90-SDP-8-92P
Correspondence

Con 12-1-1
Doc # 59293

MONTGOMERY WATSON

January 19, 1995

Ms. Patricia Schwarz
Iowa Department of Natural Resources
900 East Grand
Des Moines, IA 50319

MW #3400.0090

RE: Geotechnical Report - Landslide Area
Ottumwa-Midland Commercial Landfill

Dear Ms. Schwarz:

This letter is written to inform you of a landslide problem, subsequent investigation, and implemented solution at the Ottumwa-Midland Commercial Landfill construction site near Ottumwa, Iowa. The landslide was investigated by a qualified geotechnical engineering firm. The solution recommended by the investigating firm was implemented, and construction continued. Mr. Paul Brandt, of the Iowa Department of Natural Resources, Field Office Number 6, subsequently visited the site and was briefed on the slope stability problem and the implemented solution. Mr. Brandt commented that the construction appeared to be progressing at a reasonable pace and that, overall, the site looked good.

A small landslide was identified in November, 1994 on the east berm of the future landfill. Huntingdon Engineering and Environmental, Inc. (Huntingdon), who had previously been retained by IES Utilities, Inc. to perform in-place density tests on site, was retained to perform a geotechnical investigation of the landslide area. Huntingdon's recommendations were subsequently included in a letter report (Attachment A). It appears that the landslide was caused by earthwork being done in the area (necessary to install the groundwater underdrain layer), in combination with groundwater seeping from the east berm. These two conditions led to a small area of instability, which occurred at the overburden/clayey shale interface.

The solution, as recommended by Huntingdon, was to install a series of subsurface drains along the east berm, under the groundwater drainage layer. In combination with the construction of the 25 percent fill slope for the east berm of the groundwater underdrain system, installation of these drains would provide an adequate factor of safety against slope failure in the future (see Attachment A). The subsurface drains were designed by Montgomery Watson, and a detail is included as Attachment B. The subsurface drains were installed at 100 foot intervals at locations coincident with groundwater cleanout pipes along the east berm, and now tie into the groundwater underdrain piping system. The

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Serving the World's Environmental Needs additional drains will allow groundwater perched on the clayey shale to drain freely out of the landfill, as the groundwater underdrain system originally intended.

The construction of the east berm has continued and is approximately 70 percent complete; no subsequent problems with sliding have been observed. We believe that the landslide problem is now taken care of, and no further difficulties are expected. If you would like to discuss this matter further, or require additional information, please contact either John Cummings or me.

Sincerely,

Thomas A. Blair

Thomas A. Blair
Project Engineer

jrc/nes
Attachments

cc Alan Arnold, IES Utilities
Paul Brandt, IDNR Field Office Number 6

ATTACHMENT A

GEOTECHNICAL EXPLORATION REPORT
LANDSLIDE REMEDIATION
OTTUMWA-MIDLAND COMMERCIAL LANDFILL
OTTUMWA, IOWA
LAB NO. 6010-95-0009

PERFORMED FOR

IES UTILITIES, INC.
BOX 351
CEDAR RAPIDS, IOWA 52406

Huntingdon
Consulting Engineers Environmental Scientists

Patzig Testing Laboratories Company Inc.

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration; the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations.

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report:

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership; or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed.

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts.Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

Huntingdon
Consulting Engineers Environmental Scientists

Patzig Testing Laboratories Company Inc.
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GEOTECHNICAL EXPLORATION REPORT
LANDSLIDE REMEDIATION-OTTUMWA-MIDLAND COMMERCIAL LANDFILL
OTTUMWA, IOWA
LAB NO. 6010-95-0009

PERFORMED FOR

IES UTILITIES, INC.
BOX 351
CEDAR RAPIDS, IOWA 52406

DECEMBER 16, 1994

INTRODUCTION

This report presents the data from six (6) test borings conducted at the above project. The purpose of this exploration is to determine the soil profile and to evaluate physical characteristics of subsurface conditions with respect to the project design. Contained herein is a summary of the project characteristics as we understand them, a discussion of the subsurface conditions encountered, and recommendations based on the results of this exploration. This exploration has not been designed to include procedures intended to determine the presence or extent of any potential environmental contamination at this site.

-Continued-

AUTHORIZATION

This geotechnical exploration was performed in accordance with our proposal and general conditions dated October 20, 1994 and authorized by IES Purchase Order No. B09935 dated November 2, 1994.

PROJECT INFORMATION

The engineering recommendations provided in this report are based on our understanding of the project as described in the following paragraphs. The recommendations are valid for a specific set of project conditions. If the characteristics of the project change from those indicated in this report, it is necessary that we be contacted and given the opportunity to review our recommendations in light of the changed conditions.

IES Utilities, Inc. anticipates the development of a new commercial landfill at a former open pit brick clay site near Ottumwa, Iowa. Clay and clay shale for the manufacture of brick was mined by open pit methods wherein existing slopes were constructed by excavation to finish grades on the order of 2:1 and 3:1 (horizontal to vertical). Review of a topographic map, developed from aerial photography dated December 22, 1992, indicates discontinuities in contours along the east boundary of the site where existing grades range between 825 and 760 feet, sloping downward from east to west. Review of aerial photographs reportedly taken in 1993 clearly indicate the discontinuities in the topographic contours as the result of a landslide in this area.

-Continued-

IES Utilities, Inc. plans the construction of a commercial landfill and construction drawings have been prepared by Montgomery Watson Consulting Engineers of Des Moines, Iowa. The design plans indicate that the commercial landfill will involve cut-and-fill construction to develop 4:1 (horizontal to vertical) finish slopes with a leachate collection system and an engineered liner for the commercial landfill. Therefore, the new 4:1 (horizontal to vertical) slopes will result in the placement of 20 to 25 feet of new fill over the present landslide to provide the desired final grades.

A site visit was performed by a representative of Huntingdon Engineering & Environmental, Inc. on October 20, 1994 for the purpose of reviewing existing conditions. At the time of our site visit, preliminary earthwork had been performed for construction of the new commercial landfill and based on conversations with on-site personnel, the landslide area had experienced additional movement on two occasions, most likely due to excavation of overburden materials near the toe of the landslide. A landslide scarp was visible at the time of our site visit and movement of the overburden soils on top of clay shale bedrock was noted. Ground water seepage was noted at the base of the scarp and additional relic landslide scraps were noted south of the most recent landslide activity.

The purpose of this exploration was to explore subsurface conditions with respect to the soil and bedrock profile at the site, ground water conditions, in-situ soil strength parameters, and perform slope stability analyses in order to provide recommendations for safe slope construction.

-Continued-

FIELD EXPLORATION

Six (6) exploratory borings were drilled at the site to depths ranging between 5 and 35 feet during the period of October 25 and 26, 1994. Test boring locations shown on the enclosed Boring Site Plan were measured in the field from existing landmarks. Surface elevations of the test borings shown on the Log of Test Borings enclosed in the Appendix were interpolated from contours on a Site Plan prepared by Montgomery Watson. A brief description of the drilling, sampling, standard laboratory testing techniques, and other related information is provided in the Appendix to this report.

SUBSURFACE CONDITIONS

Geology

The project site is located within a geomorphic region known as the "Southern Iowa Drift Plain". The region is characterized by steeply rolling hills with areas of level upland divides and alluvial lowlands. Soil stratigraphy generally consists of Wisconsinan loess over paleosol underlain by Pre-Illinoian glacial till. The loess is an eolian (wind) deposit of clayey silt soil and tends to have a relatively uniform particle size. The underlying paleosol is generally weathered glacial drift with clay predominating the soil matrix. Pre-Illinoian glacial till generally underlies the paleosol and consists of a well graded mixture of clay, silt, and sand having pebbles, cobbles, and occasional boulders. The Pre-Illinoian glacial till will be underlain by the Pennsylvanian bedrock system which consists of undifferentiated formations of shale, coal, sandstone, and limestone.

-Continued-

Soil Profile

Six (6) exploratory borings were drilled at the site to depths between 5 and 35 feet below existing grades. Detailed descriptions of soils encountered by this exploration are provided on the Log of Test Borings enclosed in the Appendix.

Bedrock identification as shown on the Log of Test Borings is based on visual classification and our experience; petrographic analysis may indicate other rock types or units to exist. An explanation of our Rock Description Terminology is included in the Appendix.

In general, the test borings encountered a subsurface profile consisting of overburden soils and Pennsylvanian bedrock consistent with the previously described regional geology. Test Boring Nos. 1 and 5, which were drilled in upland positions, encountered loess underlain by paleosol overlying Pre-Illinoian glacial till. The Pre-Illinoian overburden soils included a stratum of glacial drift consisting of reddish brown silty fine sand containing traces of gravel. Both moisture seepage and long term water levels were observed to be within the glacial drift in both of these upland position test borings.

Test Boring Nos. 2, 3, and 6 were drilled at downslope positions and encountered either fill or glacial drift underlain by bedrock. Test Boring Nos. 2 and 3 were drilled at the most recent landslide area and fill due to preliminary earth work activities was encountered above the natural clay shale bedrock. Test Boring No. 6, which was drilled downslope of Test Boring No. 5, encountered fill overlying the glacial bedrock.

-Continued-

Natural clay shale bedrock was encountered beneath the overburden soils in Test Boring Nos. 1, 2, 3, 5, and 6. The clay shale bedrock typically consisted of dark gray and black clay shale ranging in moisture content from damp to dry, moisture content decreasing with depth. A two inch thick coal seam was encountered in Test Boring No. 1 within the clay shale bedrock. Test Boring No. 4 was drilled in recently placed compacted clay shale fill for the purpose of determining properties of proposed landfill construction materials.

In addition to undisturbed samples obtained at the time of the field exploration, in-situ borehole shear tests were performed to obtain shear strength parameters of soil and bedrock at the site for slope stability analyses. The following Table No. 1 presents a summary of the in-situ borehole shear test results performed for this exploration.

TABLE 1

Summary of In-Situ Bore Hole Shear Tests

Test Boring Number	Depth (feet)	Material Type	Moisture Content (percent)	Dry Unit Weight (pounds/cubic foot)	Cohesion (pounds/square foot)	Friction Angle (degrees)
4	3.5	Shale Fill	17.5	----	1680	15
5	23.5	Sand	17.7	116	22	23
6	4.5	Clay Shale	17.7	105	1165	17

Ground Water Observations

Ground water accumulation was monitored in the test borings during and shortly after the completion of drilling operations. We wish to point out that these ground water observations are not necessarily a true indication of the static ground water conditions. In order to accurately

-Continued-

determine the static ground water level, observation over a long period of time is usually required. Such periods of observation are normally not available in a typical soil boring exploration program.

The results of our water level observations are provided on the Log of Test Borings enclosed in the Appendix. Moisture seepage was noted during drilling operations within the glacial drift near depths of 21 and 23 feet below existing grades in Test Boring Nos. 1 and 5. Upon completion of drilling operations, ground water accumulation was observed near depths of 20 and 21.5 feet below existing grades in Test Boring Nos. 1 and 5. Ground waster seepage was observed at existing ground surface near Test Boring Nos. 2 and 3.

The free ground water surface or ground water table within unconfined aquifers is generally a subdued reflection of surface topography and water generally flows downward from upland positions (recharge zones) to low lying areas or surface water bodies (discharge zones). Therefore, ground water levels and the level of any perched water at the project site will vary with climatic conditions, surface drainage, site topography, and subsurface drainage.

<u>Slope Stability Analysis</u>

Soil on a sloping ground surface is subject to gravitatio[illegible] which tend to pull the soil downward creating a more level surface. Downward mov[illegible] shear strength of the soil. Depending upon slope and soil p[illegible] seepage forces could add to the downhill forces tending to pull the soil downward. [illegible] forces of gravitation and seepage should exceed resisting soil shear strength, the soil will slump or slide down the slope until the activating and resisting forces become equal. Analysis of slope

-Continued-

stability requires the determination of the soil zone where the ratio of activating and resisting forces is the most severe. The magnitude of activating and resisting forces will depend upon slope geometry, soil characteristics (texture, density, shear strength, moisture content, etc.) and ground water conditions.

The ratio of activating to resisting forces is often referred to as a factor of safety. A factor of safety equal to 1.0 indicates that these forces are in equilibrium and no movement will occur. A factor of safety of greater than 1.0 indicates that there is a margin of safety against movement. The closer the factor of safety is to 1.0, the probability of movement is greater. The degree of risk or the magnitude of the factor of safety which is considered acceptable depends upon many factors such as: unpredictable and unknown slope conditions, local experience, variability of the site conditions, cost of repair, and the owner's willingness to accept risk. In our opinion, the factor of safety for slope conditions similar to those encountered at this project should be at least 1.5.

Slope stability analyses for this project utilized a microcomputer program (PCSTABL4) provided by the Federal Highway Administration. PCSTABL4 calculates the factor of safety against slope failure using a two-dimensional limiting equilibrium method. Utilizing test boring data, water level observations, and the Iowa Borehole Shear Test results, PCSTABL4 randomly generates a series of potential failure surfaces and determines the most critical failure surface with the corresponding factor of safety. Several computer trial runs were conducted utilizing various slope geometries, subsurface profiles, and ground water surface profiles. The following is a summary of the slope stability analyses performed for this project.

-Continued-

1) Computer trials utilizing the observed ground water conditions at time of this exploration with the existing slope conditions and subsurface profile resulted in calculated safety factors ranging from 0.9 to 1.0. These analyses correlate well with the recent observations of landslide movements at the site.

2) Computer trials showed the most critical failure surface generally intersected the interface between the sand and shale bedrock surface.

3) Modeling the proposed new 4:1 (horizontal to vertical) slopes over the existing slope condition yielded a long term factor of safety ranging between 1.2 and 1.3.

4) As is the case with most landslides, ground water conditions and effects on shear strength parameters have a major influence on slope stability.

Modeling of the proposed 4:1 slopes with subsurface drains installed to positively drain the natural sands in the existing slope yielded a long term factor of safety of 1.6.

5) We conclude that a system of "fingers" drains integrally connected with the natural sands will provide the positive drainage necessary to provide a factor of safety greater than 1.5.

Belmondo's

RECOMMENDATIONS

Based on the results of the field exploration and our slope stability analyses, we recommend that a remedial program of subsurface drainage be implemented prior to slope reconstruction to provide positive drainage and minimize the potential for future landslide movements.

-Continued-

We recommend that subsurface drainage be installed in the form of "finger drains" to provide positive drainage of the existing failed slope prior to new slope construction. We envision that the finger drains would be installed perpendicular to the existing slope and initiate at the base of the existing slope and/or landslide scrap. The drains would be extended westerly and connect to the previously engineered underdrain system for the commercial landfill. The finger drains should consist of trenches having a minimum width of 18 inches and extend in depth to the top of the natural clay shale surface. Slotted or perforated PVC pipe should be installed in the bottom of the trench and encapsulated in clean free draining (less than 5 percent passing the No. 200 sieve) granular material. Transverse spacing for the finger drains should be on the order of 50 to 100 feet center to center.

GENERAL

The information contained in this report is based on data which are assumed to be representative of the site explored. Results are based on data obtained from the boring locations and extrapolated over the entire site. Careful observations should be made of conditions encountered during construction to insure that they are in agreement with conditions inferred from the results of this exploration. We make no warranty, either expressed or implied, for the

-Continued-

information contained within this report except that our services were performed in accordance with the level of care and skill practiced by members of the profession in this area and at this time.

Respectfully submitted,

HUNTINGDON ENGINEERING & ENVIRONMENTAL INC.

Michael T. Lustig, P.E.

MTL/mab
2 pc Above
Attn: Alan Arnold
1 pc Above
Montgomery Watson
Attn: John Cummings, P.E.

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of Iowa.

Signed: Date December 16, 1994

Michael T. Lustig, P.E. IA Reg No. 10059

My registration renewal date is December 31, 1994

A P P E N D I X

DRILLING AND SAMPLING

The test borings were conducted in accordance with the procedures indicated for each test boring. Soil sampling and/or in-situ testing such as Shelby Tube (ST), split-spoon (SS), drive cone (DC), or core (C) was conducted at depth intervals which were selected in consideration of the characteristics of the proposed construction. Generally, undisturbed soil samples are taken at 5-foot depth intervals or change in soil types. Disturbed soil samples from the auger, either jar size or bulk size samples, may be taken at intermediate intervals for purpose of soil classification or laboratory testing. Test borings conducted for soil classification only will show no designation of sampling although disturbed sampling is performed. Soil samples obtained in the field were identified and sealed for transportation to the laboratory for performance of pertinent physical testing and engineering classification.

STANDARD LABORATORY TESTING

Representative undisturbed soil samples were tested for moisture content, density (dry) and unconfined compressive strength in the laboratory. Results of these tests appear on the respective Log of Test Borings. Standard laboratory testing procedures are outlined on Page 2 of this section. Specialized laboratory testing (if conducted) to determine pertinent soil characteristics is discussed in the "Laboratory Testing" section of the report.

SOIL PROFILE AND LOG OF TEST BORINGS

The soil types encountered during the drilling operations were recorded on field logs. The soil profile represented on the Log of Test Borings is based on final classification performed by a geotechnical engineer. The soil stratigraphy demarcation lines shown on the Log of Test Borings indicate changes in soil characteristics, however, actual soil changes or variations may occur as a gradual transition.

Where the soil is identified with a two letter designation conforming to the Unified Soil Classification System, this classification is generally based upon visual and apparent physical soil characteristics, comparison with other samples, and our experience with the soil. Additional soil testing including grain size analysis and Atterberg Limits are conducted, if necessary, for classification in accordance with the Unified Soil Classification System.

Soil profile discussion, Log of Test Borings information, water levels and recommendations presented in this report are based upon measured depths below ground levels existing at time of the field exploration unless otherwise specified.

LAB. NO. 6010-95-0009

TEST BORING LEGEND

Drilling Method

CFA - Continuous Flight Auger; 4, 6 or 8-inch diameter (ASTM D1452)

RD - Rotary Drilling; using drilling fluid in cased or uncased boring (ASTM D2113)

HSA - Hollow Stem Auger; 6 or 8-inch diameter, continuous flight auger remains in boring with soil removed from hollow stem through which undisturbed sampling is conducted

Depth to Water

Depth to free water in boring measured from ground surface at times indicated after completion of boring.

C&D - Caved and Dry at depth indicated

C&W - Caved and Wet at depth indicated

Sample Type

ST - Shelby Tube; thin-walled tube samples of cohesive soils (ASTM D1587)

SS - Split Spoon; penetration test and split-barrel samples (ASTM D1586)

DC - Drive Cone; dynamic in-place testing of soil using a 2-inch diameter cone with a 60° point driven into the soil for continuous 1-foot intervals in the same manner as Split Spoon, no sample obtained

C - Core; sampling hard soil or bedrock with a diamond core barrel in a rotary drill boring (ASTM D2113)

SPT - Standard Penetration Test; number of blows required to drive sampler (split spoon or drive cone) into the soil with a 140-pound weight dropping a distance of 30 inches (ASTM D1586), number of blows recorded for each 6-inch interval in an 18-inch (or more) penetration depth, values shown are for each 6-inch interval (if a series of number sets are shown) or a total of the last two 6-inch intervals (if only one number set is shown) which is commonly referred to as "N" in blows per foot. High resistance is indicated by number of blows for a lesser penetration depth listed in inches.

TEST BORING LEGEND - continued

Standard Laboratory Testing

MC - Moisture Content; expressed in percent (%) on an oven-dry weight basis (ASTM D2216)

D - Density (dry); expressed in pounds per cubic foot (pcf) on an oven-dry weight basis

UCS - Unconfined Compressive Strength; expressed in pounds per square foot (psf) for cohesive soils (ASTM D2166)

Water Level

WL - Water Level; indicator at measured depth from ground surface to water

CONSISTENCY AND DENSITY NOMENCLATURE

Consistency of Cohesive Soils

Consistency	UCS (psf)	SPT (bpf)
Very Soft	0 - 500	0 - 2
Soft	500 - 1000	2 - 4
Medium Stiff	1000 - 2000	4 - 8
Stiff	2000 - 4000	8 - 15
Very Stiff	4000 - 8000	15 - 30
Hard	Over 8000	30 - 100

Density of Granular Soils

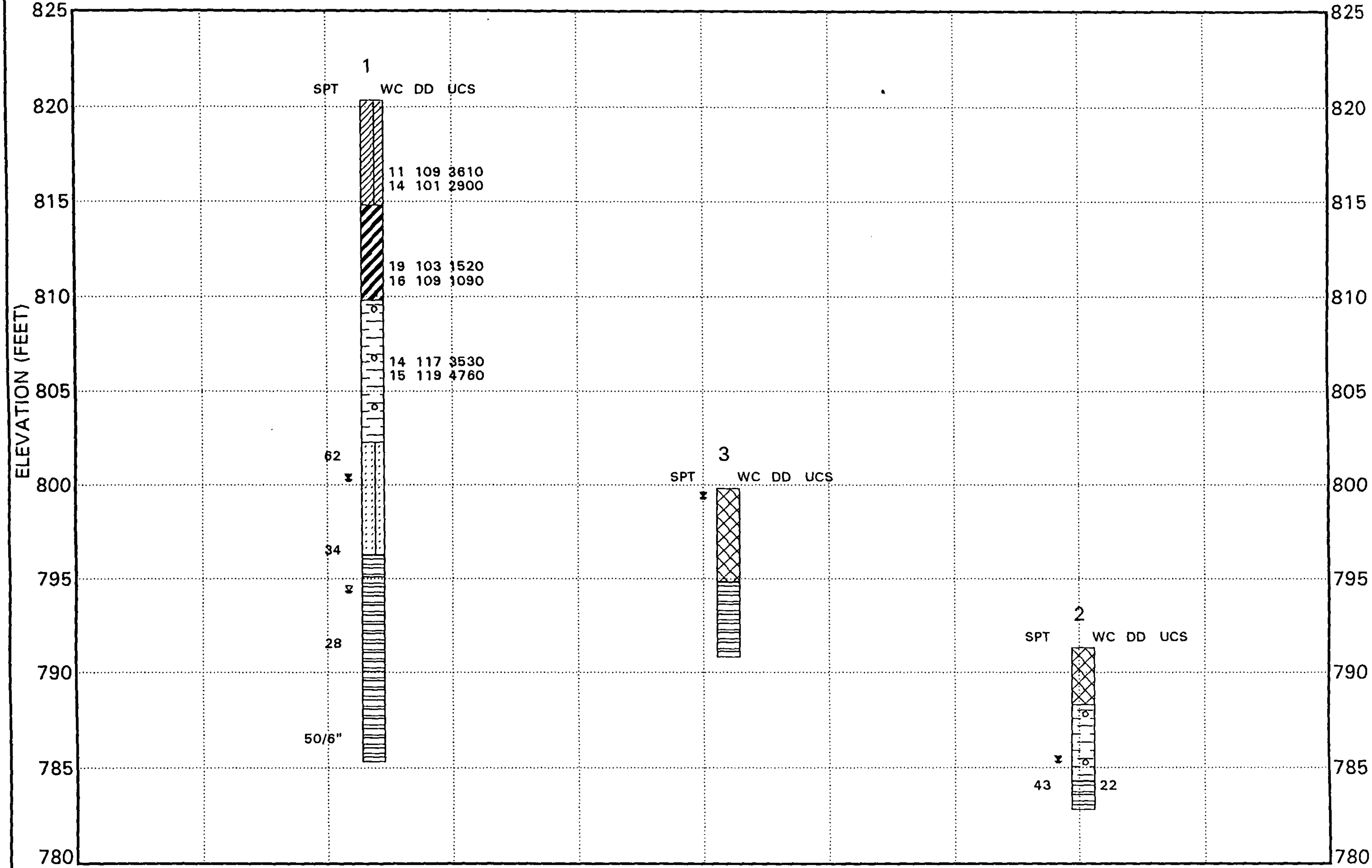
Density	SPT (bpf)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

COMMONLY USED ABBREVIATIONS

ft. or ' - feet
in. or " - inches
psf - pounds per square foot
pcf - pounds per cubic foot
kip - 1000 pounds
ksf - 1000 pounds per square foot
k/f - 1000 pounds per lineal foot
tsf - tons per square foot
bpf - blows per foot

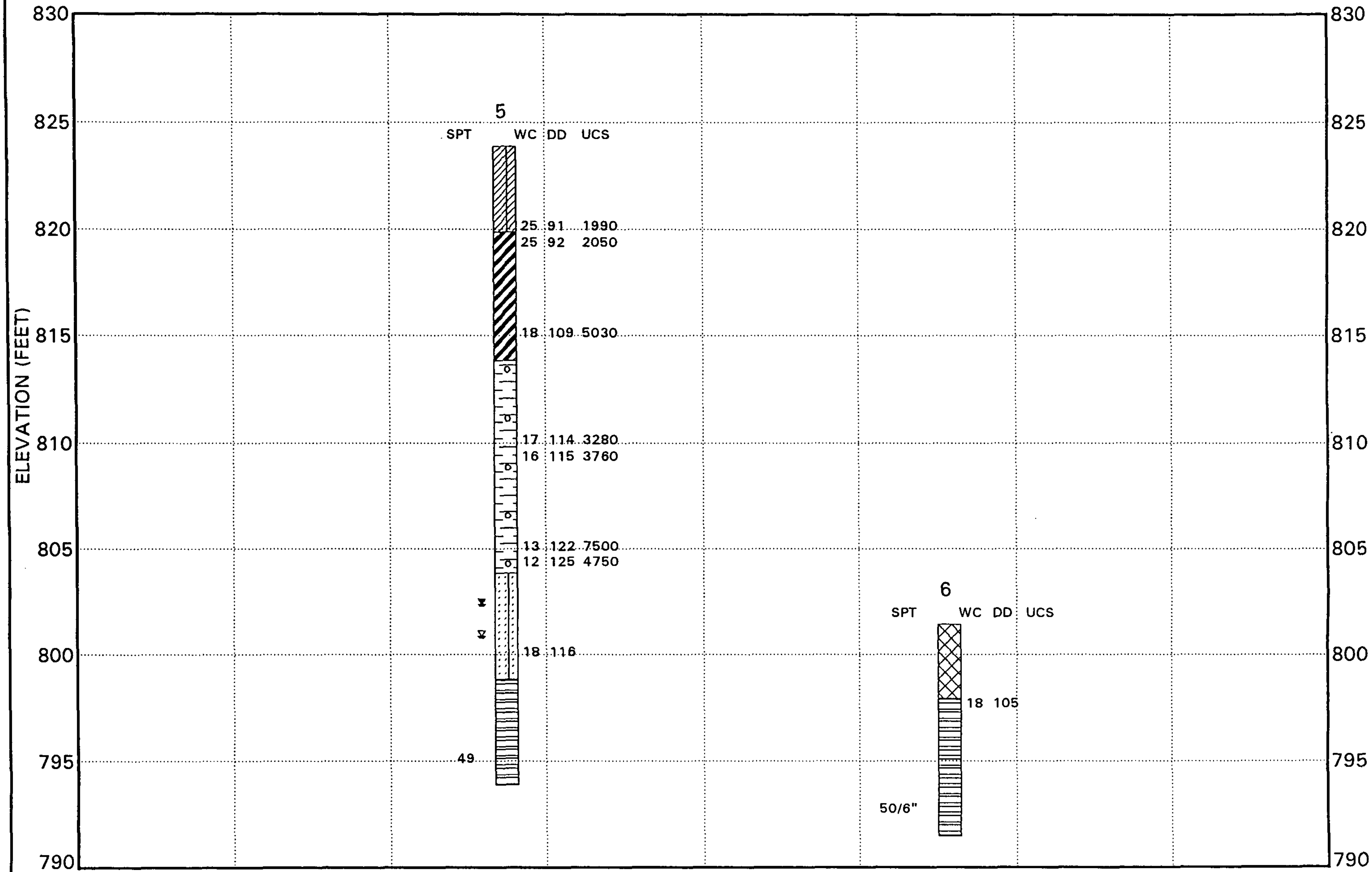
elev. - elevation
% - percent
No. - number
TB - test boring
N - blow count (SPT)
USC - United Soil Class.
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index

Lab No. 6010-95-0009



SUBSURFACE SOIL PROFILE	Ottumwa-Midland Landfill Ottumwa, Iowa	PROJECT # 6010-95-0009	DATE NOV 94	PLATE 1

Lab No. 6010-95-0009



SUBSURFACE SOIL PROFILE	Ottumwa-Midland Landfill Ottumwa, Iowa	PROJECT # 6010-95-0009	DATE NOV 94	PLATE 1

Huntingdon

Engineering and Science for a Safer Environment

(515) 266-5101 3922 DELAWARE AVENUE DES MOINES, IOWA 50313

LOG OF TEST BORING

LAB. NO. 6010-95-0009

Boring No. 1 (page 1 of 1)

Date Drilled 10-25-94
Surface Elevation 820.3
Depth Drilled 35.0'
Drilling Method 4" CFA
Depth to Water 26.0 ft @ completion (▽), 20.0 ft @ 32 hrs. (▼), ____ ft @ ____ hrs. (▼)

Project Ottumwa-Midland Landfill
Ottumwa, Iowa
Client IES Utilities, Inc.
Box 351 Cedar Rapids, Ia 52406

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Graphic Log	Soil Description
										Light brown, gray, and dark brown mottled silty clay, dry to damp (CL-ML) LOESS
	1	ST		11.4	109	3610				
5				13.8	101	2900		5.5		
										Reddish brown, gray mottled silty clay minor sand, damp to moist (CH) PALEOSOL
	2	ST		18.8	103	1520				
10				16.1	109	1090		10.5		
										Reddish brown, gray mottled silty very sandy clay, moist (CL) PRE-ILLINOIAN GLACIAL TILL
	3	ST		14.4	117	3530				
15				14.5	119	4760				
								18.0		
										Bright reddish brown silty fine sand trace gravel, moist (SM) Light gray interbedded silt seams throughout Moisture seepage noted from 21' - 23' GLACIAL DRIFT
20	4	SS	62				▼			
								24.0		
										Very dark gray and black clay shale, damp (CH)
25	5	SS	34				▽			
30	6	SS	28							2" Coal seam in 6SS
										BEDROCK
35		SS	50/6"					35.0		

Huntingdon

Engineering and Science for a Safer Environment

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LOG OF TEST BORING

LAB. NO. 6010-95-0009

Boring No. 2 (page 1 of 1)

Date Drilled 10-25-94
Surface Elevation 791.3
Depth Drilled 8.5'
Drilling Method 4" CFA

Project Ottumwa-Midland Landfill
Ottumwa, Iowa
Client IES Utilities, Inc.
Box 351 Cedar Rapids, Ia 52406

Depth to Water ____ft @ completion (▽), 6.0 ft @ 24 hrs. (▼), ____ft @ ____hrs. (▼)

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Graphic Log	Soil Description
								3.0		DArk gray with light brown sandy silty clay trace pebbles and gravel, very moist (CL) FILL
5							▼	7.0		Light brown silty sandy clay, very moist (CL) PRE-ILLINOIAN GLACIAL TILL
	1	SS	43	21.8				8.5		Very dark gray and black clay shale, damp (CH) BEDROCK

Huntingdon

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(515) 266-5101 3922 DELAWARE AVENUE DES MOINES, IOWA 50313

LOG OF TEST BORING

LAB. NO. 6010-95-0009

Boring No. 3 (page 1 of 1)

Date Drilled 10-25-94 | Project Ottumwa-Midland Landfill
Surface Elevation 799.8 | Ottumwa, Iowa
Depth Drilled 9.0' | Client IES Utilities, Inc.
Drilling Method 4" CFA | Box 351 Cedar Rapids, Ia 52406

Depth to Water C&W @ 1 ft @ completion (▽), 0.5 ft @ 24 hrs. (▼), ____ ft @ ____ hrs. (▽)

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Graphic Log	Soil Description
							▼	5.0		Light brown to light gray sandy silty clay with clay shale, moist to very moist (CL-CH) FILL. Coal content and moisture seepage noted at 4.5'
5								9.0		Light gray clay shale, dry (CH) BEDROCK

Huntingdon

Engineering and Science for a Safer Environment

(515) 266-5101 3922 DELAWARE AVENUE DES MOINES, IOWA 50313

LOG OF TEST BORING

LAB. NO. 6010-95-0009

Boring No. 4 (page 1 of 1)

Date Drilled 10-26-94

Surface Elevation

Depth Drilled 5.0'

Drilling Method 4" CFA

Project Ottumwa-Midland Landfill, Ottumwa, Iowa

Client IES Utilities, Inc., Box 351 Cedar Rapids, Ia 52406

Depth to Water ____ ft @ completion (▽), ____ ft @ ____ hrs. (▼), ____ ft @ ____ hrs. (▽)

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Graphic Log	Soil Description
										Dark gray clay shale, moist (CH) FILL
5	1	ST		17.5				5.0		

Huntingdon

Engineering and Science for a Safer Environment

(515) 266-5101 3922 DELAWARE AVENUE DES MOINES, IOWA 50313

LOG OF TEST BORING

LAB. NO. 6010-95-0009

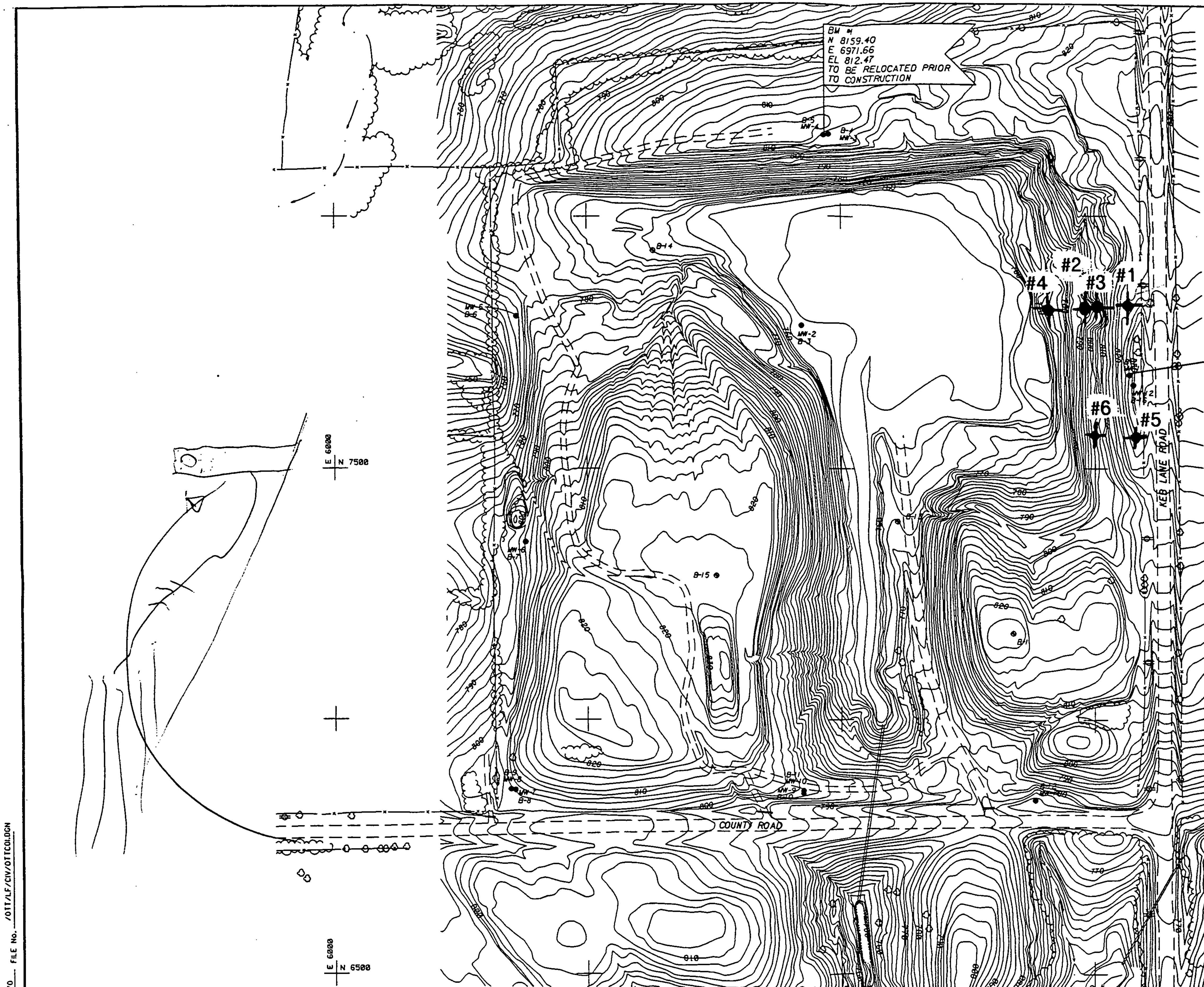
Boring No. 5 (page 1 of 1)

Date Drilled: 10-26-94
Surface Elevation: 823.9
Depth Drilled: 30.0'
Drilling Method: 4" CFA
Depth to Water: 23.0 ft @ completion (▽), 21.5 ft @ 7 hrs. (▼), ___ ft @ ___ hrs. (▼)

Project: Ottumwa-Midland Landfill, Ottumwa, Iowa
Client: IES Utilities, Inc., Box 351 Cedar Rapids, Ia 52406

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
0 – 4.0	1	ST		25.4 / 25.1	91 / 92	1990 / 2050		4.0	Light brown silty clay, moist (CL-ML) LOESS
4.0 – 10.0	2	ST		18.2	109	5030		10.0	Light brown silty clay minor sand, damp to moist (CH) PALEOSOL
10.0 – 20.0	3	ST		16.7 / 16.3	114 / 115	3280 / 3760			Light brown silty very sandy clay with gravel, moist (CL) PRE-ILLINOIAN GLACIAL TILL
	4	ST		12.6 / 11.5	122 / 125	7500 / 4750		20.0	
20.0 – 25.0	5	ST		17.7	116		▼ (21.5) ▽ (23.0)	25.0	Reddish brown silty fine to medium sand, very moist (SM) Interbedded clay seams throughout Moisture seepage noted at 23' GLACIAL DRIFT
25.0 – 30.0	6	SS	49					30.0	Light brown and brown clay shale, moist (CH) Black clay shale below 26.5' Coal seam at 28' - 28.5' BEDROCK

6010-95-0009



LEGEND:

●	MONITORING WELL
◉	SOIL BORING
	POWER POLE
	TREE OR SHRUB
	TREE LINE
	ROAD
770	GROUND SURFACE CONTOUR
	CULVERT
x	FENCE

NOTES:

1. DATE OF PHOTOGRAPHY: 12-22-92
2. MW-2, MW-3 & MW-4 WILL BE PROPERLY ABANDONED BY THE ENGINEER PRIOR TO CONSTRUCTION. ALL OTHER WELLS TO REMAIN UNDISTURBED OR EXTENDED BY THE CONTRACTOR AS REQUIRED. POSITIVE DRAINAGE AWAY FROM ALL MONITORING WELLS MUST BE MAINTAINED.
3. BM #1 TO BE REMOVED AND REESTABLISHED BY ENGINEER PRIOR TO CONSTRUCTION.

SOIL BORING SITE PLAN

JOB No. 3400.0070 FILE No. /OTT/LF/CIV/OTTC01.DGN

REV	DATE	BY	DESCRIPTION

SCALE: 1" = 100'

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED T. BLAIR
DRAWN J. DRISCOLL
CHECKED J. CUMMINGS

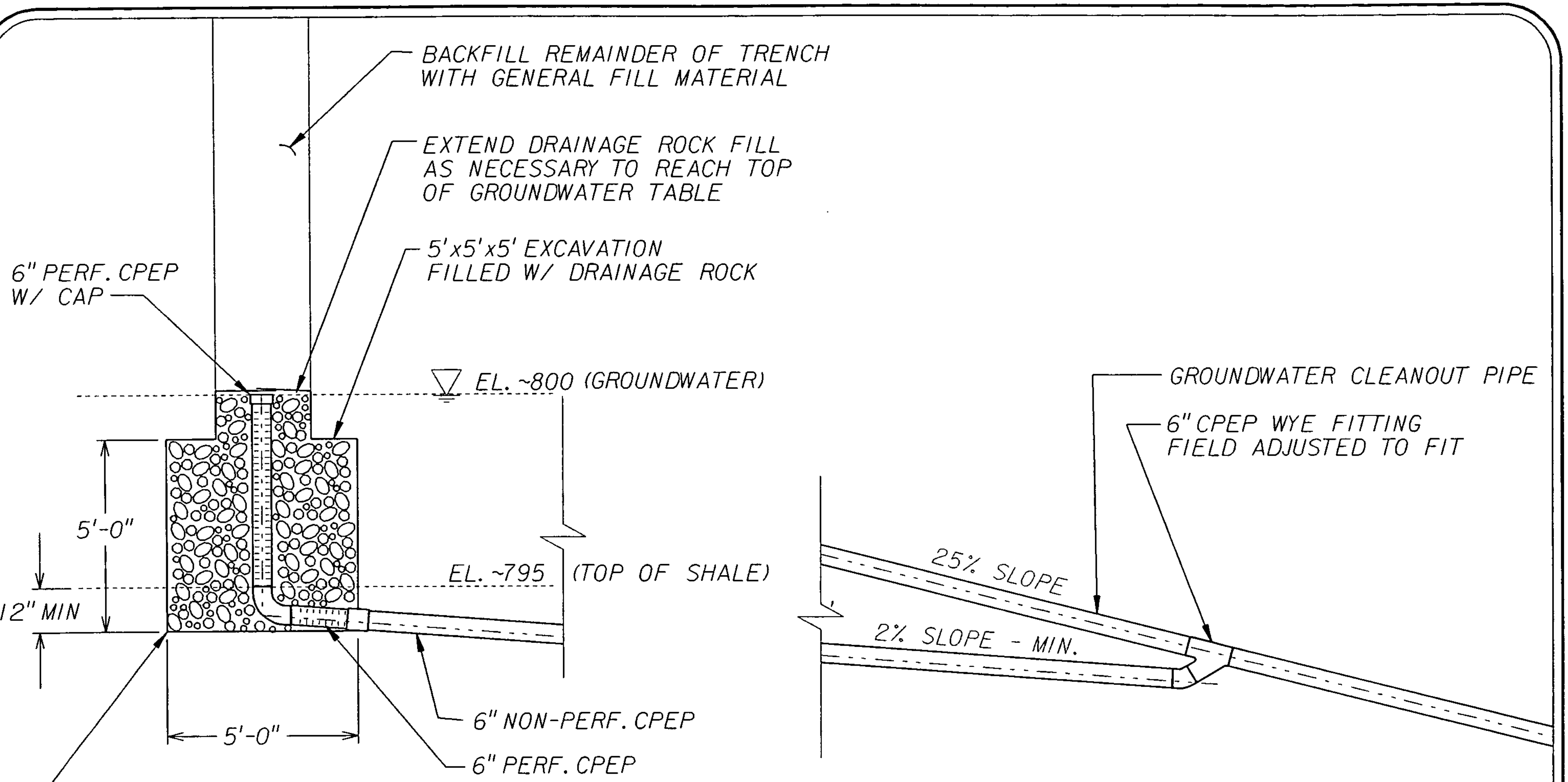
SUBMITTED
PROJECT ENGINEER REG. NO. DATE
MONTGOMERY WATSON REG. NO. DATE

MONTGOMERY WATSON
Des Moines, Iowa

IES UTILITIES, INC.
OTTUMWA-MIDLAND COMMERCIAL LANDFILL
EXISTING CONDITIONS

SHEET C-01

ATTACHMENT B



NOTES:

1. ELEVATIONS SHOWN ARE APPROXIMATE, ACTUAL ELEVATIONS TO BE DETERMINED IN THE FIELD
2. INSTALL ONE FINGER DRAIN EVERY 100 FEET ALONG EAST SIDE OF LANDFILL AT LOCATIONS OF GROUNDWATER UNDERDRAIN.

MONTGOMERY WATSON

IES UTILITIES

FINGER DRAIN DETAIL

01/95-05
01/95-06

Pictures of Ottumwa-Midland Landfill
90-SDP-8-92-P

The 102,027 cubic yards of soil available is enough for the estimated 95,900 cubic yards of intermediate cover needed. If needed, additional soil can be obtained from the areas east and west of the sediment pond.

Wells Within 1,000 feet

During the preparation of the Hydrological Investigation Report an effort was made to identify all active, unused or abandoned wells within one mile of the landfill. None of the wells identified during this effort were within three miles of the site. The report prepared by Howard R. Green dated August 1990 indicated that several wells possibly existed within 1,000 feet of the landfill. One possible well was located close to a nearby home to the east of the landfill. This home and well have been removed and no longer exist. The other possible well was located at a nearby home to the southwest and is actually a cistern, not a well. This home is connected to rural water and no longer uses the cistern.

Siting Requirements

Since the permit application, additional siting requirements have been added to the regulations of the IDNR. The following addresses the additional siting requirements:

Faults and Seismic Impact Zones. The Geological Survey Bureau of the IDNR has been contacted to determine if the landfill is located on any faults or seismic impact zones. The staff of the Geological Survey Bureau indicated the landfill is not located on any faults or seismic impact zones.

Unstable Areas. Using information obtained during drilling activities at the site, the landfill does not appear to be located in an unstable area. There is indication that previous underground coal mines were located to the south of the portion of the property to be developed as a landfill. As previously discussed in our letter to Doc Hallada dated March 10, 1994, it is expected that these underground coal mines, constructed during the late 1800's and early 1900's, have collapsed. If the landfill is expanded into these areas in the future, a geotechnical engineering analysis will be completed to evaluate the potential magnitude of surface subsidence due to further settling in the collapsed mine workings.

Groundwater Underdrain System Evaluation

Montgomery Watson has evaluated the groundwater underdrain system and the location and design of the groundwater underdrain system wetwell pumping station. The groundwater wetwell pumping station is intended to be a permanent structure and is designed to be used during the second phase as well as the first phase of landfill development. Therefore, the groundwater wetwell pumping station is located to the south of the sedimentation pond to accommodate the second phase of landfill development.
In order to provide a gravity outlet for the groundwater underdrain system instead of a wetwell pumping station, the outlet for the system must be lower than the intake of the