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TOPOGRAPHIC SURVEY AND GEOTECHNICAL INVESTIGATION FMPC WATER POLLUTION CONTROL, FERNALD, OHIO

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REPORT

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TOPOGRAPHIC SURVEY AND GEOTECHNICAL INVESTIGATION

FMPC WATER POLLUTION CONTROL
FERNALD, OHIO

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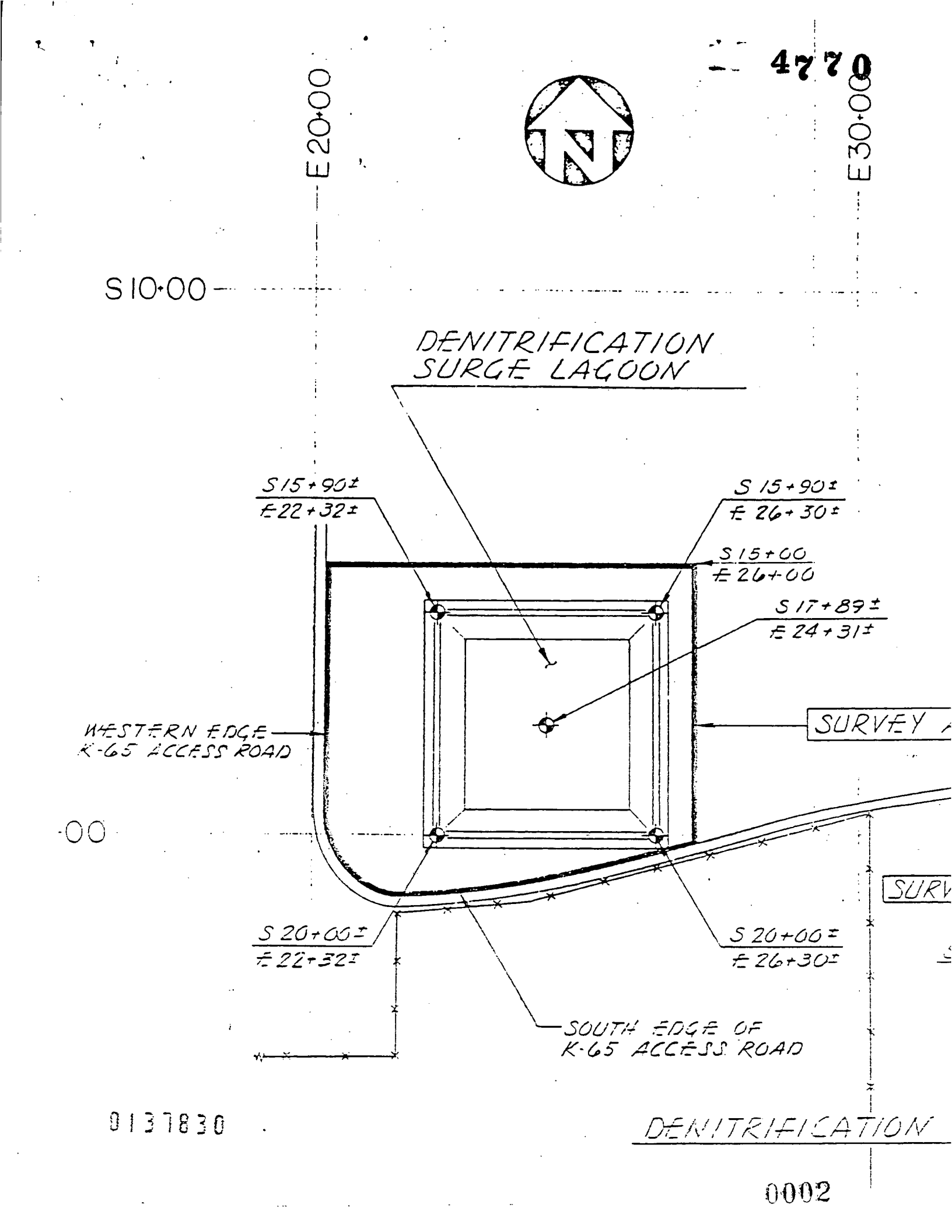

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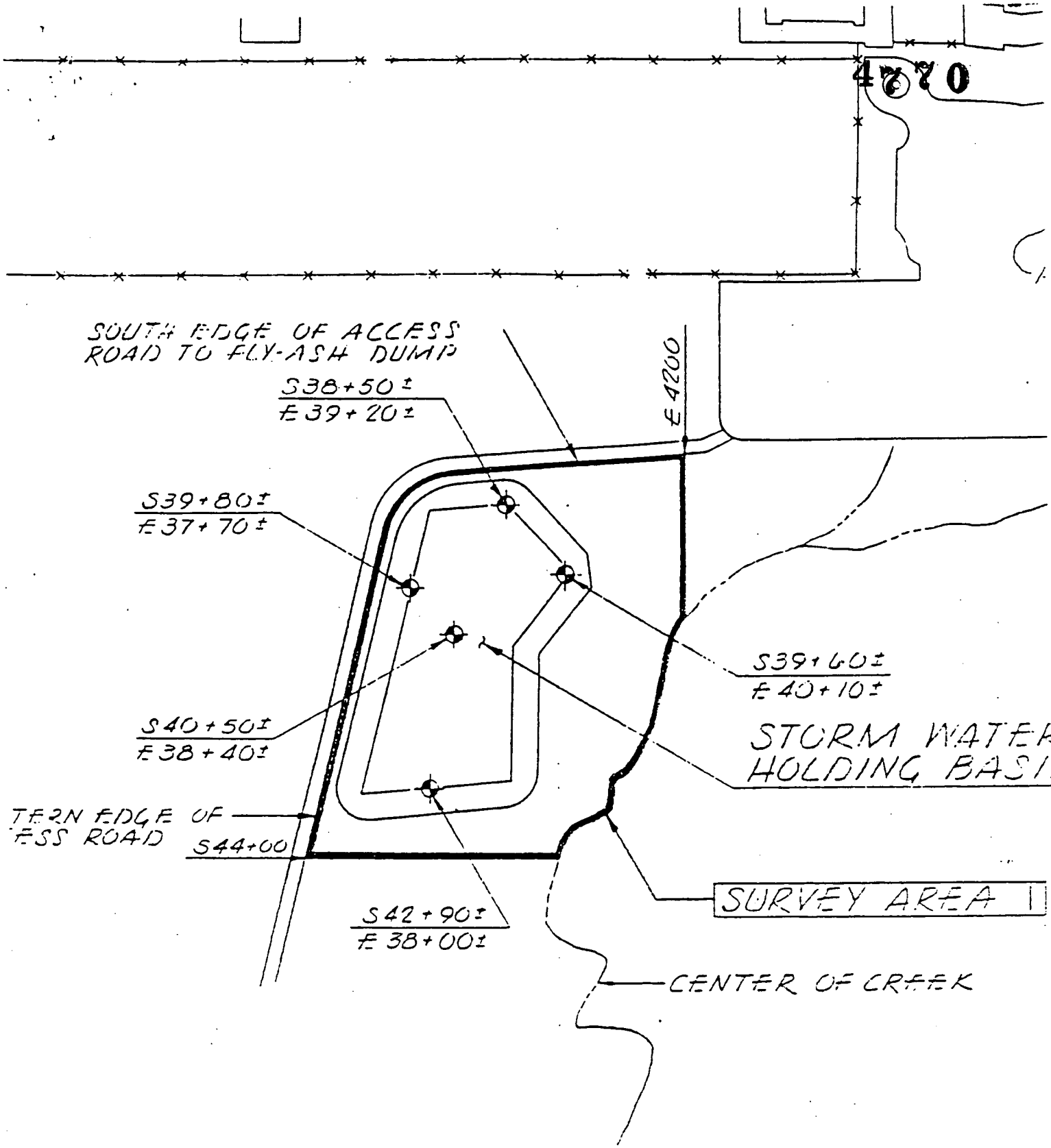
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STORM WATER HOLDING BASI
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S44+00
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S42+90±
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CENTER OF CREEK

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TOPOGRAPHICAL SURVEY
AND
GEOTECHNICAL INVESTIGATION

NLO, INCORPORATED
FMPC WATER POLLUTION CONTROL
FERNALD, OHIO

ATEC FILE NUMBER 22-23057

1.0 INTRODUCTION

This report presents the results of a topographic survey, geotechnical investigation and soils evaluation for the proposed new additions to be constructed within the DOE Feed Materials Production Center in Fernald, Ohio. The investigation was performed for the client, NLO, Incorporated, and was authorized by Mr. Peter I. Camprisi, Attorney, with a notice to proceed dated August 17, 1982.

The scope of this investigation included a topographic survey of the five designated survey areas as shown on Drawing Number 00X-5500-G-01358, review of available geologic and soils data for the project area, a comprehensive subsurface investigation at the site consisting of twelve (12) standard soil test borings located as shown on the Topographic Survey of Survey Areas #1, #2, and #4, field and laboratory soil testing, and an engineering analysis and evaluation of the subsurface materials encountered at this site.

The purpose of the investigation was to provide a topographic survey of the designated areas; to determine the types of subsoils present at the proposed sites; to determine the general

engineering characteristics of these various soil profile components; and to provide a basis for making recommendations regarding the bearing capacity, compressibility and drainage characteristics of the subsurface materials for use by the project engineer in preparing final project designs. Taken also into consideration were construction problems which may arise during design and/or construction of the project in view of the existing site conditions.

2.0 PROJECT AND SITE CHARACTERISTICS

The site of the existing Feed Materials Production Center is located on the north side of Fernald and is bounded by Cincinnati Brookville Road (State Route #126) to the north and Willey Road to the south. The existing facilities are concentrated at the center of the FMPC grounds. The work areas were denoted as Survey Areas #1 through #5 with the geotechnical studies being confined to Survey Areas #1, #2, and #4.

Survey Area #1 consists of the construction of a Storm Water Holding Basin. The topography of this area is relatively flat, the site generally being grass covered, with a small creek and existing basin to the east, and a gravel access road to the north and west. The new basin will be cut approximately 23 feet below the existing site grades, and lined with an impermeable synthetic liner at a design pond bottom elevation of approximately 553 feet.

Survey Area #2 consists of the construction area for a new Denitrification Surge Lagoon which will serve the Biodenitrification System proposed for Survey Area #4. The surge lagoon will be constructed by excavating approximately 5 feet below existing grades at the center, and constructing a 5 to 8 feet high embankment around the perimeter of the lagoon. The pond will also be lined with an impermeable filter fabric, with side slopes of 3 to 1 on the dike embankments. The topography of this area is also generally flat, with a small drainage swale flowing along the northern edge. The area is grass and weed covered, with the drainage swale holding 2 to 8 inches of standing water and large cattails.

The Biodenitrification System will be constructed in Survey Area #4, within the main plant site. This area is currently flat and covered with a layer of gravel. The system will consist of a bioreactor and vibrating screens, with several associated storage tanks. This entire system of equipment will be supported on a mat foundation.

Loading conditions for the Biodenitrification System were not readily available at the time of this investigation. For purposes of our analyses, we have assumed a maximum net bearing pressure of 2,000 psf and a mat size of 45 X 45 feet. Allowable settlements are 0.75 inches total settlement and 0.5 inches of differential settlements. The allowable settlement at the center of the surge lagoon and storm water holding basin is assumed to be 6 inches.

3.0 GENERAL SUBSURFACE CONDITIONS

The foundation supporting conditions encountered at this site during our investigation can be considered satisfactory for the development of foundations and the various lagoons. The subsurface soil profile and groundwater conditions are described in detail on the boring logs in the Appendix to this report, but in general terms consist of the following.

3.1 General Geology

The geologic history of this area is composed of relatively recent events during the Pleistocene epoch. The site is currently located along the western edge of the Great Miami River Valley which has been filled with sands, gravels, silts, and clays from several glacial ice advances. the upper 20 to 30 feet of soil in the areas explored appear to be deposits left by the Illinoian followed by the Wisconsin glacial advances.

The deeper noncohesive deposits found in our borings are outwash sands and gravels mostly left behind by the Illinoian glaciation. Several of the borings then encountered a glacial till that is overlain by glacial drift and alluvial sediments following the Wisconsin glaciation. The gray layered silty clays encountered in several borings are lakebed sediments from the marginal lakes formed wnen the glaciers blocked the various streams and rivers during its advance.

3.2 Soil Profile of Denitrification Surge Lagoon

The subsoil conditions for the surge lagoon was explored by Borings #1 through #5. These borings penetrated a surficial layer of topsoil that is underlain by a mottled brown silty clay to clayey silt. The topsoil ranges in thickness from 0.3 to 0.5 feet with an average of 0.4 feet. A 0.4 feet layer of gravel was also encountered beneath the topsoil in Boring #4. The mottled brown silty clays and clayey silts extend to depths of 2.5 feet in Boring #5 to 5.5 feet in Borings #1 and #3. Borings #1, #2, and #4 then encountered mottled brown and mottled brown and gray silty sands and sandy clayey silts that extend to depths of 8.5 feet in Borings #2 and #4 to 10.7 feet in Boring #1. All of these borings then encountered gray colored soils that range in texture from a laminated silty clay to a clayey silt to a sandy silt.

These upper soils typically exhibit a moist to very moist natural moisture content with a medium stiff to very stiff consistency for the cohesive soils. The noncohesive soils generally exhibit a very moist condition with a medium dense relative density. The lower lying gray colored soils exist in a very moist to moist material state with a medium stiff to very stiff consistency.

Two additional borings, denoted as BA and BB, were also performed within the drainage swale that crosses this particular site. These borings indicate that wet, very soft soils exist to a depth of 3.0 to 3.5 feet that will require removal during site preparation.

5.3 Soil Profile of Biodenitrification System

This area was explored by Borings #6 and #7. Each boring encountered a layer of gravel on the ground surface ranging in thickness from 0.3 to 1.6 feet in Borings #6 and #7, repsectively. Significant amounts of water were also observed flowing into the open hole from the gravel in Boring #7.

Boring #7 then encountered a dark gray clayey silt that contains 4.8 percent organic matter. This soil extends to a depth of 4.5 feet and exists in a moist, stiff natural condition. Mottled brown and gray sandy clayey silts to silty clays with trace amounts of fine sand were then encountered to depths of 9.5 to 12.0 feet. Boring #6 then encountered a gray very moist silty sand that extends beyond the depth explored and Boring #7 encountered gray layered silty clays to 16.0 feet where the texture changed to a very sandy clayey silt.

These soils exhibit a moist natural moisture content that grades to very moist within the gray colored soils. The consistency of these soils is soft to stiff in the upper 20 feet then increases to very stiff in Boring #7 and dense in the sands of Boring #6. These soils are typically medium to low in plasticity and medium in compressibility.

3.4 Soil Profile for Storm Water Holding Basin

The storm water holding basin was explored by Borings #8 through #12. These borings encountered a surface layer of topsoil that ranges in thickness from 0.4 to 0.8 feet with an average thickness of 0.5 feet. Highly organic soils such as topsoil are highly compressible and should be considered as unsuitable for engineering purposes.

These borings then encountered a surface layer of light brown clayey silt that extends to depths of 2.0 to 2.5 feet in Borings #9 through #12. Underlying these surficial soils are mottled brown and mottled brown and gray silty clays that extend to depths of 5.0 feet in Boring #9 to 12.5 feet in Boring #10. The cohesive soils encountered exhibit a moist, natural moisture content with a medium stiff to hard consistency.

Noncohesive and cohesive glacial deposits were then encountered that extend beyond the depths explored. These deposits generally consist of brown and mottled brown sandy silts and sands that extend to depths of 9.5 to 19.0 feet where a gray sandy silty clay was encountered. This stratum extends to depths of 19.7 to 24.0 feet where a brown fine to coarse sand with trace amounts of gravel was encountered. These noncohesive soils are typically in a moist to very moist natural condition above the gray conesive soil and exhibit a medium dense to dense relative density. The gray cohesive soils exist in a moist, very stiff to hard natural condition.

3.5 Groundwater Level

Groundwater was encountered in several borings at widely varying depths. Following is a discussion of the groundwater conditions encountered at each site during our investigation. The reader is asked to keep in mind that this groundwater data is only valid for the particular time at which it was obtained. The actual groundwater level is dependent upon local and seasonal variations in precipitation and can rise or lower depending upon the local weather conditions. The exact groundwater level can only be determined after several days of observation in a series of cased holes.

3.5.1 Biodenitrification Surge Lagoon

Groundwater was noted on the drilling tools at a depth of 9.5 feet and upon completion at 14.0 feet in Boring #2 and at a depth of 16.2 feet in Boring #1 upon completion, with all other borings remaining dry. One hour after the completion of Boring #2, groundwater was measured at 5.9 feet. Based upon these data, we feel that the groundwater observed is resulting from water bearing granular seams. Minor problems may be experienced during construction but any water encountered should be easily handled by pumping from sumps or by the use of a cut off trench.

3.5.2 Biodenitrification System

Groundwater was encountered on the drilling tools of Boring #6 at a depth of 16.0 feet. Upon completion, groundwater was measured at 23.0 feet and at 21.6 feet in Boring #7. Groundwater was then measured at 5.0 feet, 1.5 hours after the completion of Boring #6. Groundwater was also observed in the offset Boring #6 at 5.1 feet in addition to water observed flowing into the open bore hole of Boring #7 from the surface gravel.

Based upon these observations, we feel that this groundwater also originates from water bearing granular seams and that the groundwater table is at an estimated depth of 16.0 feet. This conclusion, however, can only be verified by a sophisticated observation well program consisting of peizometers or any other similar method.

3.5.3 Storm Water Holding Basin

Groundwater was encountered on the drilling tools of Borings #9 and #12 at a depth of 13.0 feet. At completion, water was measured at depths of 29.0 and 22.0 feet, respectively, and at 30.0 feet in Boring #11. One day after completion of these borings water was measured at depths of 21.0, 11.0, and 11.5 feet in Borings #8, #9, and #10, respectively.

Based upon this information, we feel that the water encountered on the rods at 13.0 feet is due to a perched water table on the gray glacial tills and the static groundwater table can be found at 29 to 30 feet.

The water level readings after one day are believed to be the result of water bearing granular seams in the glacial soils. In any event, certain amounts of groundwater problems can be expected during construction, which will be discussed in further detail in Section 5.4.3.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon our analysis of the soil conditions and the preliminary design details supplied for this project by the client as previously outlined the following conclusions were reached, and the stated recommendations were developed. If the project characteristics are changed from those assumed herein, our recommendations should be reviewed to see whether any modifications are needed.

4.1 Structure Foundation Recommendations

It is recommended that the Biodentirification System be supported on a structural mat foundation dimensioned for a net allowable soil bearing pressure of 2,000 psf and extend at least 3.0 feet below exterior finish grades for frost protection. The net soil bearing pressure is defined as

the weight of the foundation concrete and above ground dead and live loads minus the weight of the soil displaced by the concrete.

Current plans indicate that the proposed foundation system will consist of a 1.0 foot thick slab with a top elevation of 577.0 supported on 6 inches of compacted crushed stone. A frost wall will then be constructed around the foundation perimeter to a depth of 3.0 feet (Elevation 574.0). A 1.0 feet thick curb varying in height from 9 inches to 5.0 feet will also be constructed around the nitric acid tanks and the bioreactors, with a shallow sump pit in each of these two sections.

Based upon the anticipated loading conditions, we estimate total settlements on the order of 0.9 inches and differential settlements of 0.7 inches at the 2,000 psf loading. The organic content of the dark gray silty clays found in Boring #7 are the primary reason for the differential settlements to be as severe as mentioned above. By removing these soils to a depth of up to 5.0 feet at Boring #7, and backfillinng with a suitable compacted material the differential settlements can be reduced to 0.4 inches. The use of a well graded granular material would be preferable but a suitable borrow material can also be used. These recommendations provide a factor of safety of 3 to 4.

We feel that preloading of this area is not feasible, as primary consolidation settlements will equal approximately one third of the total settlements and any differential settlements will occur over a long period of time as secondary consolidation.

The subgrade area should also be properly proofrolled prior to the placement of the granular base coarse. The removal and proper backfilling of any soft areas will minimize the possibility of shear punch through of the foundation soils, and help hold down settlements.

4.2 Walls, Pits, and Slabs

The walls and pits for the various structures in the storm water holding basin, surge lagoon, and biodentrification system should be backfilled with a granular backfill material to assure adequate compaction. THe only on-site materials found to be suitable for this purpose are the brown fine to medium sands and silty sands found at the holding basin from approximately 10 to 15 feet depth. Any other on-site materials will be too fine-grained to gain proper compaction and drainage in confined areas. Imported granular soils would be better suited for a backfill soil, primarily due to easier compactability and better drainage. The use of ODOT aggregate #310 or any other similar well graded aggregate is recommended.

Table I, below, summarizes the lateral earth pressure coefficients to be used in the design of the walls and pits.

TABLE I
LATERAL EARTH PRESSURE COEFFICIENTS

Material	Estimated Angle of Internal Friction (ϕ)	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At Rest Condition Coefficient (K_o)
On site fine to medium sand and silty sand	28°	0.361	2.770	0.530
ODOT Item #310	33°	0.295	3.392	0.455
ODOT Item #304	38°	0.238	4.204	0.384
On site Silty Clays	12°	0.656	1.525	0.792
On site Sandy Silty Clays	18°	0.528	1.894	0.691
On site Clayey Silts	15°	0.589	1.698	0.741

The above coefficients are estimates based upon our experience with soils in the local area. We would like to remind the designer that any walls and/or pits greater than 3.0 feet in height should be well drained to minimize the build up of any excess hydrostatic pressures. The use of ODOT Item #304 or #310 Grading A are the most desirable materials to use or any other well graded gramular soil with not more than 10 percent passing the Number 200 sieve.

The above estimated angles of internal friction can also be used in estimating the coefficient of friction for sliding resistance. Table II summarizes these values:

TABLE II
DATA FOR DETERMINING THE COEFFICIENTS OF SLIDING RESISTANCE

Material	Estimated Angle of Internal Friction Between Soil and Concrete (Ø)	Estimated Cohesion (C) (psf)
On site fine to medium sand and silty sand	14°	-----
ODOT Item #310	18°	-----
ODOT Item #304	24°	-----
On site Silty Clays	-----	800
On site Sandy Silty Clays	-----	1,000
On site Clayey Silts	-----	1,000

Horizontal Resistance = W tan (Ø) for granular soils

Horizontal Resistance = cB for cohesive soils

Where W = weight of wall and soil above the base

The above Table and equations, or an equivalent method, should be used in calculating the stability against sliding. It is also very important that the base of any structure susceptible to sliding be kept dry until concrete can be placed to minimize the possibility of lower cohesion values for the cohesive bearing soils.

4.3 Floor Slabs

It is recommended that any ground supported floor slabs for this project be "floating", that is designed to be structurally independent of any building footings or walls, and appropriately reinforced to support the loads proposed.

All slabs should be supported on a six (6) to eight (8) inch compacted layer of free-draining select granular subbase material, such as ODOT Item #304. This material should be properly placed and compacted on a subgrade prepared in accordance with our enclosed Recommended Earthwork Specifications. Particular attention is called to Item 2 under the heading of Stripping, and Item 4 under the heading of Fill to assure a satisfactory subgrade. For design purposes, we recommend the use of a modulus of subgrade reaction equal to 125 to 140 psi/in due to the wide variety of potential subgrade materials.

The use of a vapor barrier beneath the slab concrete has been debated at length by many people. While it assists in the objective of uniform shrinkage across the depth of the slab by reducing "drag" between the concrete and base, it also causes the slab to dry out in a non-uniform fashion due to unequal moisture evaporation. As a result, we feel that the benefits of a vapor barrier are only realized when the slab is within 3 to 5 feet of a water table. That does not appear to be the case at this site.

4.4 Lagoons

Present plans indicate that the surge lagoon and storm water holding basin will both be lined with an impermeable synthetic liner. As a precaution, however, the base and sidewalls of these lagoons will be prepared in the event of any leakage. A design permeability rate was not available at the time of this writing. As a result, we are assuming a rate of 10^{-6} feet/min is required. Table III below summarizes the estimated permeability rate of the predominant soils encountered on this site.

TABLE III
ESTIMATED COMPACTED PERMEABILITY RATES OF ON SITE SOILS

Material	Compacted Permeability with out Bentonite (ft/min)	Compacted Permeability rate with Bentonite amount needed/Permeability (ft/min)
Silty Clays	10^{-7}	——
Clayey Silts	10^{-5}	——
Sandy Silty Clays	10^{-6}	——
Fine to coarse Sand and Gravels	10^{-4}	20-30 (pcf)/10^{-6}

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Site Preparation

No unusual problems are anticipated because of the types of soils at this site. Soil containing organic matter is

relatively compressible and would be detrimental if used beneath footings, subbase materials, pavements, or if used in any engineered fill. A careful inspection should be made of the proposed site to detect any debris and/or miscellaneous fills, topsoil, refuse, or other unsuitable materials in the building areas. Accordingly, all such soils should be stripped from building and pavement areas and wasted or stockpiled for landscaping use.

No expansive soil materials were noted within our test borings for this investigation. Therefore, we do not anticipate the need to take any special precautions beyond following good engineering and construction practices to allow for expansive soil activities on construction at this site.

The swale traversing the surge lagoon will require undercutting for any embankment that will be built in its vicinity. As a result, we recommend that the entire swale area be undercut to firm soils and properly backfilled with suitable fill materials. Based upon Borings #EA and #BB, we estimate an undercut depth of 3 to 4 feet. These undercut soils will be rather wet and silty and may not be suitable for a fill material unless it is dried and mixed with other soils.

5.2 Compaction Controls

After the existing subsoils are stripped of undesirable materials or excavated to design sugrade, proper control of subgrade compaction, backfill, and structural fill placement and compaction should be maintained. We recommend that all backfill and structural fill materials be placed and compacted as outlined in our Recommended Earthwork Specifications for this work. It is further recommended that a representative of the soils engineer be present at the site during the construction of any fill, backfill or structural fill relating to the building floor slabs and foundations to assure that adequate placement and compaction of the fill materials is attained.

We recommend the use of a Standard Proctor dry density test (ASTM D-698) for all embankment and dike fills. The use of a Standard Proctor is desirable for the dikes and lagoons over the Modified Proctor due to its higher optimum moisture content. This higher optimum moisture content will result in a more flexible fill that will not crack under minor settlements. We also recommend the use of the Standard Proctors in the other construction areas due to economic and construction considerations. If the floor slab loadings or settlement in any structure are critical, we recommend increasing the relative degree of compaction from 95 to 98 percent of the Standard Proctor dry density.

Primarily the soils involved in this project are glacial cohesive and non-cohesive soils with low to medium plasticities. These types of material can be placed with little or no difficulty provided the moisture content of the material is near or on the low side of optimum.

Two soil types were tested for their suitability as fill materials. These soils were obtained from the storm water holding basin from 2 to 4 feet and in the proposed borrow area north of the surge lagoon from 1 to 3 feet. Our laboratory tests indicate that each of these materials are suitable for structural fills at a modulus of subgrade reaction equal to 140 psi/in if used as a subgrade material. Other possible on-site materials for use as a fill material can be evaluated at a later date or during construction when plans become more definitive.

5.3 Excavations

It is anticipated that little difficulty will be experienced in excavating the site for this project. Because of the noncohesive and glacial nature of most of the soils at this site, the sides of all but very shallow excavations should be laid back to prevent their collapse during construction.

All foundation excavations should be inspected by a qualified soils engineer or his representative to assure that all excessively loose, soft or otherwise undesirable materials are removed, and that the foundations will bear

on satisfactory material. At the time of such inspections, the geotechnical engineer may find it necessary to make hand auger borings or use a hand penetration device in the bases of the foundation excavations to assure that the soils below the base are satisfactory for support of the foundation loads. The necessary depth of penetration will be established during inspection.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against any detrimental change in condition, such as from disturbance, rain and/or freezing. Every effort must be made to assure that the supporting material is not disturbed or permitted to dry or become wet during construction operations. Surface runoff water should be drained away from the excavations and not be allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not possible, the footing bearing materials should be adequately protected.

5.4 Groundwater Problems

Groundwater was encountered in each of the three construction areas at varying depths. Due to the glacial nature of these soils, it is believed that the majority of groundwater that will be encountered will originate from water bearing granular seams and/or a perched water table condition. Following is a discussion of what we feel the best methods of controlling the groundwater may be. The reader should keep in mind that these discussions are only offered as suggestions and a guide for the contractor in controlling any groundwater he may encounter.

5.4.1 Biodenitrification Surge Lagoon

Groundwater was found in Boring #1 and #2 at varying depths with the remaining borings being dry. We conclude, therefore, that this water is the result of water bearing granular seams in at least the upper 14.0 feet of soil. Since no excavation is expected to extend beyond 10 feet depth, any groundwater problems encountered can be expected to be minor. Any water found can more than likely be removed by pumping from sumps located at the point of in-flow. If any water bearing seam is to large to control with one or more sump pits, a cut off trench can be installed to keep any water from flowing into the work areas.

We would also like to point out that significant amounts of water is ponding in the surface swale. It will be necessary to remove this water by pumping from sumps before construction begins to minimize any excavation problems that may occur during site preparation.

5.4.2 Biodenitrification System

The static groundwater level is expected to be found at a depth of 16 to 18 feet, however, other groundwater was found to be flowing from granular seams and the surface gravel. Design bottom of the frost wall surrounding the mat is 574.0±, requiring

a 5.0 feet excavation. Based upon the water level readings in Boring #6 and the offset boring, some water can be expected at the bottom of the excavation. Since every effort must be made to keep the foundation excavations dry it will more than liekly be necessary to remove any water by pumping from sumps.

No long term groundwater problems are expected after construction.

5.4.3 Storm Water Holding Basin

Groundwater conditions at this site consist of a perched water table at a depth of 13.0 feet (Elevation 563.0) and the static water table at a depth of 29 feet (Elevation 547.0). The design bottom of this basin is at Elevation 553.0±, which is within 6 feet of the water table and in the brown fine to coarse sands.

Groundwater problems can therefore be expected in this area and certain precautions and construction methods will be needed to minimize delays, etc.

First of all, construction should take place during the dry periods of the year, such as from July to September, when the water table is at its lowest and will not interfere with installation of the liner.

The initial water problem to be encountered, however, is the perched water table at Elevation 563.0. We feel that the best method of removing this water is to construct a series of temporary drainage trenches and removing the water by pumping from a series of sump pumps when the water is encountered. It will be necessary to halt construction in the affected area for a period of 7 to 10 days in order to remove the majority of perched water. The trenches should be desined to extend into the gray glacial tills and be backfilled with a coarse gravel, such as ODOT #57, if the trench will not remain open. We do not expect them to, however.

An alternative method of removing this water would be the installation of a series of wells installed at a 20 to 30 feet spacing. These wells should also be screened in the area of the perched water to allow this water to percolate into the lower lying sands. The success of this method, however, is highly dependent upon the location of the water table in these sands. If the water table is within 3 feet of the design bottom of the excavation, including the recompacted liner and drainage at the base, consideration should be given to installing these wells to a depth of 40 to 45 feet and pumping from them until the water table is effectively lowered. At this time, the wells within the construction area can be removed and the wells along

the perimeter can continue to pump water to keep the water table below the depth of any excavations. Should this procedure be necessary, we estimate a period of pumping from 2 to 3 weeks prior to the start of construction. We would like to point out that this is only an estimate based upon engineering judgement and the final dewatering procedures should be left up to the contractor. We will be happy to further consult with you on this if the water table in the deep sand does become a major problem.

As far as long term groundwater problems are concerned, they are expected to be at a minimum as long as the water table never raises above the depth of water within the basin. We do suggest, however, that subsurface drains (french drains) be installed in the side slopes to remove any water flowing from granular seams. These additional drains can more than likely be tapped into the proposed underdrains beneath the base of the this basin.

6.0 FIELD INVESTIGATION

The soil borings for this geotechnical study were performed with an ATV mounted drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples of the subsurface soils were obtained employing split-barrel sampling procedures in accordance with ASTM Procedure D-1586. Relatively undistrubed (Thin walled or Shelby Tube) samples were obtained in accordance with ASTM Procedure D-1587.

The types of foundation materials encountered have been visually classified and are described in detail on the boring logs. The results of the field penetration tests, strength tests, water level observations, and other field notes are presented on the boring logs in numerical and written form. Representative samples of the soil encountered in the field were placed in sample jars and are now stored in our laboratory for further analysis, if desired. Unless we are notified to the contrary, all samples will be disposed of 30 days from the date of this report.

The actual boring locations were staked in the field by our surveyor, Hartman Walters, Incorporated. Topographic surveys of the five survey areas were also performed by this firm.

7.0 LABORATORY INVESTIGATION

In conjunction with the field investigation, a supplementary laboratory investigation was conducted to ascertain additional pertinent engineering characteristics of the foundation materials necessary for analyzing the behavior of the foundations for the proposed structure. The laboratory testing program included supplementary visual classifications and moisture content tests on representative soil samples. Selected samples of the cohesive soil from the split-barrel sampling device were tested for plasticity by Atterberg limit tests. Sieve analysis and hydrometer tests were performed on representative samples of soil materials to provide data on their possible behavior under foundation loads and permeability in addition to testing of potential fill materials. All tests were conducted in general accordance with ASTM specifications.

8.0 SUMMARY

8.1 Technical Data Summary

To briefly summarize this report, cohesive and noncohesive glacial soils in a medium to very stiff or dense to hard condition were encountered at this site. Static groundwater was not noted within the boring depths although some water is present in various strata of soil as described in the report. Some groundwater related or construction problems are anticipated for the stormwater holding basin with minor problems expected in the other construction areas.

A net allowable bearing pressure of 2,000 psf can be used in designing or dimensioning the mat for the Biodenitrification System provided they are founded at or below the suggested elevations on firm soil. The organic soils found in Boring #7 should also be undercut and properly backfilled to minimize differential settlements.

Little difficulty is expected with the excavations at this site, and all excavation walls should be properly laid back in granular soils to prevent their collapse.

8.2 General Information

An exploration and evaluation of the subsurface conditions has been conducted at the site of the proposed FMPC Water Pollution Control Project for NLO, Incorporated in Fernald,

Ohio. Foundation design criteria have been suggested, and possible design and construction problems have been discussed. The exploration and analysis of the subsurface conditions at the subject site as reported herein, are considered in sufficient detail and scope to form a reasonable basis for final design.

Our recommendations for this project were developed utilizing soils information obtained from the test borings that were made at the proposed site. At this time we would like to point out that soil test borings only depict the soil conditions at the specific locations and time at which they were made. The soil conditions at other locations on the site may differ from those occurring at the boring locations; however, only minor variations are expected at this particular site.

The conclusions and recommendations herein have been based upon the available soil information and the preliminary design details furnished by the owner of the proposed project. Any revision in the plans for the proposed structure from those anticipated in this report should be brought to the attention of the soils engineer so that he may determine whether any changes in the foundation recommendations are necessary. If deviations from the noted foundations conditions are encountered during construction, they should also be brought to the attention of the soils engineer.

Respectfully submitted,

ATEC ASSOCIATES, INC.

Robert T. Stickney

Robert T. Stickney, P.E.
Project Engineer

Larry A. Jeffers

Larry A. Jeffers, P.E.
Vice President
Ohio District Manager

RTS/bjg

APPENDIX

Generalized Soil Profiles

Logs of Borings

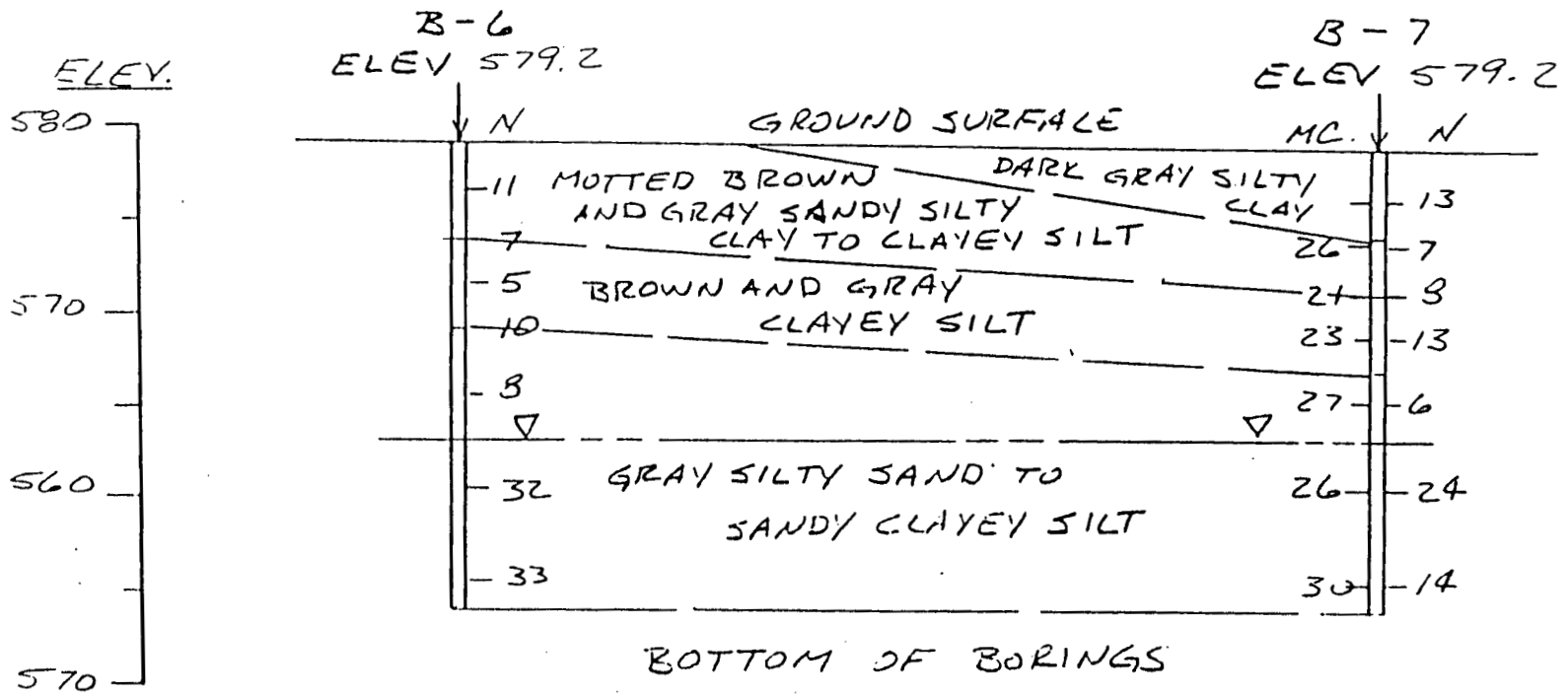
Gradation Curves

Moisture/Density Relationship

Consolidation Test Reports

Field Classification System
for Soil Exploration

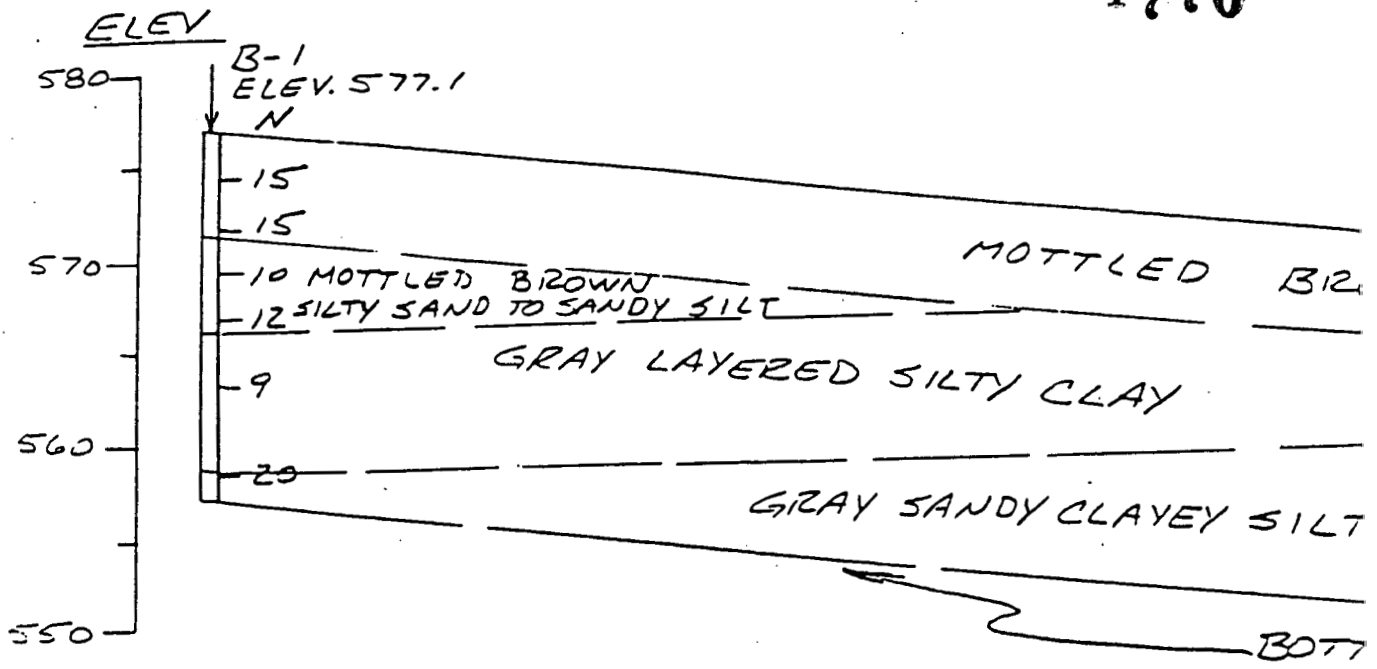
Recommended Earthwork Specifications



GENERALIZED SOIL PROFILE
OF
BIODENITRIFICATION SYSTEM

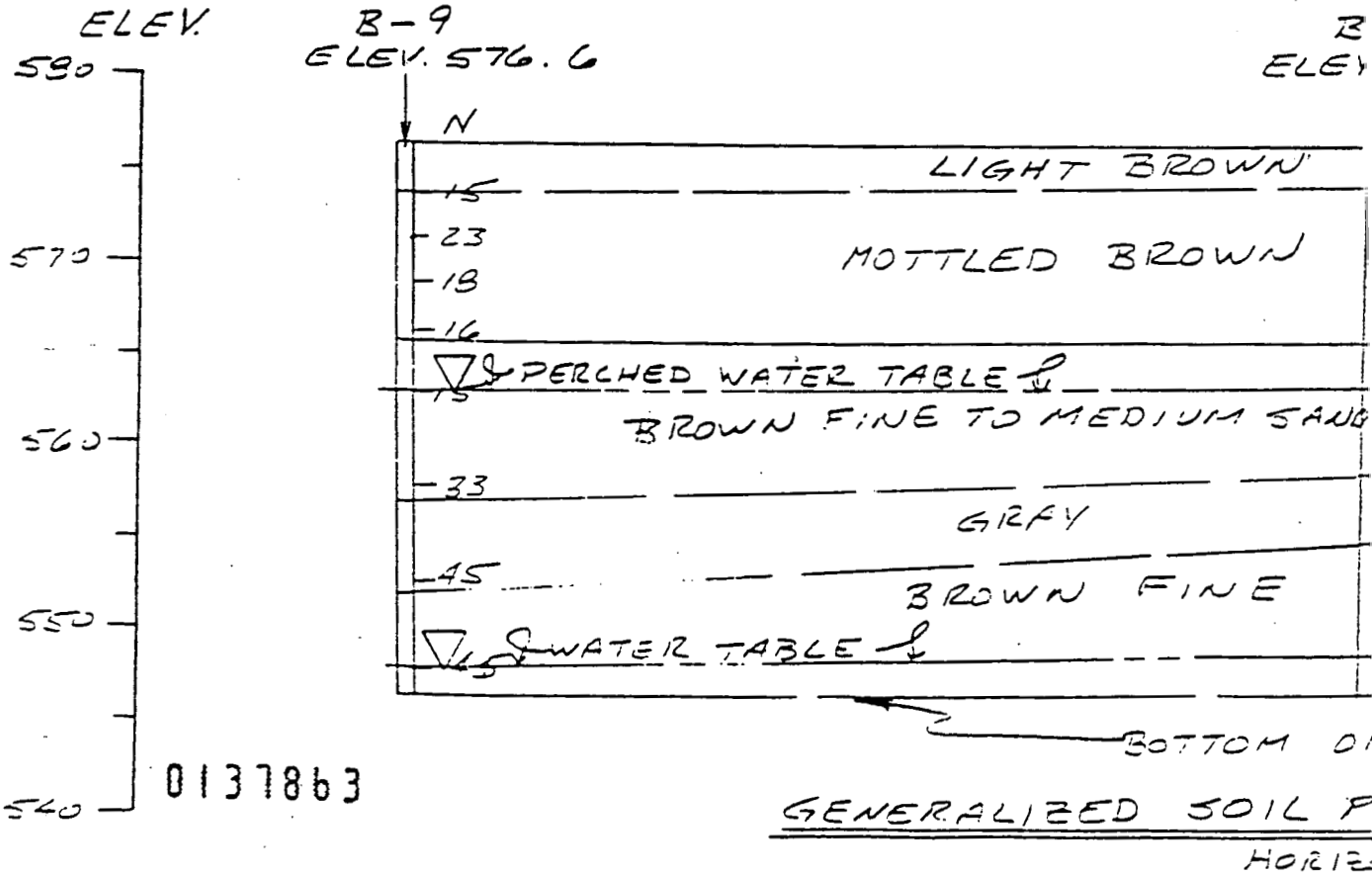
SCALE: 1" = 10'

ATEC ASSOCIATES, INC.



GENERALIZED SOIL PR

HOR



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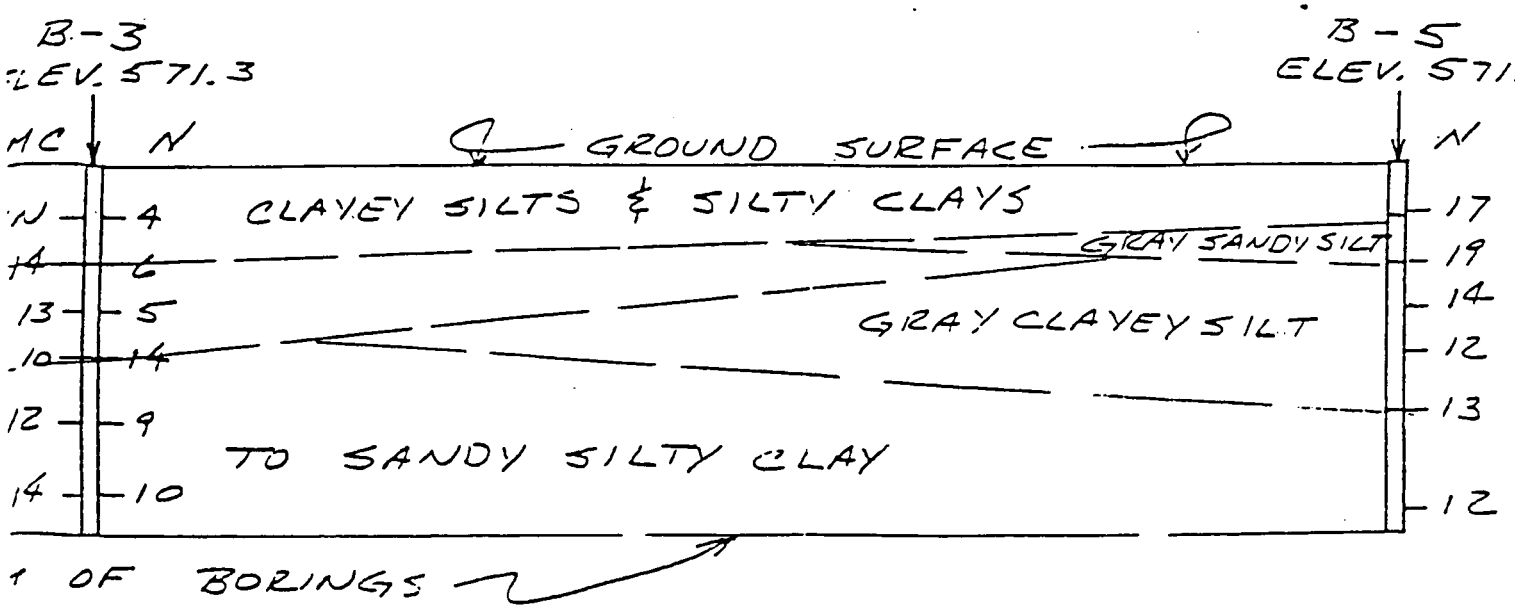
GENERALIZED SOIL P

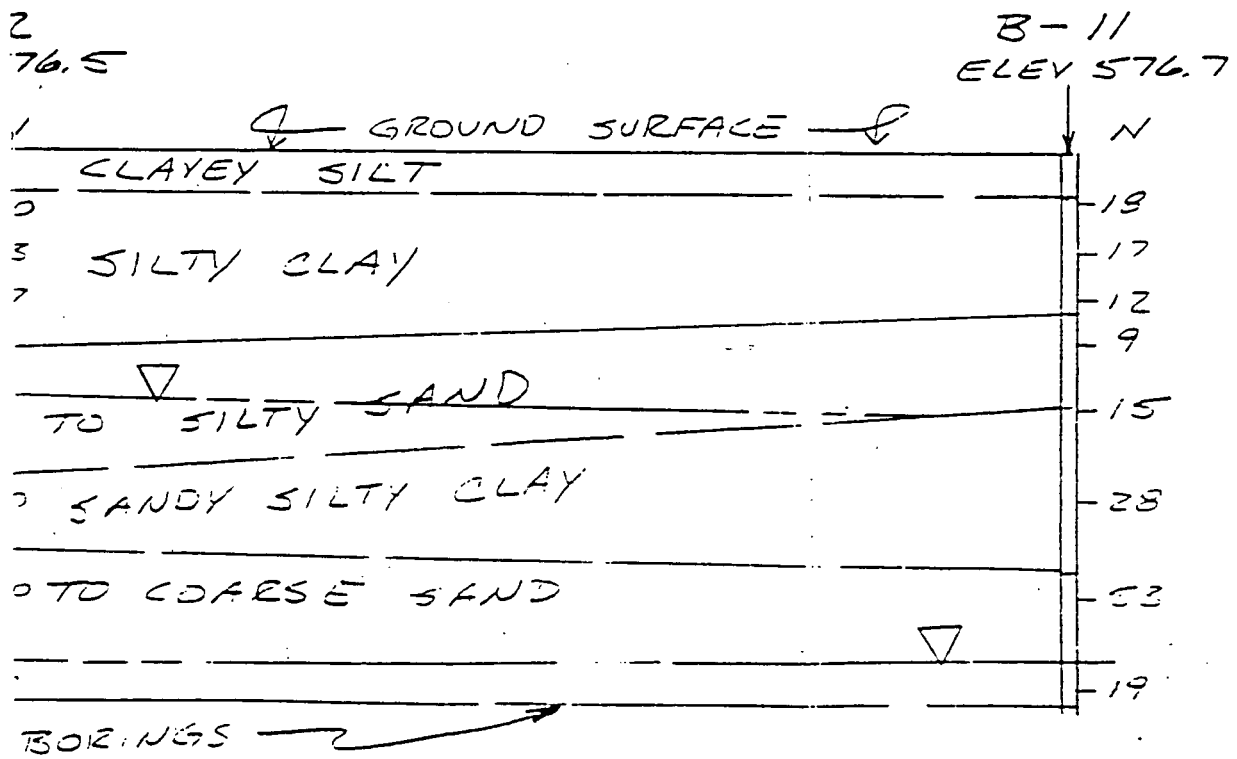
HORIZ

4770



FILE OF SURGE LAGOON AREA

NTAL SCALE: 1" = 40'
TICAL SCALE: 1" = 10'



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0036

FILE OF HOLDING BASIN AREA

AL SCALE: 1" = 40'
AL SCALE: 1" = 10'

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A-270

LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring # 1
Job # 22-23071
Drawn By TT
Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 8/30/82 Hammer Wt. 140 lbs.
Date Completed 8/30/82 Hammer Drop 30 in.
Drill Foreman BC Spoon Sampler O.D. 2 in.
Inspector PM Rock Core Dia. in.
Boring Method HSA Shelby Tube O.D. in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION — 577.1)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.5											
Mottled brown CLAYEY SILT, with some fine sand and iron oxide stains. slightly moist to wet, stiff to very stiff	4.5		1	SS	72		16					
			2	SS	89		15					
Mottled brown and gray SILTY CLAY. moist, stiff	5.5	5	3	SS	83		15					
Mottled brown grading to brown and gray SILTY SAND to SANDY SILT. very moist, medium dense/ medium stiff to stiff	10.2		4	SS	72		10					
	10.7	10	5	SS	100		12					
Brown SILTY SAND, with some fine gravel. very moist, medium dense			6	SS	100	▽	9					
Gray laminated SILTY CLAY, with numerous thin sand seams. very moist, medium stiff	17.5	15										
Gray very sandy CLAYEY SILT. very moist, very stiff	20.0	20	7	SS	83		20					
Boring discontinued at 20.0 feet depth.												
Boring caved in at 19.2 feet depth.		25										

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SS — SPLIT SPOON
ST —
CA — CONTINUOUS FLIGHT AUGER
RC — ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 16.2 FT
▽ AFTER FT
WATER ON RODS FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0037

4770

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Cincinnati, Ohio 45242
(513) 489-1221

LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring #: 2
Job #: 22-23071
Drawn By: TT
Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 8/31/82 — Hammer Wt.: 140 lbs.
Date Completed: 8/31/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

SOIL CLASSIFICATION SURFACE ELEVATION — 575.2	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.3											
Mottled brown CLAYEY SILT, with some fine sand and trace amounts of organic soil in Sample #2. slightly moist, very stiff	5.0	5	1	SS	44		19					
			2	SS	61		17				13	
			3	SS	72	▽	3				20	
Mottled brown and gray CLAYEY SILTY, with some fine sand. moist, very soft	7.0											
	8.5		4	SS	67		13				19	
Brown fine to coarse SAND and GRAVEL, with some silt. wet, medium dense		10	5	SS	72		11				21	
Gray fine SANDY SILT grading to SANDY SILTY CLAY. very moist to moist, stiff to very stiff			6	SS	72	▽	23				13	
	20.0	15	7	SS	72		26				13	
Boring discontinued at 20.0 feet depth.		20										
Boring caved in at 17.5 feet depth.		25										

TEST DATA

SA
SS — DF
ST — PF
CA — CI
RC — R

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GROUND WATER DEPTH
AT COMPLETION 14.0 FT.
AFTER 1 hour 5.9 FT.
WATER ON RODS 9.5 FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0038

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Cincinnati, Ohio 45242
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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 2 Offset Boring
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/1/82 — Hammer Wt. ____ lbs.
Date Completed 9/1/82 — Hammer Drop ____ in.
Drill Foreman BC — Spoon Sampler O.D. ____ in.
Inspector PM — Rock Core Dia. ____ in.
Boring Method HSA — Shelby Tube O.D. 3 in.

SOIL CLASSIFICATION / SURFACE ELEVATION —	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.^{2}	Pocket Penetrometer q_p Tons/Ft.^{2}	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.3											
Mottled brown CLAYEY SILT, with some fine sand.	5.0	5				▽						
Mottled brown and gray CLAYEY SILTY, with some fine sand.	7.0		1	ST	96							
Boring discontinued at 7.0 feet depth.		10 15 20 25										

SAMPLER TYPE
SS — DRIVEN SPLIT SPOON
ST — PRESSED SHELBY TUBE
CA — CONTINUOUS FLIGHT AUGER
RC — ROCK CORE

GROUND WATER DEPTH
▽ AT COMPLETION 5.1 FT.
▽ AFTER ____ FT.
WATER ON RODS ____ FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring #: 3
Job #: 22-23071
Drawn By: TT
Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 8/31/82 — Hammer Wt.: 140 lbs.
Date Completed: 8/31/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

SOIL CLASSIFICATION SURFACE ELEVATION — 571.3	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	TEST DATA: Unconfined Compressive Strength q, u Tons/Ft.²	TEST DATA: Pocket Penetrometer q, p Tons/Ft.²	TEST DATA: Natural Dry Density lbs./cu. ft.	TEST DATA: Water Content %	TEST DATA: Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.4		1	SS	56		8				18	
Mottled brown and gray SILTY CLAY. moist, medium stiff to soft			2	SS	72		4				27	LL=48 PL=24
	5.5	5	3	SS	100		6				14	
Gray layered SILTY CLAY, with numerous thin silt seams. moist to very moist, soft			4	SS	100		5				13	
	10.0	10	5	SS	67		14				10	
Gray SANDY SILTY CLAY, with trace fine gravel and numerous sand seams. moist to very moist, medium stiff		15	6	SS	88		9				12	
	20.0	20	7	SS	50		10				14	
Boring discontinued at 20.0 feet depth. Boring caved in at 18.8 feet depth. Water at 18.6 feet after pulling augers.		25										

0137868

SS —
ST —
CA —
RC —

GROUND WATER DEPTH
AT COMPLETION dry FT
AFTER FT
WATER ON RODS FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0040

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(513) 489-1221

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. | Boring #: 3 Offset Boring
Architect Engineer: | Job #: 22-23071
Project Name: FMPC Water Pollution Control | Drawn By: TT
Project Location: Fernald, Ohio | Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 9/1/82 | Hammer Wt. ____ lbs.
Date Completed: 9/1/82 | Hammer Drop ____ in.
Drill Foreman: BC | Spoon Sampler O.D. ____ in.
Inspector: PM | Rock Core Dia. ____ in.
Boring Method: HSA | Shelby Tube O.D. 3 in.

SOIL CLASSIFICATION / SURFACE ELEVATION —	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.^{2}	Pocket Penetrometer q_p Tons/Ft.^{2}	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.4											
Mottled brown and gray SILTY CLAY.		5	1	ST	65							
	5.5											
Gray layered SILTY CLAY, with numerous thin silt seams.			2	ST	96							LL=23 PL=17
	9.0											
Boring discontinued at 9.0 feet depth.		10 15 20 25										

TEST DATA

S
SS — D
ST — P
CA — C
RC — R

0137869

GROUND WATER DEPTH
▽ AT COMPLETION dry FT
▽ AFTER ____ FT.
WATER ON RODS ____ FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0041

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. — Boring #: 4
Architect Engineer: — Job #: 22-23071
Project Name: FMPC Water Pollution Control — Drawn By: TT
Project Location: Fernald, Ohio — Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 8/31/82 — Hammer Wt.: 140 lbs.
Date Completed: 8/31/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

SOIL CLASSIFICATION (SURFACE ELEVATION — 579.8)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	TEST DATA: Unconfined Compressive Strength q_u Tons/Ft.²	TEST DATA: Pocket Penetrometer q_p Tons/Ft.²	TEST DATA: Natural Dry Density lbs./cu. ft.	TEST DATA: Water Content %	TEST DATA: Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.3											
GRAVEL	0.7		1	SS	56		46					
Mottled brown SANDY SILT. dry, very stiff			2	SS	78		21				9	
	5.0	5										
Brown SANDY CLAYEY SILT, with trace fine gravel. moist, very stiff			3	SS	83		18				12	
	8.5		4	SS	78		16				9	
Gray SANDY CLAYEY SILT to SANDY SILTY CLAY, with some fine gravel. moist, medium stiff		10	5	SS	100		10				12	
		15	6	SS	83		9				14	
	20.0		7	SS	89		9				14	
		20										
Boring discontinued at 20.0 feet depth.												
Boring caved in at 17.3 feet depth.		25										

0137870

SS
ST
CA
RC

GROUND WATER DEPTH
▽ AT COMPLETION dry FT.
▼ AFTER FT
WATER ON RODS FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0042

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4770

LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. — Boring #: 5
Architect Engineer: — Job #: 22-23071
Project Name: FMPC Water Pollution Control — Drawn By: TT
Project Location: Fernald, Ohio — Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 8/31/82 — Hammer Wt.: 140 lbs.
Date Completed: 8/31/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION — 571.0)	STRATUM DEPTH	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
Mottled brown SILTY CLAY. moist, medium stiff	2.5	1	SS	72		10					
Gray fine SANDY SILT. moist, very stiff	5.0	2	SS	67		17					
Gray CLAYEY SILT, with some fine to medium sand and trace gravel. moist, very stiff to stiff	13.0	3	SS	93		19					
		4	SS	78		14					
		5	SS	61		12					
Gray SILTY CLAYEY SAND, with trace medium gravel. moist, medium dense/stiff	20.0	6	SS	78		13					
		7	SS	72		12					
Boring discontinued at 20.0 feet depth. Boring caved in at 18.2 feet depth.											

DEPTH SCALE: 5, 10, 15, 20, 25

137811

SS
ST
C.
B

GROUND WATER DEPTH
▽ AT COMPLETION dry FT.
Ψ AFTER FT.
WATER ON RODS FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0043

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4770

LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. — Boring #: 5 Offset Boring
Architect Engineer: — Job #: 22-23071
Project Name: FMPC Water Pollution Control — Drawn By: TT
Project Location: Fernald, Ohio — Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 9/1/82 — Hammer Wt. ____ lbs.
Date Completed: 9/1/82 — Hammer Drop ____ in.
Drill Foreman: BC — Spoon Sampler O.D. ____ in.
Inspector: PM — Rock Core Dia. ____ in.
Boring Method: HSA — Shelby Tube O.D. 3 in.

SOIL CLASSIFICATION / SURFACE ELEVATION —	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
Mottled brown SILTY CLAY.	2.5											
Gray fine SANDY SILT.	5.0	5										
Gray CLAYEY SILT, with some fine to medium sand and trace gravel.	8.5		1	ST	69							
Boring discontinued at 8.2 feet depth.		10 15 20 25										

TEST DATA

SA
SS — DB
ST — PR
CA — CO
RC — RC

137872

GROUND WATER DEPTH
▽ AT COMPLETION dry FT.
▽ AFTER ____ FT.
WATER ON RODS ____ FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0044

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4770

LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # BA
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started — Hammer Wt. 140 lbs.
Date Completed — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in.
Inspector PM — Rock Core Dia. — in.
Boring Method HSA — Shelby Tube O.D. — in.

SOIL CLASSIFICATION / SURFACE ELEVATION —	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	TEST DATA: Unconfined Compressive Strength q_u Tons/Ft.²	TEST DATA: Pocket Penetrometer q_p Tons/Ft.²	TEST DATA: Natural Dry Density lbs./cu. ft.	TEST DATA: Water Content %	TEST DATA: Atterberg Units LL - Liquid Limit PL - Plastic Limit
Gray organic SILTS, wet, very soft	2.0		1	SS	22		2/3					
Gray layered SILTY CLAY, with thin silt and sand seams, very moist, soft to medium stiff		5	2	SS	67		6					
	6.5		3	SS	61		13					
Boring discontinued at 6.5 feet depth.		10, 15, 20, 25										

SS 0137873
ST
CA
RC

GROUND WATER DEPTH
▽ AT COMPLETION dry FT.
▽ AFTER — FT.
WATER ON RODS — FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0045

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(513) 489-1221

4770

LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. — Boring #: BB
Architect Engineer: — Job #: 22-23071
Project Name: FMPC Water Pollution Control — Drawn By: TT
Project Location: Fernald, Ohio — Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 8/31/82 — Hammer Wt.: 140 lbs.
Date Completed: 8/31/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

SOIL CLASSIFICATION / SURFACE ELEVATION —	STRATUM DEPTH	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TEST DATA											
Mottled brown SILTY CLAY. wet, very soft	2.5	1	SS	61		2					
Brown fine SAND. wet, loose	4.0	2	SS	61		12					
Mottled brown SANDY SILT. wet, very stiff	6.5	3	SS	67		31					
Boring discontinued at 6.5 feet depth.											

DEPTH SCALE: 5, 10, 15, 20, 25

GROUND WATER DEPTH
▽ AT COMPLETION: dry FT.
▽ AFTER: FT.
WATER ON RODS: 1.0 FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring #: 6
Job #: 22-23071
Drawn By: TT
Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 9/1/82 — Hammer Wt.: 140 lbs.
Date Completed: 9/1/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

SOIL CLASSIFICATION (SURFACE ELEVATION — 579.2)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
GRAVEL	0.3											
Mottled gray and brown SANDY SILTY CLAY, with trace fine to medium gravel. moist, very stiff to stiff			1	SS	61		18					
			2	SS	72	▽	11					
	5.0	5										
Mottled brown and gray CLAYEY SILT, with trace to some fine sand. moist, medium stiff to soft			3	SS	78		7					
			4	SS	72		5					
	9.5	10										
Gray fine SILTY SAND, with some clay and medium gravel below 22.0 feet depth. very moist, loose to dense			5	SS	78		10					
Wet auger returns starting at 12.5 feet depth.			6	SS	89		8					
		15										
			7	SS	89		32					
		20				▽						
	25.0		8	SS	56		33					
Boring discontinued at 25.0 feet depth.		25										

0137875 9.0 feet

GROUND WATER DEPTH
▽ AT COMPLETION 23.0 FT.
▽ AFTER 1.5 hours 5.0 FT.
WATER ON RODS 16.0 FT.

GER

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0047

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4770

LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring #: 6 Offset Boring
Job #: 22-23071
Drawn By: TT
Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 9/1/82 — Hammer Wt. ____ lbs.
Date Completed: 9/1/82 — Hammer Drop ____ in.
Drill Foreman: BC — Spoon Sampler O.D. ____ in.
Inspector: PM — Rock Core Dia. ____ in.
Boring Method: HSA — Shelby Tube O.D. 3 in.

SOIL CLASSIFICATION / SURFACE ELEVATION —	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
GRAVEL	0.5											
Mottled brown and gray SANDY SILTY CLAY, with trace fine to medium gravel.	5.0	5				▽						
Mottled brown and gray CLAYEY SILT, with trace to some fine sand.	9.0		1	ST	83							
Boring discontinued at 9.0 feet depth.		10 15 20 25										

TEST DATA

0137876

SS
ST
CA
RC

GROUND WATER DEPTH
▽ AT COMPLETION 5.1 FT.
▽ AFTER ____ FT.
WATER ON RODS ____ FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0048

4770

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. — Boring #: 7
Architect Engineer: — Job #: 22-23071
Project Name: FMPC Water Pollution Control — Drawn By: TT
Project Location: Fernald, Ohio — Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 9/1/82 — Hammer Wt.: 140 lbs.
Date Completed: 9/1/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION — 579.2	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
SAND and GRAVEL. very moist, dense	1.6		1	SS	67		24					
Dark gray CLAYEY SILT, with some fine sand and trace organic matter. moist, stiff	4.5	5	2	SS	72		13					
			3	SS	78		7				26	
Mottled brown and gray SILTY CLAY, with trace fine sand. moist, medium stiff	7.5		4	SS	89		8				21	
Brown grading to gray CLAYEY SILT to SILT, with some fine sand. moist, medium stiff	12.0	10	5	SS	83		13				23	
Gray layered SILTY CLAY, with numerous thin sand seams. very moist, soft	16.0	15	6	SS	89		6				27	
Gray very SANDY CLAYEY SILT, with trace fine gravel. very moist, very stiff	25.0	20	7	SS	89	▽	24				26	
		25	8	SS	83		14				30	
Boring discontinued at 25.0 feet depth. Boring caved in at 20.0 feet												

0137877

SS —
ST —
CA —
RC —

GROUND WATER DEPTH
▽ AT COMPLETION 21.6 FT.
▽ AFTER ____ FT.
WATER ON RODS ____ FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc.
Architect Engineer
Project Name FMPC Water Pollution Control
Project Location Fernald, Ohio

Boring # 8 Page 1 of 2
Job # 22-23071
Drawn By TT
Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/2/82 Hammer Wt. 140 lbs.
Date Completed 9/2/82 Hammer Drop 30 in.
Drill Foreman BC Spoon Sampler O.D. 2 in.
Inspector PM Rock Core Dia. in.
Boring Method HSA Shelby Tube O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION — 573.4	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.6		1	SS	56		17		4.5+			
Mottled brown SILTY CLAY, with trace fine sand. moist, very stiff to hard	5.0	5	2	SS	50		30		4.5+		16	
Mottled brown and gray SANDY SILT, with trace clay and occasional medium sand seams. moist, very stiff	8.5		3	SS	61		16				24	
			4	SS	67		18				16	
Brown fine to coarse SAND, with some medium gravel. very moist, dense	9.5	10	5	SS	50		17				16	
Gray SANDY SILTY CLAY, with trace medium gravel. moist, very stiff - Wet zone from 15.0 to 17.5 feet depth.		15	6	SS	89		25				15	
	19.7		7	SS	72	▽	35				13	
Brown fine to coarse SAND, with trace fine gravel. moist, dense		20										
		25	8	SS	72		36				8	

0137878

JGER

GROUND WATER DEPTH
▽ AT COMPLETION dry FT
▽ AFTER 1 day 21.0 FT.
WATER ON RODS FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0050

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 8 Page 2 of 2
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION
Date Started 9/2/82 — Hammer Wt. 140 lbs.
Date Completed 9/2/82 — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in.
Inspector PM — Rock Core Dia. ____ in.
Boring Method HSA — Shelby Tube O.D. ____ in.

SOIL CLASSIFICATION (continued)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
Brown fine to coarse SAND, with trace fine gravel. moist, dense		25	8	SS	72		36				8	
			9	SS	89		41					
Boring discontinued at 30.0 feet depth.		30										
Boring caved in at 22.5 feet depth.		35										
Water at 22.0 feet after pulling augers.		40										
		45										

GROUND WATER DEPTH
AT COMPLETION dry FT.
AFTER ____ FT.
WATER ON RODS ____ FT.

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

37879

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 9 Page 1 of 2
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/2/82 — Hammer Wt. 140 lbs.
Date Completed 9/2/82 — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in.
Inspector PM — Rock Core Dia. ____ in.
Boring Method HSA — Shelby Tube O.D. ____ in.

SOIL CLASSIFICATION SURFACE ELEVATION — 576.6	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.4											
Light brown CLAYEY SILT. dry, very stiff	2.5		1	SS	78		17					
Mottled brown grading to a brownish gray color SILTY CLAY, with gray streaks and trace fine sand. moist, stiff to very stiff		5	2	SS	44		15				9	
			3	SS	72		23				18	
			4	SS	78		18				20	
	10.5	10	5	SS	72	▽	16				9	
Brown fine to medium SAND. moist, dense	12.5											
Brown medium to coarse SAND, with trace silt and medium gravel. very moist, medium dense to dense		15	6	SS	78		15				15	
	19.0		7	SS	67		33				12/16	
Gray SANDY SILTY CLAY, with numerous sand seams. moist, hard		20										
	24.0		8	SS	89		45				16/8	
Brown fine to coarse SAND, with some medium gravel. moist, dense		25										

TEST DATA

137880

GROUND WATER DEPTH
▽ AT COMPLETION 29.0 FT.
▽ AFTER 1 day 11.0 FT.
WATER ON RODS 13.0 FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0052

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 9 Page 2 of 2
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/2/82 — Hammer Wt. 140 lbs.
Date Completed 9/2/82 — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in.
Inspector PM — Rock Core Dia. ____ in.
Boring Method HSA — Shelby Tube O.D. ____ in.

SOIL CLASSIFICATION (continued)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	TEST DATA: Unconfined Compressive Strength q_u Tons/Ft.²	TEST DATA: Pocket Penetrometer q_p Tons/Ft.²	TEST DATA: Natural Dry Density lbs./cu. ft.	TEST DATA: Water Content %	TEST DATA: Atterberg Units LL - Liquid Limit PL - Plastic Limit
Gray SANDY SILTY CLAY, with numerous sand seams. moist, hard	24.0											
Brown fine to coarse SAND, with some medium gravel. moist, dense		25	8	SS	89	▽	45				16/8	
	30.0	30	9	SS	89		45					
Boring discontinued at 30.0 feet depth.												
Boring caved in at 12.5 feet depth.		35										
		40										
		45										

0137881

GROUND WATER DEPTH
▽ AT COMPLETION 29.0 FT
▽ AFTER 1 day 11.0 FT
WATER ON RODS 13.0 FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0053

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc. — Boring #: 10 Page 1 of 2
Architect Engineer: — Job #: 22-23071
Project Name: FMPC Water Pollution Control — Drawn By: TT
Project Location: Fernald, Ohio — Approved By: RTS

DRILLING and SAMPLING INFORMATION

Date Started: 9/3/82 — Hammer Wt.: 140 lbs.
Date Completed: 9/3/82 — Hammer Drop: 30 in.
Drill Foreman: BC — Spoon Sampler O.D.: 2 in.
Inspector: PM — Rock Core Dia.: in.
Boring Method: HSA — Shelby Tube O.D.: in.

SOIL CLASSIFICATION (SURFACE ELEVATION — 576.5)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.5											
Mottled brown CLAYEY SILT, with some fine sand and trace organic matter. dry, hard	2.5		1	SS	56		36					
			2	SS	61		10				19	
Mottled brown and gray SILTY CLAY, with some fine sand and numerous silt seams. moist, medium stiff to stiff		5	3	SS	67		15				18	
			4	SS	67		17				19	
		10	5	SS	72	▽	12				20	
Mottled brown and gray SILTY SAND. wet, medium dense	12.5		6	SS	33		15				25	
Gray SANDY CLAYEY SILT, with some fine gravel. moist, very stiff	17.5	15										
		20	7	SS	72		25				4	
Brown fine to coarse SAND. moist, very dense to dense	23.0											
		25	8	SS	78		55				9	

0137882

GROUND WATER DEPTH
AT COMPLETION dry FT
AFTER 1 day 11.5 FT.
WATER ON RODS FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0054

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring # 10 Page 2 of 2
Job # 22-23071
Drawn By TT
Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/3/82 Hammer Wt. 140 lbs.
Date Completed 9/3/82 Hammer Drop 30 in.
Drill Foreman BC Spoon Sampler O.D. 2 in.
Inspector PM Rock Core Dia. in.
Boring Method HSA Shelby Tube O.D. in.

TEST DATA

SOIL CLASSIFICATION (continued)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.^{2}	Pocket Penetrometer q_p Tons/Ft.^{2}	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
Gray SANDY CLAYEY SILT, with some fine gravel. moist, very stiff	23.0											
Brown fine to coarse SAND. moist, very dense to dense		25	8	SS	78		55				9	
	30.0		9	SS	78		38					
Boring discontinued at 30.0 feet depth.		30										
Boring caved in at 20.5 feet depth.		35										
		40										
		45										

GROUND WATER DEPTH
AT COMPLETION dry FT
AFTER 1 day 11.5 FT
WATER ON RODS FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0137883

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 11 Page 1 of 2
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/3/82 — Hammer Wt. 140 lbs.
Date Completed 9/3/82 — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in
Inspector PM — Rock Core Dia. — in
Boring Method HSA — Shelby Tube O.D. — in.

SOIL CLASSIFICATION (SURFACE ELEVATION — 576.7)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.8		1	SS	72		11					
Light brown CLAYEY SILT. dry, medium stiff	2.0											
Mottled brown SILTY CLAY, with gray streets and trace fine sand. moist, very stiff	7.8	5	2	SS	50		18				17	
			3	SS	56		17				22	
Mottled gray and brown SILTY SAND. very moist, medium dense	9.5	10	4	SS	72		12				23	
Mottled brown SANDY SILT, with medium sand seams. very moist, medium dense	13.0		5	SS	72		9				19	
Gray very sandy SILTY CLAY to SANDY SILTY CLAY, with some fine to medium gravel. moist, stiff to very stiff		15	6	SS	67		15				9	
		20	7	SS	89		28				12	
Brown fine to coarse SAND. moist, very dense	22.0	25	8	SS	67	▽	53				4	

S: 0137884
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C
R

GROUND WATER DEPTH
AT COMPLETION 30.0 FT
AFTER 4 hours 27.0 FT
WATER ON RODS FT

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

0056

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 11 Page 2 of 2
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/3/82 — Hammer Wt. 140 lbs.
Date Completed 9/3/82 — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in.
Inspector PM — Rock Core Dia. ____ in.
Boring Method HSA — Shelby Tube O.D. ____ in.

SOIL CLASSIFICATION (continued)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TEST DATA												
Gray very sandy SILTY CLAY to SANDY SILTY CLAY, with some fine to medium gravel. moist, stiff to very stiff	22.0											
		25	8	SS	67		53				4	
Brown fine to coarse SAND. moist, very dense												
	30.0	30	9	SS	72	▽	19					
Boring discontinued at 30.0 feet depth.												
Boring caved in at 27.0 feet depth.		35										
		40										
		45										

37885

GROUND WATER DEPTH
AT COMPLETION 30.0 FT
AFTER 4 hours 27.0 FT
WATER ON RODS ____ FT

BORING METHOD
HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD — MUD DRILLING

0057

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LABORATORY REPORT OF SOIL EXPLORATION

Client NLO, Inc. — Boring # 12 Page 1 of 2
Architect Engineer — Job # 22-23071
Project Name FMPC Water Pollution Control — Drawn By TT
Project Location Fernald, Ohio — Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/3/82 — Hammer Wt. 140 lbs.
Date Completed 9/3/82 — Hammer Drop 30 in.
Drill Foreman BC — Spoon Sampler O.D. 2 in.
Inspector PM — Rock Core Dia. ____ in.
Boring Method HSA — Shelby Tube O.D. ____ in.

SOIL CLASSIFICATION SURFACE ELEVATION — 576.5	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
TOPSOIL	0.4		1	SS	67		23					
Light brown CLAYEY SILT, with trace fine sand. dry, very stiff	2.0		2	SS	56		10				19	
Mottled brown SILTY CLAY, with gray streaks and numerous thin silt seams. moist, medium stiff to stiff		5	3	SS	67		13				19	
			4	SS	67		17				20	
	10.5	10	5	SS	83		7				19	
Brownish gray fine SANDY SILT to SILT. very moist, medium stiff	13.5		6	SS	83		31				20	
Brown fine to medium SAND. wet, dense	17.5	15										
Gray SANDY SILTY CLAY. very moist, very stiff			7	SS	44		20				17	
	21.0	20				▽						
Brown fine to coarse SAND, with some fine gravel. moist to wet at 29.0 feet/ very dense to dense			8	SS	67		50				3	
		25										

GROUND WATER DEPTH
AT COMPLETION 22.0 FT
AFTER ____ FT
WATER ON RODS 13.0 FT

BORING METHOD
HSA -- HOLLOW STEM AUGERS
CFA -- CONTINUOUS FLIGHT AUGERS
DC -- DRIVING CASING
MD -- MUD DRILLING

SS ST 0137886

0058

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LABORATORY REPORT OF SOIL EXPLORATION

Client: NLO, Inc.
Architect Engineer:
Project Name: FMPC Water Pollution Control
Project Location: Fernald, Ohio

Boring # 12 Page 2 of 2
Job # 22-23071
Drawn By TT
Approved By RTS

DRILLING and SAMPLING INFORMATION

Date Started 9/3/82 Hammer Wt. 140 lbs.
Date Completed 9/3/82 Hammer Drop 30 in.
Drill Foreman BC Spoon Sampler O.D. 2 in.
Inspector PM Rock Core Dia. in.
Boring Method HSA Shelby Tube O.D. in.

SOIL CLASSIFICATION (continued)	STRATUM DEPTH	DEPTH SCALE	SAMPLE NO.	SAMPLE TYPE	% RECOVERY	GROUND WATER	TEST DATA: Standard Penetration Test N, Blows/Ft.	Unconfined Compressive Strength q_u Tons/Ft.²	Pocket Penetrometer q_p Tons/Ft.²	Natural Dry Density lbs./cu. ft.	Water Content %	Atterberg Units LL - Liquid Limit PL - Plastic Limit
Gray SANDY SILTY CLAY. very moist, very stiff	21.0					▽						
Brown fine to coarse SAND, with some fine gravel. moist to wet at 29.0 feet/ very dense to dense		25	8	SS	67		50				3	
			9	SS	83		37				4	
	30.0	30										
Boring discontinued at 30.0 feet depth.												
Boring caved in at 14.5 feet depth.		35										
		40										
		45										

0137887

GROUND WATER DEPTH
AT COMPLETION 22.0 FT
AFTER FT
WATER ON RODS 13.0 FT

BORING METHOD
HSA -- HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
DC — DRIVING CASING
MD MUD DRILLING

0059

4770

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Consulting Geotechnical & Materials Engineers

GRADATION CURVES

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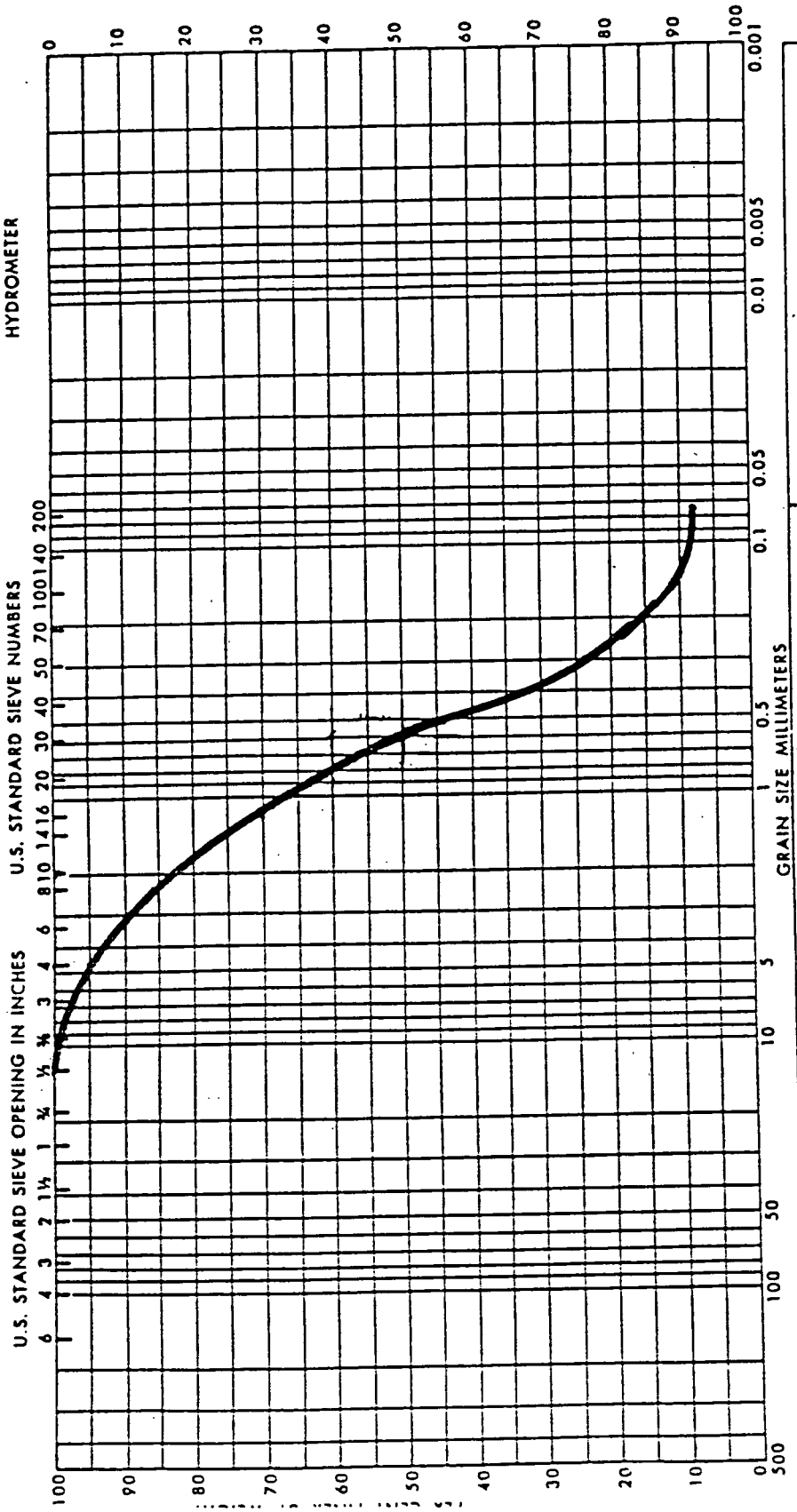

SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
8	23.5 to 25.0 feet	Gray fine to coarse SAND, with trace fine gravel	8			

PROJECT: FMPC Water Pollution Control
AREA: Storm Water Holding Basin
BORING NO. 8
DATE: September 17, 1982

ATEC JOB NO: 22-23071
CLIENT: NLO, Inc.

0060

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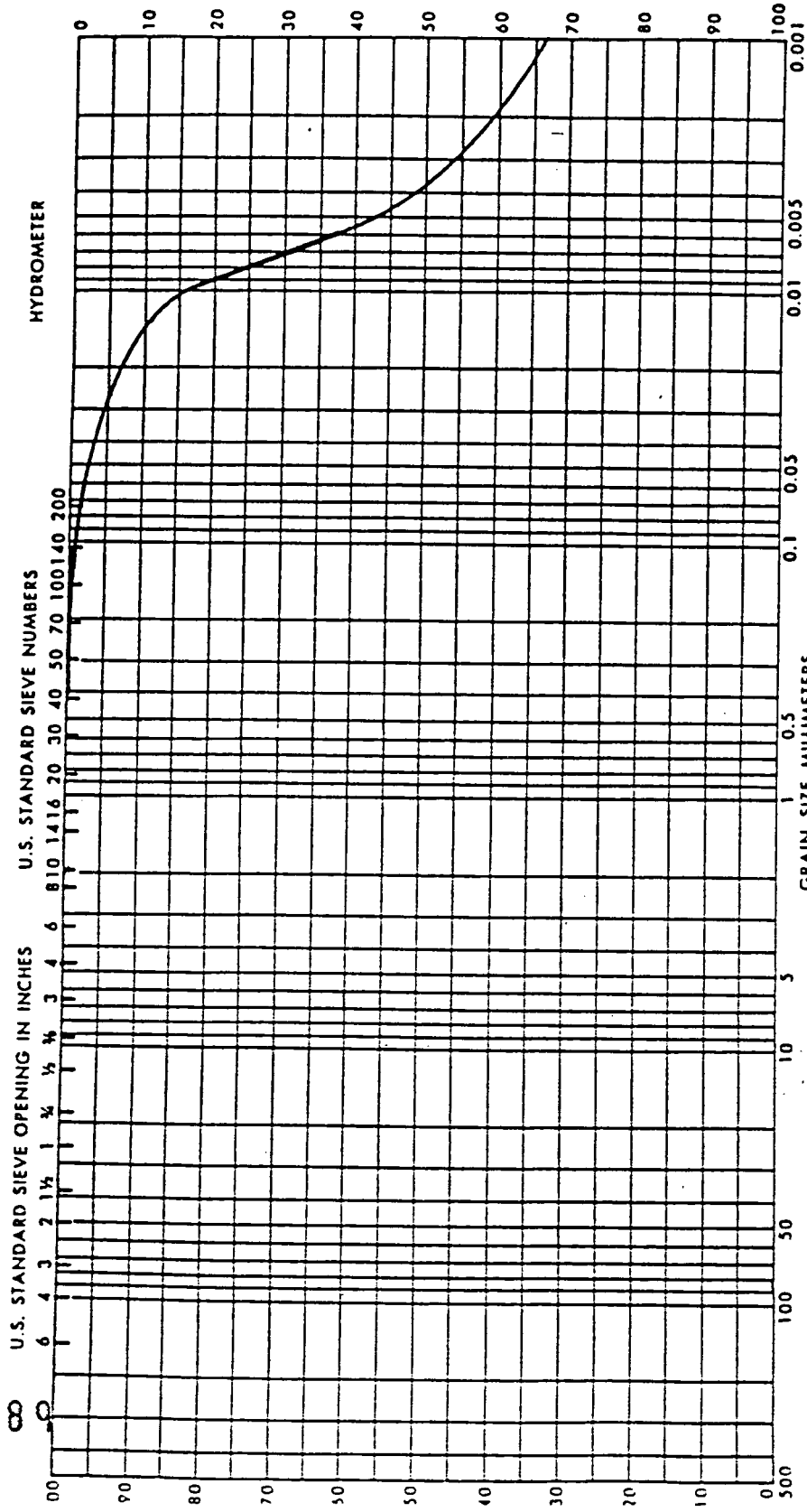
4770

GRADATION CURVES



SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
4	7.5'-9.0'	Brownish gray SILTY CLAY, with trace fine sand	20			

PROJECT: FMPC Water Pollution Control
AREA: Storm Water Holding Basin
BORING NO. 9
DATE: September 17, 1982

ATEC JOB NO: 22-23071
CLIENT: NLO, Inc.

0131880

0061

ATEC Associates, Inc.

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MOISTURE/DENSITY RELATIONSHIP
(Proctor Method)

4770

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Client: NLO, Inc. ATEC Job No: 22-23071

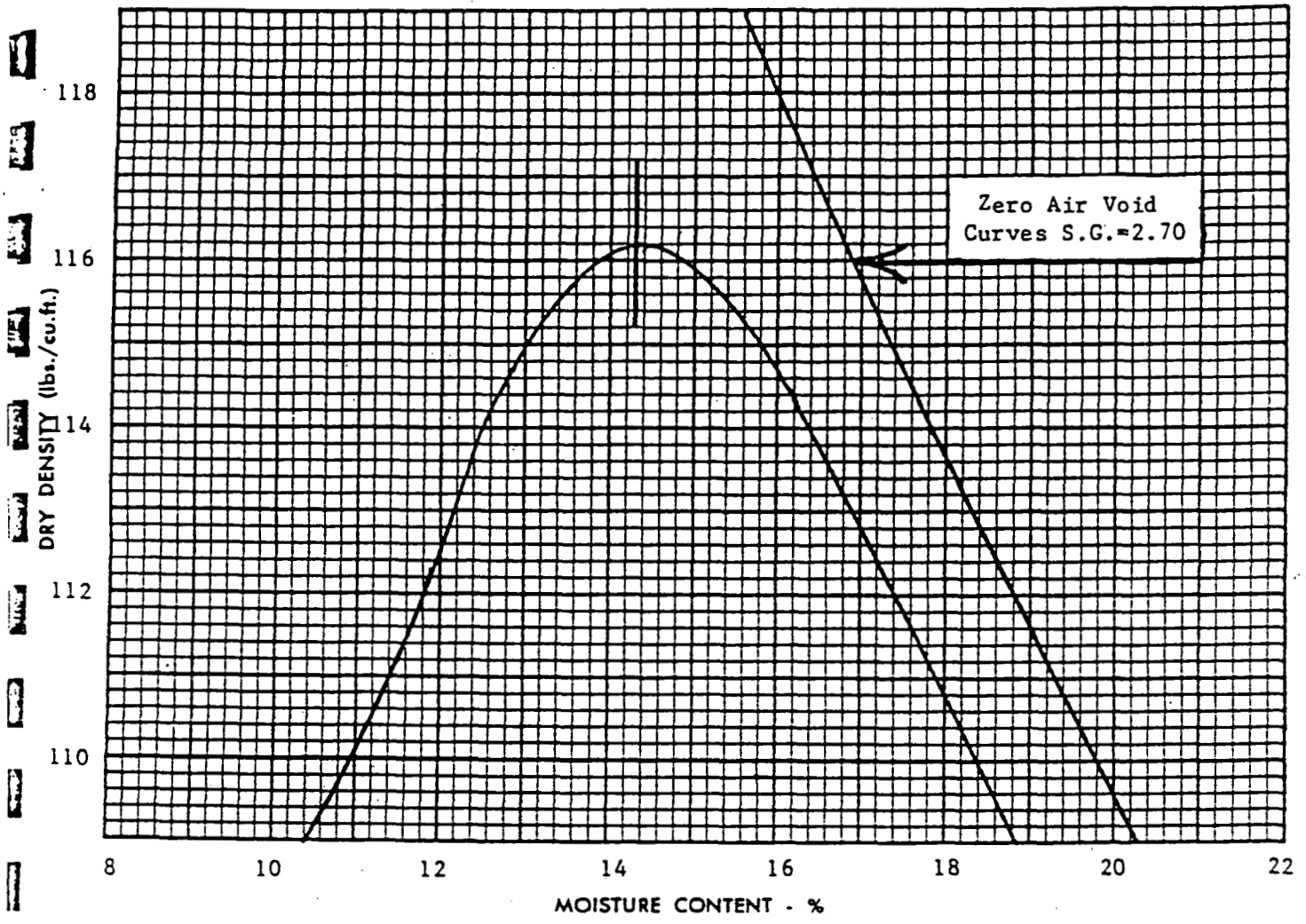
Project Name: FMPC Water Pollution Control Project location: Fernald, Ohio

Sample obtained from: B-2, 2 to 4 feet Sample No: 1

Sample Description: Mottled brown CLAYEY SILT, with trace fine sand

Test Type: ASTM D-698 Method A Proctor: STANDARD

Tested by: Stan Ramge Date: September 24, 1982



Maximum Dry Density 116.2 lbs./cu.ft. Optimum Moisture 14.3 %

Remarks: LL = 25

PL = 16

PI = 9

0137090

USCS Classification: CL - ML

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MOISTURE/DENSITY RELATIONSHIP
(Proctor Method) 4770

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Affiliates: Beckley/Norfolk/Santa Rosa/Riyadh

Client: NLO, Inc. ATEC Job No: 22-23071

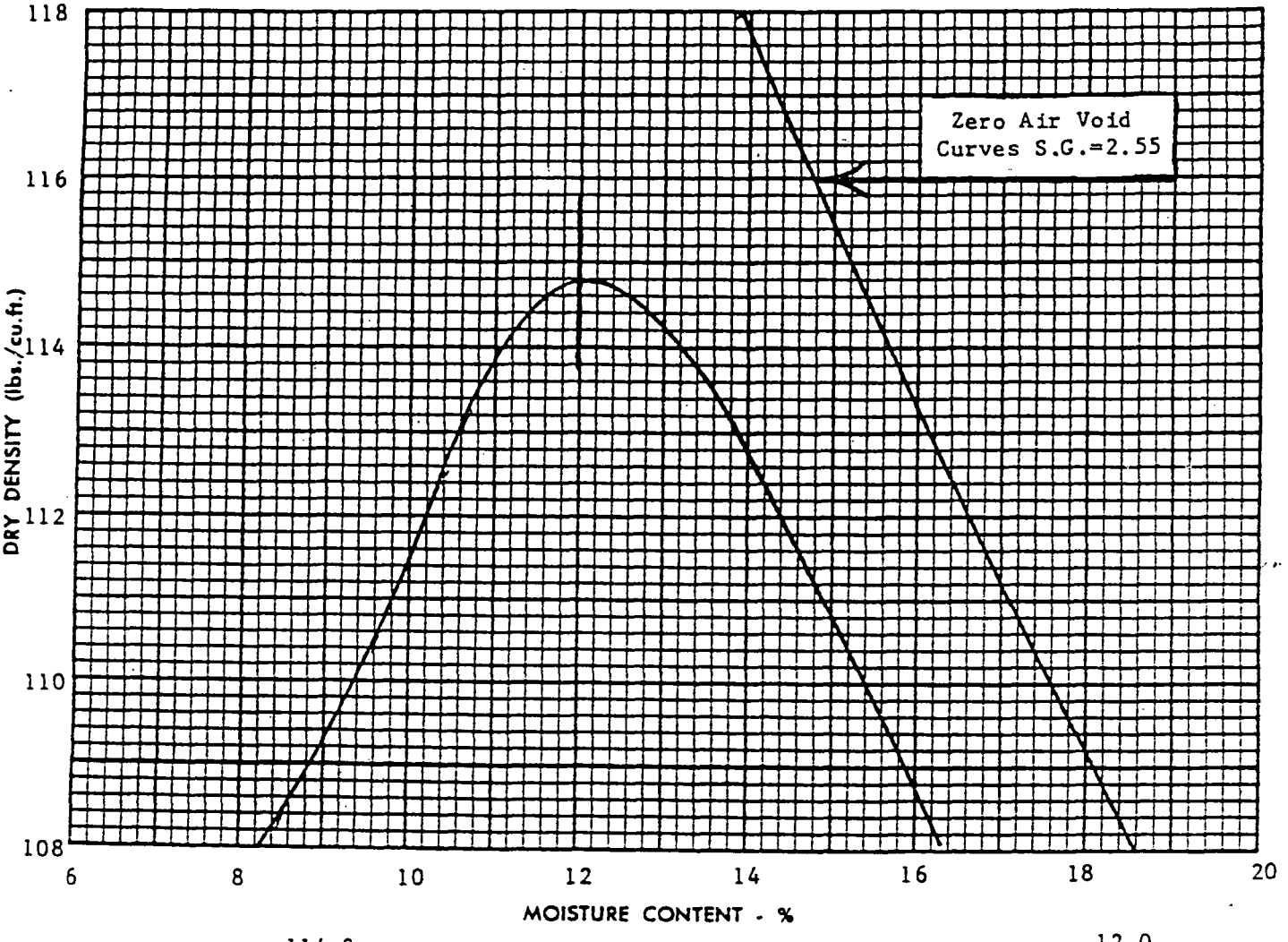
Project Name: FMPC Water Polluction Control Project location: Fernald, Ohio

Sample obtained from: Borrow Area North of Surge Lagoon, 1 to 3 feet Sample No: 2

Sample Description: Dark gray CLAYEY SAND, with silt and gravel

Test Type: ASTM D-698 Method A Proctor: STANDARD

Tested by: Stan Ramge Date: September 24, 1982



Maximum Dry Density 114.8 lbs./cu.ft. Optimum Moisture 12.0 %

Remarks:

0137891

0063

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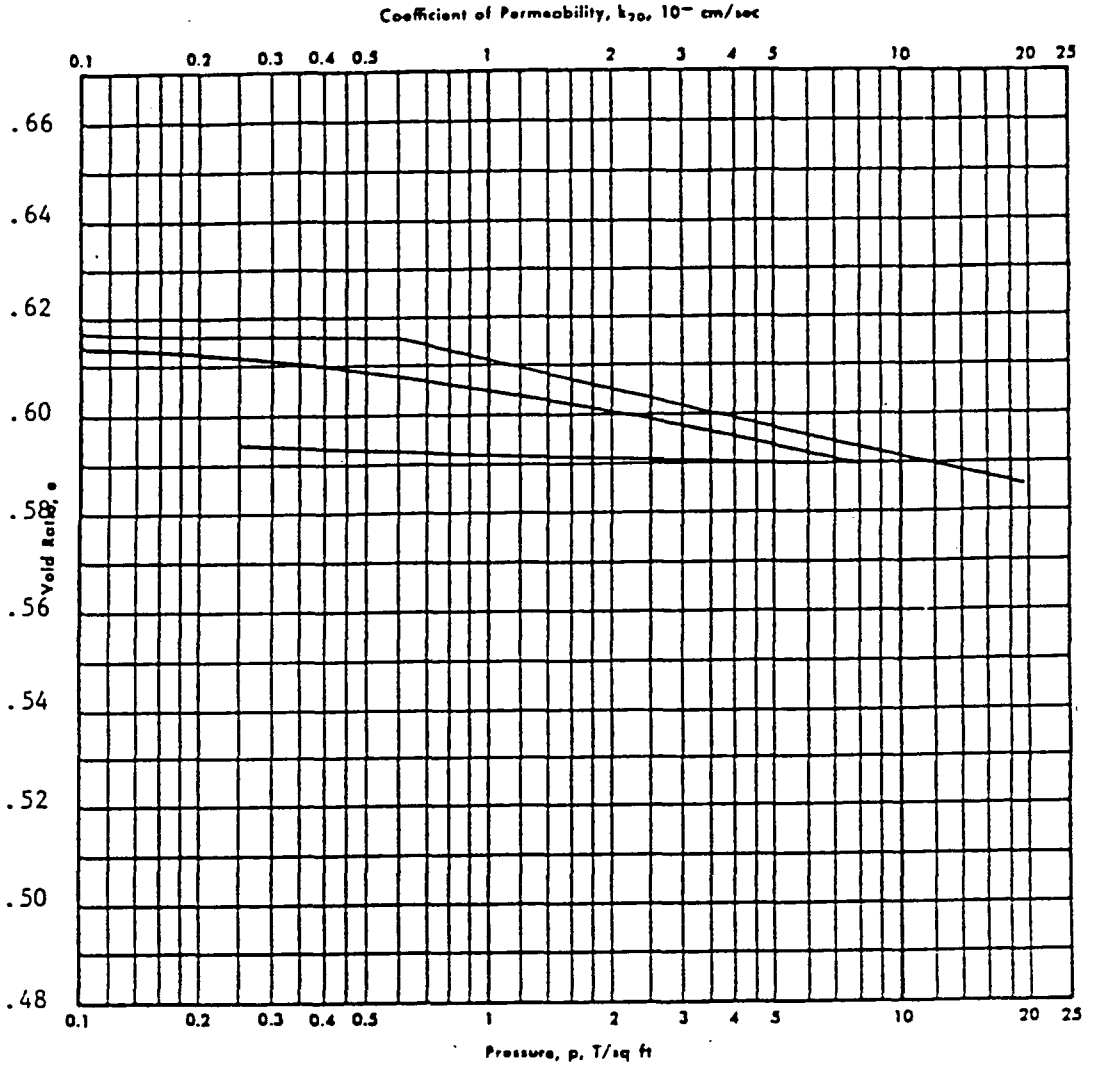
CONSOLIDATION TEST REPORT 4770



Type of Specimen	SHELBY TUBE			Before Test		After Test	
Diam	2.50 in.	Ht	0.993 in.	Water Content, w_o	23.3 %	w_f	27.7 %
Overburden Pressure, p_o	0.5 T/sq ft			Void Ratio, e_o	0.617	e_f	0.593
Preconsol. Pressure, p_c	-- T/sq ft			Saturation, S_o	98.3 %	S_f	100.0 %
Compression Index, c_c	0.019			Dry Density, γ_d	102.4 lb/ft³		
Classification	CL - ML			k_{30} at e_o =	$\times 10^{-}$ cm/sec		
LL	23	G.	2.65 (assumed)	Project	FMPC Water Pollution Control		
PL	17	D_{10}			Fernald, Ohio		
Remarks	Gray CLAYEY SILT			Area	Surge Lagoon		
0137892	C_c = 0.0016			Boring No.	3	Sample No.	2
				Depth El	7 to 9 feet	Date	

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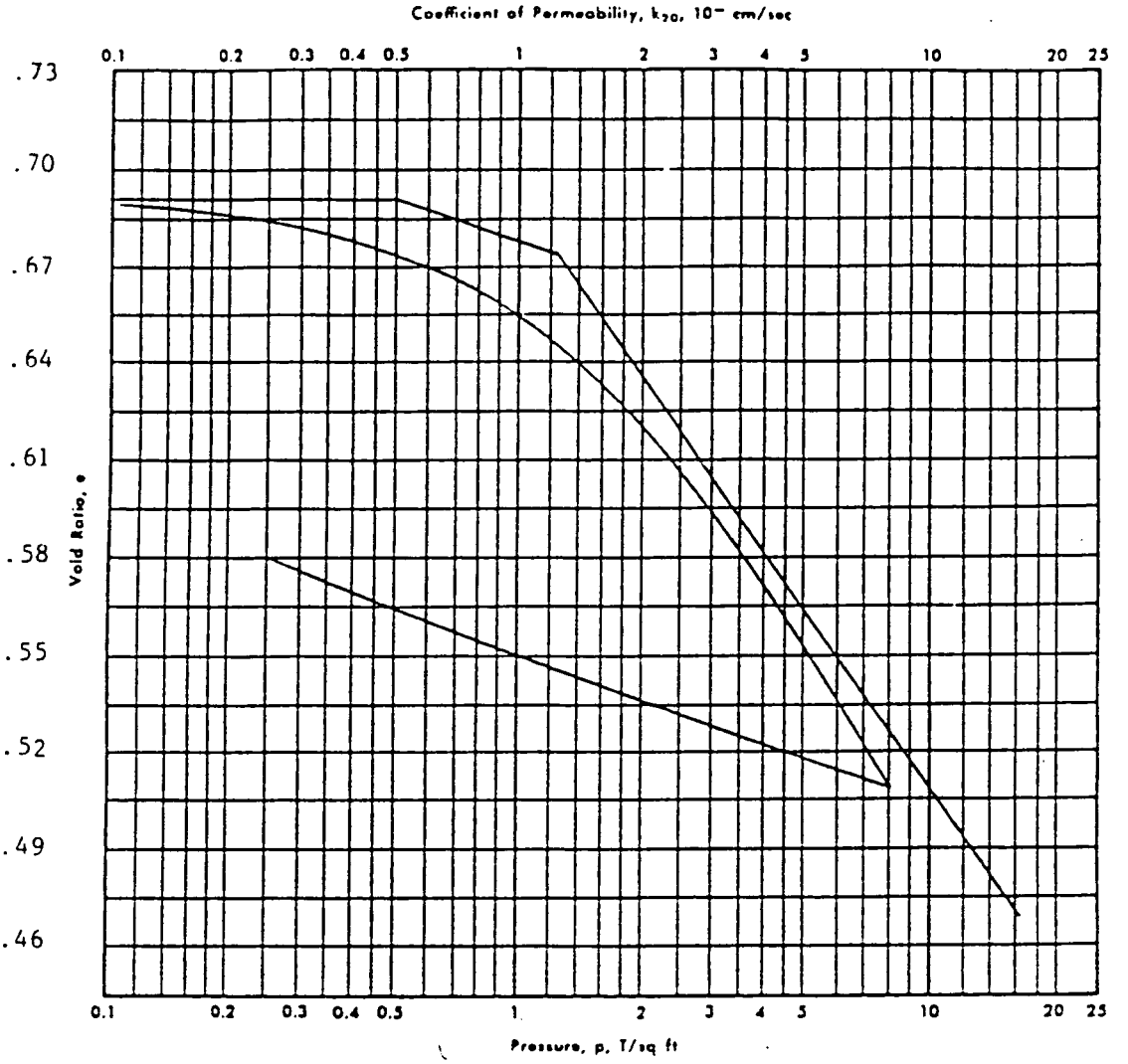
CONSOLIDATION TEST REPORT 4770



Type of Specimen	SHELBY TUBE			Before Test		After Test	
Diam	2.50 in.	Ht	1.00 in.	Water Content, w_o	24.9 %	w_f	20.3 %
Overburden Pressure, p_o	0.49 T/sq ft			Void Ratio, e_o	0.691	e_f	0.580
Preconsol. Pressure, p_c	1.22 T/sq ft			Saturation, S_o	95.3 %	S_f	100.0 %
Compression Index, c_c	0.179			Dry Density, γ_o	97.8 lb/ft³		
Classification	CL			k_{20} at e_o =	× 10^{-} cm/sec		
LL		G.	2.65 (assumed)	Project	FMPC Water Pollution Control		
PL		D_{10}			Fernald, Ohio		
Remarks	Mottled brown and gray CLAYEY SILT			Area	Biodenitrification System		
	C_r = 0.053			Boring No.	6	Sample No.	1
	C_c = 0.045			Depth El	7 to 9 feet	Date	

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