STRATUM ENGINEERING, LLC
Geotechnical Engineering ♦ Testing and Inspection Services

September 16, 2024

Jindal Tubular USA, LLC
13092 Sea Plane Road
Bay St. Louis, Mississippi 39520
Phone: (228) 669-0068

Attn: Mr. Chad Walters

Re: Geotechnical Investigation
Proposed Material Storage Slab
Jindal Tubular Facility
Bay St. Louis, Mississippi
SE Project No. G24-069

Dear Mr. Walters:

Stratum Engineering, LLC (SE) is pleased to submit our Geotechnical Engineering Report for the above referenced project. This report includes the results of the field exploration and laboratory testing as well as recommendations for foundation design and general site development.

We appreciate the opportunity to perform this geotechnical study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
STRATUM ENGINEERING, LLC

William "Dean" McInnis, P.E.
Vice President

Tony Y. Maroun, P.E.
Principal

TONY YOUSSEF MAROUN
REGISTERED PROFESSIONAL
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WDM/TYM:jkh

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# PROJECT INFORMATION

## Project Authorization

Stratum Engineering, LLC (SE) has completed a geotechnical exploration for the proposed Material Storage Slab to be constructed at the Jindal Tubular Facility in Bay St. Louis, Mississippi. The exploration was accomplished in general accordance with SE Proposal No. G24-093R, initially dated June 11, 2024 and later revised June 27, 2024.

## Project Description

We understand the project will include the construction of a slab or a mat foundation at the north end of the facility near Mulatto Bayou. The slab will have a footprint of about 40,000 square feet and will be an open area used to store rolls of steel off-loaded from barges. The rolls will be stocked 2 high and will exert a total weight of approximately 8,000 tons. The area will be consistently restocked inducing a uniform load of about 400 pounds per square feet across the slab.

In addition, a new building will be constructed on the east side of the main structure to house a drop weight tear testing machine. The new equipment will utilize a 3,000 pound hammer dropped from a height of 12 to 15 feet in order to test steel plate specimens. The foundation supporting the machine will have a footprint of 10 feet by 10 feet and will be about 8 feet thick.

The geotechnical recommendations presented in this report are based on the available project information, slab and building location, and subsurface materials described in this report. If any of the noted information is incorrect, please inform SE in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. SE will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

## Purpose and Scope of Services

The purpose of this study was to explore the subsurface conditions at the site to enable an evaluation of a cost effective foundation system for the proposed slab storage area and Tear Testing Equipment Building. Six (6) borings were drilled to depths of 20 feet below the existing ground surface within the storage slab and building footprints. The approximate locations of the borings are indicated on a plan included in the Appendix. The plan is a reproduction of a Google Earth photo of the Jindal Tubular Facility.

Our scope of services included a reconnaissance of the project site, drilling the soil borings, select laboratory testing, and preparation of this geotechnical report. The report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and provides recommendations regarding the following:

- Foundation type, allowable bearing capacity, and an estimate of settlement;
- Seismic site classification;
- Site preparation, including subgrade preparation and fill compaction requirements;
- Factors influencing construction and performance of the proposed storage and building areas.

The scope of geotechnical services did not include an environmental assessment for determining the presence or absence of wetlands; or hazardous or toxic materials in the soil, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

## SITE AND SUBSURFACE CONDITIONS

### Site Location and Description

The Jindal Tubular Facility encompasses a large tract of land situated between Port and Harbor Drive and Mulatto Bayou in Bay St. Louis. The facility consists of multiple pre-engineered metal warehouse structures surrounded by aggregate surfaced yard and parking areas. Similarly, the site of the proposed storage slab is covered with a mixture of sandy topsoil with gravel. Detailed grading information was unavailable at the time the report was prepared. However, we assumed that minimal amount of fill may be needed to achieve the storage slab and Tear Testing Equipment Building design grades.

### Drilling, Sampling, and Laboratory Testing Procedures

The borings were drilled with an All-Terrain Vehicle (ATV) mounted drilling rig. Auger rotary drilling techniques were used to advance the borings. Samples were generally obtained continuously from the ground surface to a depth of ten feet and at maximum five foot intervals thereafter. Drilling and sampling techniques were accomplished in general accordance with ASTM Standards.

Undisturbed samples of cohesive soils were generally obtained using thin-wall tube sampling procedures in general accordance with the procedures for “Thin-Walled Tube Geotechnical Sampling of Soils” (ASTM D1587). These samples were extruded in the field with a hydraulic ram and were wrapped in aluminum foil prior to placement in a plastic wrapping to preserve moisture. The samples were transported to the laboratory in containers to prevent disturbance.

For cohesionless soils and semi-cohesive soils, Standard Penetration Tests (SPT) were performed to obtain standard penetration values of the soil. The standard penetration value (N) is defined as the number of blows of a 140 pound hammer, falling 30 inches, required to advance the split-barrel sampler one (1) foot into the soil. Samples of granular soils were obtained utilizing a two (2) inch O.D. split-barrel sampler in general accordance with procedures for "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D1586). To perform the test and obtain a sample, the sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three (3) successive increments of six (6) inches penetration. The "N" value is obtained by adding the second and third incremental numbers. The results of the standard penetration test indicate the relative density of cohesionless soils and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components. The split spoon samples were identified according to the project number, boring number and depth, and were also placed in polyethylene plastic wrapping to protect against moisture loss

The laboratory testing program included supplementary visual classification and water content tests on all of the soil samples. In addition, selected samples were subjected to unconfined compression testing, percent passing the #200 sieve and Atterberg Limits determination. Additional estimates of unconfined compressive strength were made using a hand penetrometer. The laboratory testing was performed in general accordance with ASTM Standard Procedures.

## **Subsurface Conditions**

Based on the borings, the surface is generally covered with either 10 inches of limestone or a mixture of sandy soil with gravel. The surface material was underlain by a mixture of silty sand and aggregate extending to about 2 feet and followed by medium dense reddish clayey sand extending to a depth of 6 to 12 feet. Intermittent layers of tannish gray silty sand were noted in a few of the borings around 10 feet. Below the clayey sand, medium dense poorly graded sand was encountered and extended to at least 20 feet, the maximum depth explored.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the Appendix should be reviewed for specific information at the boring locations. These records include soil descriptions, stratification, penetration resistances, and locations of the samples and laboratory test data. The stratification shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratification represents the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on the logs. The samples, which were not altered by laboratory testing, will be retained for 60 days from the date of this report and then will be discarded.

## Groundwater Conditions

Groundwater was initially encountered in the borings between 9 ½ and 15 feet during drilling and was later measured at a depth of 8 to 13 feet upon completion of the drilling operations. It should be noted that groundwater level will be influenced by the water level in the nearby bayou and will fluctuate with seasonal variations in rainfall, extended periods of drought and surface runoff. Therefore, it is recommended that the actual groundwater level at the site be determined by the contractor at the time of the construction activities, if needed.

## IBC Site Classification

*The International Building Code (IBC), 2021 Edition,* was reviewed to determine the site classification for seismic design. Based on the soils encountered in the borings and our experience in the general vicinity, the site can be classified as Site Class "D", as outlined in Section 1613.2.2 of the Building Code.

# EVALUATION AND RECOMMENDATIONS

## General

The type and depth of foundation suitable for a given structure primarily depends on several factors including the subsurface conditions, the function of the structure, the loads it may carry, the cost of the foundation and the criteria set by the Design Engineer with respect to vertical and differential movement which the structure can withstand without damage.

The results of the exploration indicate that the soils at the site are fair in bearing quality and suitable for supporting the storage area and the Tear Testing Equipment Building on a shallow foundation system provided the site is prepared as recommended in the report. Details related to site preparations and foundation recommendations, as well as construction considerations, are presented in subsequent sections of the report.

## Site Preparation

The surface at the storage slab and Tear Testing Building areas is mostly covered with a mixture of sand and gravel. Therefore, these materials may remain in place provided they are free of surface vegetation. Any topsoil with organics and other deleterious materials encountered in the development area should be stripped and removed from the site.

The exposed subgrade in the storage and building areas should be proofrolled with a rubber tired vehicle weighing about 20 tons. Soils, which are observed to rut or deflect excessively under the moving load, should be undercut and replaced with compacted structural fill. The proofrolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.

After the subgrade preparation and observation have been completed, the structural fill should be placed in a relatively uniform horizontal lift and should be adequately keyed into the stripped and scarified soils. The structural fill should consist of sandy clays or clayey sands having a maximum liquid limit of 40 percent and a maximum plasticity index of 20. The fill should be compacted to at least 95 percent of the fill's maximum dry density as determined by ASTM D698 (Standard Proctor).

The structural fill should be placed in maximum lifts of 8 inches of loose material and should be compacted within the range of one (1) percentage point below to three (3) percentage points above the optimum moisture content value. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Each lift of compacted structural fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts. In-place density measurements should be taken to assure that the above degree of compaction is achieved. The compacted structural fill should extend 5 feet beyond the perimeter of the building prior to sloping. Adequate drainage should be provided prior to and during site work. The site should be graded to promote rapid runoff.

Crowning of the improvement areas during fill placement, particularly in wet periods, is highly recommended to minimize ponding of water and allow rapid runoff of surface water. Construction traffic should not be allowed on the building and storage pads during wet weather, where practical.

## Shallow Footings

Based on the field data and laboratory test results, the proposed building for the Tear Testing Equipment may be supported on a shallow foundation system, provided the site is prepared as discussed in the Site Preparation section of this report. Spread footings and continuous footings, bearing at least 2 feet below the finished grade in the medium dense naturally occurring sand or on compacted structural fill, could be designed for maximum allowable bearing pressures of 2,500 and 2,000 psf, respectively. Minimum dimensions of 24 inches for column footings and 18 inches for continuous footings should be used in foundation design to minimize the possibility of a localized bearing failure. The above bearing capacities include a design factor of safety of three (3).

The uplift resistance of shallow spread footings formed in open excavations should be limited to the weight of the foundation concrete and the soil above it. For preliminary design purposes, the uplift resistance can be computed by using a total unit weight of 115 pcf for the structural fill placed and compacted above the footing and the unit weight of 150 pcf for the concrete. Concrete reinforcing steel should be properly sized to resist uplift forces. We recommend that a factor of safety of at least 1.5 be used when determining the allowable uplift resistance of spread footings.

Soil resistance to horizontal forces is developed by lateral earth pressures acting on the face of the footing and by friction or adhesion on the footing base. We recommend that the allowable passive pressure be computed for spread footings below grade using the following equations:

$$P_p = 350H \text{ (Sand)}$$

where $P_p$ is the lateral soil resistance in psf (pounds per square foot) and H is the depth in feet. For exterior footings, H is measured from one (1) foot below adjacent finished grade, provided that the adjacent finished grade extends level and at least beyond a point that makes a 45-degree angle from the bottom of the exterior footing to the finished ground surface.

The top foot of passive resistance at foundations should be neglected unless the ground surface around the footing is covered by concrete or pavement. The resistance to sliding of spread footings bearing in structural fill can be computed by multiplying the footing base contact area by a sliding friction factor of 0.38. Spread footings should also be sized to resist overturning due to moment forces.

The foundation excavations should be observed by a representative of SE prior to steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed to the level of firm soils or adequately compacted fill as directed by the Geotechnical Engineer. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted structural fill, as determined by the Geotechnical Engineer.

The concrete should be placed in the footing excavations as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond prior to or after concrete placement. The foundation concrete should be placed during the same day the excavation is made. If it is required that footing excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

**Settlement**

Settlement of spread footings, designed for the recommended bearing pressure, is estimated to be less than 1 inch. Differential settlement will be about 50 percent of the total settlement. While settlement of this magnitude is generally considered tolerable for structures of the type proposed, the design of masonry walls should include provisions for liberally spaced, vertical control joints to minimize the effects of cosmetic cracking.

**Storage Slab**

The soil supported slab for the proposed storage area should bear on a minimum of 12 inches of compacted structural fill overlaid by 6 inches of limestone base. Placement of the new fill and preparation of the subgrade should be performed in accordance with the Site Preparation section of the report to identify any soft or unstable soils which should be removed from the storage slab area prior to additional fill placement and/or slab construction.

For design purposes, a Modulus of Subgrade Reaction (k) of 300 pci can be used with the addition of 6 inches of aggregate base which will better distribute the load to the underlying subsurface soils and provide a good working surface during construction. The aggregate base under the slab should consist of 610 crushed limestone conforming to the following grading requirements:

| U.S. Standard Sieve Size | % Passing, by Weight |
|---|---|
| 1 ½” | 100 |
| 1” | 90-100 |
| ¾” | 70-100 |
| No. 4 | 35-65 |
| No. 40 | 12-32 |
| No. 200 | 5-12 |

The crushed limestone should be compacted to 95 percent of its maximum dry density as determined by ASTM D698. The slab should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage.

**Mat Foundation**

We understand that Tear Testing Equipment will be used to test steel plate specimens. The equipment will utilize a 3,000 pound hammer dropped 12 to 15 feet delivering 36,000 to 45,000 foot-pounds of energy per drop. The equipment foundation will be 10 feet long, 10 feet wide and about 8 feet thick. Considering the expected load, a mat foundation may be used to support the Tear Testing Equipment provided the mat is sized properly and bearing at a sufficient depth to resist the anticipated dynamic loads during testing of the material. A mat foundation with a minimum bearing depth of 8 feet below the existing grades may be used to support the equipment.

Boring B-6 characterized the subsurface conditions at the Testing Equipment area located west of the storage slab area. A mat foundation bearing on 6 inches of 610 limestone placed over the naturally occurring reddish clayey sand at a minimum depth of 8 feet may be designed for an allowable bearing pressure of 3,000 psf based on dead load and design live load. Should the mat bear at a shallower depth, any soft material encountered at the bearing depth should be removed and replaced with compacted sand or limestone.

Subgrade Reaction Modulus estimates for mat foundations will depend on the type and strength of the bearing soils, size, shape, depth of bearing and magnitude of sustained loads. The Subgrade Modulus ($K_s$) for the bearing material at the recommended bearing depth was estimated to be on the order of 300 pci.

## CONSTRUCTION CONSIDERATIONS

It is recommended that SE be retained to provide observation and testing of construction activities involved in the foundations and related activities of this project. SE cannot accept any responsibility for any conditions which deviate from those described in this report, nor for the performance of the foundations, if not engaged to also provide construction observation and testing for this project.

**Moisture Sensitive Soils/Weather Related Concerns**

The upper soils encountered at this site are relatively sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, an increase in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

**Drainage and Groundwater Concerns**

Water should not be allowed to collect in the foundation excavations, slab areas, or on the prepared subgrade in the construction areas either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff. Positive site surface drainage should be provided to reduce infiltration of surface water around the storage and building areas.

Groundwater was measured in the borings at an approximate depth of 8 to 13 feet upon completion of the drilling operations. However, it is possible that seasonal variations will cause fluctuations of the water table. Additionally, perched water may be encountered in discontinuous zones within the overburden soils. Any water accumulation should be removed from the excavations by pumping. If excessive and uncontrolled amounts of seepage occur, the Geotechnical Engineer should be consulted to provide additional recommendations, if necessary.

**Excavations**

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P". This document was issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavation, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR, Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. SE does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

## REPORT LIMITATIONS

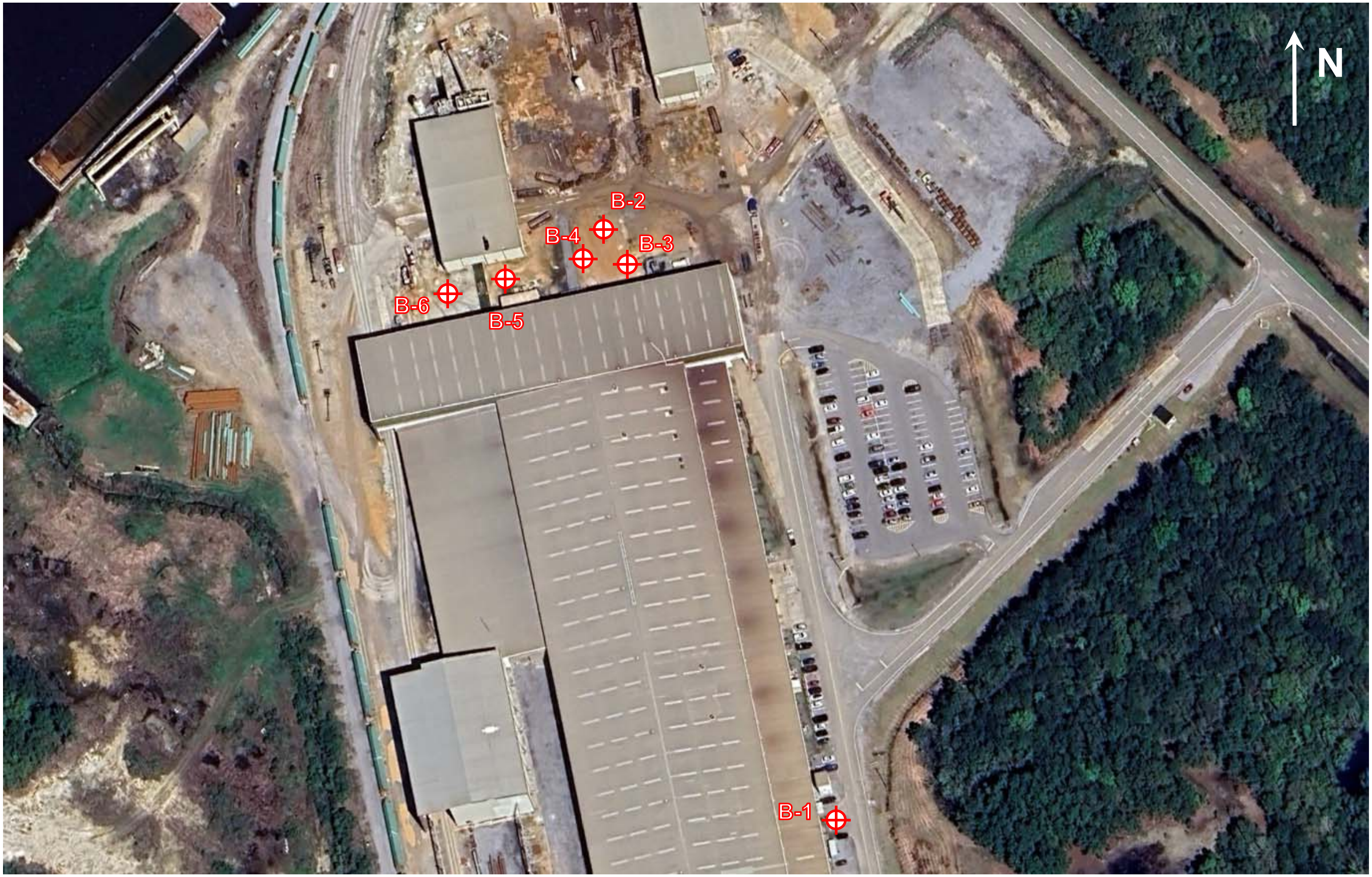
The recommendations submitted in this report are based on the available subsurface information obtained by SE and design details furnished by Jindal Tubular USA, LLC. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, SE should be notified immediately to determine if changes in the foundation recommendations are required. If SE is not notified of such changes, SE will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated in to the design documents. At that time, it may be necessary to submit supplementary recommendations. If SE is not retained to perform these functions, SE will not be responsible for the impact of those conditions on the project. This report has been prepared for the exclusive use of Jindal Tubular USA, LLC for the specific application to the proposed Material Storage Slab and the Tear Testing Equipment Building to be constructed at the north end of the Jindal Tubular Facility in Bay St. Louis, Mississippi.

# APPENDIX

STRATUM
ENGINEERING, LLC




STRATUM ENGINEERING, LLC

**BORING LOCATION PLAN**
**SE PROJECT NO. G24-069**

GEOTECHNICAL ENGINEERING SERVICES
**PROPOSED MATERIAL STORAGE SLAB**
**JINDAL TUBULAR FACILITY**
BAY ST. LOUIS, MISSISSIPPI

STRATUM ENGINEERING, LLC

# LOG OF BORING B-1

## PROPOSED MATERIAL STORAGE SLAB
## JINDAL TUBULAR FACILITY
## BAY ST. LOUIS, MISSISSIPPI

**TYPE OF BORING:** AUGER ROTARY **LOCATION:** STORAGE AREA **PROJECT NO.:** G24-069

| DEPTH, FT. | SOIL TYPE | SAMPLES | DESCRIPTION | N-BLOWS/FT. | UNCONFINED COMPRESSIVE STRENGTH tsf | HAND PENTROMETER tsf | TORVANE tsf | UNIT DRY WEIGHT pcf | MOISTURE CONTENT % | LIQUID LIMIT | PLASTICITY INDEX | % PASSING #200 SIEVE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 10" Limestone | | | | | | 30 | | | |
| | | | Limestone with Clayey Sand Mixture | | | | | | | | | |
| | | | Loose red Clayey Sand | | | 1.00 | | | 15 | | | |
| 5 | | | | | 0.78 | 1.00 | | 115 | 11 | 27 | 14 | 29 |
| | | | Medium dense tan Silty Sand | 29 | | | | | 14 | | | 15 |
| | | | Loose to medium dense tannish gray Clayey Sand | 9 | | | | | 12 | | | 35 |
| 10 | | | | | | | | | | | | |
| | | | | 11 | | | | | 20 | | | |
| 15 | | | | | | | | | | | | |
| | | | | 16 | | | | | 19 | | | 17 |
| 20 | | | | | | | | | | | | |
| | | | Boring Terminated at 20 Feet | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |
| 40 | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |

**DEPTH OF BORING:** 20 Feet **GROUNDWATER:** Measured at 8 Feet Upon Completion of Drilling

**DATE:** 7/31/2024

# LOG OF BORING B-2

STRATUM ENGINEERING, LLC

**PROPOSED MATERIAL STORAGE SLAB**
**JINDAL TUBULAR FACILITY**
**BAY ST. LOUIS, MISSISSIPPI**

**TYPE OF BORING:** AUGER ROTARY **LOCATION:** STORAGE AREA **PROJECT NO.:** G24-069

| DEPTH, FT. | DESCRIPTION | N-BLOWS/FT. | UNCONFINED COMPRESSIVE STRENGTH tsf | HAND PENTROMETER tsf | TORVANE tsf | UNIT DRY WEIGHT pcf | MOISTURE CONTENT % | LIQUID LIMIT | PLASTICITY INDEX | % PASSING #200 SIEVE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 12" Sand with gravel | | | | | | 20 | | | |
| | Medium dense red Clayey Sand | | | | | | | | | |
| | | | 1.20 | 1.25 | | 114 | 14 | 44 | 19 | 37 |
| 5 | | 13 | | | | | 24 | | | |
| | | | 1.17 | 1.50 | | 111 | 18 | | | |
| | - becomes tannish gray at 8' | | | 2.50 | | | 17 | | | |
| 10 | | | | | | | | | | |
| | Medium dense tannish gray Silty Sand with trace of clay | | | 1.25 | | | 19 | | | |
| 15 | | | | | | | | | | |
| | | | | 1.50 | | | 21 | | | |
| 20 | Boring Terminated at 20 Feet | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |

**DEPTH OF BORING:** 20 Feet
**DATE:** 7/31/2024
**GROUNDWATER:** Measured at 10 ½ Feet Upon Completion of Drilling

# LOG OF BORING B-3

**PROPOSED MATERIAL STORAGE SLAB**
**JINDAL TUBULAR FACILITY**
**BAY ST. LOUIS, MISSISSIPPI**

STRATUM ENGINEERING, LLC

**TYPE OF BORING:** AUGER ROTARY  **LOCATION:** STORAGE AREA  **PROJECT NO.:** G24-069

| DEPTH, FT. | SOIL TYPE | SAMPLES | DESCRIPTION | N-BLOWS/FT. | UNCONFINED COMPRESSIVE STRENGTH tsf | HAND PENTROMETER tsf | TORVANE tsf | UNIT DRY WEIGHT pcf | MOISTURE CONTENT % | LIQUID LIMIT | PLASTICITY INDEX | % PASSING #200 SIEVE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 10" Sand with gravel | | | | | | 46 | | | |
| | | | Gray Silty Sand with light weight aggregate | | | | | | | | | |
| | | | Medium dense red Clayey Sand | | 1.76 | 2.50 | | 110 | 22 | | | |
| 5 | | | | | | 3.00 | | | 16 | | | |
| | | | - loose at 6' | | 0.35 | 0.50 | | 92 | 21 | 37 | 21 | 44 |
| | | | - becomes tannish gray at 8' | 24 | | | | | 14 | | | 43 |
| 10 | | | | | | | | | | | | |
| | | | Medium dense Poorly Graded Sand | | | | | | | | | |
| | | | | 12 | | | | | 28 | | | |
| 15 | | | | | | | | | | | | |
| | | | | 16 | | | | | 24 | | | 10 |
| 20 | | | | | | | | | | | | |
| | | | Boring Terminated at 20 Feet | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | |
| 40 | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |

**DEPTH OF BORING:** 20 Feet  **GROUNDWATER:** Measured at 10 Feet Upon Completion of Drilling
**DATE:** 7/31/2024

STRATUM ENGINEERING, LLC

# LOG OF BORING B-4

**PROPOSED MATERIAL STORAGE SLAB**
**JINDAL TUBULAR FACILITY**
**BAY ST. LOUIS, MISSISSIPPI**

**TYPE OF BORING:** AUGER ROTARY **LOCATION:** STORAGE AREA **PROJECT NO.:** G24-069

| DEPTH, FT. | DESCRIPTION | N-BLOWS/FT. | UNCONFINED COMPRESSIVE STRENGTH tsf | HAND PENTROMETER tsf | TORVANE tsf | UNIT DRY WEIGHT pcf | MOISTURE CONTENT % | LIQUID LIMIT | PLASTICITY INDEX | % PASSING #200 SIEVE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10" Sand with gravel | | | | | | 23 | | | 21 |
| | Red Silty Sand with light weight aggregate | | | | | | | | | |
| | Medium dense red Clayey Sand | | | 2.50 | | | 16 | 40 | 17 | 37 |
| 5 | - loose, 4' to 8' | | | 0.75 | | | 18 | | | |
| | | | | 1.00 | | | 17 | | | |
| | Medium dense tannish gray Silty Sand | | | 1.25 | | | 10 | | | 22 |
| 10 | ▼ | | | | | | | | | |
| | ▽ | | | | | | | | | |
| | Medium dense tannish gray Poorly Graded Sand | | | | | | | | | |
| 15 | | 14 | | | | | 26 | | | 11 |
| 20 | | 17 | | | | | 26 | | | |
| | Boring Terminated at 20 Feet | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |

**DEPTH OF BORING:** 20 Feet **GROUNDWATER:** Measured at 10 Feet Upon Completion of Drilling
**DATE:** 7/31/2024

STRATUM ENGINEERING, LLC

# LOG OF BORING B-5

**PROPOSED MATERIAL STORAGE SLAB**
**JINDAL TUBULAR FACILITY**
**BAY ST. LOUIS, MISSISSIPPI**

**TYPE OF BORING:** AUGER ROTARY **LOCATION:** STORAGE AREA **PROJECT NO.:** G24-069

| DEPTH, FT. | DESCRIPTION | N-BLOWS/FT. | UNCONFINED COMPRESSIVE STRENGTH tsf | HAND PENTROMETER tsf | TORVANE tsf | UNIT DRY WEIGHT pcf | MOISTURE CONTENT % | LIQUID LIMIT | PLASTICITY INDEX | % PASSING #200 SIEVE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10" Sand with aggregate | | | | | | 23 | | | 32 |
| | Red Silty Sand with traces of light weight aggregate | | | | | | | | | |
| | Medium dense to dense red Clayey Sand | | | 4.00 | | | 13 | | | |
| 5 | | | 1.18 | 2.50 | | 118 | 15 | 40 | 21 | 47 |
| | | | | 1.50 | | | 17 | | | |
| | - becomes tannish gray at 8' | 25 | | | | | 13 | | | 49 |
| 10 | | | | | | | | | | |
| | Medium dense tannish gray Poorly Graded Sand | | | | | | | | | |
| | | 13 | | | | | 25 | | | |
| 15 | | | | | | | | | | |
| | | 27 | | | | | 24 | | | 11 |
| 20 | Boring Terminated at 20 Feet | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |

**DEPTH OF BORING:** 20 Feet **GROUNDWATER:** Measured at 9 ½ Feet Upon Completion of Drilling
**DATE:** 7/31/2024

STRATUM ENGINEERING, LLC

# LOG OF BORING B-6

**PROPOSED MATERIAL STORAGE SLAB**
**JINDAL TUBULAR FACILITY**
**BAY ST. LOUIS, MISSISSIPPI**

**TYPE OF BORING:** AUGER ROTARY **LOCATION:** TEAR TESTING EQUIPMENT AREA **PROJECT NO.:** G24-069

| DEPTH, FT. | DESCRIPTION | N-BLOWS/FT. | UNCONFINED COMPRESSIVE STRENGTH tsf | HAND PENTROMETER tsf | TORVANE tsf | UNIT DRY WEIGHT pcf | MOISTURE CONTENT % | LIQUID LIMIT | PLASTICITY INDEX | % PASSING #200 SIEVE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10" Sand with aggregate | | | | | | 21 | | | |
| | Red Silty Sand with light weight aggregate | | | | | | | | | |
| | Medium dense red Clayey Sand | | 0.98 | 1.50 | | 111 | 17 | 41 | 18 | 45 |
| 5 | | | | 2.00 | | | 21 | | | |
| | - loose at 6' | | 0.40 | 0.50 | | 105 | 20 | | | |
| | - becomes tannish gray at 8' | 28 | | | | | 17 | | | |
| 10 | | | | | | | | | | |
| | Medium dense tannish gray Silty Sand | 14 | | | | | 18 | | | 22 |
| 15 | | | | | | | | | | |
| | | 16 | | | | | 26 | | | |
| 20 | Boring Terminated at 20 Feet | | | | | | | | | |
| 25 | | | | | | | | | | |
| 30 | | | | | | | | | | |
| 35 | | | | | | | | | | |
| 40 | | | | | | | | | | |
| 45 | | | | | | | | | | |
| 50 | | | | | | | | | | |

**DEPTH OF BORING:** 20 Feet **GROUNDWATER:** Measured at 13 Feet Upon Completion of Drilling
**DATE:** 7/31/2024

# KEY TO TERMS AND SYMBOLS USED ON LOGS

## SOIL TYPE

ROCK | GRAVEL | SAND | SILT | CLAY | PEAT

## MODIFIERS

STONE | GRAVELY | SANDY | SILTY | CLAYEY | FILL

## SAMPLER TYPE

NO SAMPLE | AUGER SAMPLE | SHELBY TUBE | SPLIT SPOON

NO RECOVERY | ROCK CORE | 2" SHELBY TUBE | TXDOT CONE

## UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487 (1980)

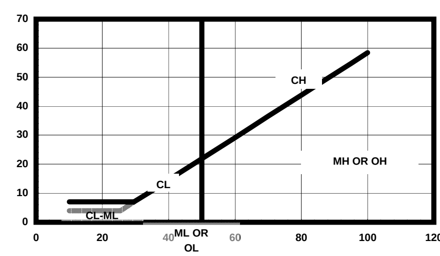
| MAJOR DIVISIONS | | | LETTER SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|
| COARSE GRAINED SOILS LESS THAN 50% PASSING NO. 200 SIEVE | GRAVEL & GRAVELY SOILS LESS THAN 50% PASSING NO. 4 SIEVE | CLEAN GRAVEL (LITTLE OR NO FINES | GW | WELL GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | | GP | POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | W/ APPRECIABLE FINES | GM | SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURES |
| | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | SANDS MORE THAN 50% PASSING NO. 4 SIEVE | CLEAN SANDS LITTLE FINES | SW | WELL GRADED SAND, GRAVELY SAND (LITTLE FINES) |
| | | | SP | POORLY GRADED SANDS, GRAVELY SAND (L.FINES) |
| | | SANDS WITH APPREA. FINES | SM | SILTY SANDS, SAND-SILT MIXTURES |
| | | | SC | CLAYEY SANDS,SAND-CLAY MIXTURES |
| FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE | SILTS AND CLAYS LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/ LOW PI |
| | | | CL | INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS |
| | | | OL | ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI |
| | SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS |
| | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS |
| | | | OH | ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT |
| HIGHLY ORGANIC SOIL | | | PT | PEAT AND OTHER HIGHLY ORGANIC SOILS |
| UNCLASSIFIED FILL MATERIALS | | | | ARTIFICIALLY DEPOSITED AND OTHER UNCLASSIFIED SOILS AND MAN-MADE SOIL MIXTURES |

## CONSISTENCY OF COHESIVE SOILS

| CONSISTENCY | SHEAR STRENGTH IN TONS/FT$^2$ |
|---|---|
| VERY SOFT | 0. TO 0.125 |
| SOFT | 0.125 TO 0.25 |
| FIRM | 0.25 TO 0.5 |
| STIFF | 0.5 TO 1.0 |
| VERY STIFF | 1.0 TO 2.0 |
| HARD | > 2.0 OR 2.0+ |

## RELATIVE DENSITY - GRANULAR SOILS

| CONSISTENCY | N-VALUE (BLOWS/FOOT) |
|---|---|
| VERY LOOSE | 0-4 |
| LOOSE | 4-9 |
| MEDIUM DENSE | 10-29 |
| DENSE | 30-49 |
| VERY DENSE | > 50 OR 50+ |




## ABBREVIATIONS

HP - HAND PENETROMETER
TV - TORVANE
MV - MINIATURE VANE
UC - UNCONFINED COMPRESSION TEST
UU - UNCONSOLIDATED UNDRAINED TRAIXIAL
CU - CONSOLIDATED UNDRAINED

DELAYED GROUNDWATER LVL

LEVEL GROUNDWATER ENCOUNTERED

NOTE: PLOT INDICATES SHEAR STRENGTH AS OBTAINED BY ABOVE TESTS

## CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

6" | 3" | 3/4" | 4 | 10 | 40 | 200

| BOUL--DERS | COBBLES | GRAVEL | | SAND | | | SILT | CLAY |
|---|---|---|---|---|---|---|---|---|
| | | COARSE | FINE | COARSE | MEDIUM | FINE | | |

152 | 76.2 | 19.1 | 4.76 | 2.0 | 0.42 | 0.075 | 0.002

GRAIN SIZE IN MM