GEOTECHNICAL REPORT

Phoenix V Condominium
c/o Coastline Management LLC.
Front Lobby Foundation Evaluation Project

Orange Beach, Alabama

Thompson Engineering Project No.: 21-1102-0146

December 1, 2021

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December 1, 2021

Phoenix V Condominium
c/o Coastline Management LLC.
24400 Perdido Beach Blvd.
Orange Beach, Alabama

Attention: **James Redwine**

Subject: **Geotechnical Consulting Services**
Phoenix V Front Lobby Foundation Evaluation
Thompson Project No.: 21-1102-0146

Dear Mr. Redwine:

Thompson Engineering (Thompson) is pleased to present this geotechnical report for the front lobby foundation evaluation project at the Phoenix V Condominium in Orange Beach, Alabama. This report has been prepared in accordance with the scope of services presented in Thompson's proposal dated May 5, 2021. Authorization for our services was made by the Coastline Management LLC. Purchase Order 228.

This document constitutes the geotechnical study performed within the vicinity of the existing front lobby at the Phoenix V Condominium. This document may be used in support of foundation remediation for the existing shallow founded front lobby area. Details of the evaluation study and recommendations are presented in the **Report Text** and **Attachments**.

We appreciate the opportunity to assist the project team with project-related geotechnical matters. Please do not hesitate to contact our office with any questions concerning this submittal.

Respectfully,

THOMPSON ENGINEERING, INC

Christopher J. LaFroscia, P.E.
Geotechnical Project Engineer
P.E. Registration No. 37558

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1.0 INTRODUCTION

Thompson has completed the geotechnical evaluation for the existing shallow foundation for the front lobby at the Phoenix V Condominium in Orange Beach, Alabama, in general accordance with the contracted scope of work between Coastline Management, LLC. and Thompson. The geotechnical exploration program summarized in this document was performed in accordance with generally accepted local soil and foundation geotechnical engineering practices.

This report presents the results of the geotechnical field exploration and laboratory testing programs and provides recommendations for potential remediation alternatives for the existing front lobby shallow foundation.

2.0 SCOPE OF SERVICES

The scope of geotechnical services deemed appropriate for this study, in light of the project requirements, our understanding of the project as summarized herein, and with reliance on our knowledge of the local geology, included the following:

- Perform two (2) concrete cores within the front lobby foundation. Perform probing within each core location to determine the soil density beneath the existing slab foundation.
- Perform one (1) standard penetration test (SPT) boring to a maximum depth of 50 feet below existing grade within the vicinity of the existing front lobby.
- Classification and stratification of recovered soil specimens
- Performance of a limited laboratory soil testing program
- Assessment of groundwater conditions
- Provide a Geotechnical Study Report to include the results of the subsurface soil investigation and concrete cores, and foundation remediation recommendations

3.0 PROJECT DESCRIPTION

Based on provided information, we understand that the main multi-story condominium building is supported on deep pile foundations, while the existing ground floor lobby is supported by on-grade foundations, that, is a slab-on-grade and shallow footings. Over the last several years, the Phoenix V Condominium HOA have encountered various signs of settlement within the ground floor lobby.

The Phoenix V Condominium HOA requested Thompson perform a soil boring within the vicinity of the existing front lobby and concrete cores within the front lobby to evaluate the existing soil conditions beneath the front lobby. It is noteworthy, that the ground-floor lobby area has been inundated with water due to extreme hurricane events in the past, with the most recent event occurring during Hurricane Sally in September of 2020.

The above information represents our understanding of this project and serves as the basis for our recommendations. If any of the above information changes or is not current, Thompson Engineering should be contacted for review as additional recommendations or analysis may be necessary.

4.0 OBSERVED SITE CONDITIONS

Thompson visited the project site to observe and document the existing settlement concerns within the condominium front lobby. During our site visit, we observed the separation of the front lobby from the main condominium structure. As seen in **Figure 1** below, the existing front lobby structure has separated from the main condominium structure creating a gap that has been filled with grout and painted to match the existing frame color.

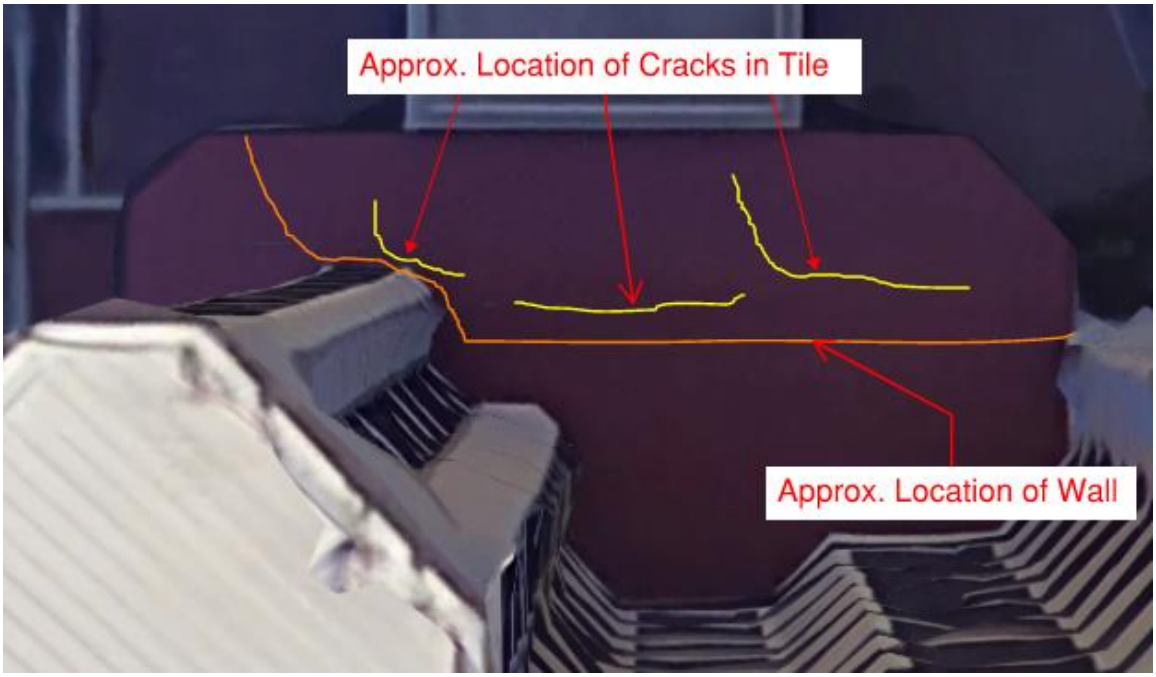
Figure 1: Front Lobby and Condominium Separation

In addition, various cracking was visible within the ground floor tile installed in the front lobby. The extent of the tile cracking can be seen in **Figure 2**, presented below.

Figure 2: Front Lobby Tile Cracking

An overview of the ground floor lobby showing the approximate locations of the tile cracks and condominium support wall are presented in **Figure 3** below.

Figure 3: Overview of Front Lobby



5.0 FIELD EXPLORATION PROGRAM

Geotechnical data collection activities for this geotechnical study incorporated concrete coring within the interior front lobby, probing beneath the existing shallow foundation of the front lobby, and standard penetration test (SPT) protocols. A brief description of the tests performed are presented below.

The overall intent of the field exploration program was to evaluate the density of the subgrade soils beneath the existing concrete slab and to establish a site-specific subsurface conditions database for the project area. One (1) soil boring was performed within the vicinity of the existing front lobby. The Boring Location Plan and Record of Test Boring are included in **Appendix A**.

5.1 Foundation Cores and Subgrade Probing

Two (2) – 3-inch diameter concrete cores were performed within the existing ground floor lobby on November 3, 2021. Based on the two (2) concrete core samples, the thickness of the existing slab ranged from approximately 4.5 to 5 inches. Notably, a gap of approximately 1 to 2 inches was measured from the bottom of the slab to the top of the existing subgrade soils – this is evidence of settlement of near surface loose sands beneath the slab.

Thompson personnel performed probing at each core location to a depth of approximately four (4) feet below the top of the existing concrete slab. The subgrade soils encountered during probing activities were confirmed to be loose sands with very little resistance to probing. Groundwater was not encountered during probing activities.

5.2 Standard Penetration Test (SPT) Borings

The SPT boring was performed in accordance with ASTM Procedure D-1586, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils on November 20, 2021. Continuous sampling was performed within the upper 10 feet of the subsurface profile. The SPT total number of blows required to drive the sampler the second and third 6-inch increments is designated as the N-value, and provides an indication of in-place soil strength, relative density and consistency.

At time of drilling groundwater measurements were taken in the borehole. The borehole was backfilled and an asphalt patch was placed upon field work completion. The approximate boring location is presented on the Boring Location Plan attached in **Appendix A**.

Representative portions of the subsurface soil samples recovered from the borehole were transported to Thompson's Mobile geotechnical laboratory facility. The recovered soil specimens were visually classified by an experienced Geotechnical Engineer. The results of the classification and stratification are presented on the Records of Test Boring. Some variations in subsurface soil conditions may be anticipated from those shown on the appended documents. Recovered samples were not examined, either visually or analytically, for chemical composition or environmental hazards. The Records of Test Boring are presented in **Appendix A**.

6.0 LABORATORY SOIL TESTING PROGRAM

The soil samples were visually classified in general accordance with the guidelines of ASTM D-2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) and ASTM D-2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The quantity and type of laboratory tests performed for this geotechnical study were determined and adjusted by Thompson's engineering personnel based on the uniformity and character of the subsurface soil conditions encountered, and our experience and knowledge of local soil conditions.

Laboratory soil tests were performed to aid in the classification of the soils, and to help in the evaluation of engineering characteristics of the soils. Representative soil samples recovered from the soil test boring were selected for percent finer #200 sieve testing. Test protocols were in accordance with ASTM Procedures. The test results are presented on the Records of Test Boring in **Appendix A**.

7.0 SUBSURFACE FINDINGS

While establishment of generalized subsurface conditions is useful for the geotechnical engineering evaluation process, such generalizations should be reviewed with caution as they promote extrapolation of recovered data between soil test sounding locations.

Soil stratification lines shown on the appended Records of Test Boring represent approximate boundaries between soil types, and may not depict exact subsurface soil conditions. The actual transition between soil types may be more gradual than those depicted. The subsurface findings for this project are summarized below.

7.1 Subsurface Conditions

Our assessment of the subsurface conditions is based on results of the soil test boring, laboratory testing program, and our understanding of the project requirements. The generalized subsurface soil conditions for the existing front lobby are described below:

- From the existing ground surface to an approximate depth of 4.5 feet, medium dense Sand (SP) was typically encountered.
- From a depth of 4.5 feet to an approximate depth of 12 feet, very loose to loose Sand (SP) was typically encountered. This layer has the potential to settle significantly with load application or other settlement triggers.
- From a depth of 12 feet to the maximum explored depth of 50 feet, medium dense to very dense Sand (SP) was typically encountered.

7.2 Groundwater Level

Groundwater levels were observed and measured in the open SPT borehole during drilling activities. Groundwater was encountered at an approximate depth of 12 feet below existing site grades. Fluctuations of the groundwater level on this project may be expected to occur seasonally as a result of rainfall, surface runoff, and tidal influences of the Gulf of Mexico.

8.0 ENGINEERING CONSIDERATIONS AND CONCLUSIONS

It is noteworthy that significant thicknesses of loose sand layers were encountered during our field activities. In particular, loose sands were noted just beneath the slabs within the lobby area, within the explored depth of 4 feet beneath the slab. The boring performed just outside the lobby indicated this loose sand layer extends to depths of up to 12 feet below existing grades.

Loose sands are susceptible to settlement. Settlement of loose sands may be caused by load application, vibration loading (such as traffic or seismic), or repetitive inundation such as during flooding.

Settlement from load application in sands typically occurs during building construction when footings are loaded by the building dead loads. Additional settlement can occur if the footings or foundation on the loose sands receives live loads and/or wind loads. A structural engineering assessment would be necessary to determine building loads during storm events, and such is currently outside of scope of services. However, it is possible that some portion of the settlement experienced at the site may be related to building and wind loads being supported by shallow foundations placed over loose sands.

Settlement of clean sands can also occur with the application of traffic or seismic vibration. This phenomenon is typically referred to as liquefaction settlement. It is very unlikely that appreciable seismic activity has occurred in the area. However, if significant vibrations have occurred from other sources, such as machinery or heavy traffic, some settlement of the loose sands could occur. It is our opinion that there is low potential for vibration or liquefaction settlement at this site.

Repeated inundation of loose sands can lead to settlement. Water flowing within the voids of the loose sand can reorient the particles allowing settlement to occur. Often times, clean sands are compacted by flooding the sands. It is likely that some settlement of the loose sands in the upper 12 feet has occurred as a result of repeated flooding and/or variations of the groundwater level.

An additional way that settlement could occur is if sands are being mined out from under the slab area. Some projects along the beach have experienced erosion as a result of recent storms. Erosion or migration of the sand particles can occur when floodwaters are receding. No evidence of erosion was noted during our site visit; however, an exhaustive inspection was not performed as such is outside our current scope of services.

It is our engineering opinion that the settlement experienced at the project site is the result of settlement of the loose sands encountered below the slab which extend to depth of up to 12 feet below the ground surface. Likely the application of footing and slab loads and the repeated inundation of the loose sands has caused the settlement.

Remediation of the settlement should involve the design and construction of deep foundation elements that transfer the foundation loads to the dense soils beneath or ground improvement measures to prevent further settlement. While each of these of systems are typically proprietary, in our experience, deep foundation elements such as helical piles or micropiles can be successfully installed to prevent further settlement of the shallow founded structure. These systems can be installed using low overhead equipment, thereby preserving most existing structure. The design of a helical or micropile support system should be performed by a Structural Engineer. Once foundation design loads have been determined, Thompson’s

geotechnical engineers can provide additional recommendations for specific pile types, sizes, and load carrying capabilities.

Alternatively, ground improvement measures such as grouting or the installation of stone columns or similar could be installed beneath the structure to improve the density and/or reduce the settlement potential of the loose sand layer. However, in our experience, these systems may not be economically feasible due to site access limitations or the need for demolition of the structure.

Remediation measures that simply void fill beneath the slabs are not recommended. These systems typically involve the placement of urethane or cementitious grout beneath slabs and pressurizing the grout can raise slabs and foundations. However, without improvement of the loose sands beneath the grouted voids, additional settlement of the loose sands could occur with the application of the triggers previously described.

9.0 REPORT LIMITATIONS

This report is prepared for the exclusive use by **Coastline Management, LLC. and the Phoenix V Condominium HOA** and is prepared in accordance with the Standard of Care reasonably expected of similar geotechnical engineers, providing similar services in a similar locale. No warranty is expressed or implied and all such warranties are disclaimed. This report is prepared for a limited purpose as further detailed by the objectives and/or scope work identified herein.

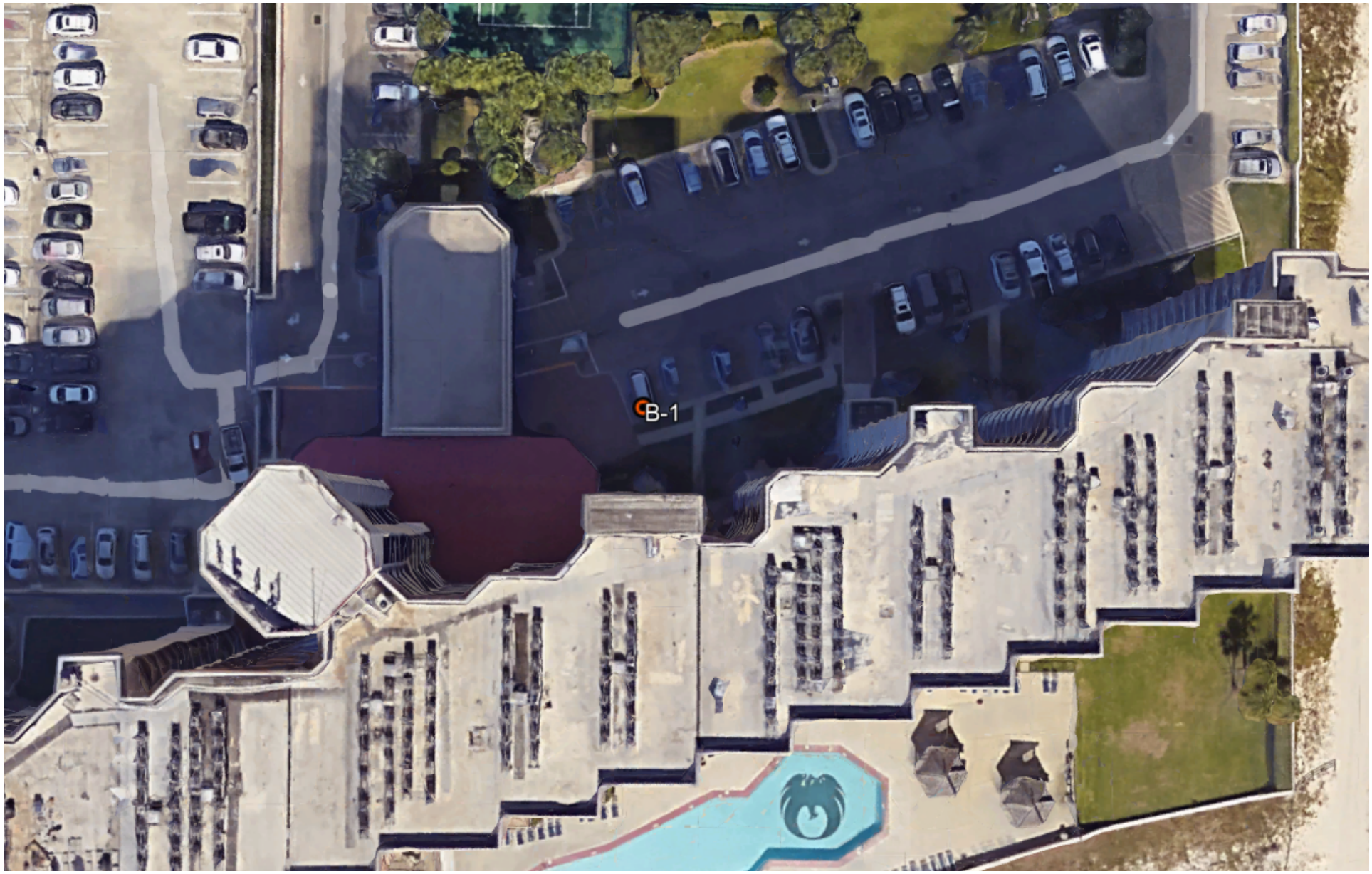
The evaluation and recommendations submitted in this geotechnical study are based in part upon the data obtained from the field exploration program. The nature or extent of variations throughout the subsurface profile may not become evident until the time foundation remediation. If variations then appear evident, it may be necessary to reevaluate our recommendations as provided in this geotechnical report.

The soil borings or other subsurface tests presented in this report were performed in support of the geotechnical evaluations and recommendations as defined by the scope of services and not for determining the presence or extent of any subsurface debris which may exist at the site. Depending on project location, subsurface conditions, and the history of the site, buried debris, environmental contamination, or other soil types and conditions not identified may be encountered during construction.

We appreciate the opportunity to assist the project team with project-related geotechnical matters. Please do not hesitate to contact our office with any questions concerning this submittal.

APPENDIX A

Boring Location Plan
and Record of Test Boring



Geotechnical Investigation
Phoenix V Condo
Orange Beach, AL.

thompson
ENGINEERING

Boring Location Plan

Project No. 21-1102-0146

DATE: December 1, 2021

RECORD OF TEST BORING

thompson ENGINEERING

BORING NO.: B-01

PROJECT: Phoenix V Condominiums
CLIENT: Coastline Management
PROJECT NO.: 21-1102-0146
SAMPLE METHOD: ASTM D1586
TYPE BORING: Mud Rotary
PAGE: 1 OF 2
LOCATION: Refer To Boring Location Plan
DRILLER: R.Odom
LAT.: 30°15'47.69" N
STATION:
DRILL RIG: CME 550X
LONG.: 87°36'28.95" W
GWL:
ENGINEER: C.LaFroscia
DATE: 11/20/21
GWL AT 24 HRS.:
WEATHER: Clear and Cold
ELEVATION:

DEPTH/ ELEV. (FT)	SYMBOL	SAMPLER	SPT BLOWS	SAMPLE I.D.NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	SPT N/ (REC%)	% F	MC	LL	PI	UW (pcf)	OC (%)	UU (psf)	UC (psf)	PP (psf)	VS (psf)	FS (psf)
			6 8 9	S-1	**SAND (SP-SM)**	Medium dense, fine grained, light brown, moist	17	9.2										
			5 8 8	S-2		Medium dense, trace gravel	16	3.6										
			5 6 7	S-3		Medium dense	13	2.5										
5			3 3 2	S-4		Loose, fine to medium grained	5	1.5										
			3 2 2	S-5		Very loose	4	1.9										
			1 2 2	S-6		Very loose	4	1.5										
10																		
			6 11 15	S-7		Medium dense, white to light brown	26	1.9										
15					**SAND (SP)**													
			8 10 20	S-8		Medium dense	30											
20																		
			23 36 47	S-9		Very dense, light brown	83											
25																		
			21 28 32	S-10		Very dense	60	5.3										
30																		
			11 20 30	S-11		Very dense, Soft drilling at 36'	50											

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report.
Actual strata changes may be gradual over depth.

(Continued Next Page)

RECORD OF TEST BORING

thompson ENGINEERING

BORING NO.: B-01

PROJECT: Phoenix V Condominiums **CLIENT:** Coastline Management **PROJECT NO.:** 21-1102-0146

PAGE: 2 OF 2

DEPTH/ ELEV. (FT)	SYMBOL	SAMPLER	SPT BLOWS	SAMPLE I.D.NO.	MAJOR SOIL COMPONENT	OTHER COMPONENTS	SPT N/ (REC%)	% F	MC	LL	PI	UW (pcf)	OC (%)	UU (psf)	UC (psf)	PP (psf)	VS (psf)	FS (psf)
40			16 23 27	S-12	**SAND (SP)** ***(continued)***	Very dense	50											
45			18 20 23	S-13		Dense	43											
			20 21 15	S-14		Dense	36											
50						Bottom of borehole at 50.0 feet.												

Refer to Notes and Legend on separate sheet for additional information. This Record of Test Boring is part of the project Geotechnical Report.
Actual strata changes may be gradual over depth.