# GEOTECHNICAL REPORT

# PUMP STATION No. 8 RELOCATION
# DES PLAINES, ILLINOIS

**IDOT JOB No. D-91-226-07**
**PTB # 144-Item 13**

**for**

**AB&H, A Donohue Group**

**125 South Wacker Drive, Suite 1850**

**Chicago, IL 60606**

**by**

**Wang Engineering, Inc.**

**1145 North Main Street**

**Lombard, IL 60148**

**(630) 953-9928**

**December 9, 2008**

WEI Ref. No. 200-25-01

Wang Engineering

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December 9, 2008

Mr. Kou Chang, P.E.
Project Manager
AB&H, A Donohue Group
125 South Wacker Drive, Suite 1850
Chicago, IL 60606

Ref: Geotechnical Report
Pump Station No. 8 Relocation
Des Plaines, Illinois
IDOT Job No. D-91-226-07
PTB No. 144- Item 13
Wang No. 200-25-01

Dear Mr. Chang:

Wang Engineering, Inc. (Wang) is pleased to present this Geotechnical Report for the referenced IDOT project. This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluation for the referenced project. The purpose of our investigation was to characterize the site soil and groundwater conditions and to provide geotechnical recommendations for the design and construction of the new pump station.

Four copies of the report are provided. This report incorporates your comments on our draft report.

It has been a pleasure being of service to AB&H, A Donohue Group. If you have any questions please call us at 630-953-9928.

Sincerely,

**WANG ENGINEERING, INC.**

Corina T. Farez, P.E., P.G.
Vice President

Mohammed (Mike) Kothawala, P.E.
Project Manager/Sr. Geotechnical Engineer

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# GEOTECHNICAL REPORT

## PUMP STATION No. 8 RELOCATION
## DES PLAINES, ILLINOIS
## IDOT JOB NO. D-226-07

## FOR
## AB&H, A DONOHUE GROUP

## 1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluation to support the design and construction of IDOT Pump Station No. 8 Relocation for AB&H, A Donohue Group (AB&H). The project site is located in Des Plaines, Illinois. A *Site Location Map* is presented as Exhibit 1.

The purpose of our investigation was to characterize the site soil and physical groundwater conditions and provide geotechnical analyses and recommendations for the design and construction of a new pumping station building.

## 2.0 METHODS OF INVESTIGATION

### 2.1 Subsurface Investigation

The subsurface investigation, consisting of one structure boring, was performed on November 26, 2008. The boring was located at the site by Wang Engineering, Inc. (Wang) based on the information provided by AB&H. The boring was drilled to a depth of 80 feet below ground surface (bgs) at the location shown in Exhibit 2, *Boring Location Map.*

A truck mounted drilling rig, equipped with hollow stem augers, was used to advance and maintain an open borehole. Soil sampling was performed according to AASHTO T 206-87, "Penetration Test and Split Barrel Sampling of Soils." The soil was sampled at 2.5-foot intervals to a depth of 30 feet and at 5-foot interval below 30 feet to termination depth.

A Wang field soil technician monitored the drilling activities and maintained field boring logs. The field logs included results of Standard Penetration Test (SPT) recorded as blows per 6 inches. Theses values are shown on the boring logs as N values (blows per final 12 inches). The soils were described and classified according to Illinois Division of Highways'

Textural Classification system. The unconfined compressive strengths of cohesive soil samples were obtained using Rimac Spring Tester on the SPT samples.

All samples collected in the field were placed in sealed glass jars and transported to Wang geotechnical laboratory in Lombard, Illinois for further laboratory testing. The field log was finalized by an experienced geologist after verifying visual classifications and soil samples.

The soil samples will be retained in our laboratory for 60 days following the final report submittal. The samples will be discarded unless a specific written request is received as to their disposition.

The boring was located in the field by Wang and as-drilled location was determined using a mapping grade GPS survey system (model GeoXH hand held made by Trimble Navigation limited).

Groundwater observations were made during and at the end of drilling operations. Due to safety considerations, the boreholes were backfilled and/or grouted immediately upon completion. No long-term groundwater measurement were taken.

### 2.2 Laboratory Testing

Laboratory testing program included moisture content (AASHTO T 265-93) on all the soil samples. The field visual descriptions of the samples were reviewed in the laboratory. The laboratory test results are presented on the boring log.

## 3.0 SITE AND SUBSURFACE CONDITIONS

As shown on Exhibit 1, the project site is located in northwest Cook County in the City of Des Plaines. On the USGS "Arlington Heights" quadrangle map, the project site is in the NW ¼ of Section 17, Tier 41 North, Range 17 East, and west of Northwest Highway intersection with the Wisconsin Central Railroad / Union Pacific Railroad intersection. The project site is owned by ComEd and has overhead, high mast power lines. Generally, the area of the proposed pump station is flat and at an elevation of approximately 646 feet NAVD (North American Vertical Datum). The Northwest Highway that underpasses the railroads' intersection to the east of the project site is at about Elevation 627.

Detailed descriptions of the soil conditions encountered in the borings are presented on the attached boring log. Please note that the strata contact lines represent approximate boundaries between soil types. During construction, the actual transition between soil types in the field may be different in horizontal and vertical directions. The following presents in detail the soil layers as revealed during the subsurface investigation.

## 4.1 Mat Foundation

It is our opinion that the main building mat foundation can be established at the planned Elevation 601 feet on the natural soil consisting of very stiff/hard clay. The mat foundation may be proportioned utilizing an allowable net bearing pressure of 8,000 pounds per square foot (psf). The allowable soil bearing pressure refers to total design loads, dead and live and is a net pressure. The allowable bearing pressure includes a factor of safety of 3.0. It is also recommended that the Modulus of Subgrade Reaction ($K_S$) value used for design of the mat foundation not exceed 150 pounds per cubic inch (approximately 260 kips per cubic foot).

## 4.2 Lateral Pressures

The below grade walls should be designed to resist lateral soil pressure. Since the horizontal movement of the walls will be restricted at the top, it is recommended that the walls be designed considering 60 psf per foot depth as a design lateral soil load with a drainable backfill (granular material). Design lateral pressure from surcharge loads due to adjacent foundations, and construction (including backfill compaction stresses), maintenance and operation equipment, etc. should be added to the lateral soil load. The backfill against the walls should consist of free draining granular soil material, meeting the requirement of IDOT "Porous Granular Backfill." The perimeter underdrain pipe behind the walls should be provided. The backfill should be placed in lifts not exceeding 8 inches in loose thickness and should be compacted using a small vibratory compacter. The provisions to prevent accumulations of water behind the walls should be provided.

If the walls are poured directly against the temporary earth retention system, we recommend that the wall be designed considering 70 psf per foot of depth, in addition to hydrostatic pressure. The ground water level during the borings was recorded to be at a depth of approximately 22 feet (Elevation 625). However, conservatively ground water level should be considered at the ground surface considering a flooding condition. 90 psf - Email (12-15-08)

Although lateral pressure will depend on the type and condition of soils present behind the walls, the distribution of pressure should be considered as triangular.

## 4.3 Uplift Resistance

The uplift forces due to groundwater may be resisted by the total effective weight of the structure, including weights of fixed equipment. During pump station operating conditions, it may be necessary to suppress the groundwater level to keep uplift pressures within acceptable limits. No long-term ground water level observations were made during this investigation. The groundwater levels were measured around approximate Elevation 625 feet during drilling. We recommend considering groundwater level at Elevation 625 feet for calculating uplift forces. By providing the perimeter underdrain pipe behind the walls at or

below Elevation 625 feet will assure that the groundwater level will not rise above Elevation 625. We recommend considering Floatation Safety Factor of 1.5 for a normal operation loading condition and 1.3 for a construction loading condition. When calculating safety factor, the vertical resistance mobilized by friction along the exterior faces of the structure should be neglected.

### 4.4 Temporary Earth Retention System

The construction of the pump station structure will require temporary excavation up to 46 feet deep below the existing grade. The side slopes for temporary excavations should be flat enough to provide a safe and stable excavation and to comply with all regulatory codes and laws. Sheeting, shoring or bracing systems may be used to create vertical excavation walls, if it is necessary due to space limitations.

If space limitations are not severe, all excavations can be accomplished as open cuts with stable side slopes. We performed a slope stability analysis using a computer program, SLIDE Version 5.0, to calculate the factor of safety. The simplified Bishop Method was used. The result is shown in the Exhibit 3. The calculated minimum factor of safety for a short term condition is 2.11 for a slope of 1V:1H.

A temporary vertical excavation support system may be required on the side where nearby electrical towers exists and existing utilities are to be protected. A temporary slope will also require backfilling of the open cut areas. Therefore, it is our opinion that a temporary enclosed braced system will be more appropriate than the open cut excavation.

The soil parameters for the design of temporary bracing system may be determined from the field and laboratory test results and soil description shown on the boring logs. It is recommended that the design groundwater level for a short-term condition be assumed to be at Elevation 625 feet. In addition, the lateral pressures imposed by adjacent foundations and other surcharge loads such as construction equipment should also be considered in the design of the bracing system. The lateral soil pressure distribution behind a bracing system will be dependent on the scheme selected to support the excavation walls. Therefore, it is recommended that the pressure distribution utilized in the design of the bracing system be reviewed by a qualified geotechnical engineer. Normally selection of the type of temporary earth retention system and design is left to the contractor. The bracing system should be designed for different construction stages and by a structural engineer licensed in the State of Illinois. It should be noted that the driving of steel sheet piling would be difficult and may not be possible below a depth of approximately 54 feet because of hard silty clay and very dense silt.

## 5.0 CONSTRUCTION CONSIDERATIONS

### 5.1 Site Preparation

All vegetation, surface topsoil, and debris should be stripped and cleared from the project site before any fill, foundation, pavement are to be placed.

### 5.2 Excavation

Foundation excavations should be performed in accordance with local, state, and federal regulations. The potential effect of ground movements upon nearby railroad and utilities should be considered. The soils excavated below the topsoil can be reused for general site grading and for the construction of the roadway/parking embankment. The excavated soil consisting of silt should not be reused as a structural fill but can be used in the landscaping areas.

### 5.3 Groundwater Control

Based on the results of boring, serious groundwater problems are not anticipated during the construction of the pump station building. Perched water existing in the sand and silt layers will seep into the excavation in relatively small quantity which can be handled by sump and pump.

### 5.4 Mat Foundation Bearing Stratum

The in-place bearing stratum (the subgrade) for the mat foundation should be checked to verify the in-situ condition. If the conditions deviate from those anticipated, the geotechnical engineer should be consulted to determine if additional measures are necessary. Prior to pouring foundations, all loose and soft material and water must be removed from the bottom of the foundation excavations. If soft soils are encountered at the bottom of the foundation excavations, the soft soils should be excavated and replaced with a controlled, compacted crushed stone meeting the requirement of IDOT gradation CA-6 material. No softening of the subgrade should be allowed because of water accumulation at the bottom of the foundation excavations, particularly if construction is undertaken during periods of rain. The exposed foundation bearing subgrade may deteriorate upon exposure to the construction disturbance and water. Therefore, final excavation should be deferred until just before concreting. If delays in pouring of foundations are anticipated, the bottom of the foundation excavation should be protected by a thin layer of lean concrete (approximately 3 inches thick).

### 5.5 Filling and Backfilling

Fill material used to attain the final design structure subgrade elevations should be structural fill material. An IDOT gradation CA-6 aggregate or an approved on-site soil could be acceptable as structural fill. This fill material should be free of organic matter and debris, and it should be placed in lifts not exceeding 8 inches in loose thickness. The fill should be compacted to minimum 95 percent maximum dry density, as determined in accordance with AASTHO T-99, Standard Proctor Method.

All backfill materials against the buildings must be pre-approved by the site engineer. The fill should be free of organic materials and debris.

## 6.0 QUALIFICATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from one soil boring drilled at the location shown on Exhibit 2. This report does not reflect any variations that may occur on the site, variations who nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of the structure are planned, we should be timely informed so that changes can be reviewed, and approved in writing by the geotechnical engineer.

It has been a pleasure to assist AB&H, A Donohue Group on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

**WANG ENGINEERING, INC.**

Jerry W.H. Wang, Ph.D., P.E.
Principal

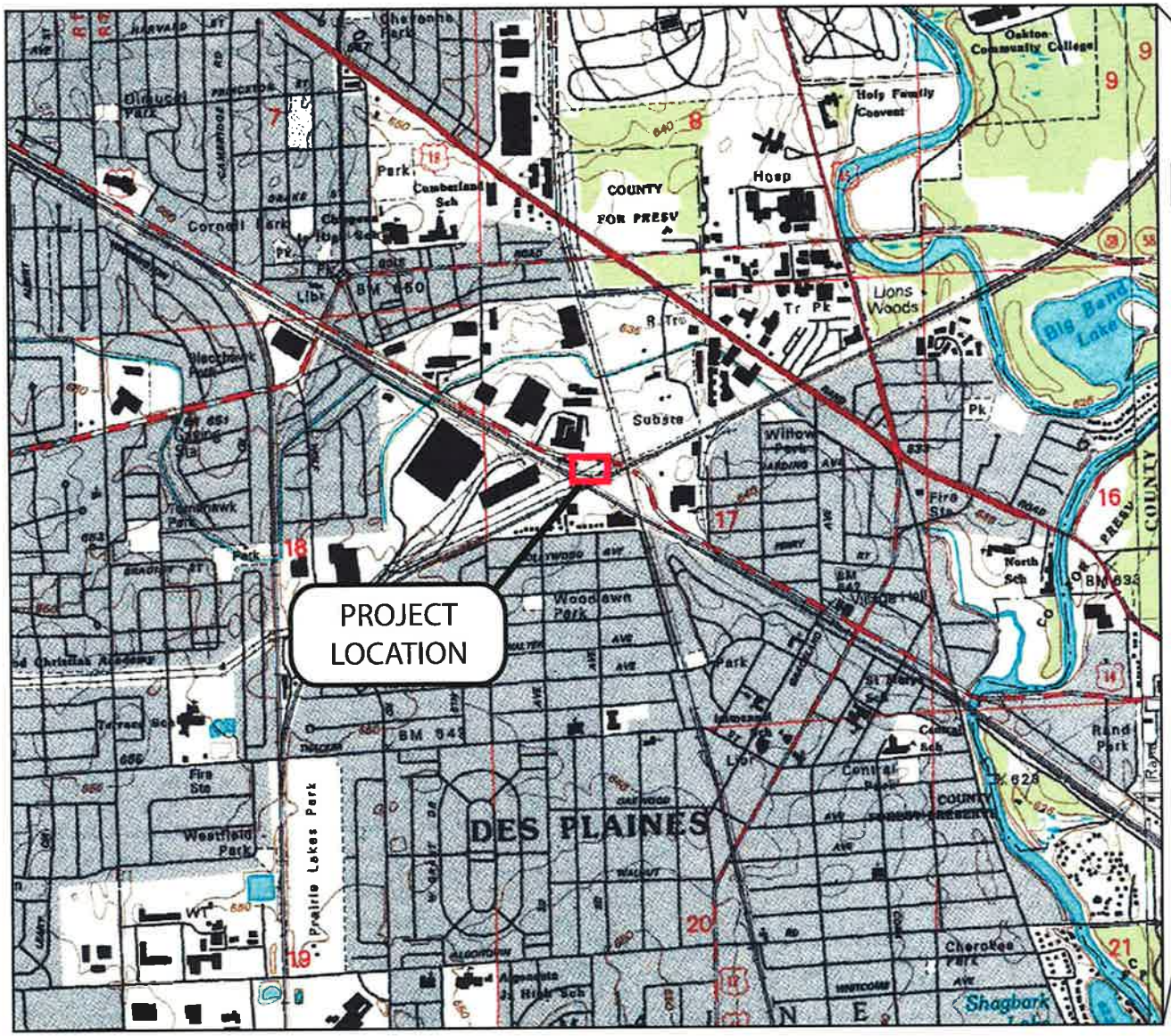
Mohammed (Mike) Kothawala, P.E.
Project Manager/Senior Geotechnical Engineer

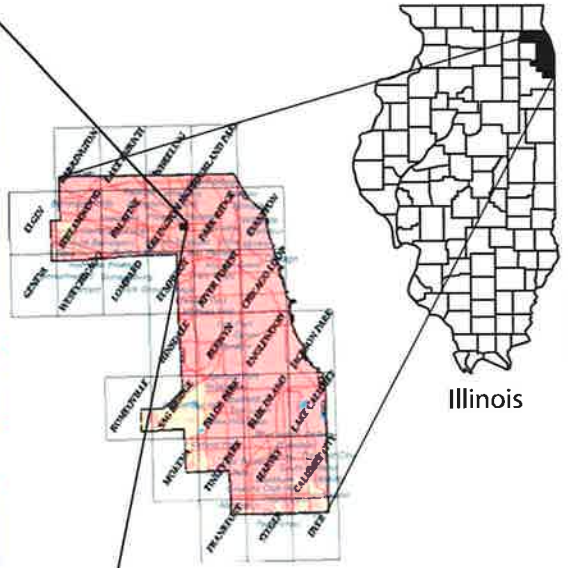
## REFERENCES

**American Association of State Highway Transportation Officials**, 2002, *Standard Specifications for Highway Bridges*.

**Illinois Department of Transportation**, 1999, *Geotechnical Manual*.

**Illinois Department of Transportation**, 2002, *Standard Specifications*.




0 1 2 3 4 Miles

SITE LOCATION: PUMP STATION 8 RELOCATION,
IDOT No. D-91-226-07, PTB 144/13, DES PLAINES, ILLINOIS

| SCALE: GRAPHICAL | EXHIBIT 1 | DRAWN BY: E. Datz<br>CHECKED BY: M. Kolhawala |
|---|---|---|

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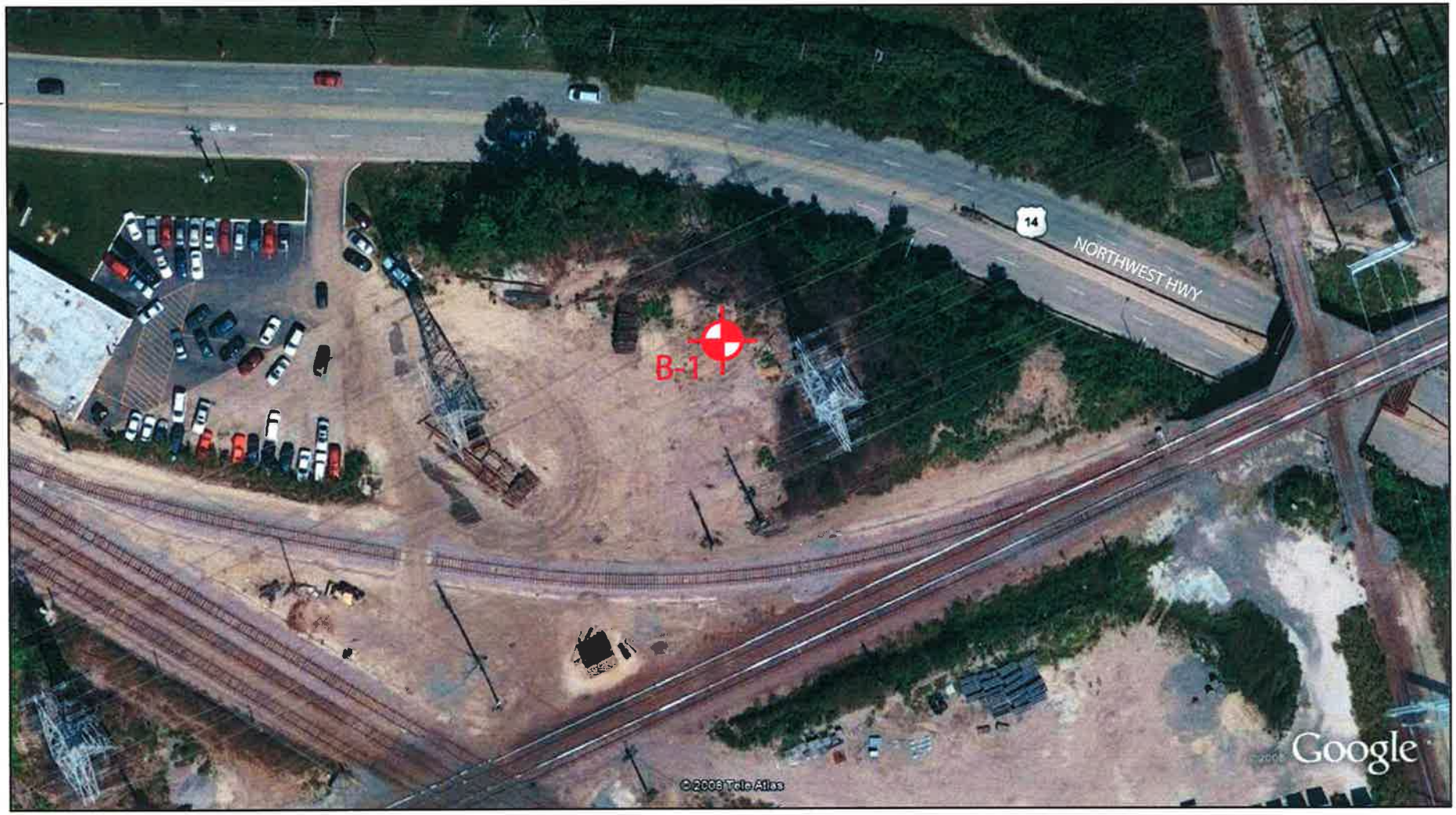
FOR AB&H, A Donohue Group | 200-25-01




0 50 100 150 200 Feet

BORING LOCATION MAP: PUMP STATION 8 RELOCATION,
IDOT No. D-91-226-07, PTB 144/13, DES PLAINES, ILLINOIS

| SCALE: GRAPHICAL | EXHIBIT 2 | DRAWN BY: E. Dalz<br>CHECKED BY: M. Kothawala |
|---|---|---|

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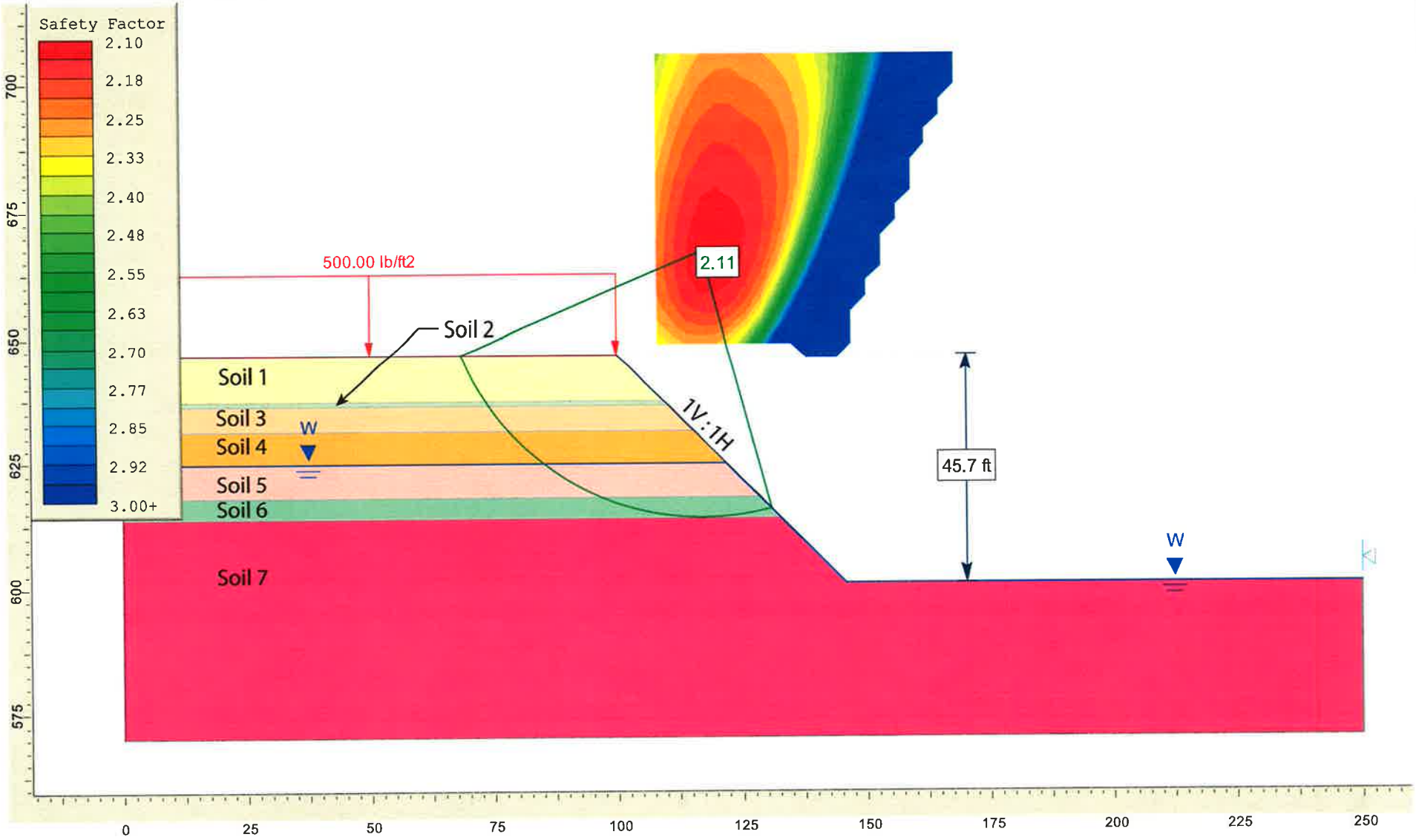


| Soil ID | Material | Unit Weight [pcf] | Cohesion [psf] | Friction Angle [deg.] |
|---|---|---|---|---|
| Soil 1 | Cohesive | 120 | 2000 | 0 |
| Soil 2 | Cohesive | 100 | 400 | 0 |
| Soil 3 | Cohesive | 130 | 4000 | 0 |
| Soil 4 | Cohesive | 120 | 1750 | 0 |
| Soil 5 | Granular | 120 | 0 | 31 |
| Soil 6 | Cohesive | 110 | 1000 | 0 |
| Soil 7 | Cohesive | 125 | 3500 | 0 |

SHORT TERM SLOPE STABILITY ANALYSIS: PUMP STATION #8 RELOCATION
IDOT No. D-91-226-07, PTB 144/13, DES PLAINES, ILLINOIS

SCALE: GRAPHICAL | EXHIBIT 3 | DRAWN BY: S. Sugiarto | CHECKED BY: M. Kothawala

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FOR AB&H, A DONOHUE GROUP | 200-25-01

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# BORING LOG B-1

**WEI Job No.: 200-25-01**

Client **AB&H**
Project **IDOT Pump Station #8**
Location **NW 1/4, Sec. 17, T41N, R12E; Des Plaines, IL**

Datum: NGVD
Elevation: 646.77 ft
North: 1960091.79 ft
East: 1102201.19 ft
Station:
Offset:

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type / recovery | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| 645.5 | 15-inch thick, brown and gray GRAVELLY SAND | | | | | | |
| | Very stiff, brown and gray SILTY CLAY --FILL-- | | | 1 | 25 7 6 | 3.00 P | 16 |
| | | | | 2 | 5 4 4 | NR | |
| | | 5 | | | | | |
| 641.3 | Stiff, brown and gray SILTY CLAY | | | 3 | 3 3 3 | 1.64 B | 25 |
| | | | | 4 | 3 3 3 | 0.41 S | 31 |
| 637.3 | Soft, brown and gray SILTY | 10 | | | | | |
| 636.3 | CLAY | | | | | | |
| | Hard, brown and gray SILTY CLAY | | | 5 | 6 8 8 | 5.33 B | 18 |
| | | | | 6 | 3 4 7 | 4.10 B | 16 |
| | | 15 | | | | | |
| 631.3 | Stiff to very stiff, gray SILTY CLAY | | | 7 | 3 4 6 | 2.05 B | 19 |
| | | | | 8 | 3 3 5 | 1.65 B | 19 |
| | | 20 | | | | | |
| 624.8 | | | ▽ | 9 | 3 5 6 | 2.05 B | 28 |
| | Medium dese, gray SILT to SILTY LOAM | | | | | | |
| | | | | 10 | 7 11 11 | NP | 16 |
| | | 25 | | | | | |

| Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type / recovery | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| 618.0 | Stiff, gray SILTY CLAY | | | | | | |
| | | | | 11 | 4 6 7 | NP | 20 |
| | | 30 | | 12 | 2 3 4 | 1.23 B | 15 |
| 612.5 | | | | | | | |
| 612.0 | Medium dense, GRAVEL | | | 13 | 5 10 10 | 3.28 B | 18 |
| | Very stiff, gray SILTY CLAY | 35 | | | | | |
| | | 40 | | 14 | 13 11 12 | 3.69 B | 13 |
| | | 45 | | 15 | 8 9 16 | 3.69 B | 15 |
| | | 50 | | 16 | 8 15 20 | 3.69 B | 15 |

## GENERAL NOTES

Begin Drilling **11-26-2008** Complete Drilling **11-26-2008**
Drilling Contractor **Groff Testing Service** Drill Rig **CME LC-60 ATV**
Driller **T &G** Logger **S. Sugiarto** Checked by **E. Datz**
Drilling Method **3.25" IDA HSA**

## WATER LEVEL DATA

While Drilling ▽ **22.00 ft**
At Completion of Drilling ▼ **66.50 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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# BORING LOG B-1

**WEI Job No.: 200-25-01**

Client **AB&H**
Project **IDOT Pump Station #8**
Location **NW 1/4, Sec. 17, T41N, R12E; Des Plaines, IL**

Datum: NGVD
Elevation: 646.77 ft
North: 1960091.79 ft
East: 1102201.19 ft
Station:
Offset:

| Profile | Elevation (ft) | SOIL AND ROCK DESCRIPTION | Depth (ft) | Sample Type recovery | Sample No. | SPT Values (blw/6 in) | Qu (tsf) | Moisture Content (%) |
|---|---|---|---|---|---|---|---|---|
| | | | 55 | | 17 | 7<br>12<br>14 | 5.74<br>B | 16 |
| | | | 60 | | 18 | 13<br>16<br>19 | 3.69<br>B | 11 |
| | 584.8 | Very dense, gray SILT | | | | | | |
| | | | 65 | | 19 | 50/5" | 7.37<br>B | 13 |
| | 579.8 | Very stiff, gray SILTY CLAY | | | | | | |
| | | | 70 | | 20 | 8<br>10<br>17 | NP | 14 |
| | | | 75 | | 21 | 9<br>9<br>13 | 3.28<br>B | 16 |
| | 566.8 | | 80 | | 22 | 10<br>9<br>13 | 2.46<br>B | 17 |
| | | Boring terminated at 80.00 ft | 85 | | | | | |
| | | | 90 | | | | | |
| | | | 95 | | | | | |
| | | | 100 | | | | | |

## GENERAL NOTES

Begin Drilling **11-26-2008** Complete Drilling **11-26-2008**
Drilling Contractor **Groff Testing Service** Drill Rig **CME LC-60 ATV**
Driller **T &G** Logger **S. Sugiarto** Checked by **E. Datz**
Drilling Method **3.25" IDA HSA**

## WATER LEVEL DATA

While Drilling ▽ **22.00 ft**
At Completion of Drilling ▼ **66.50 ft**
Time After Drilling **NA**
Depth to Water ▼ **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.