.6	20	5		45						
	2.0	1.5	75					50						
5-7/8" Tricone								-1.3'	52			B.O.H.: 52.0'		

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE

MIDDLESEX LANDFILL

79

HOLE NO.

81-BA

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-9
SITE MIDDLESEX LANDFILL					COORDINATES +685.8 60.6 L					ANGLE FROM HORIZ. Vertical		BEARING ---		
BEGIN	COMPLETED	DRILLER			DRILL MAKE AND MODEL		HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH				
12/11/81		Layne - G. Jackson			Mobile B80		8"	26'	---	26'				
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK						
---		---	3	51.7'	50.46'	17.1'/33.4'		---						
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE: DIA./LENGTH			LOGGED BY:								
140 lbs./30"			See Observation Well Log			A. Atkinson								
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS "N."	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.			
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES	50.5'	0		0.0-16.5': <u>LANDFILL</u> : Predominantly commercial and domestic waste.	8" flight auger drilled to 25.5'.			
							15	Tin can in sampler tip - sample not valid.						
SS	18"	--	18-22-21					Approximate Contact						
SS	18"	18"	9-7-9				34.0'	16.5-20.0': <u>CLAY</u> : Red, mixed with petroleum waste.		Water level on 12/15/81 at 18'.				
								Approximate Contact						
SS	18"	10"	6-10-13				30.5'	20.0-26.0': <u>SAND</u> : Red, medium-grained, silty, clayey.						
								24.0': Mixed with red clay.		5-7/8" rock bit from 25.5-26.0'.				
SS	18"	4"	11-13-13					25						
Tricone							24.5'	26	B.O.H. = 26.0'					
								30						
								35						

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-9

GEOLOGIC DRILL LOG				PROJECT		JOB NO.	SHEET NO.	HOLE NO.					
				FUSRAP		14501	1 OF 2	81-10					
SITE			COORDINATES			ANGLE FROM HORIZ.		BEARING					
MIDDLESEX LANDFILL			+12.4 39.7 L			Vertical		---					
BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL		HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH					
12/1/81	12/10/81	Layne - T. Molliton	Mobile B61		8	20.3	49.7	71.5'					
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK					
36.0/72		2	3	42.7'	40.94'	8.9'/32.0'		20.3'/20.6					
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE: DIA./LENGTH			LOGGED BY:							
			See Observation Well Log			A. Atkinson							
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
								40.9'	0			0.0-10.0': LANDFILL: Predominantly commercial and domestic waste.	Water level on 12/3/81 at 2.5'. 8" flight auger drilled to 20.3'.
SS	18"	7"	2-7-8					30.9'	10			Approximate Contact 10.0-14.5': CLAY: Gray to brown, sandy, silty, with roots.	Water level on 12/4/81 and 12/7/81 at 9'.
SS	18"	6"	42-43-45					26.4'	15			Approximate Contact 14.5-71.5': SHALE: Red-brown. 14.5': Decomposed. 19.5-20.3': Weathered. 30.5': Weak, closely spaced horizontal fractures with black manganese oxide coatings below about 40', local solution pits. 40.5': Occasional joints with black manganese oxide coatings. 64.4': 60° sub-planar joint, black coating.	
SS	10"	10"	29-100/4"						20				
NX Core	4.7	0	0*						25				*Poor core recovery due to metal fragments that had fallen into hole from hole wall while placing casing. Fragments picked up in third core run (30-35'). Longest core piece ("LP") = 0.3' Average length of core pieces ("AP") = 0.1'
	5.0	0	0*	4.1	20	5		30					
	5.0	3.4	68*					35					

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-10

GEOLOGIC DRILL LOG										PROJECT		JOB NO.	SHEET NO.	HOLE NO.
										FUSRAP		14501	2 OF 2	81-10
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
HX Core	5.0	4.0	80						35				LP = 0.7' AP = 0.2' Metal fragments	
					2.5	10	5		40				LP = 0.5' AP = 0.2' Metal fragments	
	5.0	5.0	100											
	5.0	4.9	98						45				LP = 1.1' AP = 0.3' Metal fragments	
					5.0	30	5		50				LP = 0.8' AP = 0.5'	
	5.0	4.8	96											
	5.0	4.2	84						55				LP = 0.7' AP = 0.3'	
	5.0	4.8	96		2.9	30	5		60				LP = 1.2' AP = 0.4'	
								65				LP = 0.8' LP = 0.4'		
	5.0	4.9	98						70				5-7/8" rock bit from 70.0-71.5'	
5-7/8" Tricone								-30.4'	70					
								-30.4'	71.5			B.O.H. = 71.5'		

SS = SPLIT SPOON; ST = SHELBY TUBE;
O = DENNISON; P = PITCHER; Q = OTHER

SITE

MIDDLESEX LANDFILL

HOLE NO.

81-10

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-11	
SITE MIDDLESEX LANDFILL					COORDINATES +11.7 33.2 L					ANGLE FROM HORIZ. Vertical		BEARING ---			
BEGUN 12-14-81	COMPLETED	DRILLER Layne - J. Wilgus			DRILL MAKE AND MODEL Bucyrus - Erie 20W		HOLE SIZE 6"	OVERBURDEN (FT.) 16'	ROCK (FT.) ---	TOTAL DEPTH 16'					
CORE RECOVERY (FT./%) ---		CORE BOXES ---	SAMPLES ---	EL. TOP OF CASING 42.8'	GROUND EL. 41.00'	DEPTH/EL. GROUND WATER 8.8'/32.2'		DEPTH/EL. TOP OF ROCK ---							
SAMPLE HAMMER WEIGHT/FALL ---			CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log			LOGGED BY: A. Atkinson									
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
						LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
										42.8'	0			Hole drilled as observation well only. See geologic log of adjacent hole 81-10 for geologic details.	
										27.5	15			B.O.H. = 15.3'	

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER
SITE
MIDDLESEX LANDFILL
HOLE NO.
81-11

GEOLOGIC DRILL LOG										PROJECT		JOB NO.	SHEET NO.	HOLE NO.
										FUSRAP		14501	1 OF 2	81-13
SITE					COORDINATES					ANGLE FROM HORIZ.		BEARING		
MIDDLESEX LANDFILL					+271.5 110.2 L					Vertical		---		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL			HOLE SIZE	OVERBURDEN (FT.)	ROCK (FT.)	TOTAL DEPTH			
12/10/81		Layne - T. Molliton			Mobile B61			8" NX	21.6	15'	36.6'			
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER			DEPTH/EL. TOP OF ROCK					
12.1'/81%		1	3	43.6'	41.88'	8.9'/33.0'			21.6'/ 20.3'					
SAMPLE HAMMER WEIGHT/FALL			CASING LEFT IN HOLE: DIA./LENGTH			LOGGED BY:								
140 lbs./30"			See Observation Well Log			A. Atkinson								
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
									41.9'	0			0.0-8.0': <u>LANDFILL</u> : Predominantly commercial and domestic waste.	Water level on 12/14/81 at 1'. 8" flight auger drilled to 21.5'.
										5				
SS	18"	5"	2-1-2							10		1	8.0-14.5': <u>CLAY</u> : Gray, sandy, silty.	
SS	18"	7"	1-3-4						27.4'	15		2	14.5-16.5': <u>SAND</u> : Red-brown, clayey, silty, gravelly, medium-grained.	
									25.4'				Approximate Contact	Contact based on drilling characteristics.
										20		3	16.5-36.6': <u>SHALE</u> : Red-brown.	
													19.5': Decomposed (weathered).	
SS	18"	15"	20-34-34							25			21.6-36.6': Occasional gray streaks, weak, moderately to highly fractured (most fractures horizontal), some black manganese oxide coatings on fractures.	
NX Core	5.0	3.9	78							30				Longest core piece = 0.3'.
														Average length of core piece = 0.1'.
	5.0	4.0	80							35				Longest core piece = 0.5'.
														Average length of core piece = 0.1'.
	5.0	4.2	84											

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE: MIDDLESEX LANDFILL

HOLE NO. 81-13

GEOLOGIC DRILL LOG	PROJECT	JOB NO.	SHEET NO.	HOLE NO.
	FUSRAP	14501	2 OF 2	81-13

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
FUSRAP	14501	2 OF 2	81-13

JOB NO.	SHEET NO.	HOLE NO.
14501	2 OF 2	81-13

SHEET NO.	HOLE NO.
2 OF 2	81-13

HOLE NO.
81-13

SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
NX Core								5.3'	35				
									36.6			B.O.H. = 36.6'	

GEOLOGIC DRILL LOG										PROJECT		JOB NO.	SHEET NO.	HOLE NO.
										FUSRAP		14501	1 OF 1	81-14
SITE					COORDINATES					ANGLE FROM HORIZ.		BEARING		
MIDDLESEX LANDFILL					+276.2 106.5 L					Vertical		---		
BEGUN	COMPLETED	DRILLER			DRILL MAKE AND MODEL			HOLE SIZE	OVERBURDEN (FT.)	ROCK (PT.)	TOTAL DEPTH			
12/1/81		Layne - J. Debres			Bucyrus - Erie 20W			6"	16.5'	---	16.5'			
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING	GROUND EL.	DEPTH/EL. GROUND WATER		DEPTH/EL. TOP OF ROCK						
---		---	---	43.7'	41.95'	8.6'/33.4'		---						
SAMPLE HAMMER WEIGHT/FALL				CASING LEFT IN HOLE: DIA./LENGTH				LOGGED BY:						
---				See Observation Well Log				A. Atkinson						
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLE RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
								42.0'	0			Hole drilled as observation well only. See geologic log of adjacent hole 81-13.	Water level on 12/17/81 at 8.0'.	
								25.5'	16.5					B.O.H. = 16.5'

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-14

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-15
SITE MIDDLESEX LANDFILL					COORDINATES +464.6 95.7 L					ANGLE FROM HORIZ. Vertical		BEARING ---		
BEGUN 12/15/81		COMPLETED		DRILLER Layne - T. Molliton		DRILL MAKE AND MODEL Mobile B61		HOLE SIZE 8" to NX	OVERBURDEN (FT.) 20'	ROCK (FT.) 15'	TOTAL DEPTH 35.0'			
CORE RECOVERY (FT./%)			CORE BOXES	SAMPLES	EL. TOP OF CASING 38.7'	GROUND EL. 36.96'	DEPTH/EL. GROUND WATER 3.9'/33.0'			DEPTH/EL. TOP OF ROCK 2.0'/ 16.9'				
SAMPLE HAMMER WEIGHT/FALL				CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log				LOGGED BY: A. Atkinson						
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
								37.0'	0			0.0-10.0': LANDFILL: Predominantly commercial and domestic waste.	Water level on 12/17/81 at 0.0'. 8" flight auger drilled to 20.0'. Approximate Contact 10.0-10.5': SAND: Red-brown, silty, clayey, fine- to medium-grained. 10.5-35.0': SHALE: Red-brown, grading downward from weathered to fresh. 10.5': Weathered. 15.0': Weathered, with a thin (1/4") cream-colored band. 20.5': Weak, moderately to highly fractured. Longest core piece ("LP") = 0.3'. Average core piece ("AP") = 0.1'. LP = 0.3' AP = 0.1' LP = 0.4' AP = 0.1'	
2" SS	18"	12"	9-8-10					36.0'	10					
								35.5'						
2" SS	18"	15"	14-26-37						15					
									20					
NX Core	5.0	3.8	76						25					
	5.0	3.2	64						30					
	5.0	4.0	80						35					
								2.0'						
B.O.H. = 35.0'														

SS = SPLIT SPOON; ST = SHELBY TUBE;
 D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL
 HOLE NO.
 81-15

GEOLOGIC DRILL LOG										PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 81-16	
SITE MIDDLESEX LANDFILL				COORDINATES +458.1 97.2 L				ANGLE FROM HORIZ. Vertical		BEARING ---					
BEGUN 12-17-81		COMPLETED 12-17-81		DRILLER Layne - T. Molliton		DRILL MAKE AND MODEL Mobile B61		HOLE SIZE 8"		OVERBURDEN (FT.) 11.5'		ROCK (FT.) ---		TOTAL DEPTH 11.5'	
CORE RECOVERY (FT./%) ---				CORE BOXES ---		SAMPLES ---		EL. TOP OF CASING 38.9'		GROUND EL. 37.16'		DEPTH/EL. GROUND WATER 3.4' / 33.8'		DEPTH/EL. TOP OF ROCK ---	
SAMPLE HAMMER WEIGHT/FALL ---				CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log				LOGGED BY: A. Atkinson							
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLER BLOWS PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.		
				LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES									
								37.2'	0			Drilled as observation well only. See geologic log of adjacent hole 81-15 for geologic details.	8" flight auger.		
								25.7'	5						
									10			B.O.H. = 11.5'			
									11.5						

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-16

GEOLOGIC DRILL LOG				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 2	HOLE NO. 81-17					
SITE MIDDLESEX LANDFILL			COORDINATES +244.4 219.5 L			ANGLE FROM HORIZ. Vertical		BEARING ---					
BEGUN 12/18/81	COMPLETED	DRILLER Layne - T. Molliton	DRILL MAKE AND MODEL Mobile B61	HOLE SIZE 8" to NX	OVERBURDEN (FT.) 20.0'	ROCK (FT.) 50.0'	TOTAL DEPTH 70'						
CORE RECOVERY (FT./%)		CORE BOXES	SAMPLES	EL. TOP OF CASING 37.4'	GROUND EL. 35.65'	DEPTH/EL. GROUND WATER 4.0'/32.6'		DEPTH/EL. TOP OF ROCK 20.0'/15.6'					
SAMPLE HAMMER WEIGHT/FALL		CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log			LOGGED BY: A. Atkinson								
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
								35.6'	0				Water level on 12/19/81 and on 12/21/81 at 2'.
SS	18"	6"	1-3-3						5		1-SS	0.0-7.5': SAND: Red-brown, stained, silty, clayey, medium-grained, quartzose.	
								28.1'	10		2-SS	7.5-70.0': SHALE: Red-brown, grades downward from highly weathered to fresh, jointed where fresh solution pits.	
SS	18"	12"	2-10-11						15		3-SS	10.5': Decomposed (highly weathered).	
									20		4-SS	15.5': Weathered.	
									25		5-SS	45.0': Gray, solution pits.	
SS	12"	11"	12-100/6"						30		6-SS	49.5': Vertical jointing.	
									35		7-SS	52.5': Large proportion of solution pits.	
											8-SS	53.5': Highly fractured.	
											9-SS	61.0': 60° planar joint.	
NX Core	5.0	4.5	90										Longest core piece ("LP") = 0.6'.
	5.0	4.5	90										Average core piece ("AP") = 0.2'.
				3.6	30	5							LP = 0.5' AP = 0.3'
	5.0	4.5	90										LP = 0.6' AP = 0.3'

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
MIDDLESEX LANDFILL

HOLE NO.
81-17

GEOLOGIC DRILL LOG										PROJECT		JOB NO.	SHEET NO.	HOLE NO.	
										FUSRAP		14501	2 OF 2	81-17	
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH CORE RUN	SAMPLER RECOVERY CORE RECOVERY	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
					LOSS IN O.P.M.	PRESSURE P.S.I.	TIME IN MINUTES								
NX Core	5.0	5.0	100		9.6	30	8		35					LP = 0.7' AP = 0.2'	
	5.0	4.9	98						40					LP = 0.8' AP = 0.3'	
	5.0	3.8	76						45					LP = 0.4' AP = 0.2'	
	5.0	4.8	96		22.8	20	5		50					Driller reports void from 49.0-49.5' - complete water loss. LP = 0.5' AP = 0.2'	
	5.0	4.8	96						55					Partial water return after drilling a few additional feet. LP = 0.8' AP = 0.3'	
	5.0	4.2	84		6.1	10	5		60					LP = 0.5' AP = 0.2'	
	5.0	5.0	100						65					LP = 0.8' AP = 0.3'	
									70						
								34.4'							
												B.O.H. = 70.0'			
SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER														SITE MIDDLESEX LANDFILL	HOLE NO. 81-17

BORING LOG										PROJECT FUSRAP		JOB NO. 14501		SHEET NO. 1 OF 2		HOLE NO. 83-18	
SITE Middlesex Landfill				COORDINATES 6+86.7 56.1 Left						ANGLE FROM HORIZ. 90°		BEARING -					
BEGUN 6/7/83		COMPLETED 6/30/83		DRILLER Testwell Craig - Kimley		DRILL MAKE AND MODEL Mobile B-61		HOLE SIZE (INCHES) 8 3/4/3		OVERBURDEN (FT.) 33.2		ROCK (FT.) 22.8		TOTAL DEPTH (FT.) 56.0			
CORE RECOVERY (FT./%) 15.9/76				CORE BOXES N/A		SAMPLES 1		EL. TOP OF CASING (FT.) 53.88		GROUND EL. (FT.) 50.5		DEPTH/EL. GROUND WATER (FT.) 14.6/35.9 (6/13/83)		DEPTH/EL. TOP OF ROCK (FT.) 33.2			
SAMPLE HAMMER WEIGHT/FALL 140#/30"				CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log				LOGGED BY: W. R. Thackaberry									
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE (IN.)	CORE RUN (FT.)	SAMPLER RECOVERY (IN.)	CORE RECOVERY (FT.)	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	PENETRATION BLOWS				ELEVATION (FT.)	DEPTH - FT.	UNIFIED SOIL CLASSIFICATION	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
							1ST 8"	2ND 8"	3RD 8"	4TH 8"							
											48.5				0 to 2': <u>SANDY CLAY</u> , red-brown, landfill cover material.	Located near observation wells 81-8A and 81-9 Subsequent to drilling methane gas and chlorinated solvents (toxic) were detected in the hole. 11 to 11.5': some resistance. ≈ 14' ground water.	
											5			2 to 15': <u>LANDFILL</u> , trash, plastic, glass, paper, rags, wire, strong odor.			
											10						
											35.5	15			15 to 23': <u>CLAY</u> , red-brown, with possible petroleum waste, with occasional fine gravel.	0 to 27': drilled with 8" hollow stem flight auger.	
											20			20 to 22': Red clay with gravel and petroleum waste, moist.			
											25			23 to 25.5': <u>SAND</u> , gray and red-brown medium grained, becomes clayey at 25'.			
											25.0	25			25.5 to 31.7': <u>SANDY CLAY - CLAYEY SAND</u> red brown, trace fine and coarse gravel.	6/29/83 27 to 29': drilled with 3 3/4" tricone bit and then reamed with 4 3/4" tricone.	
ST 3"	24	0									30			25.5 to 26': Red brown clayey sand, sandy clay nearly dry.			
ST 3"	12	16									30			29.2 to 30.2': Red brown clayey sand with some fine subround multicolored gravel.			
SS 2"	18	1					21	27	26		18.8			30.2 to 31.7': Sandy clay w/ fine gravel.	29 to 34.7': drilled with 3 3/4" tricone.		
SS 2"	18	3					14	18	33		17.3			31.7 to 33.2': <u>CLAY</u> , red brown with green streaks.			
SS 2"	18	11					9	22	22		35			33.2 to 37.5': <u>SHALE</u> , red brown, weak, clayey, weathered, some green clay streaks, soft.			

BORING LOG										PROJECT	JOB NO.	SHEET NO.	HOLE NO.		
										FUSRAP	14501	2 of 2	83-18		
SAMPLER TYPE AND DIAMETER	SAMPLER ANALYSIS LENGTH	CORRECTION (IN.)	CORE RECOVERY (IN.)	SAMPLE BLOWS "H"	PERCENT CORE RECOVERY	PENETRATION BLOWS				ELEVATION (FT.)	DEPTH-FT	UNIFIED SOIL CLASSIFICATION	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
						1ST 6"	2ND 6"	3RD 6"	4TH 6"						
										13.0	35			(33.2 to 37.5': <u>WEATHERED SHALE</u> Cont'd)	35 to 56': drilled with NW core (at drillers option).
											40			37.5 to 56': <u>SHALE</u> , red-brown, hard to very hard, intensely fractures (vertical- horizontal and diagonal) solution pits, dark deposits on some fracture surfaces, some thin bedding visible, few clayey zones, fracturing decreases with depth.	Eberline's Health Officer Radio- logically monitored drilling through overburden.
											45			37.5 to 45': RQD 0% 45 to 50.5': RQD 7% 50.5 to 54.8': RQD 58% 54.8 to 56': RQD 0%	Nothing was found that required special handling for radiological purposes.
											50			44.8 to 45': clayey zone.	
										-5.5	56			TD 56'.	

SS = SPLIT SPOON; ST = SHELBY TUBE;
D = DENNISON; P = PITCHER; O = OTHER

SITE
Middlesex Landfill

HOLE NO.
83-18

BORING LOG				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 83-19A					
SITE Middlesex Landfill			COORDINATES 5+91.3 2+93.5R				ANGLE FROM HORIZ. 90°	BEARING -					
BEGUN 6/7/83	COMPLETED 6/17/83	DRILLER Testwell Craig - Kimley		DRILL MAKE AND MODEL Mobile B-61		HOLE SIZE (INCHES) 8	OVERBURDEN (FT.) 28.8	TOTAL DEPTH (FT.) 47.25					
CORE RECOVERY (FT./%) -		CORE BOXES -	SAMPLES 1	EL. TOP OF CASING (FT.) 53.84	GROUND EL. (FT.) 50.6	DEPTH/EL. GROUND WATER (FT.) 15.3/35.32 (7/13/83)		DEPTH/EL. TOP OF ROCK (FT.) 28.8/21.8					
SAMPLE HAMMER WEIGHT/FALL 140#/30"			CASING LEFT IN HOLE: DIA./LENGTH 6"/29' 1" PVC/47.25'			LOGGED BY: W. R. Thackaberry/D. R. Beissel							
SAMPLER TYPE AND DIAMETER	SAMPLER LENGTH (IN.)	ADVANCE (IN.)	CORE RECOVERY (IN.)	SAMPLE BLOWS	PENETRATION BLOWS				ELEVATION (FT.)	DEPTH (FT.)	UNIFIED SOIL CLASSIFICATION	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					1ST 8"	2ND 8"	3RD 8"	4TH 8"					
									46.6	5		0.0 to 4.0': <u>SANDY CLAY</u> , red-brown with shale fragments (landfill cover).	Drilling 0 to 27.0' with 8" hollow stem auger. Drill 27'-32' with tricone bit. Below 32' NW Core.
									42.6			4.0 to 8.0': <u>LANDFILL</u> , domestic, trash, paper, rug scraps, plastic, garbage odor.	6/8/83 Methane gas emanating from borehole.
										10		8.0 to 26.6': <u>SAND</u> , brown, fine to medium grains, little rounded fine gravel, silty.	6/9/83 No methane this morning.
										15			All drilling through overburden radiologically monitored by Eberline's Health Officer. Nothing required special handling or containment.
SS 2"	24	23			6	3	3	3		20	1	20.0 to 22.0': Fine to medium gravel, brown sand, silty, trace fine gravel, round coarse sand.	
												25.0 to 26.6': Fine-medium green-brown sand with some coarse subround to round red-brown sand.	
										25		26.6' to 28.8': <u>SAND</u> fine to medium grained, red-brown with some clay and weathered shale chunks.	
SS 2"	24	24			8	8		11	24.0	2	2	28.8' to 30.9': <u>CLAY - WEATHERED SHALE</u> S-3 bottom of tube had weathered (decomposed) very soft red-brown shale.	
ST 3"	10	10						7		3	3	29 to 29.5': Weathered shale, very soft, red-brown, dry.	
									21.8	4	4	29.5 to 30.9': Same as above.	
ST2	6	6			2	5	21	15		5	5	30.9 to 32.0': <u>SHALE</u> , reddish brown, slightly laminated, moist, friable, weathered, some mica flakes.	6/14/83
SS 2"	16	9.5			17	34	50	3"	19.7	6	6		
ST3	6	0							18.6	7	7	32.0 to 47.25': <u>SHALE</u> , very hard, red-brown shale, highly fractured some interbeds soft gray clay; dark mottling along bedding plane fractures.	6/15/83 Water level 8' below ground surface. Sand inflow at bottom of 6" casing.
ST2	9	8			54	100							
								(3")					
									3.35			T.D. 47.25'	

SS = SPLIT SPOON; ST = SHELBY TUBE;
 B = BENNISON; P = PITCHER; O = OTHER

SITE
Middlesex Landfill

HOLE NO.
83-19A

BORING LOG				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 OF 1	HOLE NO. 83-20								
SITE Middlesex Landfill			COORDINATES 5+96.1 2+94.6R			ANGLE FROM HORIZ. 90°	BEARING -									
BEGIN 6/28/83	COMPLETED 6/28/83	DRILLER Testwell Craig - Jeff Craig	DRILL MAKE AND MODEL Mobile B-50		HOLE SIZE (INCHES) 8	OVERBURDEN (FT.) 25.0	ROCK (FT.) -	TOTAL DEPTH (FT.) 25.0								
CORE RECOVERY (FT./%) -		CORE BOXES -	SAMPLES -	EL. TOP OF CASING (FT.) 54.44	GROUND EL. (FT.) 50.8	DEPTH/EL. GROUND WATER (FT.) 14.85/35.95 (7/13/83)		DEPTH/EL. TOP OF ROCK (FT.) -								
SAMPLE HAMMER WEIGHT/FALL -			CASING LEFT IN HOLE: DIA./LENGTH 1" PVC 25 + 3.9 Stickup			LOGGED BY: W. R. Thackaberry										
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE (IN.)	CORE RUN (FT.)	RECOVERY (IN.)	CORE RECOVERY (FT.)	SAMPLE BLOWS "N"	PERCENT CORE RECOVERY	PENETRATION BLOWS				ELEVATION (FT.)	DEPTH - FT.	UNIFIED SOIL CLASSIFICATION	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							1ST 6"	2ND 6"	3RD 6"	4TH 6"						
											48.8				0 to 2': <u>SAND</u> , clayey brown with gravel.	See log for 83-19A for a more detailed description. Hole drilled with 8" hollow stem auger
											46.3	5			2 to 4.5': <u>SAND</u> , clayey, dark gray.	
											43.8				4.5 to 7': <u>LANDFILL</u> , strong odor.	
												10			7 to 25': <u>SAND</u> , gray brown.	
												15				
												20				
												25				
											25.8				TD 25'.	

SS = SPLIT SPOON; ST = SHELBY TUBE;
 D = DENNISON; P = PITCHER; O = OTHER

SITE
Middlesex Landfill

HOLE NO.
83-20

BORING LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.															
Middlesex Landfill										FUSRAP		14501		1 OF 1		83-21															
COORDINATES										3+74.5 22.95 Left		ANGLE FROM HORIZ.		90°		BEARING															
SITE		MIDDLESEX LANDFILL		COORDINATES		3+74.5 22.95 Left		ANGLE FROM HORIZ.		90°		BEARING																			
BEGIN		6/21/83		COMPLETED		7/6/83		DRILLER		Testwell Craig - Kimley		DRILL MAKE AND MODEL		Mobile B-61		HOLE SIZE (INCHES)		8/31/3		OVERBURDEN (FT.)		21.7		ROCK (FT.)		57.3		TOTAL DEPTH (FT.)		79.0	
CORE RECOVERY (FT./%)		-		CORE BOXES		-		SAMPLES		3		EL. TOP OF CASING (FT.)		44.4		GROUND EL. (FT.)		45.1		DEPTH/EL. GROUND WATER (FT.)		10.7/34.4 (7/7/83)		DEPTH/EL. TOP OF ROCK (FT.)		21.7/23.4					
SAMPLE HAMMER WEIGHT/FALL		140#/30"		CASING LEFT IN HOLE: DIA./LENGTH		See Observation Well Log		LOGGED BY:		W. R. Thackaberry																					
SAMPLER TYPE AND DIAMETER	SAMPLER ADVANCE (IN.)	SAMPLER RETRIEVAL (IN.)	SAMPLER CORE RUN (FT.)	SAMPLER RECOVERY (IN.)	SAMPLER CORE RECOVERY (FT.)	PERCENT CORE RECOVERY	PENETRATION BLOWS				ELEVATION (FT.)	DEPTH (FT.)	UNIFIED SOIL CLASSIFICATION	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.																
							1ST 6"	2ND 6"	3RD 6"	4TH 6"																					
														0 to 2': LANDFILL COVER, clayey sand, brown.	Eberline monitored drilling through the backfill. Background in this area is 6000 cpm. Maximum reading in cuttings was 10,000 cpm. Eberline gave ok to discharge wash and cuttings.																
													2 to 11': LANDFILL - trash, papers, rags, wire, glass, etc.																		
													11 to 14': SILT, black and brown, sandy with decomposed organics and occasional fine gravel.																		
													14.0 to 17.9': SAND, brown, silty, some fine gravel.																		
SS 2"	18	12				10	12	15			27.2			17.9 to 21.7': CLAY, red-brown, soft with occasional small chunks of harder shale, moist. (Weathered Shale)	7/6/83																
ST	24	27									23.4		19.7 to 21.7' clayey with some coarse sand-fine gravel sized grains of red-brown shale, moist, very soft, slight to moderate cohesion.																		
ST	27 1/2	27 1/2											21.7 to 24.5': SHALE, reddish-brown, decomposed to heavily weathered, with hard fissile shale fragments micaceous, clayey.																		
ST	10	14									20.6		24.5 to 79.0': SHALE, red-brown, moderately hard to very hard, occasional clay seams.																		
														Drilling with 3 3/4 tricone rock bit. 38' hard drilling.	Driller says drilling like clay seams (alt. hard and soft drilling). 60 to 62' very hard drilling rod chatter. 65' still hit occasional clay seams. 73.5 to 79' very hard drilling.																
													TD 79.0'.																		

<h1 style="margin: 0;">BORING LOG</h1>				PROJECT FUSRAP		JOB NO. 14501	SHEET NO. 1 of 1	HOLE NO. 83-22	
SITE Middlesex Landfill				COORDINATES 0+6.6 37.25 Left			ANGLE FROM HORIZ. BEARING 90° -		
BEGIN 6/24/83		COMPLETED 7/8/83		DRILLER Testwell Craig - Kimley		DRILL MAKE AND MODEL Mobile B-61		HOLE SIZE (INCHES) 8 1/4 / 3 1/4	
						OVERBURDEN (FT.) 16.5		ROCK (FT.) 59.8	
CORE RECOVERY (FT./%)		CORE BOXES		SAMPLES		EL. TOP OF CASING (FT.)		GROUND EL. (FT.)	
-		-		4		44.4		41.1	
								DEPTH/EL. GROUND WATER (FT.) 7.8/33.3 (on 6/27/83)	
								DEPTH/EL. TOP OF ROCK (FT.) 16.5/24.6	
SAMPLE HAMMER WEIGHT/FALL 140#/30"				CASING LEFT IN HOLE: DIA./LENGTH See Observation Well Log				LOGGED BY: W. R. Thackaberry	

SAMPLER TYPE AND DIAMETER	SAMPLER LENGTH (in.)	SAMPLER CORRECTION (in.)	CORE RECOVERY (in.)	SAMPLE BLOWS	PERCENT CORE RECOVERY	PENETRATION BLOWS				ELEVATION (FT.)	DEPTH (FT.)	UNIFIED SOIL CLASSIFICATION	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
						1ST 8"	2ND 6"	3RD 8"	4TH 8"						
ST 3"	24	24								39.6				0 to 1.5': CLAYEY SAND, brown, trace gravel (landfill cover).	Eberline is monitoring Radiation with PRS-1 and SPA-3. Ground surface background is 8000 cpm gamma. All landfill material brought to the surface was monitored. Nothing exceeded surface reading. Strong Odor-like paint. 6' auger cutting come up wet. This boring located near observation wells 81-10 and 81-11. 10 to 12' shelby last 4" hard to push. Trouble with recovery, had to go in 3 times to get it. 7/7/83 Inserted 4" casing to 16.5' and filled with water. 7/8/83 Water level in 4" casing. This morning .8' below ground surface (dropped 2.4' in 16 hours). 27.5' driller reports hard drilling. 27.5 to 76.3' driller reports occasional clay seams (based on drilling character)
										36.1	5			1.5 to 5.0': LANDFILL - trash.	
										33.6				5.0 to 7.5': SANDY SILT, dark brown, trace organics.	
										31.6	10			7.5 to 9.5': CLAY, dark gray, soft, micaceous. Approximate	
										29.4				9.5 to 11.7': ORGANIC SILT and peat(?) dark brown.	
SS 2"	12	12				12	19			27.1				11.7 to 14.0': SAND, silty, fine, gray, trace organics, occasional fine sub-rounded to sub organic, gravel sand is red and clayey 13.5 to 14.0'.	
ST 3"	23 1/2	20								24.6	15			14.0 to 16.5': CLAY, red-brown, soft to very soft, with chunks of weathered shale. (Weathered Shale) Approximate	
SH 3"	9	9												16.5 to 27.5': SHALE, red-brown, very soft, friable, not clayey.	
ST 3"	6	5									20			17.25 - Weathered shale, very soft, dry.	
														18.0' - Weathered shale, very soft, wet.	
														21.5' - Cuttings less clayey, more hard shale chips.	
														Weathering diminishes with depth.	
										13.6	25			27.5 to 76.3': SHALE, red-brown, moderately hard to hard, occasional clay seams.	
											30				
											75			TD 76.3'.	
										-35.2					

NOTE: The landfill interval was sampled for priority pollutants. Tests indicated the presence of several heavy metals, volatile organics, and pesticides/herbicides.

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER				SITE Middlesex Landfill		HOLE NO. 83-22	
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APPENDIX B

OBSERVATION WELL

INSTALLATION LOGS

OBSERVATION WELL		PROJECT FUSRAP	WELL NO. 81-1
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +451.5 351.9 R	
BEGUN 11/18/81	COMPLETED 11/23/81	PREPARED BY R. Talmage	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing

Includes sampling in soil/rock

GENERALIZED GEOLOGIC LOG

0.0': Shale float
0.0-26.7': Sand
26.8-28.8': Clay
28.8-47.0': Shale

DEPTH	ELEV.
+1.75'	52.8'
+1.5'	52.5'
0.0'	51.03
5.0'	46.0
39.0'	12.0
41.0'	10.0
43.1'	7.9
46.0'	5.0
---	---
47.0'	4.0

OBSERVATION WELL			PROJECT FUSRAP	WELL NO. 81-2A
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +443 347.1 R		
BEGUN 11/30/81	COMPLETED 11/30/81	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	

GENERALIZED GEOLOGIC LOG

0.0-22.5': Sand
22.5': Clay (traces)

ELEV. - TOP OF SURFACE CASING: _____
 ELEV. - TOP OF RISER CASING: _____
 GROUND SURFACE

SURFACE CASING
 DIA: 6"
 TYPE: Steel casing

BOTTOM OF SURFACE CASING

BACKFILL MATERIAL
 TYPE: Type II cement with bentonite

RISER CASING
 DIA: 2 inch
 TYPE: Schedule 80 PVC

TOP OF SEAL
ANNULAR SEAL
TYPE: Volclay Tablets

14.0' 37.6
 16.0' 35.6

TOP OF FILTER PACK
 FILTER PACK
 TYPE: #2 well gravel
(special graded sand)

TOP OF SCREEN

SCREEN
 DIA: 2 inch TYPE: Sch 80 PVC
 OPENINGS: WIDTH: 0.04 inch
 TYPE:

BOTTOM OF SCREEN
 BOTTOM OF SUMP
 BOTTOM OF HOLE

HOLE DIA: 6-3/4 inch

DEPTH	ELEV.
1.75	49.8
2.0'	49.6
0.0'	51.56
5.0'	46.6'
17.3'	34.3
20.3'	31.3
20.5'	31.1
22.5'	29.1

OBSERVATION WELL			PROJECT FUSRAP	WELL NO. 81-3
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +184.6 147.7 R		
BEGUN 11/11/81	COMPLETED 11/18/81	PREPARED BY R. Talmage	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>GENERALIZED GEOLOGIC LOG</p> <p>0.0-15.5': Landfill</p> <p>15.5-21.0': Gravel</p> <p>21.0-29.0': Clay</p> <p>29.0-38.0': Shale</p> <p>38.0-43.0': Siltstone</p> </div> <div style="width: 65%;"> </div> </div>			DEPTH	ELEV.
			+2.05	49.6
			+1.8'	49.3
			0.0'	47.54
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>ELEV. - TOP OF SURFACE CASING: _____</p> <p>ELEV. - TOP OF RISER CASING: _____</p> <p>GROUND SURFACE</p> </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>SURFACE CASING</p> <p>DIA: 6"</p> <p>TYPE: Steel casing</p> </div> </div>			5.0'	42.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BACKFILL MATERIAL</p> <p>TYPE: Type II cement with bentonite (2.5# ben/sack cem)</p> </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>RISER CASING</p> <p>DIA: 2 inch</p> <p>TYPE: Schedule 80 rigid PVC, flush</p> </div> </div>				
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>TOP OF SEAL</p> <p>ANNULAR SEAL</p> <p>TYPE: Volclay Tablets</p> </div> </div>			35.5'	12.0
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>TOP OF FILTER PACK</p> <p>FILTER PACK</p> <p>TYPE: #2 well gravel (graded sand)</p> </div> </div>			35.7'	11.8
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>TOP OF SCREEN</p> <p>SCREEN:</p> <p>DIA: 2 inch TYPE: Sch 80 PVC</p> <p>OPENINGS: WIDTH: 0.04 inch</p> <p>TYPE:</p> </div> </div>			37.7'	9.8
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BOTTOM OF SCREEN</p> </div> </div>			40.7'	6.8
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BOTTOM OF SUMP</p> </div> </div>			---	
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BOTTOM OF HOLE</p> </div> </div>			43.0'	4.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>HOLE DIA: 6 inch</p> </div> </div>				

OBSERVATION WELL			PROJECT FUSRAP	WELL NO. 81-4
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +192.6 151.5 R		
BEGUN 11/13/81	COMPLETED 11/17/81	PREPARED BY R. Talmage	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	

GENERALIZED GEOLOGIC LOG

0.0-15.5': Landfill
 15.5-21.0': Gravel
 21.0-29.0': Clay
 29.0-38.0': Shale
 38.0-43.0': Siltstone

ELEV. - TOP OF SURFACE CASING: _____
 ELEV. - TOP OF RISER CASING: _____
 GROUND SURFACE

	DEPTH	ELEV.
Top of Surface Casing	+1.25	48.7
Top of Riser Casing	+1.0'	48.4
Ground Surface	0.0'	47.42
Bottom of Surface Casing	5.0'	42.4
Top of Seal Annular Seal	15.5'	31.9
Top of Filter Pack	17.0'	30.4
Top of Screen	19.0'	28.4
Bottom of Screen	22.0'	25.4
Bottom of Sump	---	
Bottom of Hole	22.0'	25.4

HOLE DIA: 8 inch

OBSERVATION WELL		PROJECT FUSRAP	WELL NO. 81-5
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +379.9 23.7 L	
BEGUN 12/1/81	COMPLETED 12/22/81	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing

GENERALIZED GEOLOGIC LOG

0.0-12.5': Landfill

12.5-17.5': Sand

17.5-76.5': Shale

DEPTH	ELEV.
+1.75	47.4
+1.5'	47.1
0.0	45.60
5.0'	40.6
63.0'	-17.4
65.5'	-19.9
71.1'	-25.5
73.7'	-28.1
74.0'	-28.4
76.5'	-30.9

Labels in diagram:

- ELEV. - TOP OF SURFACE CASING: _____
- ELEV. - TOP OF RISER CASING: _____
- GROUND SURFACE
- SURFACE CASING
- DIA: 6"
- TYPE: Steel casing
- BOTTOM OF SURFACE CASING
- BACKFILL MATERIAL
- TYPE: Type II cement with bentonite
- RISER CASING
- DIA: 2 inch
- TYPE: Schedule 80 PVC
- TOP OF SEAL
- ANNULAR SEAL
- TYPE: Volclay Tablets
- TOP OF FILTER PACK
- FILTER PACK
- TYPE: #2 well gravel (coarse sand)
- TOP OF SCREEN
- SCREEN:
- DIA: 2 inch
- TYPE: Sch 80 PVC
- OPENINGS: WIDTH: 0.04 inch
- TYPE:
- BOTTOM OF SCREEN
- BOTTOM OF SUMP
- BOTTOM OF HOLE
- HOLE DIA: 6 inch

OBSERVATION WELL		PROJECT FUSRAP	WELL NO. 81-9
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +685.8 60.6 L	
BEGUN 12/11/81	COMPLETED	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing

	DEPTH	ELEV.
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>GENERALIZED GEOLOGIC LOG</p> <p>0.0-16.5': Landfill</p> <p>16.5-20.0': Clay</p> <p>20.0-26.0': Sand</p> </div> <div style="width: 65%;"> </div> </div>	1.25	51.7
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>ELEV. - TOP OF SURFACE CASING: _____</p> <p>ELEV. - TOP OF RISER CASING: _____</p> </div> </div>	+1.0	51.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>GROUND SURFACE</p> </div> </div>	0.0	50.46
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>SURFACE CASING</p> <p>DIA: 6"</p> <p>TYPE: Steel casing</p> </div> </div>	5.0'	45.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BACKFILL MATERIAL</p> <p>TYPE: Type II cement with bentonite</p> </div> </div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>RISER CASING</p> <p>DIA: 2 inch</p> <p>TYPE: Schedule 80 flush joint PVC</p> </div> </div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>TOP OF SEAL</p> <p>ANNULAR SEAL</p> <p>TYPE: Volclay Tablets</p> </div> </div>	19.0'	31.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>TOP OF FILTER PACK</p> <p>FILTER PACK</p> <p>TYPE: #2 well gravel (coarse sand)</p> </div> </div>	20.0'	30.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>TOP OF SCREEN</p> <p>SCREEN</p> <p>DIA: 2 inch TYPE: Sch 80 PVC</p> <p>OPENINGS: WIDTH: 0.04 inch</p> <p>TYPE:</p> </div> </div>	21.7'	28.8
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BOTTOM OF SCREEN</p> </div> </div>	24.2'	26.3
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BOTTOM OF SUMP</p> </div> </div>	24.5'	26.0
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>BOTTOM OF HOLE</p> </div> </div>	26.0'	24.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>HOLE DIA: 6 inch</p> </div> </div>		

OBSERVATION WELL			PROJECT FUSRAP	WELL NO. 10
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +12.4 39.7 L		
BEGUN 12/1/81	COMPLETED 12/10/81	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	

GENERALIZED GEOLOGIC LOG

0.0-10.0': Landfill

10.0-14.5': Clay

14.5-71.5': Shale

DEPTH	ELEV.
+1.75	42.7
+1.5'	42.4
0.0	40.94
5.0	35.9
63.0'	-22.1
64.7'	-23.8
68.0'	-27.1
70.7'	-29.8
71.0'	-30.1
71.5'	-30.6

ELEV. - TOP OF SURFACE CASING: _____

ELEV. - TOP OF RISER CASING: _____

GROUND SURFACE

SURFACE CASING

DIA: 6"

TYPE: Steel casing

BACKFILL MATERIAL

TYPE: Type II cement with bentonite

RISER CASING

DIA: 2 inch

TYPE: Schedule 80 PVC

TOP OF SEAL

ANNULAR SEAL

TYPE: Volclay Tablets

TOP OF FILTER PACK

FILTER PACK

TYPE: #2 well gravel (coarse sand)

TOP OF SCREEN

SCREEN:

DIA: 2 inch TYPE: Sch 80 PVC

OPENINGS: WIDTH: 0.04 inch

TYPE: horizontal slots

BOTTOM OF SCREEN

BOTTOM OF SUMP

BOTTOM OF HOLE

HOLE DIA: 6 inch

OBSERVATION WELL		PROJECT FUSRAP		WELL NO. 81-11
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +11.7 33.2 L		
BEGUN 12/14/81	COMPLETED	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	

GENERALIZED GEOLOGIC LOG

0.0-10.0': Landfill

10.0-14.5': Clay

14.5-15.3': Shale

DEPTH ELEV.

ELEV. - TOP OF SURFACE CASING: _____ +1.75 42.8

ELEV. - TOP OF RISER CASING: _____ +1.5' 42.5

GROUND SURFACE 0.0 41.00

SURFACE CASING

DIA: 6" TYPE: Steel casing

BOTTOM OF SURFACE CASING

BACKFILL MATERIAL

TYPE: Type II cement with bentonite

RISER CASING

DIA: 2 inch TYPE: Schedule 80 PVC, flush joint

TOP OF SEAL

ANNULAR SEAL

TYPE: Volclay Tablets

TOP OF FILTER PACK

FILTER PACK

TYPE: #2 well gravel (coarse sand)

TOP OF SCREEN

SCREEN

DIA: 2" TYPE: Sch 80 PVC

OPENINGS: WIDTH: 0.04 inch

BOTTOM OF SCREEN

BOTTOM OF SUMP

BOTTOM OF HOLE

HOLE DIA: 6 inch

5.0 36.0

8.4' 32.6

9.5' 31.5

11.7' 29.3

14.2' 26.8

14.5' 26.5

15.3' 25.7

OBSERVATION WELL			PROJECT FUSRAP	WELL NO. 81-13
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +271.5 110.2 L		
BEGUN 12/11/81	COMPLETED 12/14/81	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	
GENERALIZED GEOLOGIC LOG 0.0-8.0': Landfill 8.0-14.5': Clay 14.5-16.5': Sand 16.5-36.6': Shale			ELEV. - TOP OF SURFACE CASING: _____	+1.75 43.6
			ELEV. - TOP OF RISER CASING: _____	+1.5' 43.4
GROUND SURFACE			0.0	41.88
SURFACE CASING DIA: 6" TYPE: Steel casing			5.0	36.9
BACKFILL MATERIAL TYPE: Type II cement with bentonite				
RISER CASING DIA: 2 inch TYPE: Schedule 80 PVC, flush joint				
TOP OF SEAL ANNULAR SEAL TYPE: Volclay Tablets			26.0'	15.9
TOP OF FILTER PACK TYPE: #2 well gravel (coarse sand)			28.3'	13.6
TOP OF SCREEN			31.3'	10.6
SCREEN: DIA: 2 inch TYPE: Sch 80 PVC OPENINGS: WIDTH: 0.04 inch TYPE:			33.8'	8.1
BOTTOM OF SCREEN			34.1'	7.8
BOTTOM OF SUMP			36.6'	5.3
BOTTOM OF HOLE				
HOLE DIA: 6 inch

OBSERVATION WELL		PROJECT FUSRAP	WELL NO. 81-15
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +464.6 95.7 L	
BEGUN	COMPLETED	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing

GENERALIZED GEOLOGIC LOG

0.0-10.0': Landfill

10.0-10.5': Sand

10.5-35.0': Shale

ELEV. - TOP OF SURFACE CASING: _____

ELEV. - TOP OF RISER CASING: _____

GROUND SURFACE

SURFACE CASING

DIA: 6"

TYPE: Steel casing

BOTTOM OF SURFACE CASING

BACKFILL MATERIAL

TYPE: Type II cement and bentonite

RISER CASING

DIA: 2 inch

TYPE: Schedule 80 PVC

TOP OF SEAL
ANNULAR SEAL

TYPE: Volclay Tablets

TOP OF FILTER PACK
FILTER PACK

TYPE: #2 well gravel
(coarse sand)

TOP OF SCREEN

SCREEN:

DIA: 2 inch TYPE: Sch 80 PVC

OPENINGS: WIDTH: 0.04 inch

TYPE:

BOTTOM OF SCREEN

BOTTOM OF SUMP

BOTTOM OF HOLE

HOLE DIA: 6 inch

DEPTH	ELEV.
+1.75	38.7
+1.5'	38.5
0.0	36.96
5.0	32.0
27.8'	9.2
29.5'	7.5
31.3'	5.7
33.9'	3.1
34.2'	2.8
35.0'	2.0

OBSERVATION WELL			PROJECT FUSRAP	WELL NO. 81-16
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +458.1 97.2 L		
BEGUN 12/17/81	COMPLETED 12/17/81	PREPARED BY A. Atkinson	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	

GENERALIZED GEOLOGIC LOG

0.0-10.0': Landfill

10.0-10.5': Sand

10.5-35+': Shale

DEPTH	ELEV.
+1.75	38.9
+1.5	38.7
0.0	37.16
3.0'	34.2
5.5'	31.7
8.6'	28.6
11.2'	26.0
11.5'	25.7
11.5'	25.7

OBSERVATION WELL		PROJECT FUSRAP	WELL NO. 81-17
JOB NO. 14501	SITE Middlesex Landfill	COORDINATES +244.4 219.5 L	
BEGUN	COMPLETED	REFERENCE POINT FOR MEASUREMENTS Top of Riser Casing	

GENERALIZED GEOLOGIC LOG

0.0-7.5': Sand

7.5-70.0': Shale

ELEV. -- TOP OF SURFACE CASING: _____

ELEV. -- TOP OF RISER CASING: _____

GROUND SURFACE

SURFACE CASING

DIA: 6"

TYPE: Steel casing

BOTTOM OF SURFACE CASING

BACKFILL MATERIAL

TYPE: Type II cement with bentonite

RISER CASING

DIA: 2 inch

TYPE: Schedule 80 PVC

TOP OF SEAL
ANNULAR SEAL

TYPE: Volclay Tablets

TOP OF FILTER PACK
FILTER PACK

TYPE: #2 well gravel
(coarse sand)

TOP OF SCREEN

SCREEN:

DIA: 2 inch TYPE: Sch 80 PVC

OPENINGS: WIDTH: 0.04 inch

TYPE: _____

BOTTOM OF SCREEN

BOTTOM OF SUMP

BOTTOM OF HOLE

HOLE DIA: 6 inch

DEPTH	ELEV.
+1.75	37.4
+1.5	37.2
0.0	35.65
5.0	30.6
59.5'	-23.8
61.0'	-25.4
65.1'	-29.4
67.7'	-32.1
68.0'	-32.4
70.0'	-34.4