# LETTER OF TRANSMITTAL

**Date:** July 15, 2004

David S. Koppel, P.E.
Monroe County Engineer
1100 Simonton Street
Key West, Florida 33040
(305) 292-4426

| | |
|---|---|
| **TO:** | Mr. John Clark |
| | Breezeswept Beach Estates Civic Association |
| | 281 West Indies Drive |
| | Ramrod Key, Florida 33042 |
| **RE:** | **Breezeswept Beach Estates Culvert** |

**ENCLOSED PLEASE FIND THE FOLLOWING ITEM(S):**

| *NO.* | *DATE* | *COPIES* | *DESCRIPTION* |
|---|---|---|---|
| | | 1 | Report of Geotechnical Engineering Services for Proposed Drainage Culvert |
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☐For Approval ☒For Your Use ☐For Review and Comment

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***REMARKS:***

**REPORT OF**

**GEOTECHNICAL ENGINEERING SERVICES**

**FOR**

**PROPOSED DRAINAGE CULVERT**

**BREEZESWEPT BEACH ESTATES SUBDIVISION**

**RAMROD KEY, MONROE COUNTY, FLORIDA**

**PREPARED FOR**

**MONROE COUNTY ENGINEERING DEPARTMENT**

**PREPARED BY**

**PROFESSIONAL SERVICE INDUSTRIES, INC.**

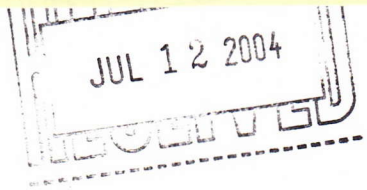
**PSI PROJECT No. 397-45068**

**JULY 9, 2004**

psi Information To Build On
Engineering • Consulting • Testing

grade is ± 3.0' NGVD
Invert @ depth of -5.5' NGVD
so bottom of culvert is 8.5' under surface

grnd water level is @ 0' NGVD




1' of topsoil
2-6' of Fill of sand/rock
B-2 (5'-6') Fill to -2' to -4' ft.
then 2' layer of silty fine sand w/ peat and wood fibers.
then lime rock to -25' (end of boring) which was found at depths of -4-6'
Groundwater @ -3.2' & -2.5'

PSI Information To Build On
Engineering • Consulting • Testing

July 9, 2004

Monroe County Engineering Department
1100 Simonton Street
Room 2-215
Key West, Florida 33040

Attention: Mr. Clark W. Briggs
Project Manager

Re: Report of
Geotechnical Engineering Services
Proposed Drainage Culvert
Breezeswept Beach Estates Subdivision
Ramrod Key, Monroe County, Florida

PSI Project No. 397-45068

Dear Mr. Briggs:

Professional Service Industries, Inc., (PSI) has conducted a subsurface exploration program and geotechnical engineering evaluation in connection with the proposed drainage culvert to be constructed at the Breezeswept Beach Estates Subdivision located in Ramrod Key, Monroe County, Florida. Our services were provided in general accordance with PSI Proposal No. P0-397-450097A dated May 19, 2004. Authorization to perform our services was provided by means of a Monroe County Board of County Commissioners Purchase Order, dated May 21, 2004.

A summary of the project description, our findings and recommendations is provided in the Executive Summary section of this report. The results of the subsurface exploration program, together with our recommendations for the culvert design and related construction, are presented in the accompanying report.

Geotechnical Engineering Services
Proposed Breezeswept Beach Culvert
Breezeswept Beach Estates
Ramrod Key, Monroe County, Florida
PSI Project No. 397-45068

Often, during design and construction of a project, questions arise concerning the subsurface conditions. PSI would be pleased to continue in its role as geotechnical engineer during the project implementation.

We appreciate the opportunity to provide our services to the Monroe County Engineering Department on this project. Please do not hesitate to contact the undersigned if you have any questions about the report or if you need additional information.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Drew Badri
Staff Geotechnical Engineer

7-09-04
Ed Miguens, P.E.
Senior Geotechnical Engineer
Florida Registration No. 47535

DB/EM/ec

cc: Addressee (3)
File (1)

psi

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APPENDIX

## 1.0 EXECUTIVE SUMMARY

A geotechnical engineering study has been carried out in order to evaluate the site preparation requirements and to provide foundation/wall design recommendations for a proposed drainage culvert to be constructed at the Breezeswept Beach Estates Subdivision in Ramrod Key, Monroe County, Florida. The culvert will connect an existing canal in the Breezeswept Beach Estates Subdivision to open water at Torch Ramrod Channel. The project description, site stratigraphy and our recommendations for foundation/wall design and related construction are summarized below.

- At this time, the Monroe County Engineering Department has two options under consideration for the culvert design: Option 1) Utilizing the insitu materials for the walls of the culvert with a concrete lid added to footings located on each side. A box type precast culvert would be utilized at the entrance and exit points of the culvert for this option. Option 2) A precast box culvert to be utilized for the entire length of the project.

- Based on the survey information provided, the approximate grade at the site is ± 3.0 ft NGVD and the bottom elevation of the proposed culvert is to be set at ± -5.5 ft NGVD.

- PSI performed two (2) Standard Penetration Test (SPT) borings to depths of 25 feet below existing grade at the subject site.

- The results of the soil test borings indicates the presence of a surficial topsoil cover followed by a layer of loose to dense fill material consisting mainly of limerock and fine sand with varying amounts of silt to depths of 2 and 6 feet below existing grade. Below the fill layer in boring B-2 was a 2 foot layer of silty fine sand with peat and wood fibers from 2 to 4 feet below existing grade. Below the fill/silty sand layers, the borings encountered weakly to well cemented limestone to the boring termination depth of 25 feet below existing grade. The top of the limestone strata was encountered at depths of 4 and 6 feet below existing grade.

- The groundwater levels were measured in the test borings at depths of 3.2 and 2.5 feet below existing grade.

- Based on the results of our test borings and the survey information furnished, it is our opinion that the option of utilizing the insitu materials as the walls of the culvert is not feasible. The insitu materials consist of limerock and/or fine sand with trace amounts of silt to depths of 6 and 4 feet at borings B-1 and B-2 followed by the natural limestone to the bottom of the proposed culvert. The limerock/sand materials will not be able to self support an open vertical excavation. Furthermore, prolonged erosion of these materials due to flowing water can cause detrimental affects to the above/adjacent development. For this reason, we recommend that a precast box culvert section (Option-2) be used for the entire length of the project.

- The proposed drainage culvert can be supported on shallow foundations. Based on the bottom elevation of the proposed drainage culvert, the footing may rest on either the natural limestone formation or compacted approved structural fill (if necessary). We recommend that the footings be designed using a maximum allowable bearing pressure of 3,000 pounds per square foot (psf).

- The side walls/wing walls of the proposed box culvert and any temporary retaining walls (i.e. sheet piles used during excavation/temporary dewatering activities) will need to be designed to resist lateral earth pressures, hydrostatic pressures and any surcharge loads using the parameters/recommendations presented in the main body of this report.

- The owner/designer should not rely solely upon the executive summary and must read and evaluate the entire contents of this report prior to utilizing our engineering recommendations.

# 2.0 INTRODUCTION

## 2.1 Authorization

This report presents the results of a subsurface exploration and geotechnical engineering evaluation performed for the proposed drainage culvert to be constructed at the Breezeswept Beach Estates Subdivision in Ramrod Key, Monroe County, Florida. Our services were provided in general accordance with PSI Proposal No. P0-397-450097A, dated May 19, 2004. Authorization to perform our services was provided by means of a Monroe County Board of County Commissioners, Purchase Order, dated May 21, 2004.

## 2.2 Purpose

The purpose of this study was to evaluate the general subsurface soil/rock conditions and groundwater levels at the site in order to assess an appropriate foundation system for the proposed drainage culvert structure and to provide side wall/wing wall/temporary retaining wall design parameters for the architect and engineers to use in preparing the design plans.

## 2.3 Scope

The scope of this study included coordination, site reconnaissance, marking the boring locations, utility clearance, subsurface exploration, field testing, engineering analysis and evaluation of subsurface materials for foundation and side wall/wing wall/retaining wall design. Additionally, PSI was provided M.O.T (i.e. Maintenance of Traffic) from the Monroe County Engineering Department.

The scope of services did not include an environmental assessment for 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 which appear in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

## 2.4 General

The general analysis of the subsurface conditions reported herein is considered sufficient in detail and scope to form a reasonable basis for the foundation and side wall/wing wall/retaining wall design. The recommendations submitted for the proposed structure is based on the available subsurface information and the design details furnished.

If there are any revisions to the plans for the proposed structure, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be retained to determine if changes in our recommendations are required. If PSI is not retained for these functions, PSI will not be responsible for the impact of those conditions on the performance of the proposed structure.

# 3.0 PROJECT DESCRIPTION

Based on the information supplied by Mr. Berry B. Rikard, Jr., P.E., Assistant County Engineer with the Monroe County Engineering Department, two (2) options have been considered for the box culvert design. These options are described below.

### Option 1: Insitu Materials as the Walls of the Box Culvert

Depending on the subsurface conditions the box culvert under consideration would utilize the natural limestone formation as the walls of the culvert with a concrete lid added to footings located on each side of the excavated culvert. A box type pre-cast culvert section would be utilized at the entrance and exit points of the culvert for this option.

**Option 2: Precast Box Culvert Section for the Entire Length**

If it is determined that Option 1 is not feasible, a pre-cast concrete box culvert would be utilized for the entire length of the project. As we understand, this option may be utilized for the projects entirety regardless of the rock situation.

Based on the survey information provided, the approximate grade at the site is ± 3.0 ft NGVD and the bottom elevation of the proposed culvert is to be set at ± -5.5 ft NGVD.

If any of this information is incorrect, or any changes are made with respect to the proposed development, please inform PSI so that we can revise this report accordingly.

## 4.0 DESCRIPTION OF SITE

### 4.1 Site Location

The site for the proposed development is located south of the intersection of West Indies Drive and Barbados Lane at the Breezeswept Beach Estates Subdivision in Ramrod Key, Monroe County, Florida. For your reference, we have included a Site Vicinity Map on Sheet 1 in the Appendix.

## 4.2 Site Conditions

The site conditions were observed by representatives of PSI during the course of our study. In general, the site conditions consisted of grass vegetation, small to medium size trees, a two-lane asphaltic concrete roadway and exposed soils. Boring B-1was performed adjacent to the existing canal, approximately 1-foot west of the edge of the pavement. Boring B-2 was performed along the proposed culvert alignment near the Torch Ramrod Channel. The grade at boring B-1 appeared to be approximately one (1) foot higher than at boring B-2. Photographs of the site are presented on Sheet 2 of the Appendix.

## 4.3 Regional Geology

The Keys are a series of islands at the southern tip of Florida. The land mass typically comprises of limestone at fairly shallow depths. At the transition between land and water, there are occasional mangrove swamps, which have a surface veneer of peat and other similar organic soils atop the rock. Portions of the islands are reclaimed, particularly in the more developed areas. In such areas, the limestone is mantled with a sand/limerock fill.

The natural limestone typically grades moderately well to well cemented. The limestone, although very porous, is not susceptible to sinkhole collapse as in other areas of the State.

## 5.0 FIELD EXPLORATION

### 5.1 General

The field exploration to evaluate the engineering characteristics of the foundation, wing walls/side walls and temporary retaining wall (during excavation/dewatering) materials included a reconnaissance of the project site, drilling of the test borings, performing Standard Penetration Tests, and recovering split spoon samples. Additionally, PSI was provided M.O.T (i.e. Maintenance of Traffic) from the Monroe County Engineering Department.

### 5.2 Standard Penetration Test (SPT) Borings

Subsurface conditions at the site were explored with two (2) Standard Penetration Test (SPT) borings drilled to depths of 25 feet below the existing ground surface. The borings were performed in general accordance with ASTM D-1586. The boring locations are presented on the Boring Location Plan on Sheet 3 of the Appendix. The borings were located in the field by representatives of PSI utilizing normal taping procedures. All references to the depths of the various strata and materials encountered are from the existing grade at the time of drilling. After completion of the test borings, the boreholes were backfilled with excavated soil and the site was cleaned as required. Care was taken so as to not damage existing features (i.e. trees) on site.

Materials encountered during the drilling operations were identified in the field. Representative samples were placed in glass jars and were transported to our laboratory for verification by a geotechnical engineer. The procedures used for drilling, sampling, and conducting field tests and measurements are discussed in the Appendix.

## 6.0 SUBSURFACE CONDITIONS

### 6.1 General

Subsurface materials encountered in the borings were visually observed and classified, and are described on the boring logs and Generalized Subsurface Profile Sheets in the Appendix. Included with the boring logs and profiles are the results of the Standard Penetration Tests and water level observations. Jar samples of the materials recovered from the borings are now stored in our office for further analysis if desired. Unless notified to the contrary, all samples will be disposed of after 60 days.

The subsurface stratification shown on the boring logs and generalized profile represents subsurface conditions at the actual boring locations. Variations may occur within a short distance from the borings. The stratification lines presented on the boring logs represent approximate boundaries between successive materials encountered, but the actual transition may be gradual, or not clearly defined. It is to be noted that, whereas the test borings were drilled and sampled by experienced drillers, it is sometimes difficult to record changes in stratification within narrow limits.

### 6.2 Soil/Rock Conditions

The results of the soil test borings indicates the presence of a surficial topsoil cover followed by a layer of loose to dense fill material consisting mainly of limerock and fine sand with varying amounts of silt to depths of 2 and 6 feet below existing grade. Below the fill layer in boring B-2 was a 2 foot layer of silty fine sand with peat and wood fibers from 2 to 4 feet below existing grade. Below the fill/silty sand layers, the borings encountered weakly to well cemented limestone to the boring termination depth of 25 feet below existing grade. The top of the limestone strata was encountered at depths of 4 and 6 feet below existing grade.

A detailed description of the subsurface soil/rock conditions is provided on the generalized soil profile sheets and boring logs given in the Appendix. The Standard Penetration Test N-values are used to evaluate the relative density of granular soils. The correlation of penetration resistance with relative density is presented in the Appendix.

### 6.3 Groundwater Conditions

Groundwater levels were measured in the open boreholes upon completion of the drilling and sampling. The water levels were measured at depths of 3.2 and 2.5 feet below the existing ground surface in borings B-1 and B-2, respectively. The groundwater levels presented in this report are the levels that were measured at the time of our field activities. Fluctuation should be anticipated. We recommend that the contractor determine the actual groundwater levels at the time of the construction to determine ground water impact on their construction procedure. We estimate that during the peak of the wet hydroperiod, with rainfall and recharge at a maximum, groundwater levels at the site could be one (1) to two (2) feet higher than those measured in the borings. Water levels are also likely to be influenced by tidal effects.

## 7.0 EVALUATION

Based on the results of our test borings and the survey information furnished, it is our opinion that the option of utilizing the insitu materials as the walls of the culvert is not feasible. The insitu materials consist of limerock and/or fine sand with varying amounts of silt to depths of 6 and 4 feet at borings B-1 and B-2 followed by the natural limestone to the bottom of the proposed culvert. The limerock/sand materials will not be able to self support an open vertical excavation. Furthermore, prolonged erosion of these materials due to flowing water can cause detrimental affects to the above/adjacent development. For this reason, we recommend that a precast box culvert section (Option-2) be used for the entire length of the project.

Based on the subsurface conditions encountered at the site, we recommend conventional, shallow, spread and/or continuous footings to support the proposed box culvert structure. Shallow foundations appear to be the most suitable type of foundation for the box culvert structure as planned, and can be constructed after the site preparation recommendations presented in this report have been implemented. Based on the bottom elevation of the proposed drainage culvert, the footing may rest on either the natural limestone formation or compacted approved structural fill material (if necessary). The side walls/wing walls of the proposed box culvert and any temporary retaining walls (i.e. sheet piles used during excavation/temporary dewatering activities) will need to be designed to resist lateral earth pressures, hydrostatic pressures and any surcharge loads.

## 8.0 RECOMMENDED FOUNDATION TYPE

### 8.1 Shallow Foundation Design

Provided that the site preparation recommendations presented in this report have been implemented the proposed box culvert structure can be supported on a shallow foundation system designed using a maximum allowable bearing pressure of 3,000 pounds per square foot (psf) for foundations resting on either compacted approved structural fill or on the natural limestone formation.

The footings should be based at least 18 inches below the finished exterior grade in order to provide confinement.

Foundations subject to transient lateral loads will resist these forces through a combination of base shearing resistance mobilized at the footing-subgrade interface and earth pressure acting on the vertical faces of the footings at right angles to the direction of the applied load. Base shearing resistance should be determined using a friction factor of 0.55.

Earth pressure resistance should be computed using an equivalent fluid pressure of 180 pounds per square foot per foot of depth, for granular backfill material above the water table and 90 pounds per square foot per foot of depth below the water table. Resistance to sliding determined in accordance with the above should be considered available/ultimate resistance. Accordingly, the design for the sliding should include a factor of safety. We recommend that a factor of safety of at least 1.5 be used.

To calculate the resistance of a footing to uplift forces, a prismatic failure block with vertical faces should be assumed above the footing base. The resisting forces will be provided by the combination of footing weight, overburden soil weight in the failure block, and shearing resistance along the faces of the soil block. The weight of the soil above the water table should be taken as 110 pounds per cubic foot (pcf). The factor of safety against uplift should not be less than 1.5.

The allowable bearing pressure refers to dead and normal live load conditions. It may be increased by 25 percent for total loads, including wind forces. The weight of the footings and backfill soils may be neglected in the foundation sizing computations.

## 8.2 Settlement Potential

The amount of settlement that a structure founded on the compacted granular soils will experience is primarily governed by the compressibility of the subsurface materials, the size and depth of its foundations, and the pressure imposed on the supporting materials by the foundations. Based on the field test data obtained, our experience with similar structures, and empirical relationships for bearing capacity and settlement, we have estimated that the maximum total settlement of the foundations for the culvert structure will be one (1) inch.

Differential settlement, between adjacent foundations, should be approximately one-half of the total settlement.

Foundation settlements are likely to occur almost immediately upon application of the loads. In this case, nearly all the settlement of the foundations due to dead loads is expected to take place during construction. The portion of the settlement due to the live load of the structure will generally take place soon after the first application of this load.

## 8.3 Earth Retaining Walls

The side walls/wing walls of the proposed drainage culvert and any temporary retaining wall (i.e. sheet piles used in excavation/temporary dewatering activities) will need to be designed for lateral earth pressures, hydrostatic pressures and any surcharge loads.

The following table summarizes our recommendations for the soil parameters and the lateral active, passive and at-rest pressure coefficients to be utilized for the box culvert side wall/wing wall and sheet pile design. The design of the wall systems shall include hydrostatic pressure acting on the active side of the wall.

## SUMMARY OF DESIGN GEOTECHNICAL PARAMETERS

| MATERIAL TYPE | SPT "N" VALUE (bpf) | SOIL UNIT WEIGHT (PCF) | | INTERNAL ANGLE OF FRICTION ϕ (DEGREES) | AVERAGE ALLOWABLE SHEAR STRENGTH Su (PSF) | EARTH PRESSURE COEFFICIENT | | |
|---|---|---|---|---|---|---|---|---|
| | | Moist | Sat | | | ACTIVE (Ka) | PASSIVE (Kp) | AT REST (Ko) |
| FILL | 0 – 10 | 105 | 115 | 30 | - | 0.33 | 3.0 | 0.5 |
| | 10 – 35 | 110 | 120 | 32 | - | 0.31 | 3.25 | 0.47 |
| Silty Sand | 0 – 10 | 100 | 110 | 28 | - | 0.36 | 2.77 | 0.53 |
| Limestone | 0 – 10 | 105 | 115 | 30 | - | 0.33 | 3.0 | 0.5 |
| | 10 – 20 | 115 | 125 | - | 3000 | - | - | - |
| | <20 | 125 | 135 | - | 5000 | - | - | - |

Note: These parameters assume direct contact between the rock and the wall system.

In order to reduce the loads being applied to the box culvert walls and promote positive water drainage, it is recommended that a granular backfill be placed directly behind the walls and extend laterally a minimum distance of five (5) feet. These granular soils should be a relatively clean, free draining granular materials containing less than five (5) percent passing the No. 200 sieve (0.074mm).

## 9.0 CONSTRUCTION CONSIDERATIONS

### 9.1 Site Preparation

Site preparation prior to the new construction should include stripping of all topsoil, pavements and any deleterious material (if any) at/adjacent to the proposed box culvert location. The stripping operation should be followed by overexcavating soil/rock to the proposed culvert bottom elevation. The culvert structure should be placed into the excavation and backfilled above/adjacent with compacted structural fill as per the recommendations presented in Section 9.2 of this report. Exposed surfaces should be proof compacted to a minimum of 95 percent of the Modified Proctor maximum dry density (ASTM D-1157) to a depth of at least 12 inches.

The contractor should anticipate that the limestone formation will be encountered and that pre-drilling may be required to assist in obtaining the required penetration during sheet pile(s) installation. Additionally, The limestone formation may necessitate the use of special equipment and breaking tools during any excavation activities during construction. Lastly, the contractor shall ensure that turbidity control measures be implemented during the overexcavation/dewatering operations in accordance with regulatory requirements.

If the excavation bottoms consist of the natural limestone formation, in lieu of compaction, the excavation bottoms should be inspected by a Geotechnical Engineer from this office to verify the integrity of the limestone. If pockets of soft soils or solution features in the form of slots or chimneys are found, they should be excavated to a depth of three (3) times the feature width or diameter and backfilled with lean concrete.

## 9.2 Structural Fill and Backfill

It is imperative that any fill be placed, compacted and tested in accordance with the specifications of this report. The tests should be performed by a qualified soils technician working under the supervision of the Geotechnical Engineer in accordance with appropriate ASTM procedures. Any fill indicating less than the recommended relative compaction should be recompacted until the required density is obtained prior to the placement of subsequent lifts or concrete for the substructure.

The structural fill material may be composed of either clean sands or limerock. The fill should be free of organic matter and consist of granular soil containing less than 12 percent material passing the No. 200 mesh sieve. The limerock should have no particle size in excess of 3 inches. The structural fill should have a Unified Soil Classification System (USCS) Designation of GP, GW, SP, SW, GP-GM, GW-GM, SW-S or SP-SM.

Structural fill or backfill to be placed below the water table level should consist of an inorganic, non-plastic material, free of any man-made debris, crushed limerock with a three (3) inch maximum particle size with ASTM (Unified) Soil Classification of GP or GW or FDOT 57 Stone. Backfill for a lateral distance of 5 feet behind the box culvert walls should contain less than 5 percent passing the No. 200 sieve.

## 9.3 Groundwater Control

Groundwater levels were measured to be approximately 3.2 and 2.5 feet below the existing ground surface. However, please note that groundwater levels fluctuate seasonally as a function of rainfall, the infiltration rate of the soil and the water levels in the adjacent canal. Therefore, at a time of the year different from the time of drilling, there is a possibility of a change in the recorded water levels. We estimate that during the peak of the wet hydroperiod with rainfall and recharge at a maximum, groundwater levels at the site could be 1 to 2 feet higher than those measured in the borings.

As indicated in Section 3.0 of this report, the bottom of the proposed box culvert foundations will be set near elevation ±-5.5 feet, NGVD. This level corresponds to about 5.5 feet below the existing surrounding groundwater levels. Accordingly, temporary dewatering measures will be required to facilitate construction of the box culvert structure and side/wing walls in the "dry". To keep the channeled flow from entering the excavation and to maintain a stable excavation, a temporary sheet pile cofferdam may be employed. The water flow in the canal should be diverted away from the excavation area during construction. A fully sanded vacuum well point system can be installed to lower the groundwater levels below the excavation bottom. In addition, a barrel sump can be used to collect and dispose of any standing water present in the excavation. The contractor should maintain ground water levels outside the excavation at the same levels encountered at the time of construction. The discharge from any dewatering system should be handled in accordance with current regulatory criteria.

The contractor may need to modify his dewatering scheme for higher flow rates due to the very high permeability/porosity characteristics of the limestone formation.

The groundwater level should be maintained at least 1 foot below the bottom of any excavations made during construction and 2 feet below the surface of any vibratory compaction operations.

## 10.0 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 Standard for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines.

These regulations are being strictly enforced. The owner and contractor will be liable for violations and subject to 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 required to maintain stability of the cut. 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. PSI is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

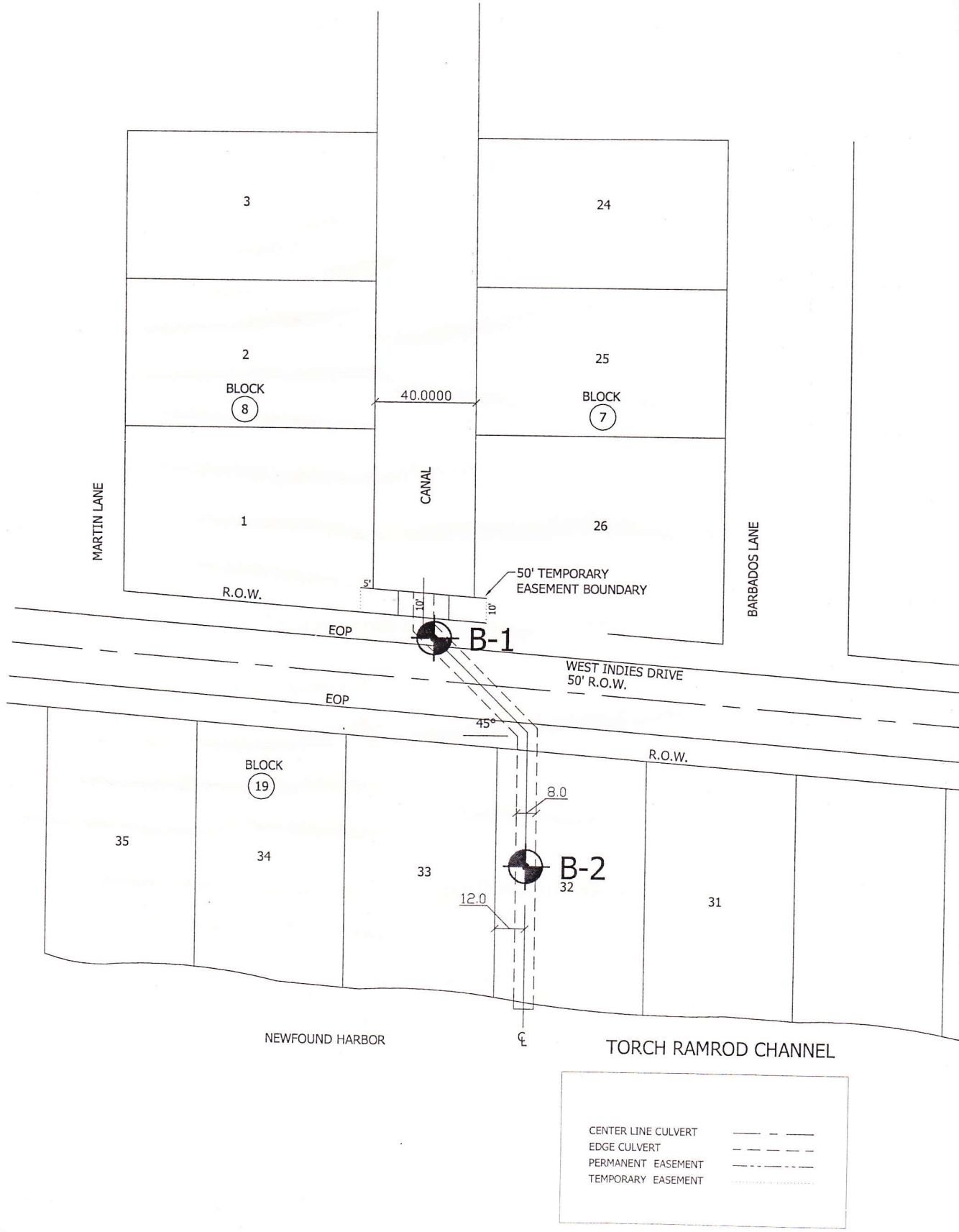
## 11.0 GENERAL CONDITIONS

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein, have been presented after being prepared in accordance with generally accepted professional practice in the field of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

After the plans and specifications are complete, it is recommended that Professional Service Industries be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and foundation recommendations and properly interpreted and implemented. At that time, it may be necessary to submit supplementary recommendations.

This report has been prepared for the exclusive use of Monroe County Engineering Department Inc. for the specific application to the proposed Breezeswept Beach Culvert to be constructed at the Breezeswept Beach Estates at Ramrod Key in Monroe County, Florida.

# APPENDIX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EOP
B-1
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50' R.O.W.
EOP
45°
R.O.W.
BLOCK
19
8.0
35
34
33
B-2
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12.0
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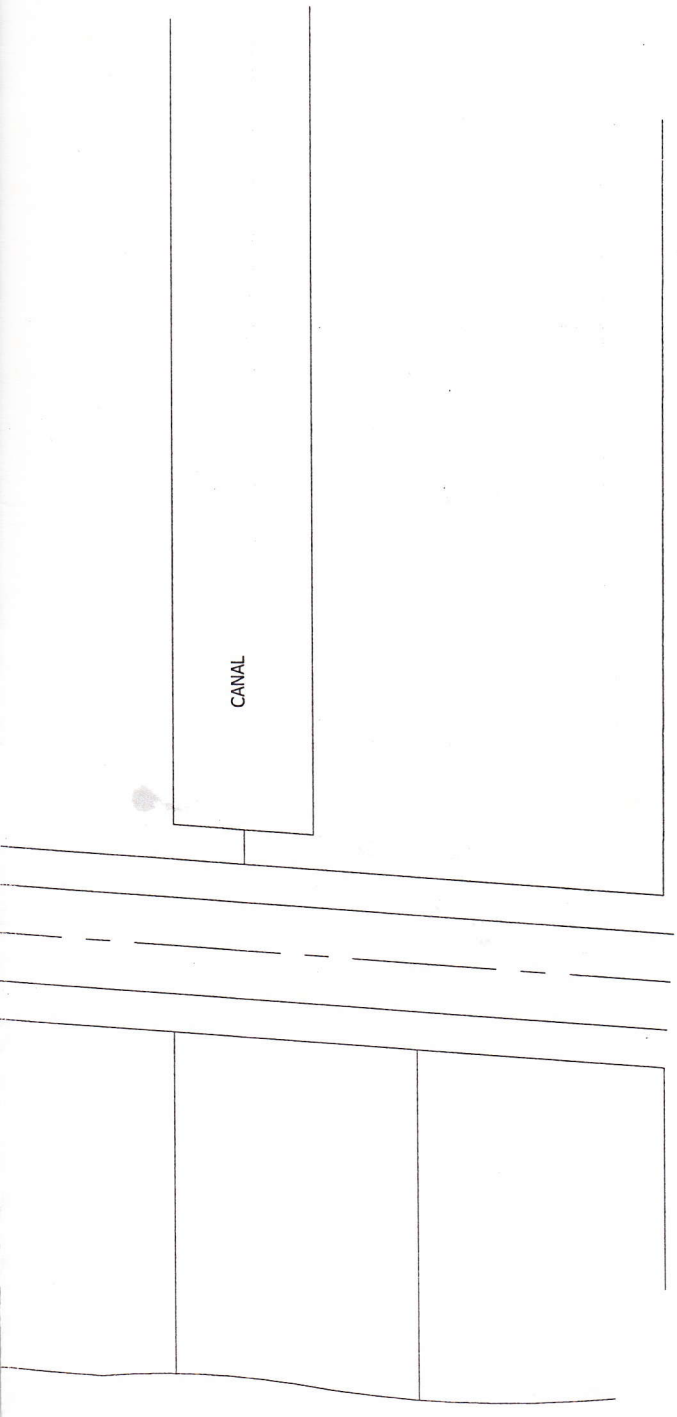
NEWFOUND HARBOR
TORCH RAMROD CHANNEL
CENTER LINE CULVERT
EDGE CULVERT
PERMANENT EASEMENT
TEMPORARY EASEMENT




LEGEND:

APPROXIMATE SPT BORING LOCATION

BORING LOCATION PLAN

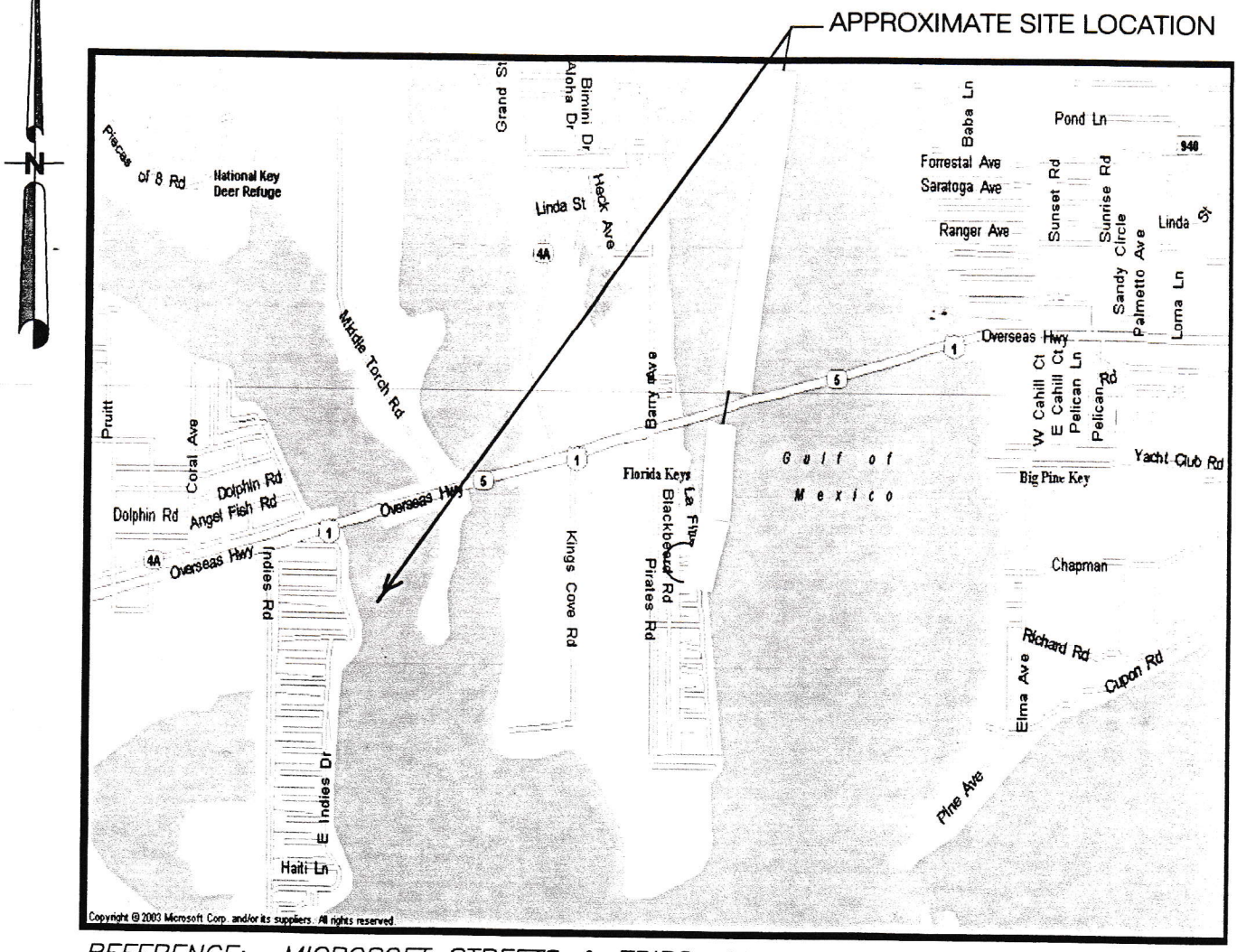
GEOTECHNICAL ENGINEERING SERVICES

PROPOSED DRAINAGE CULVERT
BREEZESWEPT BEACH ESTATES SUBDIVISION

RAMROD KEY, MONROE COUNTY, FLORIDA

| | | | |
|---|---|---|---|
| DATE: | 6/30/04 | SHEET # 3 | PROJECT No. 397-45068 |
| SCALE: | N.T.S. | | |
| DRAWN: | GG | | |
| CHKD: | DB | | |

psi Environmental Geotechnical Construction
Consulting • Engineering • Testing




*REFERENCE: MICROSOFT STREETS & TRIPS, 2004.*
*SCALE: NOT TO SCALE*

# SITE VICINITY MAP

GEOTECHNICAL ENGINEERING SERVICES

PROPOSED DRAINAGE CULVERT
BREEZESWEPT BEACH ESTATES SUBDIVISION
RAMROD KEY, MONROE COUNTY, FLORIDA

| | | | |
|---|---|---|---|
| DATE: | 7/01/04 | SHEET#1 | PROJ. NO: 397-45068 |
| SCALE: | N.T.S. | | |
| DRAWN: | GG | | |
| CHKD: | DB | | |

psi Environmental Geotechnical Construction
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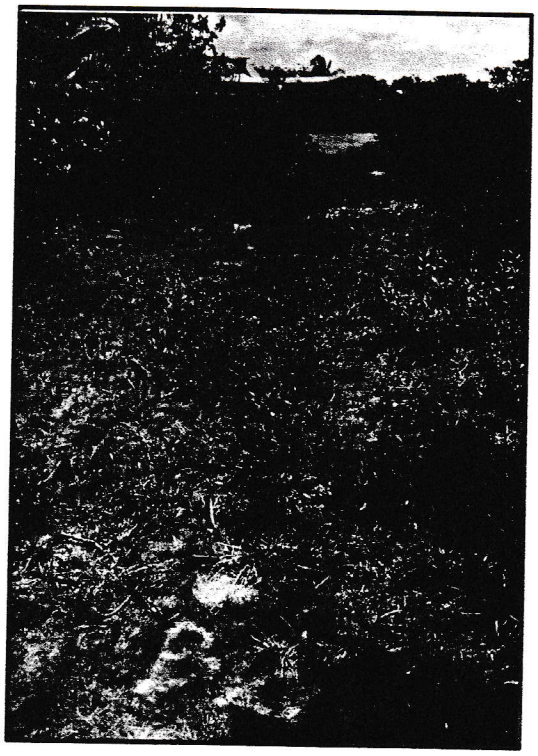
*Photograph of Boring Location B–1 (Looking West)*



*Photograph of Boring Location B–2 (Looking Northeast)*

GEOTECHNICAL ENGINEERING SERVICES

PROPOSED DRAINAGE CULVERT
BREEZESWEPT BEACH ESTATES SUBDIVISION
RAMROD KEY, MONROE COUNTY, FLORIDA

| | | | |
|---|---|---|---|
| DATE: | 7/01/04 | SHEET# 2 | PROJ. NO: 397-45068 |
| SCALE: | N.T.S. | | |
| DRAWN: | GG | | |
| CHKD: | DB | | |

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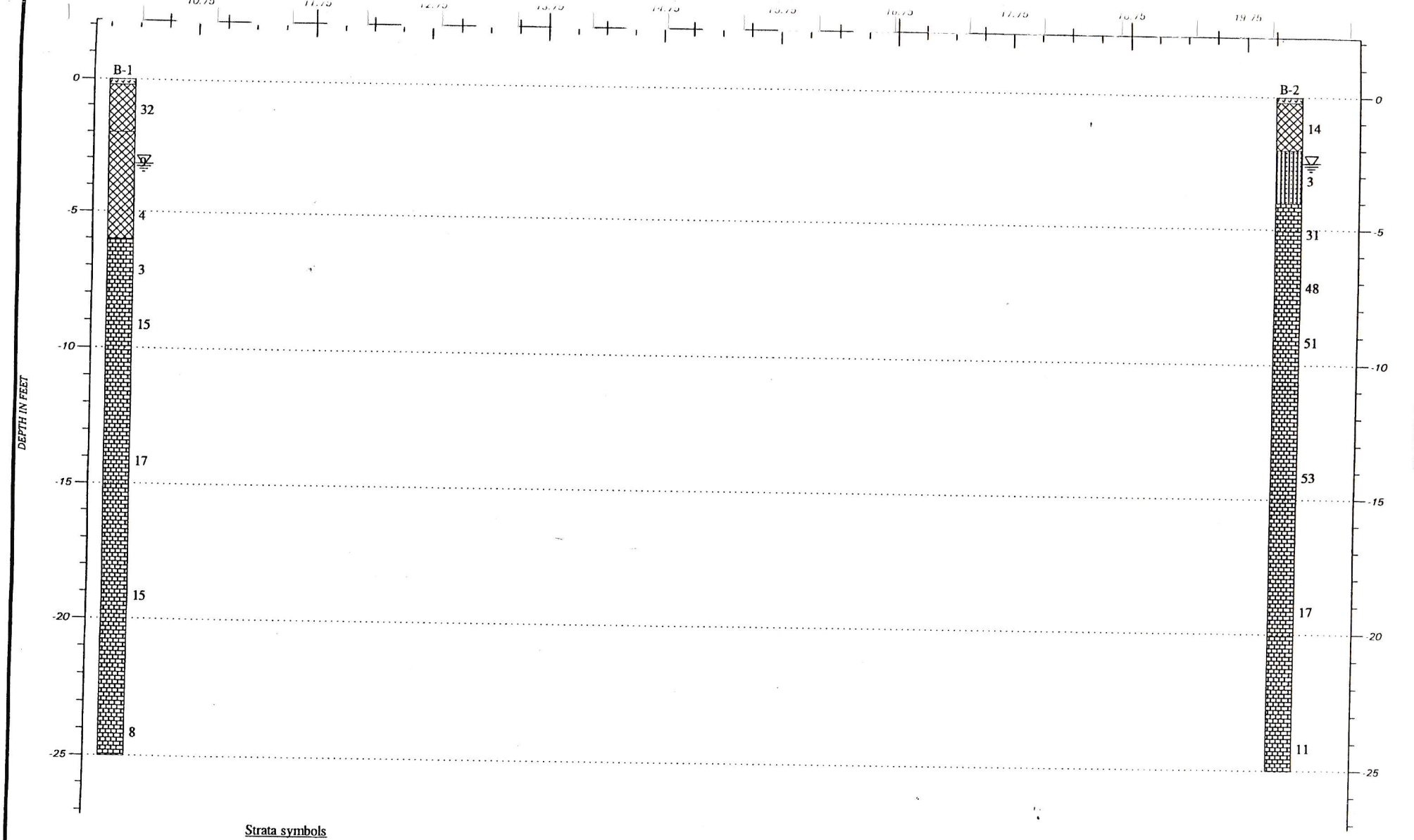


Strata symbols

- Topsoil
- Fill
- Limestone
- Silty sand

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GENERALIZED SOIL PROFILE

| HORIZONTAL SCALE: 1"=(proportional)' | DRAWN BY/APPROVED BY | DATE DRAWN |
|---|---|---|
| VERTICAL SCALE: 1"=(proportional)' | EC/DB | 7/9/2004 |

Proposed Drainage Culvert

Breezeswept Beach Estates Subdivision

# LOG OF BORING NO. B-1

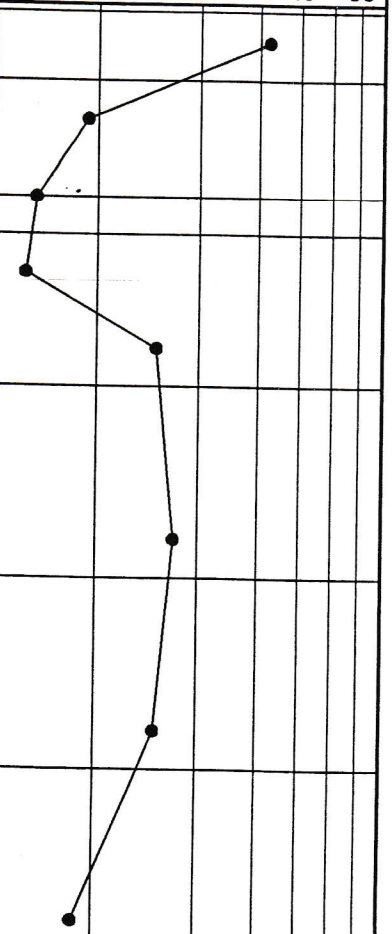
Proposed Drainage Culvert
Breezeswept Beach Estates Subdivision
Ramrod Key, Monroe County, Florida

**Client:** Monroe County Engineering Department **Project Number:** 397-45068

**Type:** 2" Split-Barrel **Location:** See Attached Boring Location Plan

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT |
|---|---|---|---|---|
| 0 | | | Brown Fine SAND with Roots (Topsoil) | |
| | | | Light Brown LIMEROCK with Fine Sand (Fill) | 32 |
| | | | Light Brown LIMEROCK with Silty Fine Sand (Fill) | 9 |
| 5 | | | | 4 |
| | | | Light Brown to Gray LIMESTONE with Fine Sand | 3 |
| 10 | | | | 15 |
| 15 | | | | 17 |
| 20 | | | | 15 |
| 25 | | | | 8 |
| | | | End of Boring | |
| 30 | | | | |
| 35 | | | | |

STANDARD PENETRATION TEST
● N-VALUE (ASTM D-1586)
10 20 30 40 60



**COMPLETION DEPTH:** 25 feet **DEPTH TO WATER IN BORING:** 3.2' **ELEVATION:** ---

**DATE:** 6/14/04 **LOGGED BY:** D.C.

PROFESSIONAL SERVICE INDUSTRIES, INC.

# LOG OF BORING NO. B-2

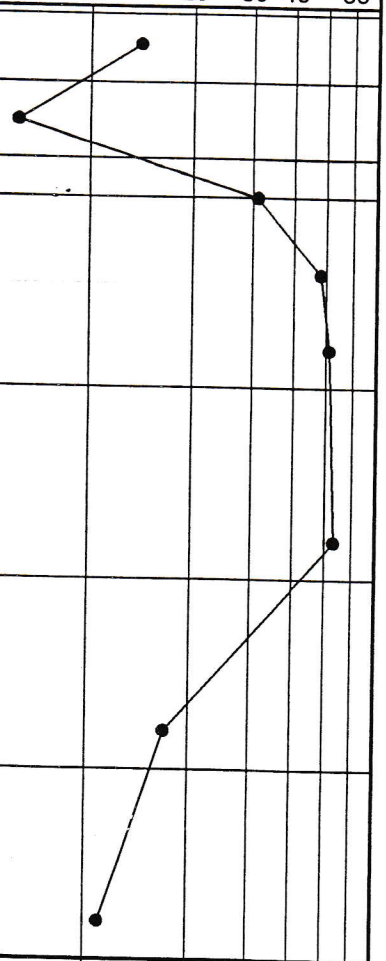
Proposed Drainage Culvert
Breezeswept Beach Estates Subdivision
Ramrod Key, Monroe County, Florida

**Client:** Monroe County Engineering Department **Project Number:** 397-45068

**Type:** 2" Split-Barrel **Location:** See Attached Boring Location Plan

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT |
|---|---|---|---|---|
| 0 | | | Brown Organic Silty Fine SAND with Roots (Topsoil) | |
| | | | Light Brown LIMEROCK with Fine Sand (Fill) | 14 |
| | | | Dark Brown Silty Fine SAND with Peat and Wood Fibers | 3 |
| 5 | | | Light Brown to Gray LIMESTONE with Fine Sand | 31 |
| | | | | 48 |
| 10 | | | | 51 |
| | | | | |
| 15 | | | | 53 |
| | | | | |
| 20 | | | | 17 |
| | | | | |
| 25 | | | | 11 |
| | | | End of Boring | |
| 30 | | | | |
| 35 | | | | |

STANDARD PENETRATION TEST
● N-VALUE (ASTM D-1586)
10 20 30 40 60



**COMPLETION DEPTH:** 25 feet **DEPTH TO WATER IN BORING:** 2.5' **ELEVATION:** ---

**DATE:** 6/14/04 **LOGGED BY:** D.C.

PROFESSIONAL SERVICE INDUSTRIES, INC.

## CORRELATION OF PENETRATION RESISTANCE WITH

## RELATIVE DENSITY OF GRANULAR SOILS

| RELATIVE DENSITY | STANDARD PENETRATION TEST BLOWS/FT. (N-VALUE) |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | Over 50 |

## DRILLING AND SAMPLING PROCEDURES

The test borings were performed with a drilling rig equipped with a rotary head. The drill holes were advanced by the use of a high speed rollercone bit, with bentonite drilling fluid being pumped through the drill rods to remove the cuttings and to stabilize the side walls and bottom of the hole. Representative samples were obtained by the use of split-barrel sampling procedures in general accordance with the procedures for "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D-1586).

## FIELD TESTS AND MEASUREMENTS

**Standard Penetration Tests** - During the sampling procedure, standard penetration tests (SPT) were performed at pre-determined intervals to obtain the standard penetration value (N) of the soil. The standard penetration value (N) is defined as the number of blows of a 140 pound hammer, falling thirty (30) inches, required to advance the split-barrel sampler one (1) foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows are 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.

**Water Level Measurements** – Depths of water level in the borings were obtained after completion of test boring operations when the water level was stabilized. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. Seasonal variations, tidal conditions, temperature, land-use, and recent rainfall conditions may influence the depths to the groundwater.

**Ground Surface Elevations** - Ground surface elevations at the test boring locations were not provided. Therefore, all references to depth of the various strata and materials encountered, are from existing grade at the time of drilling.