Patzig Testing Laboratories Co., Inc.

1922 DELAWARE AVENUE DES MOINES, IOWA 50313 (515) 266-5101

September 12, 1980

City of Ames
c/o Lutz-Daily and Brain
P.O. Box 718
Shawnee Mission, Kansas 66201

Attn: Lee Seybert, P.E.

Re: Geotechnical Investigation
Lagoon System and Borrow Area
Ames Municipal Power Plant
Ames, Iowa
Lab No. 196959

Gentlemen:

This letter presents information from additional geotechnical field work conducted at the above project, initially investigated and reported under our Lab No. 194874, the geotechnical report for the proposed lagoon system and pump house. The field work consisted of installation of 3 piezometers to be monitored by Lutz-Daily and Brain, and drilling of 13 test borings, 9 in the proposed borrow area and 4 additional borings in the lagoon expansion area. The piezometers and test borings were located under the direction of Doug Evans of Lutz-Daily and Brain, and approximate locations appear on the enclosed site plan. The surface elevations existing at the test boring locations were provided by Lutz-Daily and Brain, and are shown on the respective boring logs. Project information and the site geology has been presented in our initial geotechnical report. Methods of drilling, sampling, laboratory testing and other pertinent information are presented in the enclosed Appendix.

SOIL PROFILE

The test borings encountered a similar succession of materials with depth. These materials are generally similar to those encountered by the initial investigation; however, the upper cohesive soils are of slightly lower clay content in some areas. Also, a surficial 1 to 3-foot thick soil layer of lower clay content, which was not evident during the initial investigation, was encountered in the borrow area. Due to the thickness of this surficial layer, and due to it's apparent concentration in the borrow area, it is considered that these materials were deposited by a slightly higher stream velocity or more turbulent over-bank flow.

Borrow Site

The surficial layer encountered by the borrow area test borings consisted of a dark brown clayey sandy silt and a clayey silt and fine sand (SM-ML) generally present to depths ranging from 1 to 2 feet, and sometimes to as much as 3 feet of depth.

This surficial layer is underlain by a dark brown silty clay and a silty and fine sandy clay (ML-CL). The materials in this layer, which are present immediately beneath the surficial layer, appear to be the highest clay content soils of those encountered by the test borings in the borrow area. The dark colored cohesive soils generally continue to the underlying sands, with exception of Test Boring Nos. BA-7 and BA-8, which encountered brown very silty sandy clay and silty clay (CL) after 3 and 4.5 feet of depth, respectively. These brown cohesive soils continued to the underlying sands.

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Brown silty medium fine textured sand (SM-SP) was encountered beneath the shallow cohesive soils, below 4.5 to 7.5 feet in the borrow area. The test borings terminated at 10 feet in these materials with exception of Test Boring No. BA-1 which terminated at 10 feet in dark brown silty clay (CL) with sand seams.

Lagoon System Expansion Area

Test Boring Nos. 13 thru 16 encountered soil similar to those encountered by the initial investigation although the fine sands were encountered at slightly greater depth. Additionally, some textural variation was encountered in soils present above the sands.

Dark brown very silty clay to silty clay (CL) and dark brown very silty and fine sandy clay (CL) was encountered at the surface of Test Boring Nos. 13, 14 and 16. Test Boring No. 15 encountered dark brown clayey silt and fine sand (ML-SM) at the surface. The silty clay soils in these three similar test borings altered to a dark brown to brown clayey silt (ML) and a brown clayey silt and fine sand (ML-SM) after approximately 5.5 to 6 feet of depth. These materials continued to depths ranging from 9 to 11.5 feet in the three Test Boring Nos. 13, 14 and 16. In Test Boring No. 15, the shallow dark brown clayey silt and fine sand altered to a dark brown to brown silty clay (CL) after 5 feet which was present to 9 feet. Brown clayey silt and fine sand (ML-SM) was encountered below this depth, and continued to 11.8 feet.

Brown medium fine and medium coarse textured sand (SP,SW) was encountered below the clayey silt and fine sands, below 9.5 to 11.5 feet of depth. Texture of the sands became coarser with depth, and the four test borings terminated in the sand at 15 feet.

DISCUSSION

Borrow Site

Considerations for the borrow site include borrow soil moisture conditions, compaction characteristics, and compacted permeability properties related to the lagoon liner requirements.

Water levels observed within the test borings shortly after completion of the drilling operations appear on the respective boring logs. Generally, it appears that water levels were present below the bottom of the test borings as all borings in the borrow area remained dry with exception of Test Boring No. BA-6 where water was encountered 9.5 feet below ground surface. As previously discussed, because the sands are permeable and continuous throughout the area, water levels contained within the sands would normally be nearly horizontal. The water level observed within Test Boring No. BA-6 was approximately equivalent to the water levels of 8 to 9 feet observed in our previous investigation conducted March 19, 1980. Generally, it is expected that the underlying sands would act as an underdrain for the surficial silty clay soils, provided the groundwater table is below the top of the sand deposits.

Three soil samples were selected from the borrow area for laboratory compaction and permeability tests. Samples of dark brown slightly sandy silty clay and a dark brown silty clay were obtained from Test Boring Nos. BA-7 and BA-8 and Test Boring No. BA-3, respectively, which are located at opposite extremes of the borrow site.

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Additionally, a brown silty clay sample was selected from Test Boring Nos. BA-7 and BA-8. Maximum Standard Proctor dry density (ASTM D698) for these three materials ranged from 104 to 105.8 pounds per cubic foot for respective moisture contents ranging from 19 to 18.1 percent of the soil's dry weight. The Standard Proctor data are presented on the enclosed Table.

As discussed in our initial report, although the Iowa Department of Environmental Quality requires a minimum degree of compaction of 90 percent Standard Proctor maximum dry density, past involvement with similar projects indicates that 95 percent Standard Proctor density may be a more cost effective degree of compaction. Therefore, laboratory permeability tests were conducted on the three selected soil samples compacted to near 95 percent of Standard Proctor maximum dry density. These permeabilities, ranging from 1 to 3.5×10^{-4} feet per day, are presented on the enclosed Table, and are considered to represent the dark and brown very silty clay, silty clay and silty and fine sandy clay (ML-CL) soils present in the borrow area.

The enclosed calculation sheet indicates the calculated maximum allowable permeabilities versus soil liner thickness. These calculations do not account for variations due to large scale operations; however, the tests in comparison to these calculations indicate that a 2-foot thick dark brown silty clay soil liner compacted to a minimum of 95 percent of Standard Proctor maximum dry density would satisfy the seepage limitation. Based on the permeability test results, it appears desirable to not utilize the brown silty clay materials (lighter colored materials encountered in Test Boring Nos. 7 and 8 for the liner). Also, based on soil classification, it appears that it is desirable to not utilize the surficial clayey silt and fine sand layer encountered in the borrow area as the liner material. Soil texture should be observed during construction to delineate soils that are similar to those tested which would provide an adequate liner and coarser textured, more permeable soils which would not be a suitable liner material but could be utilized elsewhere in the lagoon structures.

Verification of seepage characteristics of the constructed lagoon liner is typically required. The lagoon seal may be tested by obtaining undisturbed soil samples in accordance with ASTM D1587 and analyzing the samples in the laboratory to determine the coefficient of permeability if test results are not in compliance with the regulations due to soil variability or construction technique, it may be necessary to treat the unacceptable areas, with bentonite for example, to obtain an adequate seal.

Lagoon Expansion Area

The proposed bottom of pond elevation is to be approximately 57 to 58 feet, 5± feet below existing grade. Under this condition, the pond bottom will primarily intersect the dark brown silty clay in the area of Test Boring Nos. 13 thru 16; however, the pond bottom may encounter brown clayey silt and fine sand near Test Boring No. 16.

Water levels observed in the test borings in this area were approximately 8 feet below ground surface shortly after completion of the drilling operations. This is below the bottom of the proposed lagoon; however, an additional 2 to 3 feet of excavation may be required to construct the lagoon bottom, and as a result, the excavation base could be near the water level depending upon precipitation levels prior to construction and adjacent stream flow.

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Other considerations pertinent to the lagoon construction have been discussed in our initial geotechnical report, Lab No. 194874. As design progresses and more detailed information becomes available regarding the geotechnical conditions, we should be consulted to provide additional design information as necessary.

You are invited to discuss any design problems involving the site soil types and conditions with us. This will enable us to apply our knowledge of the soil at the site to actual design problems and to offer suggestions. Alternate construction design may be derived from this approach.

The information contained in this report is based on data which are assumed to be representative of the site explored. It must be recognized that results are based on data obtained from the boring location 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 results of this investigation.

Respectfully submitted,

PATZIG TESTING LABORATORIES CO., INC.

Craig A. Carradus

Craig A. Carradus, E.I.T.

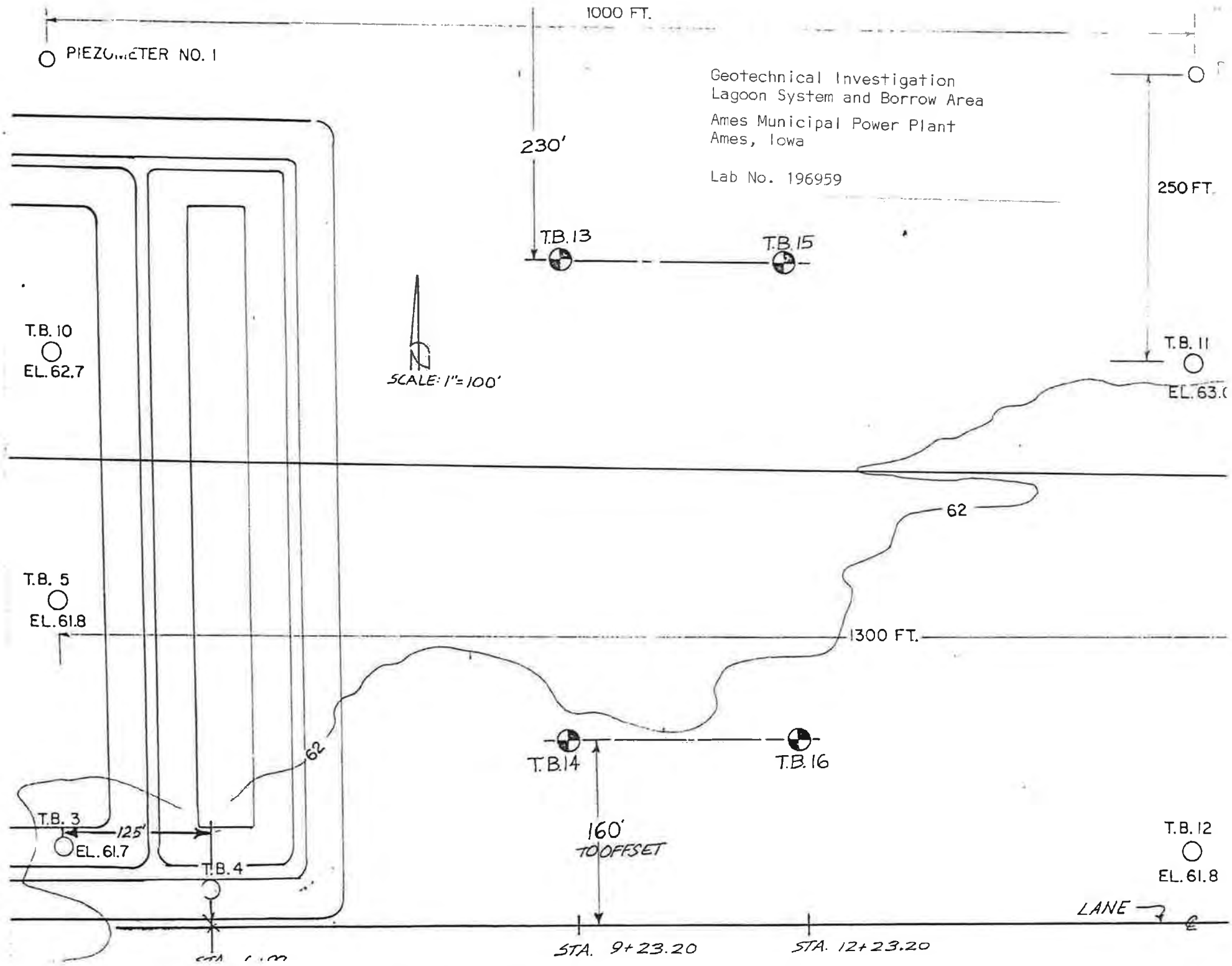
CAC/dkb

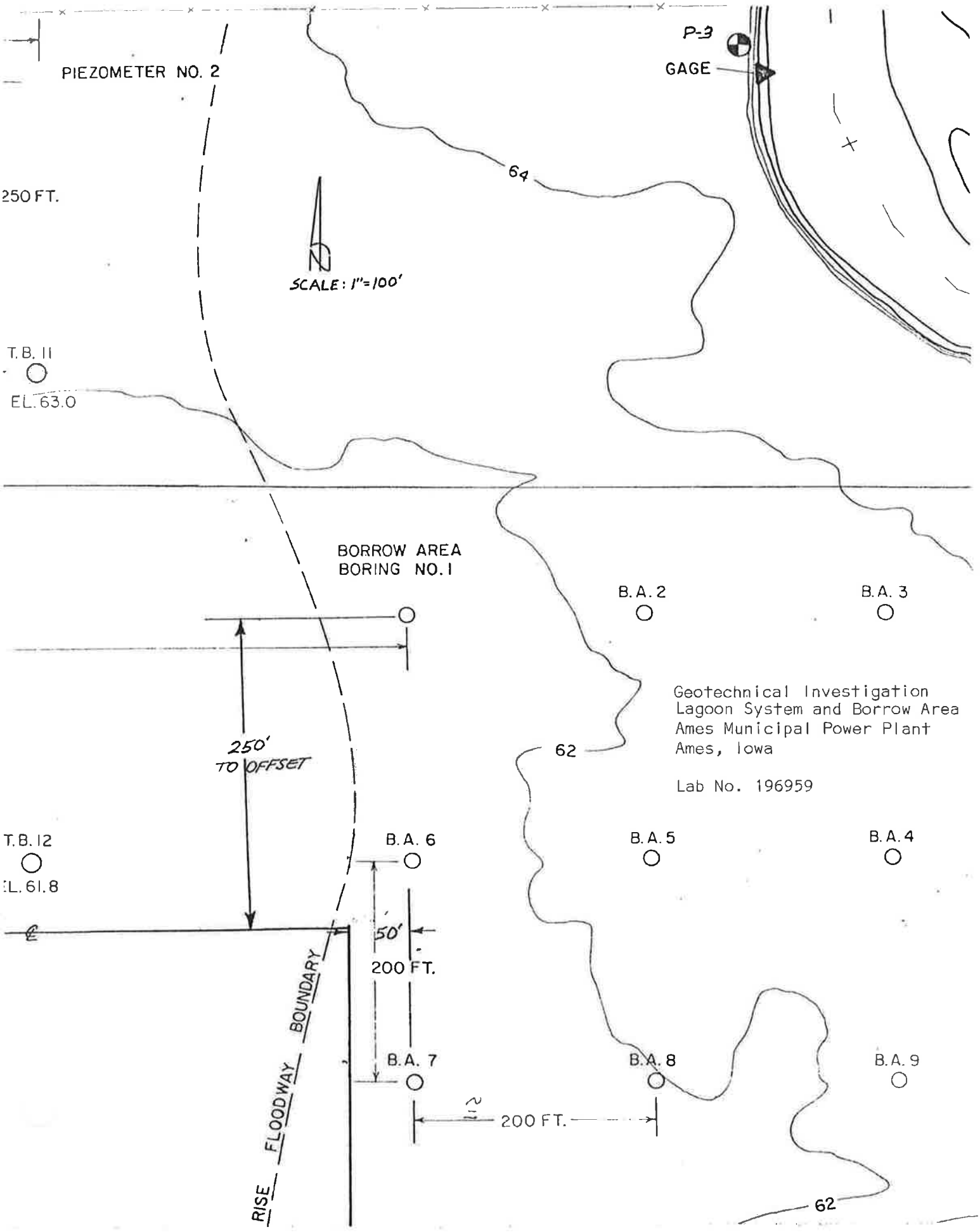
3 cc above

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

Signed Milton R Butzke Date 9/12, 1980

Milton R. Butzke, P.E., Iowa Reg. No. 6580


1000 FT.
PIEZOMETER NO. 1
Geotechnical Investigation
Lagoon System and Borrow Area
Ames Municipal Power Plant
Ames, Iowa
Lab No. 196959
230'
250 FT.
T.B. 13
T.B. 15
T.B. 10
EL. 62.7
SCALE: 1"= 100'
T.B. 11
EL. 63.(
62
T.B. 5
EL. 61.8
1300 FT.
62
T.B. 14
T.B. 16
T.B. 3
125'
EL. 61.7
T.B. 4
160'
TO OFFSET
T.B. 12
EL. 61.8
LANE
STA. 9+23.20
STA. 12+23.20



Geotechnical Investigation
Lagoon System and Borrow Area
Ames Municipal Power Plant
Ames, Iowa

Lab No. 196959

APPENDIX

LAGOON SOIL LINER THICKNESS DESIGN

Using Q=KiA (Darcey's Formula)

Where: Q= the volume of water that passes an interface during a period of time ($ft^3/day/ft^2$)
Maximum Q = 1/16-in./day = 0.0052 $ft^3/day/ft^2$ under a 20-foot water head

K = the coefficient of permeability (ft/day)
A = the cross sectional area of the interface (ft^2/ft^2)
i = the gradient or difference in head (H=20+T) divided by the thickness of the liner (T) assuming the head is dissipated through the soil liner

$$Q = 0.0052\ ft^3/day/ft^2 = K\ (ft/day)\ \frac{20+T\ (ft)}{T\ (ft)}\ A\ (ft^2/ft^2)$$

SAMPLE DESIGNS

Soil liner Thickness (T), ft	Maximum Allowable Permeability (K), ($x10^{-4}$) ft/day
0.33	0.84
0.5	1.2
1.0	2.5
1.5	3.6
2.0	4.7

NOTE: Calculations do not account for variations of large scale operations or regulation minimums. A 20 foot head is assumed worst condition.

PERMEABILITY TEST RESULTS

Sample Description	Test Boring	Sample Depth, Ft.	Permeability ($x10^{-4}$) ft/day	Permeability ($x10^{-8}$) cm/sec
(1) Dark Brown Silty Clay @ 94% ASTM D698	12	0.5 - 2	0.75	2.6
(2) Dark Silty Sandy Clay @ 95% ASTM D698	BA7, BA8	1 - 3	2.0	7.0
(3) Dark Brown Silty Clay @ 95% ASTM D698	BA3	2 - 6	1.0	3.5
(4) Brown Silty Clay @ 95% ASTM D698	BA7, BA8	4.5 - 6	3.5	12.0

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 type. 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 in 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 particle size analysis and Atterberg Limits are conducted, if necessary, to define in more detail pertinent soil characteristics 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.

TEST BORING LEGEND

Drilling Method

CFA - Continuous Flight Auger; 4, 6 or 8-inch diameter (ASTM D 1452)

RD - Rotary Drilling; using drilling fluid in cased or uncased boring (ASTM D 2113)

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 D 1587)

SS - Split Spoon; penetration test and split-barrel samples (ASTM D 1586)

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 D 2113)

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 D 2216)

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 D 2166)

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
Very Hard		Over 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 Classification
LL - Liquid Limit
PL - Plastic Limit
PI - Plasticity Index

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. P 1 (Piezometer)

Date Drilled 7/29/80
Surface Elevation
Depth Drilled 25'
Drilling Method 6" CFA
Depth to Water 11 ft @ completion (▽), ft @ hrs. (▼), ft @ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown silty sandy clay to clayey silt, moist
5									Brown after 5'
									Sandy after 7'
								8	
10							▽		Brown fine sand, moist Medium sand (wet) after 10'
15									Coarse levels Gray after 15'
20									
25								25	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. P 2 (Piezometer)

Date Drilled 7/29/80
Surface Elevation
Depth Drilled 25'
Drilling Method 6" CFA
Depth to Water 12 ft @ completion (▽), ____ ft @ ____ hrs. (▼), ____ ft @ ____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and silty sandy clay, damp
									Moist after 1'
5									
									Sandy after 8'
								8.5	
10									Brown medium sand, moist
									Wet after 10'
							▽		Coarse after 12' and gray (gravel to 2" dia.)
15									
20									
25								25	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. P 3 (Piezometer)

Date Drilled 7/29/80
Surface Elevation
Depth Drilled 25'
Drilling Method 6" CFA
Depth to Water 13 ft @ completion (▽), ____ ft @ ____ hrs. (▼), ____ ft @ ____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown silty fine sand, damp
									Moist after 3.5'
5									Very silty sandy clay after 4'
10								10	
									Brown medium sand, damp to moist
							▽		Wet after 12.5'
15									Coarse after 15'
20									
25								25	

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LOG OF TEST BORING

LAB. NO 196959

Boring No. BA 1

Date Drilled 7/29/80
Surface Elevation 62.4'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project: Lagoon System Borrow Site
Ames Municipal Power Plant
Client: City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey sandy silt, damp
									Very silty clay to silty clay (ML-CL), moist after 2'
									Silty clay (CL) after 3'
5									
									Wet sandy clay seams at 6.5'
									Very moist after 6.5'
10								10	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. BA 2'

Date Drilled 7/29/80
Surface Elevation 63.4'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and fine sand, damp
									Silty and fine sandy clay (SM-ML), moist after 1.5'
									Dark brown to brown silty clay (CL) after 3'
5								6	
									Brown silty medium fine sand (SM), moist Slightly clayey
10								10	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. BA 3

Date Drilled 7/29/80
Surface Elevation 64.4'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and fine sand (SM), damp
									Dark brown silty clay (ML-CL), moist after 2'
									Trace of sand
5								6	
									Brown silty medium fine sand (SM), moist
									Slightly clayey
10								10	

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LOG OF TEST BORING

LAB. NO 196959

Boring No. BA 4

Date Drilled 7/29/80
Surface Elevation 63.9'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz Daily Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and fine sand (SM), damp
									Silty clay (ML-CL), moist after 1.5'
									Trace of sand
								4.5	
5									Brown slightly silty fine sand (SP), damp
10								10	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. BA 5

Date Drilled 7/29/80
Surface Elevation 63.1'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz Daily Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and fine sand (SM), damp
									Silty clay (ML-CL), moist after 1.5'
									Trace of sand
									Sandy after 4'
								4.5	
5									Brown slightly silty fine sand (SP), damp
								10	
10									

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. BA 6

Date Drilled 7/29/80
Surface Elevation 62.0'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water 9.5 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project: Lagoon System Borrow Site
Ames Municipal Power Plant
Client: City of Ames
c/o Lutz Daily Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey sandy silt (SM-ML), damp
									Silty clay (ML-CL), moist after 1'
									Trace of sand
								4.5	
5									Brown silty medium fine sand (SM-SP), moist
									Wet after 8'
							▽		
10								10	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. BA 7

Date Drilled 7/29/80
Surface Elevation 61.6'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System Borrow Site
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Client City of Ames
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Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey sandy silt (ML), damp
									Very silty and fine sandy clay (ML), after 1'
									Dark brown to brown very silty sandy clay (CL), after 3'
5								6	
									Brown fine sand (SP), damp
10								10	

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LOG OF TEST BORING

LAB. NO 196959

Boring No. BA 8

Date Drilled 7/29/80
Surface Elevation 62.9'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System Borrow Site
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and medium fine sand (SM-ML)
									Dark brown to brown silty and fine sandy clay (ML-CL) after 3'
									Brown silty clay (CL) after 4.5'
5									
								7.5	
									Brown medium fine sand (SW), moist Clayey seams
10								10	

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

LOG OF TEST BORING

LAB. NO. 196959

Boring No. BA 9

Date Drilled 7/29/80
Surface Elevation 63.4'
Depth Drilled 10'
Drilling Method 6" CFA
Depth to Water Dry-10 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

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Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and fine sand (ML), damp
									Silty and fine sandy clay, moist after 2'
									Silty clay (CL), moist after 4'
5								6	
									Dark brown clayey fine sand to silty fine sand (SM-SP) after 8'
10								10	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. 13

Date Drilled 8/27/80
Surface Elevation 62.3'
Depth Drilled 15'
Drilling Method 6" CFA
Depth to Water 8.2 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown very silty clay to silty clay (CL), damp
									Moist after 1'
5									Dark brown to brown clayey silt (ML-CL)
									after 6'
							▽		Brown after 7'
								9.5	
10									Brown clayey silt and fine sand (ML-SM), moist
								10.8	
									Brown medium fine sand (SP), saturated
15								15	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. 14

Date Drilled 8/27/80
Surface Elevation 61.7'
Depth Drilled 15'
Drilling Method 6" CFA
Depth to Water 8 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown silty clay (CL), moist
									Dark brown to brown after 4.5'
5									Brown clayey silt after 5.5'
									Very moist after 7'
							▽		Sandy (ML-SM) after 7.2'
								9.5	
10									Brown medium fine sand (SP), wet
									Coarse after 12'
15								15	

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LOG OF TEST BORING

LAB. NO. 196959

Boring No. 15

Date Drilled 8/27/80
Surface Elevation 63.4'
Depth Drilled 15'
Drilling Method 6" CFA
Depth to Water 8 ft @ completion (▽), _____ ft @ _____ hrs. (▼), _____ ft @ _____ hrs.

Project Lagoon System
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown clayey silt and fine sand (ML-SM), damp
									Moist after 1'
5									Dark brown to brown silty clay (CL), after 5'
							▽		
								9	
10									Brown slightly clayey silt and fine sand (ML-SM), very moist
								11.5	
									Brown medium coarse sand (SW), wet
15								15	

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LOG OF TEST BORING

LAB. NO 196959

Boring No. 16

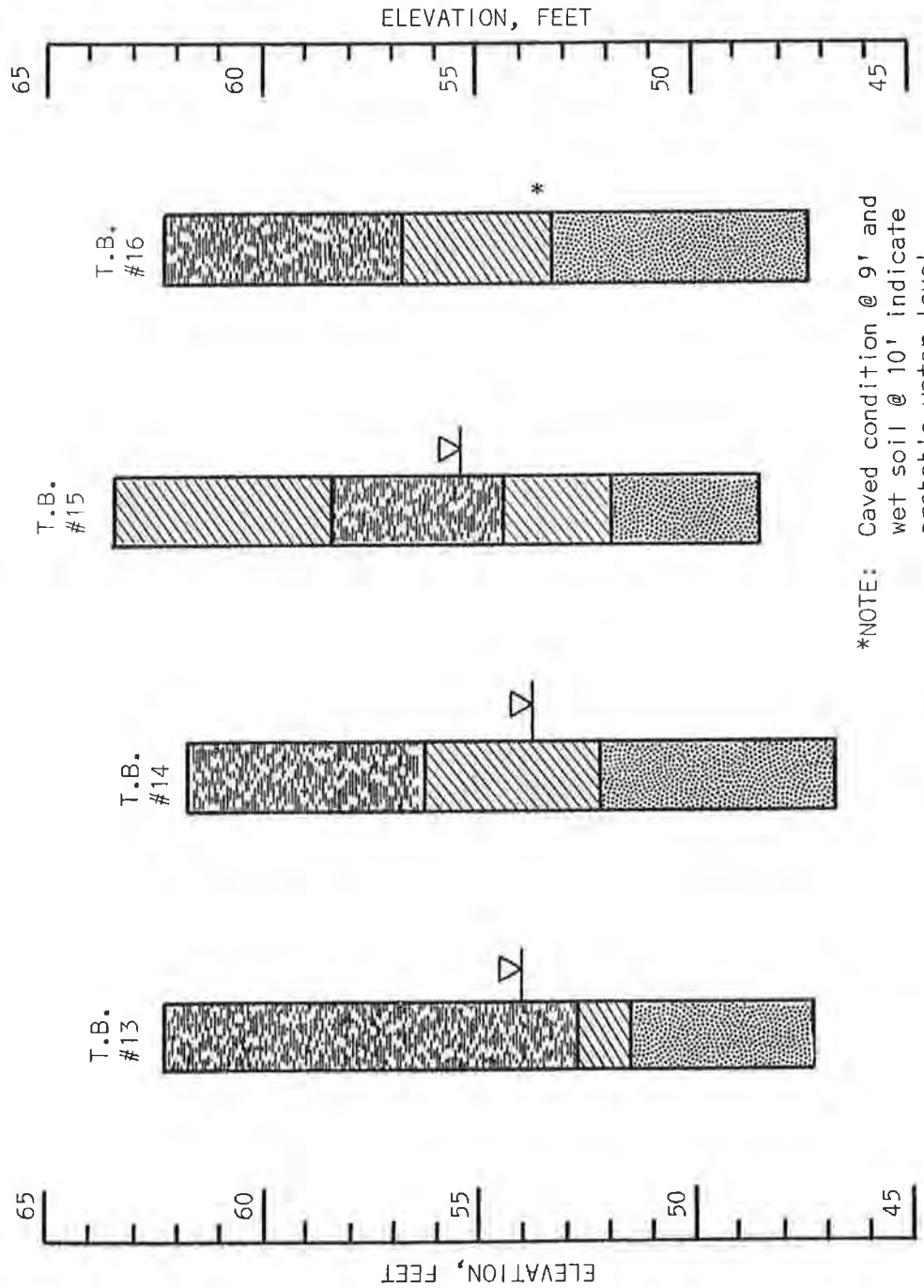
Date Drilled 8/27/80
Surface Elevation 62.2'
Depth Drilled 15'
Drilling Method 6" CFA
Depth to Water * ft @ completion (▽), ____ ft @ ____ hrs. (▼), ____ ft @ ____ hrs.

Project Lagoon System
Ames Municipal Power Plant
Client City of Ames
c/o Lutz, Daily, & Brain

Depth ft	Sample No.	Sample Type	SPT	MC %	D pcf	UCS psf	WL	Depth ft	Soil Description
									Dark brown very silty and fine sandy clay (CL), damp
									Moist after 1'
									Dark brown to brown after 4.5'
5								5.5	
									Brown clayey silt and fine sand (ML), moist
									Light gray-brown after 7'
								9	
10									Red-brown medium sand, (SW), moist
									Brown after 10' and wet
15								15	
									*Caved and dry @ 9'

PROPOSED LAGOON SYSTEM
AMES MUNICIPAL POWER PLANT
AMES, IOWA

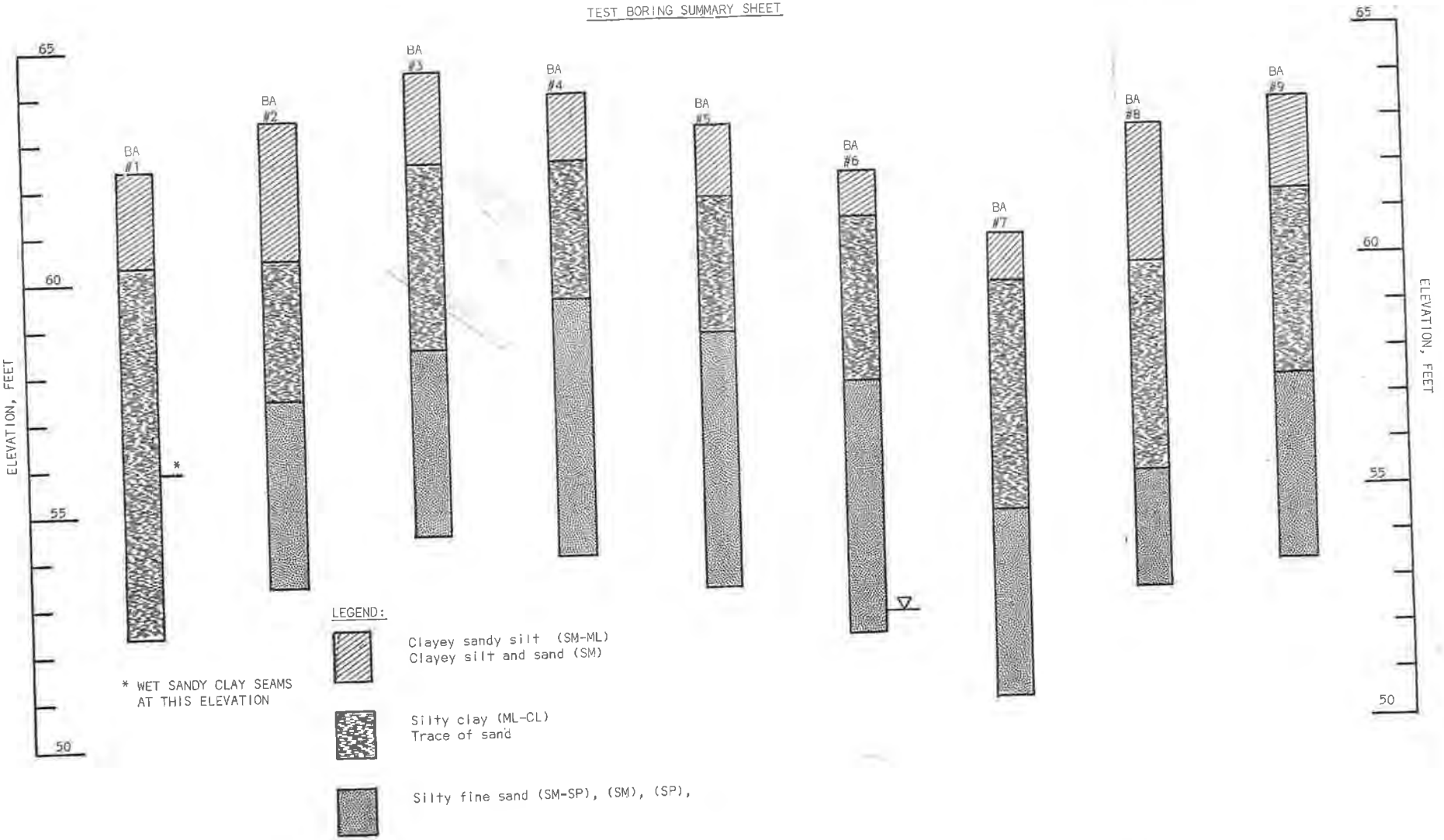
TEST BORING SUMMARY SHEET



AMES MUNICIPAL POWER PLANT
LAGOON SYSTEM BORROW SITE

LAB NO. 196959

TEST BORING SUMMARY SHEET



* WET SANDY CLAY SEAMS AT THIS ELEVATION