Appendix B contains discussions of analytical procedures used in our engineering analyses. Appendix C contains a positioning report by Fugro Chance, Inc., of Lafayette, Louisiana.

For the purposes of discussion and presentation, "driven pipe pile" is used in this report to represent foundation piles, caissons and conductors, unless otherwise specified.

## 2.2 FIELD AND LABORATORY INVESTIGATIONS

The field investigation was performed on July 4 through 6, 2008, from the R/V *Seaprobe*. The soil conditions were determined by performing four exploratory borings, two at each SPM location with one boring at a selected anchor leg location, and one boring at the proposed PLET location. Enterprise Field Services selected the boring locations. These borings were drilled to a penetration of 131-ft below mudline. The water depths at the boring locations ranged from 123 to 125 ft. A chronological summary of field operations is presented in Appendix A.

### 2.2.1 Exploratory Borings

FMMG personnel drilled the soil borings with a DMX drill rig positioned over the centerwell of the R/V *Seaprobe*. The vessel was anchored at the boring location by a 4-point mooring system. Soil conditions at the site were explored by drilling a group of four soil borings to 131-ft penetration below the seafloor. The final coordinates for the boring locations are presented in Table 2-1. A plan of borings within Block A-59, of the Galveston Area is presented on Plate 2-1. Fugro Chance, Inc., of Lafayette, Louisiana, conducted surveying utilizing STARFIX and DGPS, and performed a 360-degree scanning sonar survey. The positioning report, prepared by Fugro Chance, is presented in Appendix C. The scanning sonar reports are available from Fugro Chance upon request.

**Table 2-1: Final Boring Coordinates**
(Texas South Central Zone Coordinates)

| FMMG Boring Designation | Fugro Chance Boring Designation | Proposed Boring Coordinates | Final Boring Coordinates | Boring Termination Depth (ft) |
|---|---|---|---|---|
| SPM #1 PLET | Core 3 | X = 3,258,627.75 ft<br>Y = 236,494.60 ft | X = 3,258,640 ft<br>Y = 236,466 ft | 131 |
| SPM #1 ANCHOR LEG #2 | Core 1 | X = 3,257,224.19 ft<br>Y = 236,057.66 ft | X = 3,257,200 ft<br>Y = 236,056 ft | 131 |
| SPM #2 PLET | Core 4 | X = 3,265,632.42 ft<br>Y = 240,337.08 ft | X = 3,265,647 ft<br>Y = 240,318 ft | 131 |
| SPM #2 ANCHOR LEG #6 | Core 2 | X = 3,266,735.50 ft<br>Y = 241,308.73 ft | X = 3,266,758 ft<br>Y = 241,331 ft | 131 |

Samples were obtained through 5.0-in.-OD, 4.5-in.-IF drill pipe at all the locations. Samples were spaced at 3-ft intervals to 20-ft penetration, at 5-ft intervals to 68-ft penetration, and at 10-ft intervals thereafter to the final boring depth at the SPM #1 ANCHOR LEG #2 and SPM #2 PLET locations. Sampling intervals at the SPM #1 PLET location was completed as follows: 3-ft intervals to 20-ft penetration, 5-ft intervals to 66-ft penetration, and 10-ft intervals thereafter to the final boring depth. Sampling intervals at the SPM #2 ANCHOR LEG #6 location was completed as follows: 3-ft intervals to 20-ft penetration, 5-ft

intervals to 65-ft penetration, and 10-ft intervals thereafter to the final boring depth. The drilling and sampling techniques used to complete this boring are explained in detail in Appendix A.

Two water depths were measured at each boring using a seafloor sensor seated in the drill bit. The water depth measurements are tabulated in Table 2-2. The water depth measurements are intended for the purpose of the geotechnical investigation only, and are not corrected for tidal or other variations. If utilized for other purposes, the water depth measurement should be adjusted to account for meteorological tide and datum corrections. The water depths measuring procedures are explained in detail in Appendix B.

**Table 2-2: Measured Water Depths**

| Boring Designation | Water Depth (ft) | Time and Date of Measurement | Supplemental Water Depth (ft) | Time and Date of Measurement |
|---|---|---|---|---|
| SPM #1 PLET | 123 | 0240 hours on July 5, 2008 | 123 | 0720 hours on July 5, 2008 |
| SPM #1 ANCHOR LEG #2 | 123 | 1440 hours on July 4, 2008 | 122 | 2200 hours on July 4, 2008 |
| SPM #2 PLET | 125 | 1135 hours on July 5, 2008 | 125 | 1650 hours on July 5, 2008 |
| SPM #2 ANCHOR LEG #6 | 124 | 0220 hours on July 6, 2008 | 124 | 0655 hours on July 6, 2008 |

### 2.2.2 Field and Laboratory Tests

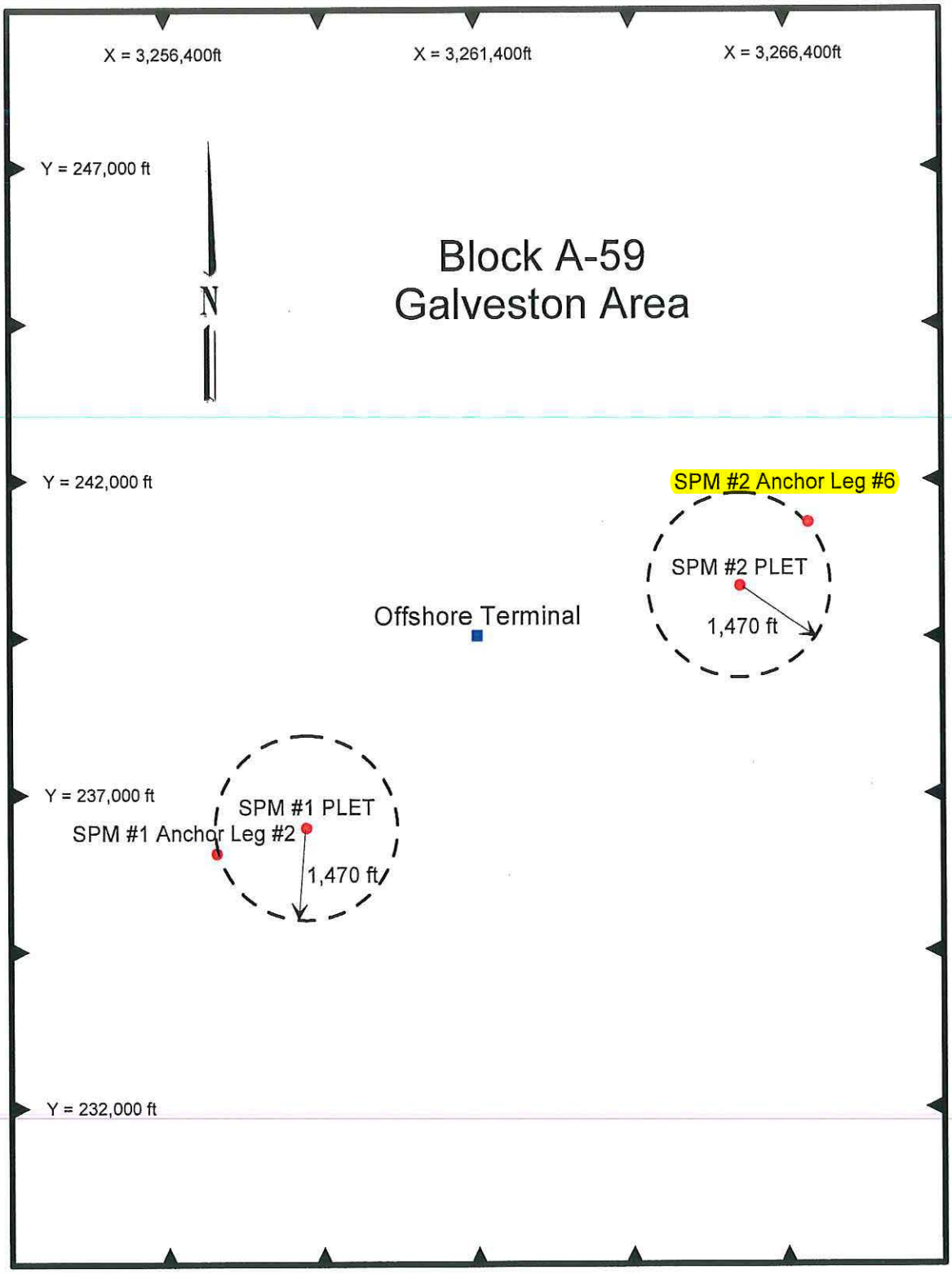
The soil testing program was designed to evaluate pertinent index and engineering properties of the foundation soils. During the field operation, all samples were extruded from the sampler and classified by the soil technician or field engineer. Unit weight, Torvane, pocket penetrometer, miniature vane and unconsolidated-undrained triaxial compression tests were performed in the field on selected cohesive samples. All of the samples were shipped to Fugro's Houston laboratory where Atterberg limit tests, water content tests, and grain-size analyses, as well as additional density tests, unconsolidated-undrained triaxial compression tests, and miniature vane tests, were performed.

A description of relevant laboratory procedures is provided in Appendix A. The strength and classification test results are presented graphically on the Logs of Boring and Test Results in Section 3. Grain-size distribution curves from sieve-analysis and stress-strain curves from triaxial compression tests are presented in Appendix A.

## 2.3 GENERAL SOIL CONDITIONS

### 2.3.1 Soil Stratigraphy

The soil stratigraphy at each of the boring locations disclosed by the field and laboratory investigations is presented in Section 3. The soil stratigraphy is based on the classification of soil samples recovered from the boring and observations made during drilling operations. Detailed soil descriptions, for each location, that include textural variations and inclusions are noted on the respective boring log



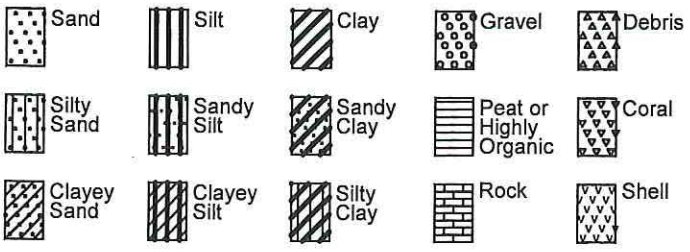

Projection: Texas South Central Zone Coordinates

## PLAN OF BORINGS

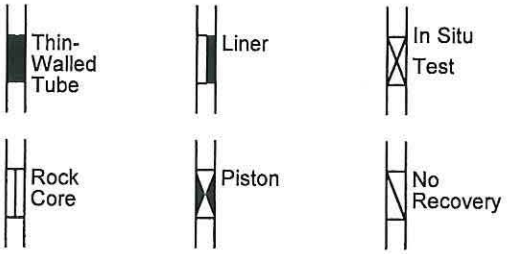
Texas Offshore Port System
Block A-59, Galveston Area

# TERMS AND SYMBOLS USED ON BORING LOG

## SOIL TYPES

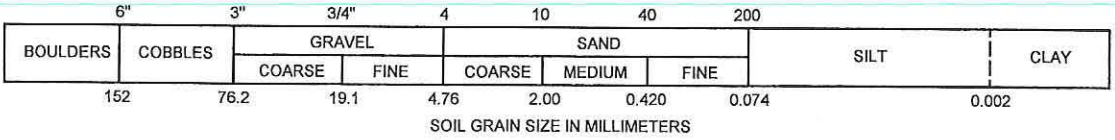



## SAMPLER TYPES




## SOIL GRAIN SIZE

U.S. STANDARD SIEVE




SOIL GRAIN SIZE IN MILLIMETERS

## STRENGTH OF COHESIVE SOILS[1]

| Consistency | Undrained Shear Strength, Kips Per Sq Ft |
|---|---|
| Very Soft | less than 0.25 |
| Soft | 0.25 to 0.50 |
| Firm | 0.50 to 1.00 |
| Stiff | 1.00 to 2.00 |
| Very Stiff | 2.00 to 4.00 |
| Hard | greater than 4.00 |

## DENSITY OF GRANULAR SOILS[2,3]

| Descriptive Term | *Relative Density, % |
|---|---|
| Very Loose | less than 15 |
| Loose | 15 to 35 |
| Medium Dense | 35 to 65 |
| Dense | 65 to 85 |
| Very Dense | greater than 85 |

*Estimated from sampler driving record

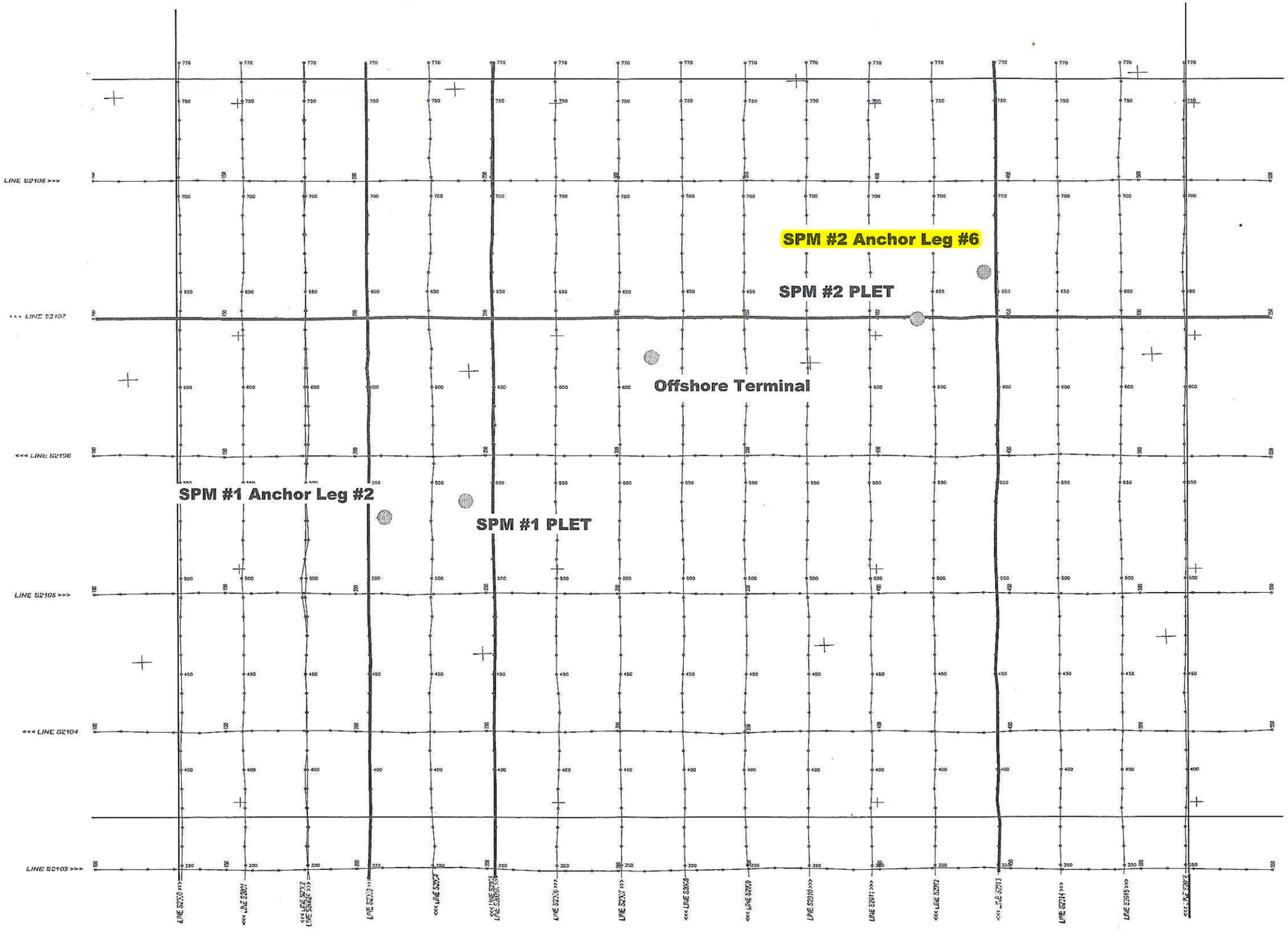
## SOIL STRUCTURE[1]

| | |
|---|---|
| Slickensided | Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along these planes. |
| Fissured | Containing shrinkage or relief cracks, often filled with fine sand or silt, usually more or less vertical. |
| Pocket | Inclusion of material of different texture that is smaller than the diameter of the sample. |
| Parting | Inclusion less than 1/8 inch thick extending through the sample. |
| Seam | Inclusion 1/8 inch to 3 inches thick extending through the sample. |
| Layer | Inclusion greater than 3 inches thick extending through the sample. |
| Laminated | Soil sample composed of alternating partings or seams of different soil types. |
| Interlayered | Soil sample composed of alternating layers of different soil types. |
| Intermixed | Soil sample composed of pockets of different soil types and layered or laminated structure is not evident. |
| Calcareous | Having appreciable quantities of carbonate. |

## REFERENCES:


(1) ASTM D 2488
(2) ASCE Manual 56 (1976)
(3) ASTM D 2049


Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the log may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated in the text, and may vary with time, geologic condition or construction activity.




MAP OF SOIL BORINGS AND SUBBOTTOM PROFILE LINES

Texas Offshore Port System

Block A-59, Galveston Area

## 3.4 SPM #2 ANCHOR LEG #6 LOCATION

### 3.4.1 Introduction

The field investigation at the location designated as SPM #2 ANCHOR LEG #6 was performed on July 5 and 6, 2008. Soil sampling was performed to 131-ft penetration at Texas South Central Zone Coordinates X = 3,266,758 ft and Y = 241,331 ft. The measured water depth was 124 ft.

### 3.4.2 Soil Stratigraphy

The soil stratigraphy disclosed by the field and laboratory investigations is presented on the boring log, Plate 3-34. The soil stratigraphy is based on the classification of soil samples recovered from the boring and observations made during drilling operations. A generalized summary of the major soil strata is tabulated below.

| Stratum | Penetration, ft From | To | Description |
|---|---|---|---|
| I | 0 | 17 | Soft to firm clay |
| II | 17 | 28 | Medium dense fine sand |
| III | 28 | 63 | Firm to stiff lean clay |
| IV | 63 | 131 | Stiff clay |

Detailed soil descriptions that include textural variations and inclusions are noted on the boring log. A key to the terms and symbols used on the boring log is presented on Plate 2-2. The Roman numeral representing each stratum is also shown on the boring log and on relevant plates. The variation in soil stratigraphy across this site is indicated in a comparison (integration) of the geophysical and geotechnical soil information presented on Plate 3-35.

#### 3.4.2.1 Interpretation of Soil Properties

The shear strength and submerged unit weight profiles shown on Plates 3-36 and 3-37, respectively, best represent the assembled test results plotted on the boring log. These profiles were used in the engineering analyses.

### 3.4.3 Pile Design Information

The pile design information developed for this study includes ultimate axial capacities, axial load-pile movement data, and lateral soil resistance-pile deflection (p-y) characteristics. The analytical methods used to develop this information are presented briefly in Section 2.5 and in more detail in Appendix B.

#### 3.4.3.1 Axial Pile Design

**Ultimate Axial Capacity.** The unit skin friction and unit end bearing values plotted on Plates 3-38 and 3-39, respectively, was calculated using the API RP 2A methods described in Appendix B. These values were used to calculate the ultimate axial compressive and tensile capacities for 42-in.-diameter pipe piles, driven to final penetration at the boring location. Capacity curves for driven pipe piles (conductors, caissons, anchor and foundation piles) are presented on Plate 3-40.

API RP 2A recommends that pile penetrations be selected using appropriate factors of safety or pile resistance factors. These factors are discussed in Section 2.5.1 of this report.

**Axial Load Transfer Data**. Axial load-pile movement analyses are usually performed using a computer solution based on methods developed by Reese (1964) or Matlock, et al. (1976). Plates 3-41 and 3-42 present the results as side load-side movement (t-z) and tip load-tip movement (Q-z) data for 42-in.-diameter driven pipe piles, respectively. The Q-z data should be used for foundation piles and neglected for caissons and conductor design. In developing the axial load transfer data in the cohesive soils, a post-peak adhesion ratio of 0.90 was utilized.

### 3.4.3.2 Lateral Pile Design Data

The soil resistance-pile deflection (p-y) characteristics of the soils at the boring location were developed for individual 42-in.-diameter driven pipe piles. These data may be used in lateral load analyses of driven piles, conductors and caissons. The p-y data for cyclic loading were developed to 100-ft penetration using procedures that have been outlined in API RP 2A and briefly explained in Appendix B. The stratigraphy and parameters used to develop the p-y data are presented on Plate 3-43. The p-y data for 42-in.-diameter driven pipe piles are presented on Plate 3-44. P-y values presented at 100-ft penetration may be used for lateral load analyses at greater depths.

Checked By: HW Date: 8/22/03

Approved By: DR Date: 9/18/03

Drawn By: for ITOM Date: 8/2...

Report No. 0201-6505

X = 3,266,758'
Y = 241,331'

Texas South Central Zone Coordinates
SEAFLOOR AT EL. - 124'

BLOW COUNT

IDENTIFICATION TESTS, [%]

SUBMERGED UNIT WEIGHT, [kcf]

UNDRAINED SHEAR STRENGTH [ksf]

| Penetration Below Seafloor, [feet] | Soil | Blow Count | Identification Tests | Undrained Shear Strength |
|---|---|---|---|---|
| 0 | SOFT TO FIRM GRAY CLAY | WOH | | |
| | | WOH | | |
| | | WOH | | |
| 10 | I | 5 | | |
| | | 10 | | |
| | (17.0') | 10 | | |
| 20 | MEDIUM DENSE GRAY FINE SAND | 10 | NP | |
| | II | 20 | | |
| | (28.0') | | | |
| 30 | FIRM TO STIFF GRAY LEAN CLAY | 15 | | |
| | | PUSH | | |
| 40 | | PUSH | | |
| | III -with an $H_2S$ odor, sand pockets, and a few shell fragments at 44' | PUSH | | |
| 50 | | PUSH | | |
| | -with a few shell fragments below 53'<br>-with silt pockets, partings, and seams at 54' | PUSH | | |
| | -with a few silt pockets and partings below 58' | PUSH | | |
| 60 | (63.0') | | | |
| | STIFF GRAY CLAY<br>-with gas blisters and a few silt pockets and partings to 65' | PUSH | | |
| 70 | | | | |
| | -expansive, with a few light gray bands, 73' to 85'<br>-with many silt pockets, partings, and seams at 74' | PUSH | | |
| 80 | | | | |
| | -with gas blisters at 84' | PUSH | | |
| 90 | | | | |
| | -platy, with many silt pockets, partings, and seams, and a few light gray bands at 94' | PUSH | | |
| | IV | | | |
| 100 | | | | |
| | -with gas blisters below 103'<br>-silt layer at 104' | PUSH | | (2.52, 104.5) |
| 110 | | | | |
| | -with a few silt pockets, 115' to 125'<br>-mottled with brown, with calcareous nodules at 115' | PUSH | | |
| 120 | | | | |
| | -brown, mottled with gray, 123' to 130'<br>-with a few silt seams at 124' | PUSH | | |
| | -with a few calcareous nodules at 129' | | | |
| 130 | -brown and expansive at 130' (131.0') | PUSH | | |
| 140 | | | | |
| 150 | | | | |
| 160 | | | | |
| 170 | | | | |
| 180 | | | | |
| 190 | | | | |
| 200 | | | | |

Note: See PLATE 3-34b for detailed soil stratigraphy to 40-ft penetration.

Note: NP - Non-plastic material

**SAMPLING TECHNIQUES**

Number of blows of a 175-lb weight (hammer) dropped approximately 5 ft to produce a maximum of 24 in. of penetration of a 2.25-in.-OD, 2.125-in.-ID thin-walled tube sampler. "PUSH" denotes a 3.00-in.-OD, 2.83-in.-ID thin-walled tube sampler was advanced 24 in. with the weight of the drill string. "WOH" denotes a 2.50-in.-OD, 2.125-in.-ID liner sampler was advanced 24 in. with the weight of the hammer.

**CLASSIFICATION TESTS**

- ▼ SOLUBILITY IN HCL, [%]
- ■ PERCENT PASSING -200 SIEVE, [%]
- ● WATER CONTENT (W), [%]
- □ SUBMERGED UNIT WEIGHT (SUW)

PLASTIC LIMIT (PL) — LIQUID LIMIT (LL)

**STRENGTH TESTS**

- ⊗ POCKET PENETROMETER (PP)
- ⊕ TORVANE (TV)
- ◇ REMOTE VANE (RV)
- ◆ MINIATURE VANE (MV) (◈ RESIDUAL (MVres) VALUE)
- ▲ UNCONSOLIDATED UNDRAINED TRIAXIAL (UU)

(Open symbols indicate remolded (r) tests)

# LOG OF BORING AND TEST RESULTS

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

PLATE 3-34a

TUGRO

Chec AW 9/25/00
Approved By: DC Date: 9/18/01
vn By: Tom 8/

Report No. 0201-6505

X = 3,266,758'
Y = 241,331'

Texas South Central Zone Coordinates
SEAFLOOR AT EL. - 124'

| | | BLOW COUNT |
|---|---|---|
| 0 | SOFT TO FIRM GRAY CLAY | |
| | -with many shell fragments at mudline | WOH |
| | -lean to 9' | |
| | -with silt pockets to 8' | |
| | -with shell fragments at 1' | WOH |
| 5 | -with a few shell fragments and pockets of organic matter, 3' to 8' | |
| | -with silt seams at 4' | WOH |
| | I | |
| 10 | -with shell fragments at 10' | 5 |
| | -with a few shell fragments, 12' to 16' | 10 |
| 15 | -sandy and lean, with many shells and shell fragments below 16' (17.0') | 10 |
| | MEDIUM DENSE GRAY FINE SAND | |
| | -silty, with shell fragments to 19' | 10 |
| 20 | -with mica below 19' | |
| | II | |
| | -with a trace of medium sand and many shell fragments at 24' | 20 |
| 25 | (28.0') | |
| | FIRM TO STIFF GRAY LEAN CLAY | |
| | -with a few shell fragments to 35' | 15 |
| 30 | -sandy silty clay to 30' | |
| | -sandy at 33' | |
| | III | |
| 35 | -lean below 34' | PUSH |
| | -with a few wood fragments at 34' | |
| | | PUSH |
| 40 | | |

IDENTIFICATION TESTS, [%]
20 40 60 80
SUBMERGED UNIT WEIGHT, [kcf]
0.03 0.04 0.05 0.06

NP

Note: NP - Non-plastic material

UNDRAINED SHEAR STRENGTH
[ksf]
0.2 0.4 0.6 0.8

Penetration Below Seafloor, [feet]

Penetration Below Seafloor, [feet]

SAMPLING TECHNIQUES

Number of blows of a 175-lb weight (hammer) dropped approximately 5 ft to produce a maximum of 24 in. of penetration of a 2.25-in.-OD, 2.125-in.-ID thin-walled tube sampler. "PUSH" denotes a 3.00-in.-OD, 2.83-in.-ID thin-walled tube sampler was advanced 24 in. with the weight of the drill string. "WOH" denotes a 2.50-in.-OD, 2.125-in.-ID liner sampler was advanced 24 in. with the weight of the hammer.

CLASSIFICATION TESTS

- ▼ SOLUBILITY IN HCL, [%]
- ■ PERCENT PASSING -200 SIEVE, [%]
- ● WATER CONTENT (W), [%]
- □ SUBMERGED UNIT WEIGHT (SUW)

PLASTIC LIMIT (PL) — LIQUID LIMIT (LL)

STRENGTH TESTS

- ⊗ POCKET PENETROMETER (PP)
- ⊕ TORVANE (TV)
- ◇ REMOTE VANE (RV)
- ◆ MINIATURE VANE (MV) (◈ RESIDUAL (MVres) VALUE)
- ▲ UNCONSOLIDATED UNDRAINED TRIAXIAL (UU)

(Open symbols indicate remolded (r) tests)

PLATE 3-34b

# LOG OF BORING AND TEST RESULTS

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

S

N

Offset: 22000 22500 23000 125 METERS 23500

410 FT

10 MSEC ~ 25 FEET

Penetration Below Seafloor, [feet]

0.050 0.060 0.070 0.080 0.090 0.100 0.110 0.120

Checked By: Date:
Approved By: Date:
Drawn By: Date:

X = 3,264,709'
Y= 241,320'
Texas South Central Zone Coordinates
BEARLOON AT EL. -13.0'

BLOW COUNT

IDENTIFICATION TESTS, (%)
SUBMERGED UNIT WEIGHT, (kcf)

UNDRAINED SHEAR STRENGTH (ksf)

SOFT TO FIRM GRAYC LAY
Note: See PLATE 3-31b for detailed soil stratigraphy to 40-ft penetration.
(17.0')

MEDIUND ENSE GRAYF INE SAND
(29.0')

FIRN TO STIFF GRAY LEAN CLAY
-with an H2S odor, sand pockets, and a few shell fragments at 44'
-with a few shell fragments below 53'
-with silt pockets, partings, and seams at 64'
-with a few silt pockets and partings below 58'
(65.0')

STIFF GRAY CLAY
-with gas blisters and a few silt pockets and partings in 65'
-sandy, with a few light gray bands, 72' to 80'
-with many silt pockets, partings, and seams at 74'
-with gas blisters at 84'
-silty, with many silt pockets, partings, and seams, and a few light gray bands at 94'
-with gas blisters below 102'
-silt layer at 104'
-with a few silt pockets, 115' to 125'
-mottled with brown, with calcareous nodules at 116'
-brown, mottled with gray, 127 to 130'
-with a few silt seams at 126'
-with a few calcareous nodules at 129'
-brown and some silt at 130'
(131.0')

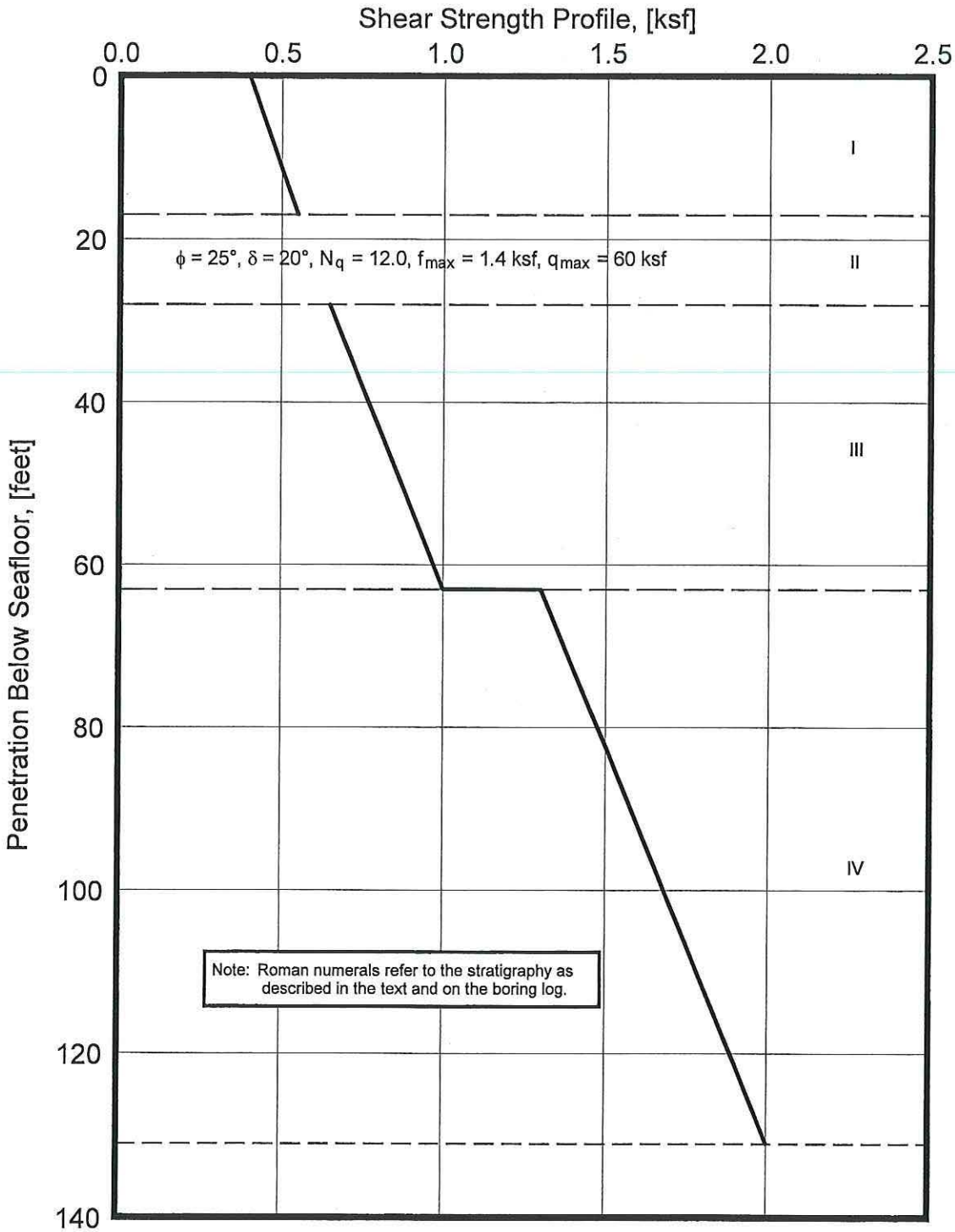
Note: NP - Non-plastic material

| CLASSIFICATION TESTS | STRENGTH TESTS |
|---|---|
| ▼ SOLUBILITY IN HCL, [%] | ⊙ POCKET PENETROMETER (PP) |
| ■ PERCENT PASSING #200 SIEVE, [%] | ⊕ TORVANE (TV) |
| ● WATER CONTENT (W), [%] | ⊕ REMOTE VANE (RV) |
| □ SUBMERGED UNIT WEIGHT (SUW) | ◆ MINIATURE VANE (MV) {◇ RESIDUAL (MVres) VALUE} |
| PLASTIC LIMIT (PL) LIQUID LIMIT (LL) | ▲ UNCONSOLIDATED UNDRAINED TRIAXIAL (UU) |
| + ---------- + | (Open symbols indicate remolded (r) tests) |

GEOPHYSICAL AND GEOTECHNICAL INTEGRATION
Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

Portion of Subbottom Profiler
Line 2013

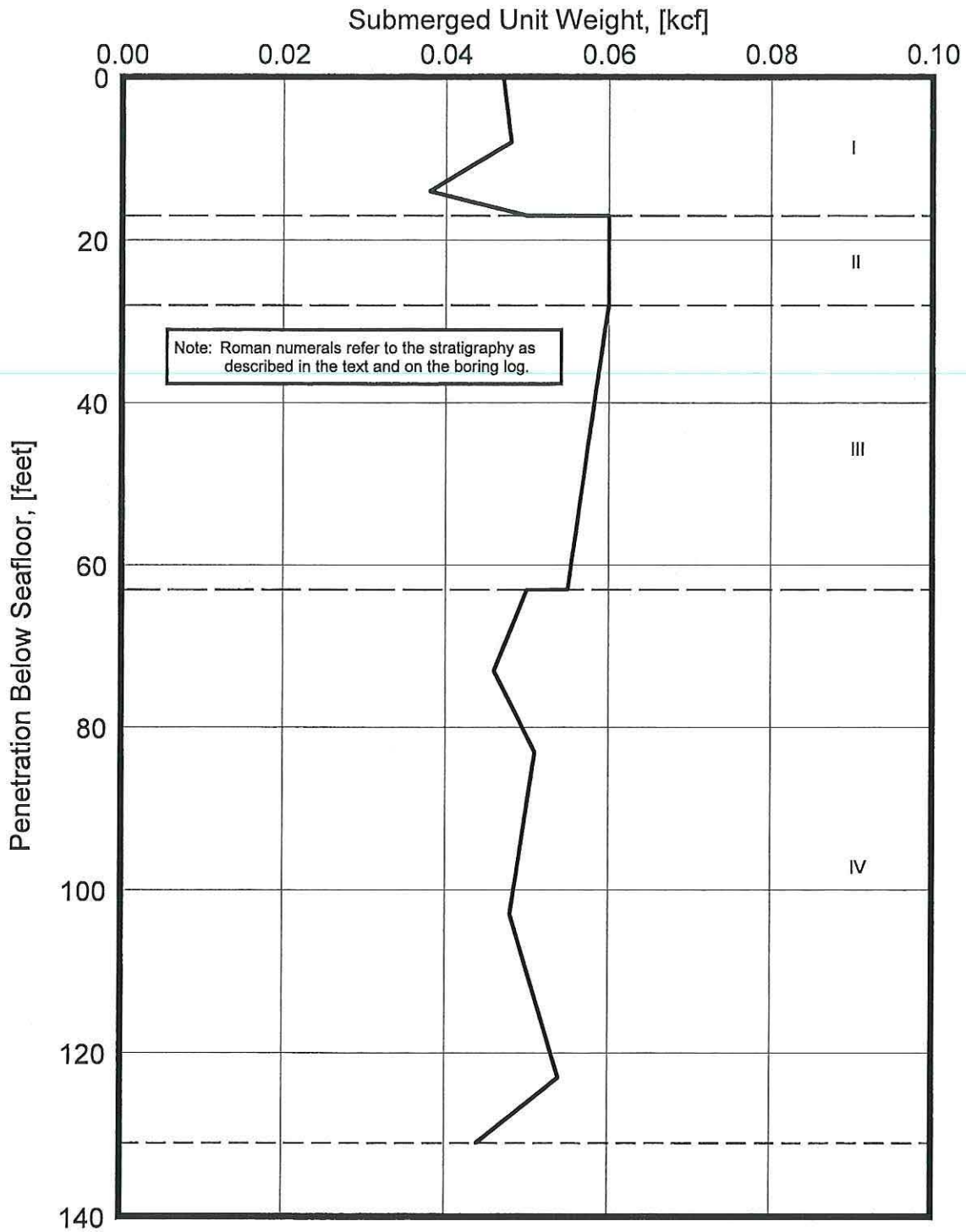
Date: 8/25/08
Drawn By: MW
Date: 8/26/08
Date: 9/18/08
Checked By: PMP
Approved By: DR




**DESIGN STRENGTH PARAMETERS**

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

Date: 8/25/08
Drawn By: MW
Date: 8/26/08
Checked By: FMP
Date: 9/8/08
Approved By: BRL



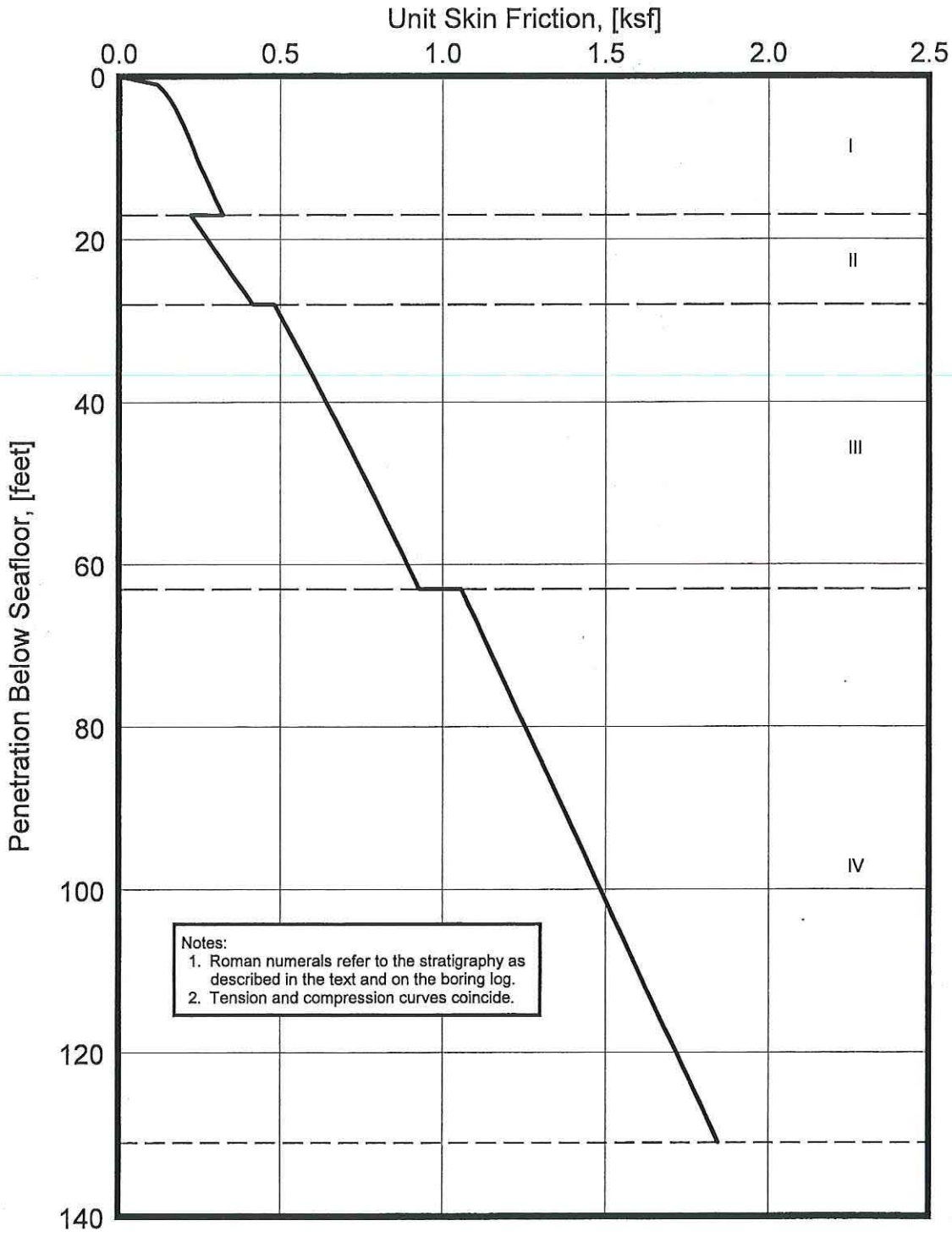

**DESIGN SUBMERGED UNIT WEIGHT**

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

Drawn By: AM Date: 8/25/08

Checked By: PMP Date: 8/26/08

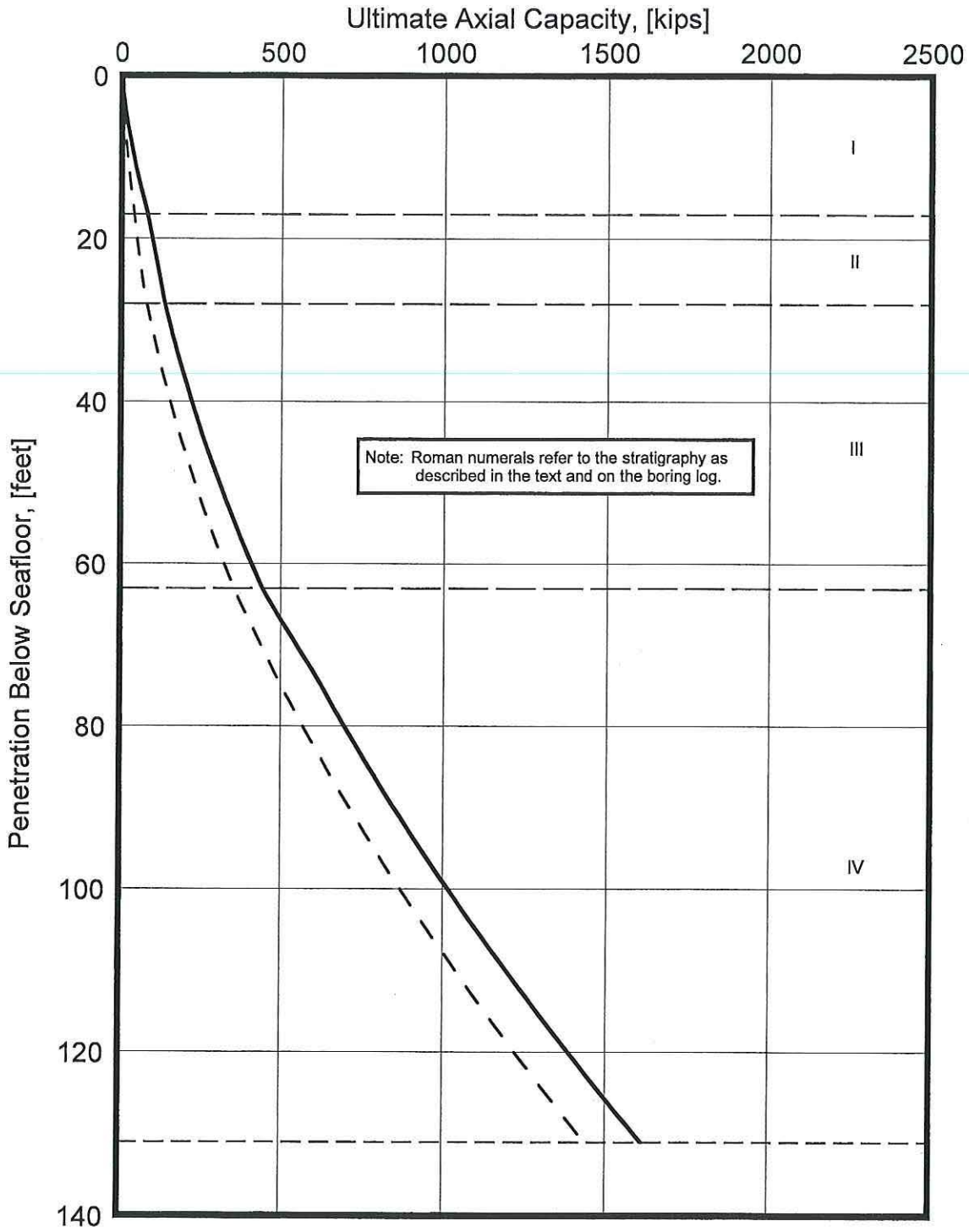
Approved By: MR Date: 8/28/08




**UNIT SKIN FRICTION**
API RP 2A (2000) Method

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

Date: 8/25/08
Drawn By: AW
Date: 8/26/08
Checked By: PMP
Date: 9/8/08
Approved By: DA




**ULTIMATE AXIAL CAPACITY**
API RP 2A (2000) Method
42-in.-Diameter Driven Pipe Piles
Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

| PENETRATION BELOW MUDLINE (feet) | | CURVE POINTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 0.0 | t | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 1.0 | t | 0.00 | 0.04 | 0.06 | 0.09 | 0.11 | 0.12 | 0.11 | 0.11 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 8.0 | t | 0.00 | 0.07 | 0.11 | 0.17 | 0.20 | 0.22 | 0.20 | 0.20 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 10.0 | t | 0.00 | 0.07 | 0.12 | 0.18 | 0.22 | 0.24 | 0.22 | 0.22 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 14.0 | t | 0.00 | 0.09 | 0.14 | 0.22 | 0.26 | 0.29 | 0.26 | 0.26 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 17.0 | t | 0.00 | 0.10 | 0.16 | 0.24 | 0.29 | 0.33 | 0.29 | 0.29 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 17.0 | t | 0.00 | 0.22 | 0.22 | | | | | |
| | z | 0.00 | 0.10 | 42.00 | | | | | |
| 28.0 | t | 0.00 | 0.42 | 0.42 | | | | | |
| | z | 0.00 | 0.10 | 42.00 | | | | | |
| 28.0 | t | 0.00 | 0.14 | 0.24 | 0.36 | 0.43 | 0.48 | 0.43 | 0.43 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 63.0 | t | 0.00 | 0.28 | 0.46 | 0.70 | 0.83 | 0.93 | 0.83 | 0.83 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 63.0 | t | 0.00 | 0.32 | 0.53 | 0.79 | 0.95 | 1.06 | 0.95 | 0.95 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 73.0 | t | 0.00 | 0.35 | 0.59 | 0.88 | 1.06 | 1.17 | 1.06 | 1.06 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 83.0 | t | 0.00 | 0.39 | 0.64 | 0.97 | 1.16 | 1.29 | 1.16 | 1.16 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 103.0 | t | 0.00 | 0.46 | 0.76 | 1.14 | 1.37 | 1.52 | 1.37 | 1.37 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 123.0 | t | 0.00 | 0.53 | 0.88 | 1.32 | 1.58 | 1.75 | 1.58 | 1.58 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |
| 131.0 | t | 0.00 | 0.55 | 0.92 | 1.38 | 1.66 | 1.85 | 1.66 | 1.66 |
| | z | 0.00 | 0.07 | 0.13 | 0.24 | 0.34 | 0.42 | 0.84 | 42.00 |

Notes: 1. "t" is mobilized soil-pile adhesion, [ksf].
2. "z" is axial pile displacement, [in.].
3. Data for tension and compression coincide.

Drawn By: [illegible] Date: 8/25/08

Checked By: [illegible] Date: 8/26/08

Approved By: [illegible] Date: 9/3/08

## AXIAL LOAD TRANSFER DATA

(T-Z DATA)

API RP 2A (2000) Method

42-in.-Diameter Driven Pipe Piles

Texas Offshore Port System, SPM #2 Anchor Leg #6

Block A-59, Galveston Area

| PENETRATION BELOW MUDLINE (feet) | | CURVE POINTS | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 63.0 | Q | 0 | 22 | 43 | 65 | 78 | 87 | 87 |
| | z | 0.00 | 0.08 | 0.55 | 1.76 | 3.07 | 4.20 | 42.00 |
| 74.0 | Q | 0 | 31 | 61 | 92 | 110 | 122 | 122 |
| | z | 0.00 | 0.08 | 0.55 | 1.76 | 3.07 | 4.20 | 42.00 |
| 131.0 | Q | 0 | 43 | 87 | 130 | 156 | 173 | 173 |
| | z | 0.00 | 0.08 | 0.55 | 1.76 | 3.07 | 4.20 | 42.00 |

Notes: 1. "Q" is mobilized end bearing capacity, [kips].
2. "z" is axial tip displacement, [in.].

Drawn By: AW Date: 8/27/08

Checked By: [illegible] Date: 8/27/08

Approved By: [illegible] Date: 8/28/08

## AXIAL LOAD TRANSFER DATA

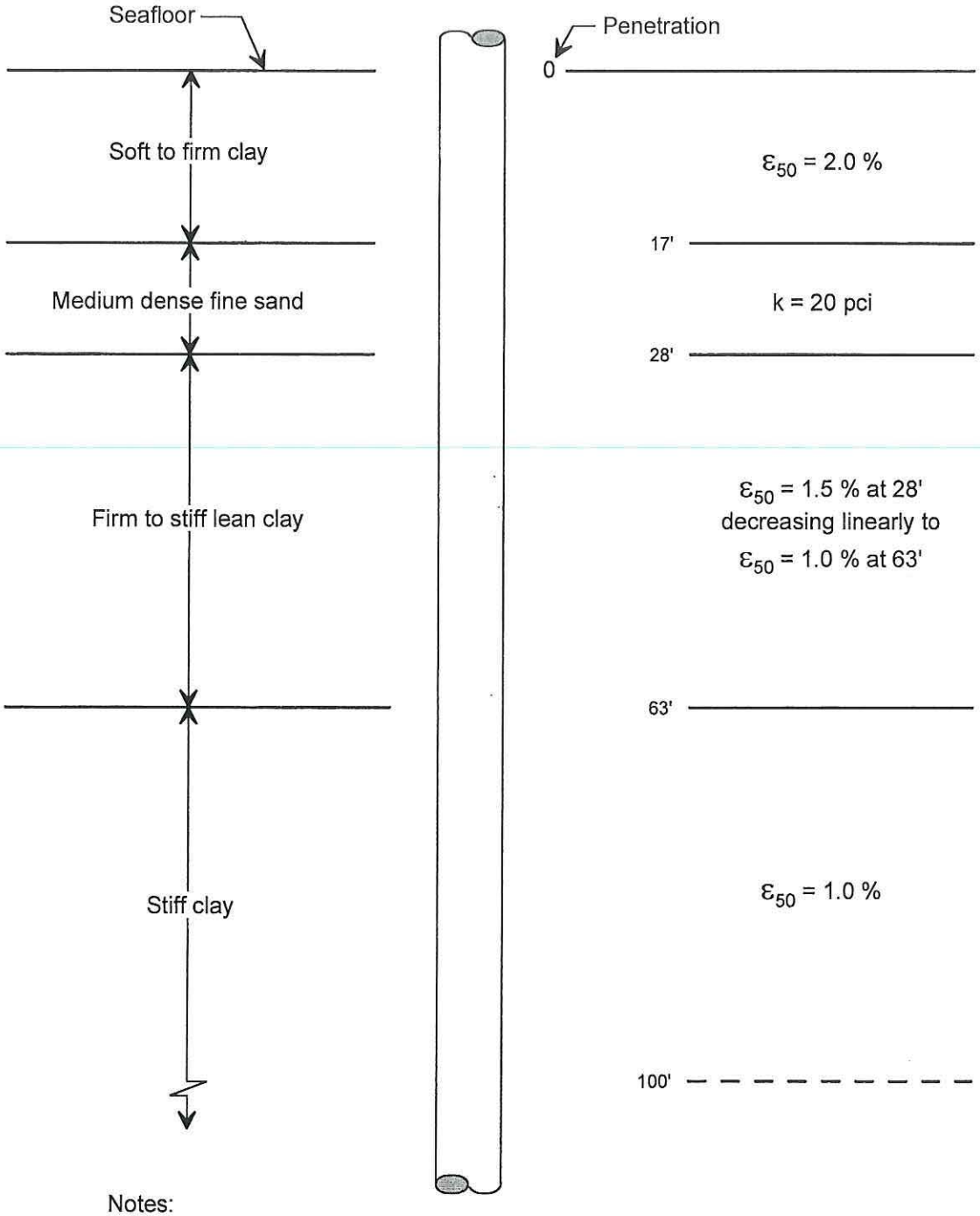
(Q-Z DATA)

API RP 2A (2000) Method

42-in.-Diameter Driven Pipe Piles

Texas Offshore Port System, SPM #2 Anchor Leg #6

Block A-59, Galveston Area




Notes:

1. $\varepsilon_{50}$ is axial strain at half of peak deviator stress for cohesive soils.
2. Soil strength parameters are shown on Plate 3-36.
3. Submerged unit weight profile is shown on Plate 3-37.
4. k is the modulus of horizontal subgrade reaction for granular soils.

## STRATIGRAPHY AND PARAMETERS FOR P-Y DATA

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

| PENETRATION BELOW MUDLINE (feet) | | CURVE POINTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 0.0 | p | 0 | 52 | 80 | 119 | 175 | 252 | 0 | 0 |
| | y | 0.00 | 0.06 | 0.21 | 0.63 | 2.10 | 6.30 | 31.50 | 42.00 |
| 4.0 | p | 0 | 76 | 117 | 173 | 254 | 366 | 61 | 61 |
| | y | 0.00 | 0.06 | 0.21 | 0.63 | 2.10 | 6.30 | 31.50 | 42.00 |
| 8.0 | p | 0 | 102 | 156 | 231 | 340 | 490 | 159 | 159 |
| | y | 0.00 | 0.06 | 0.21 | 0.63 | 2.10 | 6.30 | 31.50 | 42.00 |
| 14.0 | p | 0 | 143 | 219 | 323 | 475 | 684 | 367 | 367 |
| | y | 0.00 | 0.06 | 0.21 | 0.63 | 2.10 | 6.30 | 31.50 | 42.00 |
| 17.0 | p | 0 | 164 | 252 | 372 | 548 | 789 | 503 | 503 |
| | y | 0.00 | 0.06 | 0.21 | 0.63 | 2.10 | 6.30 | 31.50 | 42.00 |
| 17.0 | p | 0 | 484 | 806 | 1064 | 1338 | 1531 | 1596 | 1612 |
| | y | 0.00 | 0.12 | 0.22 | 0.31 | 0.47 | 0.72 | 1.05 | 42.00 |
| 24.0 | p | 0 | 976 | 1626 | 2146 | 2699 | 3089 | 3220 | 3252 |
| | y | 0.00 | 0.17 | 0.31 | 0.45 | 0.67 | 1.03 | 1.49 | 42.00 |
| 28.0 | p | 0 | 1329 | 2215 | 2924 | 3677 | 4209 | 4386 | 4431 |
| | y | 0.00 | 0.20 | 0.36 | 0.52 | 0.78 | 1.21 | 1.74 | 42.00 |
| 28.0 | p | 0 | 256 | 392 | 580 | 853 | 1228 | 1228 | |
| | y | 0.00 | 0.04 | 0.16 | 0.47 | 1.57 | 4.72 | 42.00 | |
| 63.0 | p | 0 | 394 | 604 | 893 | 1313 | 1890 | 1890 | |
| | y | 0.00 | 0.03 | 0.10 | 0.31 | 1.05 | 3.15 | 42.00 | |
| 63.0 | p | 0 | 512 | 785 | 1160 | 1706 | 2457 | 2457 | |
| | y | 0.00 | 0.03 | 0.10 | 0.31 | 1.05 | 3.15 | 42.00 | |
| 100.0 (and below) | p | 0 | 662 | 1015 | 1500 | 2206 | 3177 | 3177 | |
| | y | 0.00 | 0.03 | 0.10 | 0.31 | 1.05 | 3.15 | 42.00 | |

Notes: 1. "p" is soil resistance, [lb/in.].
2. "y" is lateral deflection, [in.].

Drawn By: HW Date: 8/25/08

Checked By: VMP Date: 8/26/08

Approved By: DR Date: 9/18/08

## P-Y DATA
(CYCLIC LOADING)
API RP 2A (2000) Method
42-in.-Diameter Driven Pipe Piles
Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

| Date | Time From | Time To | Description of Activities |
|---|---|---|---|
| July 5, 2008 | **** | 1835 | Arrive in Block A-59, Galveston Area, SPM #2 Anchor Leg #6 location aboard the vessel *R/V Seaprobe.* |
| | 1835 | 2300 | Repair anchor cable. |
| | 2300 | 2400 | Set 4-pt anchors. |
| July 6, 2008 | 0000 | 0055 | Set 4-pt anchors. |
| | 0055 | 0115 | Rig up to drill and sample. |
| | **** | 0115 | Estimate water depth of 118 ft with vessel's echo sounder and 122 ft using wireline technique. |
| | 0115 | 0125 | Perform scanning sonar survey. |
| | 0125 | 0220 | Run drill pipe to mudline. |
| | **** | 0220 | Measure water depth of 124 ft with the bottom sensor/pipe tally and 122.0 ft with pressure transducer. |
| | 0220 | 0630 | Drill and sample. Boring terminated at 131-ft penetration. |
| | 0630 | 0655 | Pull drill pipe above mudline and reposition vessel. |
| | **** | 0655 | Measure supplemental water depth of 124 ft with the bottom sensor/pipe tally and 123.0 ft with pressure transducer. |
| | 0655 | 0725 | Pull drill pipe to deck and secure equipment for travel. |
| | 0725 | 0855 | Cleaning deck and equipment for departure. |
| | 0855 | 0955 | Pull anchors. |
| | 0955 | **** | Depart location. |

## SUMMARY OF FIELD OPERATIONS

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

Checked By: AW Date: 9/5/08
Approved By: DM Date: 9/8/08

Drawn By: Tonal Date: 9/5/08

Report No. 0201-6505

# Summary of Test Results

**Job No.:** 0201-6505-4 05-Sep-2008 (Ver. #5)
**Boring:** Texas Offshore Port System, SPM #2 Anchor Leg #6
**Block:** A-59
**Area:** Galveston

| | | Identification Tests | | | | | | Strength Estimate (ksf) | | Miniature Vane Tests (ksf) | | | Compression Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | Depth (ft) | Liquidity Index | Liquid Limit (%) | Plastic Limit (%) | Moisture Content (%) | Submerged Unit Weight (pcf) | Passing No. 200 Sieve | Penetrometer | Torvane | Undisturbed | Remolded | Residual | Type Test | Moisture Content (%) | Confining Pressure (psi) | Undisturbed Strength (ksf) | Remolded Strength (ksf) | $\varepsilon_{50}$ Strain (%) | Submerged Unit Weight (pcf) | Failure Strain (%) | Type of Failure |
| 1 | 1.00 | | | | | 47 | | | | | | | | | | | | | | | |
| 2 | 1.50 | | | | | 48 | | | 0.40 | 0.43 | | 0.14 | | | | | | | | | |
| 3 | 2.00 | | | | 36 | | | | | | 0.10 | | | | | | | | | | |
| 3 | 2.00 | | | | 44 | | | | 0.40 | 0.59 | | | | | | | | | | | |
| 3 | 2.00 | .86 | 39 | 12 | 36 | | | | | | | | | | | | | | | | |
| 4 | 4.00 | | | | | 45 | | | 0.32 | | | | | | | | | | | | |
| 5 | 4.50 | | | | | 47 | | | 0.40 | 0.37 | | | | | | | | | | | |
| 6 | 5.00 | 1.03 | 36 | 13 | 37 | | | | | | | | | | | | | | | | |
| 6 | 5.00 | | | | 33 | | | | | | 0.14 | | | | | | | | | | |
| 6 | 5.00 | | | | 45 | | | | 0.52 | 0.56 | | | | | | | | | | | |
| 6 | 5.00 | | | | | | | | | | 0.16 | | | | | | | | | | |
| 7 | 7.00 | | | | | 51 | | | | | | | | | | | | | | | |
| 8 | 7.50 | | | | | 48 | | | 0.38 | 0.47 | | 0.22 | | | | | | | | | |
| 9 | 8.00 | | | | 42 | | | | | | 0.16 | | | | | | | | | | |
| 9 | 8.00 | | | | 41 | | | | 0.50 | 0.39 | | | | | | | | | | | |
| 9 | 8.00 | 1.03 | 43 | 12 | 43 | | | | | | | | | | | | | | | | |
| 10 | 10.00 | | | | | | | | 0.68 | | | | | | | | | | | | |
| 11 | 10.50 | | | | 50 | | | | | | 0.22 | | | | | | | | | | |
| 11 | 10.50 | | | | | 44 | | | | | | | UU | 47 | 41 | 0.40 | | 0.9 | 44 | 10 | A |
| 12 | 11.00 | .57 | 72 | 17 | 48 | | | | 0.70 | 0.77 | | | | | | | | | | | |
| 12 | 11.00 | | | | | | | | | | 0.30 | | | | | | | | | | |
| 13 | 13.00 | | | | | | | | 0.56 | | | | | | | | | | | | |

**NOTES:**

TYPE OF TEST
U - Unconfined Compression
UU- Unconsolidated-Undrained Triaxial
CU- Consolidated-Undrained Triaxial

TYPE OF FAILURE
A - Bulge
B - Single Shear Plane
C - Multiple Shear Plane
D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material

PLATE A-8a

FUGRO

Checked By: RW Date: 9/5/08
Approved By: DM Date: 9/19/08

Drawn By: Tomd Date: 9/5/08

Report No. 0201-6505

# Summary of Test Results

**Job No.:** 0201-6505-4 05-Sep-2008 (Ver. #5)
**Boring:** Texas Offshore Port System, SPM #2 Anchor Leg #6
**Block:** A-59
**Area:** Galveston

| | | Identification Tests | | | | | | Strength Estimate (ksf) | | Miniature Vane Tests (ksf) | | | Compression Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | Depth (ft) | Liquidity Index | Liquid Limit (%) | Plastic Limit (%) | Moisture Content (%) | Submerged Unit Weight (pcf) | Passing No. 200 Sieve | Penetrometer | Torvane | Undisturbed | Remolded | Residual | Type Test | Moisture Content (%) | Confining Pressure (psi) | Undisturbed Strength (ksf) | Remolded Strength (ksf) | $\varepsilon_{50}$ Strain (%) | Submerged Unit Weight (pcf) | Failure Strain (%) | Type of Failure |
| 14 | 13.50 | | | | | 37 | | | | | | | | | | | | | | | |
| 15 | 14.00 | | | | | | | | | | 0.25 | | | | | | | | | | |
| 15 | 14.00 | | | | 64 | | | | 0.60 | 0.74 | | | | | | | | | | | |
| 15 | 14.00 | .60 | 90 | 20 | 62 | | | | | | | | | | | | | | | | |
| 16 | 16.00 | | | | 45 | 40 | | | 0.88 | | | | | | | | | | | | |
| 17 | 16.50 | | | | | 56 | | | 0.50 | | | | | | | | | | | | |
| 18 | 17.00 | 1.21 | 28 | 10 | 31 | | | | | | | | | | | | | | | | |
| 18 | 17.00 | | | | 32 | | 28 | | | 0.21 | | | | | | | | | | | |
| 19 | 19.00 | | | | 26 | 64 | 14 | | | | | | | | | | | | | | |
| 19 | 19.00 | | | NP | 28 | | | | | | | | | | | | | | | | |
| 20 | 20.00 | | | | 24 | 62 | | | | | | | | | | | | | | | |
| 21 | 25.00 | | | | 24 | 63 | 4 | | | | | | | | | | | | | | |
| 22 | 29.00 | | | | | | | | 0.50 | | | | | | | | | | | | |
| 23 | 29.50 | | | | | 60 | | | | | | | | | | | | | | | |
| 24 | 30.00 | 1.40 | 25 | 18 | 27 | | | | | | | | | | | | | | | | |
| 24 | 30.00 | | | | 28 | | 68 | | 0.50 | 0.33 | | | | | | | | | | | |
| 24 | 30.00 | | | | | | | | | | 0.13 | | | | | | | | | | |
| 25 | 34.00 | | | | 32 | 53 | | | 0.78 | | | | | | | | | | | | |
| 26 | 34.50 | | | | | | | | | | | | UU | 28 | 41 | 0.68 | | 3.4 | 56 | 18 | A |
| 27 | 35.00 | 1.29 | 26 | 15 | 30 | | | | 0.64 | 0.25 | | | | | | | | | | | |
| 28 | 38.50 | | | | | 54 | | | 0.90 | | | | | | | | | | | | |
| 29 | 39.00 | | | | 30 | | | | 0.70 | 0.85 | | | | | | | | | | | |

**NOTES:**

TYPE OF TEST
U - Unconfined Compression
UU- Unconsolidated-Undrained Triaxial
CU- Consolidated-Undrained Triaxial

TYPE OF FAILURE
A - Bulge
B - Single Shear Plane
C - Multiple Shear Plane
D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material

PLATE A-8b

Checked By: AW Date: 9/5/08
Approved By: D Date: 9/19/08

Drawn By: Tamol Date: 9/5/08

Report No. 0201-6505

# Summary of Test Results

**Job No.:** 0201-6505-4 05-Sep-2008 (Ver. #5)
**Boring:** Texas Offshore Port System, SPM #2 Anchor Leg #6
**Block:** A-59
**Area:** Galveston

| | | Identification Tests | | | | | | Strength Estimate (ksf) | | Miniature Vane Tests (ksf) | | | Compression Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | Depth (ft) | Liquidity Index | Liquid Limit (%) | Plastic Limit (%) | Moisture Content (%) | Submerged Unit Weight (pcf) | Passing No. 200 Sieve | Penetrometer | Torvane | Undisturbed | Remolded | Residual | Type Test | Moisture Content (%) | Confining Pressure (psi) | Undisturbed Strength (ksf) | Remolded Strength (ksf) | $\varepsilon_{50}$ Strain (%) | Submerged Unit Weight (pcf) | Failure Strain (%) | Type of Failure |
| 29 | 39.00 | .84 | 31 | 15 | 28 | | | | | | | | | | | | | | | | |
| 29 | 39.00 | | | | | | | | | | 0.20 | | | | | | | | | | |
| 30 | 44.00 | | | | | | | | 0.80 | | | | | | | | | | | | |
| 31 | 44.50 | | | | | | | | | | 0.33 | | | | | | | | | | |
| 31 | 44.50 | | | | | | | | | | | | UU | 31 | 61 | 0.77 | | 1.2 | 53 | 11 | A |
| 32 | 45.00 | .70 | 35 | 14 | 29 | | | | 1.00 | 1.14 | | | | | | | | | | | |
| 33 | 49.00 | | | | | | | 1.00 | 0.92 | | | | | | | | | | | | |
| 34 | 49.50 | | | | | | | | | | | | UU | 29 | 120 | | 0.23 | | 56 | | |
| 34 | 49.50 | | | | | 55 | | | | | | | UU | 29 | 120 | 0.69 | | 1.6 | 56 | 13 | A |
| 35 | 50.00 | .78 | 35 | 14 | 30 | | | | | | | | | | | | | | | | |
| 35 | 50.00 | | | | 32 | | | | 1.10 | 1.85 | | | | | | | | | | | |
| 36 | 54.00 | | | | | | | 1.00 | 1.50 | | | | | | | | | | | | |
| 37 | 54.50 | | | | | | | | | | | | UU | | 121 | | 0.28 | | 56 | | |
| 37 | 54.50 | | | | | | | | | | | | UU | 29 | 75 | 1.29 | | 1.0 | 55 | 4 | AB |
| 38 | 55.00 | .78 | 37 | 13 | 31 | | | 1.25 | 1.50 | 1.02 | | | | | | | | | | | |
| 39 | 59.00 | | | | | | | | 1.00 | | | | | | | | | | | | |
| 40 | 59.50 | | | | | 56 | | | | | | | | | | | | | | | |
| 41 | 60.00 | | | | 33 | | | | 1.05 | 1.06 | | | | | | | | | | | |
| 41 | 60.00 | .67 | 42 | 14 | 33 | | | | | | | | | | | | | | | | |
| 42 | 64.00 | | | | | | | 1.00 | 1.30 | | | | | | | | | | | | |
| 43 | 64.50 | | | | | | | | | | | | UU | | 121 | | 0.39 | | 48 | | |
| 43 | 64.50 | | | | | | | | | | | | UU | 39 | 81 | 1.36 | | 0.8 | 49 | 6 | B |

**NOTES:**

TYPE OF TEST
U - Unconfined Compression
UU- Unconsolidated-Undrained Triaxial
CU- Consolidated-Undrained Triaxial

TYPE OF FAILURE
A - Bulge
B - Single Shear Plane
C - Multiple Shear Plane
D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material

PLATE A-8c

FUGRO

Checked By: AW Date: 9/5/08
Approved By: DC Date: 9/13/08

Drawn By: Tomo1 Date: 9/5/08

Report No. 0201-6505

# Summary of Test Results

**Job No.:** 0201-6505-4 05-Sep-2008 (Ver. #5)
**Boring:** Texas Offshore Port System, SPM #2 Anchor Leg #6
**Block:** A-59
**Area:** Galveston

| | | Identification Tests | | | | | | Strength Estimate (ksf) | | Miniature Vane Tests (ksf) | | | Compression Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | Depth (ft) | Liquidity Index | Liquid Limit (%) | Plastic Limit (%) | Moisture Content (%) | Submerged Unit Weight (pcf) | Passing No. 200 Sieve | Penetrometer | Torvane | Undisturbed | Remolded | Residual | Type Test | Moisture Content (%) | Confining Pressure (psi) | Undisturbed Strength (ksf) | Remolded Strength (ksf) | $\varepsilon_{50}$ Strain (%) | Submerged Unit Weight (pcf) | Failure Strain (%) | Type of Failure |
| 44 | 65.00 | .58 | 51 | 16 | 36 | | | 1.00 | 1.30 | 1.06 | | | | | | | | | | | |
| 45 | 74.00 | | | | | | | 1.50 | 1.70 | | | | | | | | | | | | |
| 46 | 74.50 | | | | | 46 | | | | | | | | | | | | | | | |
| 47 | 75.00 | | | | 47 | | | 1.50 | 1.45 | 1.11 | | | | | | | | | | | |
| 47 | 75.00 | | | | 41 | | | | | | | | | | | | | | | | |
| 48 | 84.00 | | | | | | | 1.50 | 1.50 | | | | | | | | | | | | |
| 49 | 84.50 | | | | | | | | | | | | UU | 37 | 120 | 1.77 | | 0.6 | 51 | 3 | B |
| 49 | 84.50 | | | | | | | | | | | | UU | | 119 | | 0.47 | | 54 | | |
| 50 | 85.00 | .49 | 51 | 14 | 33 | | | 1.50 | 1.55 | 1.59 | | | | | | | | | | | |
| 51 | 94.00 | | | | | | | 1.50 | 1.50 | | | | | | | | | | | | |
| 52 | 94.50 | | | | | 48 | | | | | | | | | | | | | | | |
| 53 | 95.00 | | | | 36 | | | | | | | | | | | | | | | | |
| 53 | 95.00 | | | | 36 | | | 1.50 | 1.50 | 1.68 | | | | | | | | | | | |
| 54 | 104.00 | | | | | | | 1.75 | 1.75 | | | | | | | | | | | | |
| 55 | 104.50 | | | | | | | | | | | | UU | | 121 | | 0.61 | | 49 | | |
| 55 | 104.50 | | | | | | | | | | | | UU | 45 | 120 | 2.52 | | 0.7 | 45 | 3 | B |
| 56 | 105.00 | .52 | 71 | 19 | 46 | | | 1.75 | 1.75 | 2.08 | | | | | | | | | | | |
| 57 | 114.00 | | | | | | | 2.00 | 1.90 | | | | | | | | | | | | |
| 58 | 114.50 | | | | 36 | | | | | | | | UU | 34 | 120 | 1.35 | | 0.7 | 51 | 11 | AB |
| 59 | 115.00 | | | | 35 | 51 | | 1.75 | 1.85 | 1.70 | | | | | | | | | | | |
| 60 | 124.00 | | | | | | | 1.50 | 1.55 | | | | | | | | | | | | |
| 61 | 124.50 | | | | | | | | | | | | UU | 33 | 120 | 1.54 | | 0.8 | 52 | 9 | A |

**NOTES:**

TYPE OF TEST
U - Unconfined Compression
UU- Unconsolidated-Undrained Triaxial
CU- Consolidated-Undrained Triaxial

TYPE OF FAILURE
A - Bulge
B - Single Shear Plane
C - Multiple Shear Plane
D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material

PLATE A-8d

FUGRO

Checked By: AW Date: 9/5/08
Approved By: DA Date: 9/8/08

Drawn By: Tomel Date: 9/5/08

Report No. 0201-6505

# Summary of Test Results

**Job No.:** 0201-6505-4 05-Sep-2008 (Ver. #5)
**Boring:** Texas Offshore Port System, SPM #2 Anchor Leg #6
**Block:** A-59
**Area:** Galveston

| | | Identification Tests | | | | | | Strength Estimate (ksf) | | Miniature Vane Tests (ksf) | | | Compression Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample No. | Depth (ft) | Liquidity Index | Liquid Limit (%) | Plastic Limit (%) | Moisture Content (%) | Submerged Unit Weight (pcf) | Passing No. 200 Sieve | Penetrometer | Torvane | Undisturbed | Remolded | Residual | Type Test | Moisture Content (%) | Confining Pressure (psi) | Undisturbed Strength (ksf) | Remolded Strength (ksf) | $\varepsilon_{50}$ Strain (%) | Submerged Unit Weight (pcf) | Failure Strain (%) | Type of Failure |
| 61 | 124.50 | | | | | | | | | | | | UU | | 120 | | 0.58 | | 54 | | |
| 62 | 125.00 | .48 | 53 | 16 | 33 | | | 1.25 | 1.60 | 1.55 | | | | | | | | | | | |
| 63 | 130.00 | | | | | | | 2.00 | 1.95 | | | | | | | | | | | | |
| 64 | 130.50 | | | | 51 | | | | | | | | | | | | | | | | |
| 65 | 131.00 | | | | 53 | 40 | | 2.00 | 1.80 | 2.38 | | | | | | | | | | | |

**NOTES:**

TYPE OF TEST
U - Unconfined Compression
UU- Unconsolidated-Undrained Triaxial
CU- Consolidated-Undrained Triaxial

TYPE OF FAILURE
A - Bulge
B - Single Shear Plane
C - Multiple Shear Plane
D - Vertical Fracture

Plus Signs [+] denote tests which exceeded the capacity of the measuring device.

NP = Non Plastic Material

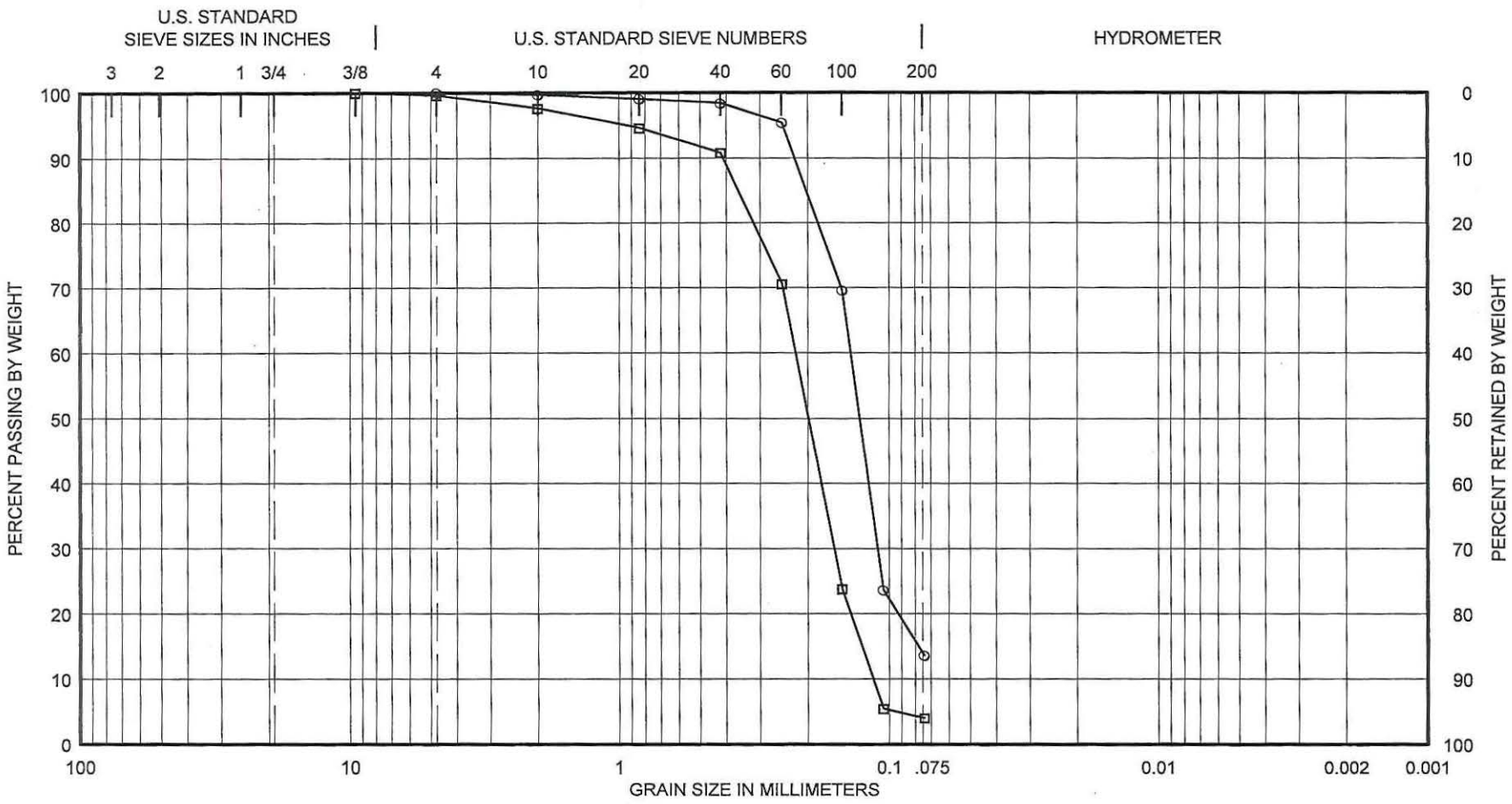
PLATE A-8e

Checked by: AW Date: 11/5/08

Approved by: DR Date: 9/10/08

Drawn by: Tomol Date: 9/5/08

Report No. 0201-6505




| GRAVEL | | SAND | | | SILT or CLAY |
|---|---|---|---|---|---|
| Coarse | Fine | Coarse | Medium | Fine | |

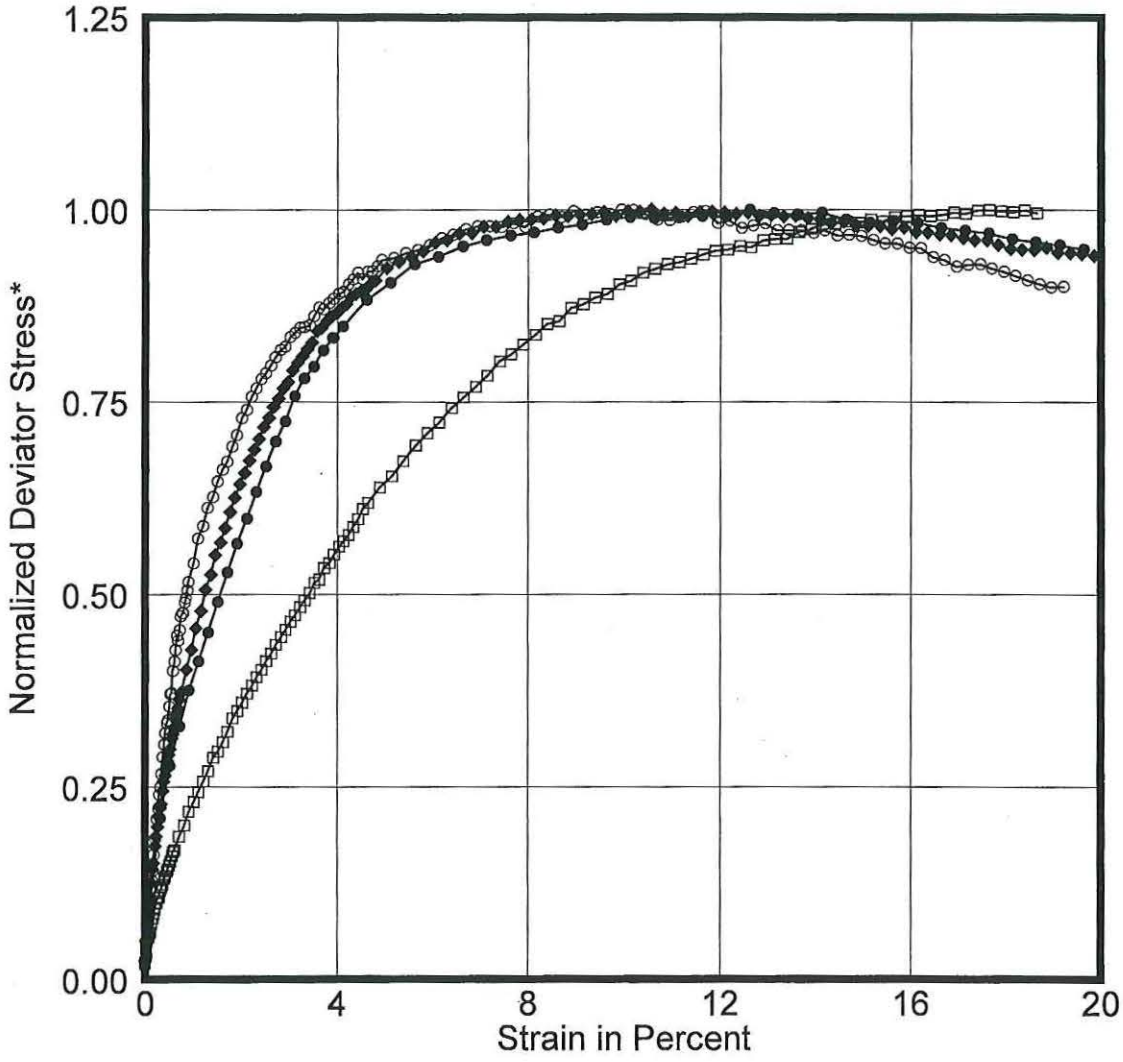
| SAMPLE NO. | DEPTH, FT | SYMBOL | CLASSIFICATION |
|---|---|---|---|
| 19 | 19.00 | ○ | SILTY FINE SAND (SM) with shell fragments |
| 21 | 25.00 | □ | FINE SAND (SP) with mica, many shell fragments, and a trace of medium sand |

## GRAIN-SIZE DISTRIBUTION CURVES

Texas Offshore Port System, SPM #2 Anchor Leg #6

Block A-59, Galveston Area

PLATE A-12



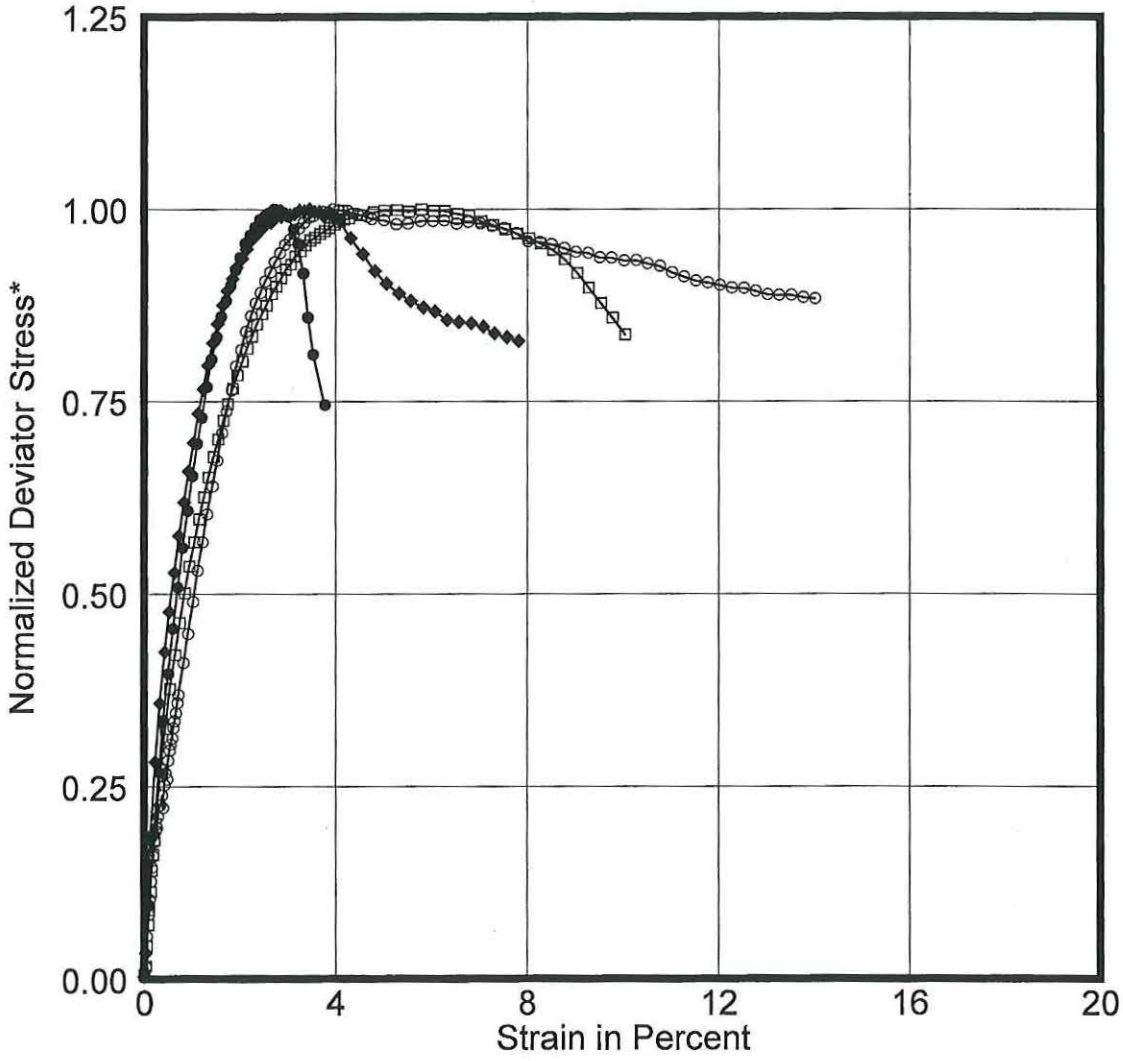

| Curve | Sample No. | Depth [ft] | Test Type | Confining Pressure [psi] | Maximum Deviator Stress [ksf] | ε50 [%] |
|---|---|---|---|---|---|---|
| ○—○ | 11 | 10.50 | UU | 41.3 | 0.80 | 0.9 |
| □—□ | 26 | 34.50 | UU | 41.4 | 1.36 | 3.4 |
| ◆—◆ | 31 | 44.50 | UU | 60.9 | 1.54 | 1.2 |
| ●—● | 34 | 49.50 | UU | 120.1 | 1.38 | 1.6 |

* Normalized with respect to maximum deviator stress.

Drawn By: Tone' Date: 9/5/08
Checked By: HW Date: 9/5/08
Approved By: DM Date: 9/9/08

## STRESS-STRAIN CURVES
Unconsolidated-Undrained Triaxial Compression Test

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area




| Curve | Sample No. | Depth [ft] | Test Type | Confining Pressure [psi] | Maximum Deviator Stress [ksf] | ε50 [%] |
|---|---|---|---|---|---|---|
| ○—○ | 37 | 54.50 | UU | 75.2 | 2.58 | 1.0 |
| □—□ | 43 | 64.50 | UU | 80.9 | 2.72 | 0.8 |
| ◆—◆ | 49 | 84.50 | UU | 119.8 | 3.53 | 0.6 |
| ●—● | 55 | 104.50 | UU | 120.3 | 5.05 | 0.7 |

* Normalized with respect to maximum deviator stress.

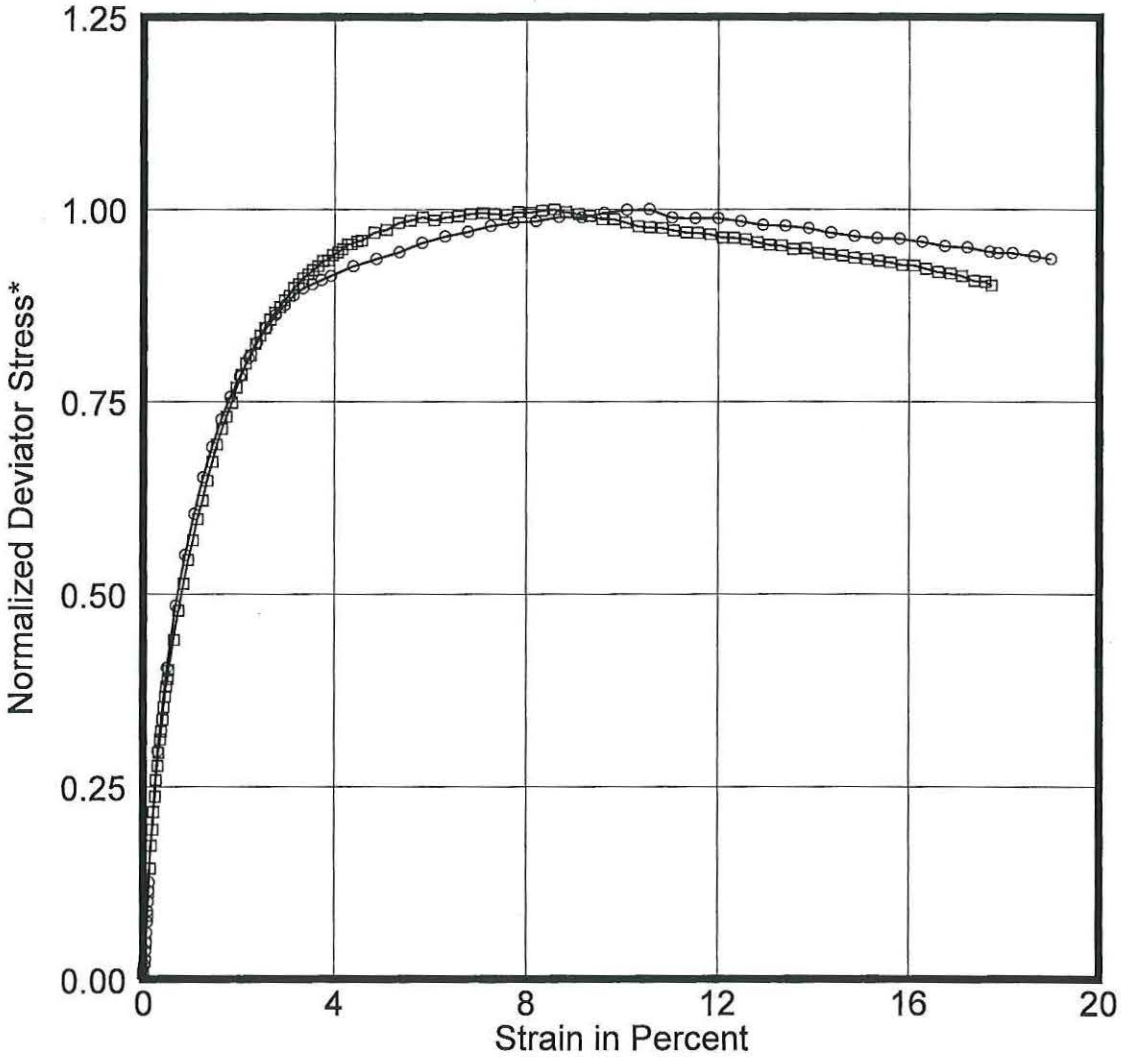
Drawn By: M. Eimel Date: 9/5/08

Checked By: MW Date: 9/5/08

Approved By: DL Date: 9/8/08

## STRESS-STRAIN CURVES
Unconsolidated-Undrained Triaxial Compression Test

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area




| Curve | Sample No. | Depth [ft] | Test Type | Confining Pressure [psi] | Maximum Deviator Stress [ksf] | ε50 [%] |
|---|---|---|---|---|---|---|
| ○—○ | 58 | 114.50 | UU | 120.1 | 2.70 | 0.7 |
| □—□ | 61 | 124.50 | UU | 120.2 | 3.08 | 0.8 |

* Normalized with respect to maximum deviator stress.

Drawn By: [illegible] Date: 7/15/08

Date: 9/15/08

Date: 9/16/08

Checked By: [illegible]

Approved By: [illegible]

## STRESS-STRAIN CURVES
Unconsolidated-Undrained Triaxial Compression Test

Texas Offshore Port System, SPM #2 Anchor Leg #6
Block A-59, Galveston Area

# ENTERPRISE FIELD SERVICES, LLC

## SOIL BORINGS
## TEXAS OFFSHORE PORT SYSTEM
## SPM #1 and SPM #2
## GALVESTON AREA BLOCK A59

**1. INTRODUCTION:**

***Fugro Chance Inc. (CHANCE)*** was contracted by Fugro-McClelland Marine Geosciences, Inc. to position the *M/V "Seaprobe"* for a soil boring in Galveston Area, Block A59, Offshore Texas.

**2. REQUIREMENTS:**

Positioning requirements were transmitted, via e-mail, to Mr. Tony Parker of ***CHANCE*** by Mr. Frank Ortiz of Fugro-McClelland Marine Geosciences, Inc. A "Survey Request" form dated June 25, 2008 e-mailed to Mr. Manuel Lopez of Enterprise Field Services, LLC, confirmed these requirements. A copy of this form was also e-mailed to Mr. Frank Ortiz.

Requirements were as follows:

**A)** Proposed Location – SPM #1 and SPM #2

The Texas South Zone Coordinates are:

| CORE 1 (Leg #2 – West) | CORE 2 (Leg #6 – East) |
|---|---|
| Y = 236,057.66' | Y = 241,308.73' |
| X = 3,257,224.19' | X = 3,266,735.50' |
| **CORE 3 (PLET #1)** | **CORE 4 (PLET #2)** |
| Y = 236,494.60' | Y = 240,337.08' |
| X = 3,258,627.75' | X = 3,265,632.42' |

**3. CHANCE PERSONNEL:**

Party Chief - C. Evans

**4. EQUIPMENT AND METHOD:**

**A)** Primary Positioning System - **STARFIX® Satellite Positioning System**

Continuous dynamic positioning through the use of Navstar GPS with differential signals from multiple reference stations corrected for ionospheric and tropospheric effects transmitted via the **STARFIX®** equatorial geosynchronous satellite.

**B)** Secondary Positioning System - **Differential Global Positioning System (DGPS)**

DGPS utilizes the Navstar Satellite Constellation with data from selected reference sites transmitted via LF radio-link for enhanced accuracy through differential techniques.

C) **STARFIX.NAV®**

**STARFIX.NAV®** is an on board computer graphic system interfaced to the primary positioning system capable of displaying real time position of a vessel in relation to known hazards, fairways, proposed location, etc. **DRONE®** units when used on anchor handling vessels utilize Differential GPS transmitted to the master station via radio telemetry link to display in real time the position of that vessel.

D) Vessel orientation by Sperry SR 50 Mod 1 North Seeking Gyro or a S. G. Brown Meridian North Seeking Gyro

North seeking Gyro compass. Accuracy $\pm$ 2° after 4 hours initial spin up.

E) Scanning Sonar

Simrad MS1000 High Resolution Sonar

## 5. RESULTS:

Geographic positions are based on Clarke 1866 Spheroid, North American Datum 1927. Grid coordinates are based on Texas South Central Zone Lambert, NAD 27.

Field operations were conducted from July 4, 2008 to July 7, 2008 with the following results:

A) **STARFIX®** position derived by averaging readings over a one hour period at an update rate of 750 ms. per reading.

CORE 1 (Leg #2 - West)

Y = 236,056.44'
X = 3,257,200.14'

Latitude: 28° 25' 28.968" N
Longitude: 95° 05' 17.113" W

This location being 6,376.44' FSL and 3,164.33' FWL of Block A59, Galveston Area

CORE 2 (Leg #6 - East)

Y = 241,330.78'
X = 3,266,758.05'

Latitude: 28° 26' 17.984" N
Longitude: 95° 03' 28.137" W

This location being 4,189.22' FNL and 3,117.76' FEL of Block A59, Galveston Area

CORE 3 (PLET #1)

Y = 236,466.44'
X = 3,258,639.61'

Latitude: 28° 25' 32.548" N
Longitude: 95° 05' 00.846" W

This location being 6,786.44' FSL and 4,603.80' FWL of Block A59, Galveston Area

CORE 4 (PLET #2)

Y = 240,317.51'
X = 3,265,646.77'

Latitude: 28° 26' 08.328" N
Longitude: 95° 03' 40.960" W

This location being 5,202.49' FNL and 4,229.04' FEL of Block A59, Galveston Area

**6. CONFIRMATION:**

DGPS was used for confirmation.

The results were as follows:

CORE 1 (Leg #2 - West)

Y = 236,057'
X = 3,257,200'

CORE 2 (Leg #6 - East)

Y = 241,331'
X = 3,266,757'

CORE 3 (PLET #1)

Y = 236,467'
X = 3,258,640'

CORE 4 (PLET #2)

Y = 240,318'
X = 3,265,648'

**7. HSE INCIDENTS:**

No incidents.

**8. CHRONOLOGY:**

July 4, 2008

1000 Conducted job change in field; aboard "Seaprobe" on standby at location GA. A59 due to weather; start time for job
1200 Preparing to set out anchors at proposed Core 1 location
1203 PB #1 Anchor on bottom
1217 PB #1 Anchor removed from bottom; will re-set per Captain

1820 En route to proposed Core 2 site
1830 At proposed Core #2 location; PB #1 Anchor on bottom; checking anchor cable socket
1840 Checking Winch #3
2040 Winch #3 working properly
2300 Cable lock dry on SB #2 Anchor; recovering PB #1 Anchor
2312 PB #1 Anchor off bottom
2323 PB #1 Anchor on bottom
2335 SB #2 Anchor on bottom
2350 SS #3 Anchor on bottom; moving onto location
2400 Continuing to set out anchors at proposed Core #2 location

June 6, 2008

0001 Continuing to set out anchors
0014 PS #4 Anchor on bottom; moving onto location
0050 Vessel on location; deployed Sonar
0058 Conducting site investigation at proposed Core #2 site; archiving Sonar data
0106 Sonar on deck; starting final tie
0206 Final tie at Core #2 complete; emailing Lafayette office for final tie confirmation; drill crew performing soil boring
0305 Received final tie confirmation; soil boring continues
0910 Core #2 complete; preparing to start anchor recovery
0922 SS #3 Anchor off bottom
0939 PS #4 Anchor off bottom
0949 SB #2 Anchor off bottom
0959 PB #1 Anchor off bottom; anchor recovery complete
1005 Departing location; en route to dock
1100 Contacted Lafayette office to discuss end of job details
1900 Arrived at dock
1930 Departed Martin Midstream; en route to Lafayette office
2400 En route to office continues

July 7, 2008

0001 En route to Lafayette office
0230 Arrived at office; end time for job

Sincerely,

***FUGRO CHANCE INC.***

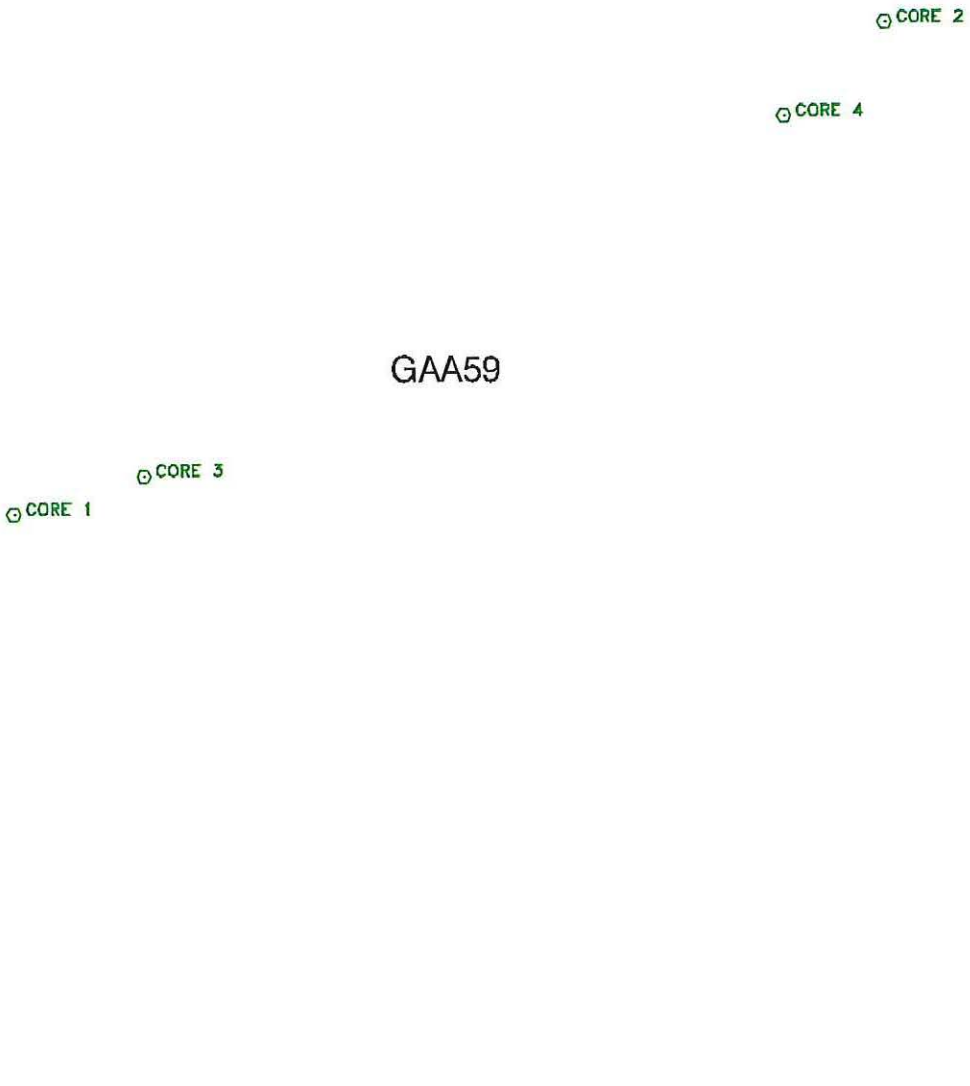
James P. O'Neal, P.L.S.
Vice-President, Marine Operations

JPO: mmg

Attachment

## FINAL SOIL BORINGS

| LOCATION | CALLNS | CALLEW | X COORDINATE | Y COORDINATE | LATITUDE | LONGITUDE |
|---|---|---|---|---|---|---|
| CORE 1 | 6,376.44' FSL | 3,164.33' FWL | 3,257,200.14' | 236,056.44' | 28° 25' 28.968"N | 95° 05' 17.113"W |
| CORE 2 | 4,189.22' FNL | 3,117.76' FEL | 3,266,758.05' | 241,330.78' | 28° 26' 17.984"N | 95° 03' 28.137"W |
| CORE 3 | 6,786.44' FSL | 4,603.80' FWL | 3,258,639.61' | 236,466.44' | 28° 25' 32.548"N | 95° 05' 00.846"W |
| CORE 4 | 5,202.49' FNL | 4,229.04' FEL | 3,265,646.77' | 240,317.51' | 28° 26' 08.328"N | 95° 03' 40.960"W |




I HEREBY CERTIFY THAT THE ABOVE FINAL SOIL BORINGS ARE CORRECT.

DIGITAL COPY
ORIGINAL PLAT SIGNED 7/7/08

REC. PROFESSIONAL LAND SURVEYOR NO. 4903
STATE OF LOUISIANA

NOTES:
1) SURVEYED COORDINATES TRANSFORMED FROM NAD83 (CPS DATUM) TO NAD27 (CHART DATUM) USING NADCON VERSION 2.1.

Printed: 7/7/08

**ENTERPRISE FIELD SERVICES, LLC**

**FINAL SOIL BORINGS**
**NO LEASE NUMBER (PROP. ANC & PLET)**
BLOCK A59
GALVESTON AREA
GULF OF MEXICO

FUGRO CHANCE INC.
200 Dulles Dr. Lafayette, Louisiana 70506-3001 (337) 237-1500

GEODETIC DATUM: NAD27
PROJECTION: TEXAS SOUTH CENTRAL
GRID UNITS: US SURVEY FEET

SCALE IN FEET 0 2,000'

Job No.: 08-01931 | Date: 7/7/08 | Drwn: TCG | Chart: 1 Of: 1

Dwgfile: D:\WellPermit\TXsc\GA\Permit\A59_CORE_NO LEASE_0801931