Geotechnical Investigation Report

City of St. Pete Beach
Pump Station No. 2
City of St. Pete Beach, Florida

Prepared for: **City of St. Pete Beach**
Pump Station No. 2
City of St. Pete Beach, Florida 33706

Prepared By:
MC Squared, Inc
5808 – A Breckenridge Parkway
Tampa, Florida 33610

Project No. T061317.148
August 2013

GEOTECHNICAL • ENVIRONMENTAL
MATERIALS TESTING

August 1, 2013

Mr. Jordan Walker, EI
Kimley-Horn & Associates, Inc.
655 North Franklin St., Suite 150
Tampa, Florida 33602

Geotechnical Engineering Services Report
City of St. Pete Beach Pump Station No. 2
City of St. Pete Beach, Florida
MC^2 Inc. Project No. T061317.148

MC Squared, Inc. (**MC^2**) has performed geotechnical engineering services for the referenced project. The results of this exploration, together with our recommendations, are included in the accompanying report.

Often, because of design and construction details that occur on a project, questions arise concerning subsurface conditions. **MC^2** will be pleased to continue our role as geotechnical consultants during the construction phase of this project to provide assistance with construction materials testing and inspection services and to verify that our recommendations are implemented.

We trust that this report will assist you in the design and construction of the proposed project. We appreciate the opportunity to be of service to you on this project. Should you have any questions, please do not hesitate to contact us.

Respectfully submitted,
MC^2

Kermit Schmidt, PE
Vice President/Chief Engineer
PE No. 45603

William Rovira, PE
Project Engineer

5808 – A Breckenridge Parkway, Tampa, Florida 33610
Phone (813) 623-3399, Fax (813) 623-6636
www.mc2engineers.com

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5808 – A Breckenridge Parkway, Tampa, Florida 33610
Phone (813) 623-3399, Fax (813) 623-6636
www.mc2engineers.com

GEOTECHNICAL ENGINEERING SERVICES REPORT

INTRODUCTION

Authorization

This report presents the findings of the subsurface exploration and associated recommendations based on a geotechnical engineering evaluation of the site for the **City of St. Pete Beach Pump Station No. 2** in Pinellas County, Florida. The services for this project were performed in general accordance with our Proposal T061317.148 dated June 26, 2013. Authorization to perform the exploration and evaluation was in the form of acceptance of our proposal by Mr. David Walthall, PE of **Kimley-Horn & Associates, Inc.**

PROJECT INFORMATION

Project information has been provided by Mr. Jordan Walker, EI **of Kimley-Horn and Associates, Inc.** through email communications including a schematic (Alternative B) of the site area. Based on our understanding, geotechnical engineering services are required to support the design for the new pump station at the location noted above. We understand that the new pump station will have a wet well and control structure 12 feet in diameter and approximately 25 feet deep. In addition, we understand proposed improvements will also include an outdoor generator, odor control unit and prefabricated electrical and controls system building as well as valve vault and piping.

We are assuming that the bottom slab of the wet well will be poured monolithically and tied in with the lower portion of the walls. The load for the structure was not provided and we have assumed it to be less than 1,000 psf.

The recommendations provided in this report are based on this information. If any of the noted information is incorrect or has changed, please inform **MC²** so that we may amend the recommendations presented in this report, if appropriate or necessary.

Site Location

The proposed site evaluated and reported herein is located on the north side of the intersection of 55th Avenue and Gulf Blvd. in Pinellas County, Florida. The location is shown on our **Boring Location Plan,** which is included as **Sheet 1** in **Appendix A.**

Purpose and Scope of Services

One (1) Standard Penetration Test (SPT) boring and one (1) hand auger boring were performed near the proposed wet well. A new outdoor generator, odor control unit, prefabricated electrical building, controls system building, as well as, a new valve vault with piping are included in the scope of proposed improvements. The approximate

locations were provided to us by **Kimley-Horn & Associates, Inc.** to develop the recommendations presented in this report.

The purpose of this exploration was to evaluate subsurface conditions at the site and to provide recommendations regarding design and general site development for the proposed new pump station construction.

Our geotechnical study and analyses consisted of a review of available subsurface test data. Sources include the USDA Pinellas County Soil Survey, USGS Maps and previous geotechnical engineering studies performed by **MC²** in this area. The testing program consisted of the following services:

Conducted a visual reconnaissance of the project site. The actual location of the proposed structures was provided by **Kimley-Horn & Associates, Inc.** personnel. However, the final boring locations were positioned considering access and utility constraints. We determined the boring locations by taping distances from boundaries and existing features; therefore, the boring locations are approximate.

- Reviewed the USDA Soil Survey for Pinellas County and the USGS topographic maps.

- Drilled one (1) Standard Penetration Test (SPT) boring at the site to provide site-specific deeper design information for the proposed structures. The boring was labeled B-1. The boring was performed to a depth of 40 feet below the existing grade.

- Performed one (1) hand auger boring to a depth of 5 feet. The boring was labeled AB-1.

- Visually examined all recovered soil samples for the project using the Unified Soil Classification Systems (USCS). Due to the nature of the soils encountered, laboratory testing was not deemed necessary.

The above data was used in performing engineering evaluations, analyses, and for developing geotechnical recommendations in the following areas:

- General assessment of area geology based on our past experience, study of geological literature and boring information for the site.

- General suitability of materials within the site for use as engineered fill and general backfill.

- General location and description of potentially deleterious materials encountered in the boring, which may interfere with the pump station's construction or performance, including existing fill or surficial organics.

- Discuss critical design and/or construction considerations based on the soil and groundwater conditions developed from the boring.

- Address the groundwater level in the boring and estimate seasonal high groundwater. Provide recommendations for de-watering, if required.

- Recommendations for design and construction may include allowable bearing pressures for foundation design, excavation conditions, dewatering and uplift resistance, structural fill, earthwork recommendations and lateral earth pressures on below grade walls for the site.

  The location of the borings and Soil Profiles are shown on the **Boring Location Plan/Report Of Core Borings (Sheet 1)** located in **Appendix A** of this report.

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

GENERAL SITE AND SUBSURFACE CONDITIONS

Regional Geology for Pinellas County

Based on our review of the Florida Geological Survey (FGS) report of investigation number 12, titled "Groundwater Resources of Pinellas County, Florida" and published in 1954 by the United States Geological Survey (USGS), the two major geologic formations in Pinellas County are the Hawthorn Formation of the lower Miocene and Caloosahatchee Marl of the lower Pliocene. The border between these formations extends across the peninsula north of the Cross Bayou Canal through Safety Harbor and Oldsmar. Soils north of this line are underlain by the Hawthorn Formation.

Caloosahatchee Marl is of marine origin. It consists of sand, sandy clay and marl and is from 2 to 85 percent shells. In places near St. Petersburg and Pinellas Park, these shells are excavated for use in road construction. The maximum thickness of this formation is about 50 feet. In areas near Oldsmar, north of St. Petersburg, near Pinellas Park, south and east of Largo, it is near enough to the surface to affect the soils. Some Astor and Manatee soils formed in this material.

The Hawthorn Formation consists of interbedded sand, clay, marl, limestone, lenses of

fuller's earth, and land-pebble phosphate. Soils that occur on the side slopes of depressions northeast of Clearwater and in cuts made by Curlew Creek north of Dunedin contain phosphatic material from this formation.

During the Pleistocene these formations were covered by marine deposits that formed four terraces. These terraces were covered by a mantle of sand that ranges from 3 to 35 feet in thickness.

The Pamlico terrace occurs at elevations of 0 to 25 feet above mean sea level. It is mainly sand 3 feet thick. In areas near Oldsmar, St. Petersburg, and Pinellas Park, the sand is only 1.5 to 3 feet thick and is underlain by Caloosahatchee Marl. Soils of the Oldsmar and Wabasso series that have acidic sand upper horizons and a non-acid, loamy subsoil formed on this terrace.

The Talbot terrace is 23 to 43 feet above mean sea level. It is fine sand not more than 15 feet thick. In a few places, the sand mantle is thin and the soils have been affected by phosphatic material from the underlying Hawthorn Formation. Most soils of the Talbot terrace are acidic. Soils of the Astatula, Immokalee, Myakka, and Pomello series formed on this terrace.

The Penholoway terrace is 43 to 69 feet above mean sea level. It is mostly fine sand as much as 30 feet thick. It is underlain by the Hawthorn Formation. On sides of depressions the sand mantle is thin, and materials from the Hawthorn Formation have affected the soils. Most soils on this terrace are acid. A few non-acid soils occur in small isolated areas in depressions and along streams. Soils of the Astatula, Immokalee, Myakka, Paola, Pomello, and St. Lucie series formed on this terrace.

The Wicomico terrace is 69 to 100 feet above mean sea level. It is mainly fine sand as much as 25 feet thick. It is underlain by the Hawthorn Formation. The soils on the terrace are dominantly acid sands of the Astatula, Immokalee, Paola, Pomello, and St. Lucie Series.

A few pockets of recently deposited muck and freshwater marl occur in low areas. With few exceptions, individual soils are not confined to a particular geologic formation or marine terrace. For example, Pinellas soils that formed in fresh-water alkaline deposits on upland terraces are very similar to Pinellas soils that formed in alkaline sediments of Caloosahatchee Marl. Though variations in characteristics of the parent material are apparent in the field, they do not affect soil classification.

Soil Survey of Pinellas County

The U.S. Department of Agriculture - Soil Conservation Service now known as the Natural Resources Conservation Service (NRCS), has mapped the shallow soils in this area of Pinellas County. This information was outlined in a report titled *The Soil Survey of Pinellas County, Florida* using Version 8, dated January 26, 2010. The aerial images

were photographed in August 13, 2007. The Soil Survey describes the soils at the site as Matlacha and St. Augustine Soils and Urban land (mapping unit 16). Small areas of other soil types may be present within the mapping unit.

The map unit composition is 32% for Matlacha and similar soils, 32% for St. Augustine and similar soils and 32% Urban land, with 4% minor components. The Matlacha consists of fine sands from the existing ground surface 6.7 feet. The depth to water table is 2 to 3 feet. The Urban land is covered by buildings and pavements so that the identification of the soils is not feasible. The St. Augustine consist of layers of sand, loamy fine sand, fine sand, sandy loam and sand extending to depths of 6.7 feet and a water table ranging from 1.5 to 3.0 feet.

The USDA Soil Survey is not necessarily an exact representation of the soils on the site. The mapping is based on interpretation of aerial maps with scattered shallow borings for confirmation. Accordingly, borders between mapping units are approximate and the change may be transitional. Differences may also occur from the typical stratigraphy, and small areas of other similar and dissimilar soils may occur within the soil-mapping unit. As such, there may be differences in the mapped description and the boring descriptions obtained for this report. The survey may, however, serve as a good basis for evaluating the shallow soil conditions of the area.

Subsurface Exploration

Subsurface conditions at the proposed wet well and other structure locations were obtained by drilling one (1) Standard Penetration Test (SPT) boring and one (1) hand auger boring at the site extending to depths of 40 and 5 feet, respectively,. The approximate boring locations are shown on the **Boring Location Plan (Sheet 1)** presented in **Appendix A.**

The SPT borings were conducted in general accordance with ASTM D-1586 (Standard Test Method for Penetration Test and Split Barrel Sampling of Soils) using the rotary wash method, where a clay slurry ("drill mud" or "drill fluid") was used to flush and stabilize the borehole. Standard Penetration sampling was performed at closely spaced intervals in the upper 10 feet and at 5-foot intervals thereafter. After seating the sampler 6 inches into the bottom of the borehole, the number of blows required to drive the sampler one foot further with a standard 140 pound hammer is known as the "N" value or blowcount. The blowcount has been empirically correlated to soil properties. The recovered samples were placed into containers and returned to our office for visual review.

The hand auger borings were performed by manually twisting and advancing a bucket auger into the ground in 4 to 6-inch increments. As each soil type was revealed, representative samples were placed in air-tight jars and returned to the **MC²** Tampa office for review by a geotechnical engineer and confirmation of the field classification.

Subsurface Conditions

The SPT and hand auger borings soil samples were classified using the Unified Soil Classification System (USCS) in general accordance with ASTM test designation D-2488. This test method classifies soils into specific categories based upon the results of the laboratory testing program. The assignment of a group name and symbol is then used to aid in the evaluation of the significant engineering properties of a soil.

The following description is of a generalized nature, provided to highlight the major subsurface strata encountered in the boring performed at the site. The **Report of Core Borings** in **Appendix A** should be reviewed for specific soil and groundwater information at the boring locations. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected across the site. The stratifications represent the approximate boundary between subsurface materials and the transition may be gradual.

In general, the borings indicated the following:

Depth Range (ft)	Stratum No.	Unified Soil Classification	N-value Range	Relative Density/Consistency
Boring No. 1				
0 – 6	1A	SP/SP-SM/SP-SC with traces to some shell fragments	HA – no N-value	Assume very loose
6 – 8	1A	SP/SP-SM/SP-SC with traces to some shell fragments	16	Medium Dense
8 – 12	2A	Silty Fine Sand (SM) with traces to some shell fragments	3	Very Loose
12 – 37	1A	SP/SP-SM/SP-SC with traces to some shell fragments	7 -11	Loose to Medium Dense
37 – 40	2A	Silty Fine Sand (SM) with trace to	4	Very Loose

Depth Range (ft)	Stratum No.	Unified Soil Classification	N-value Range	Relative Density/Consistency
		some shell fragments		
AB-1				
0 – 5	1A	SP/SP-SM/SP-SC with traces to some shell fragments	-	-

Groundwater Information

Groundwater was encountered at a depth of 3.5 feet during our drilling operations which were performed during a relative wet period (July 26, 2012). The water table can be expected to vary at times and will fluctuate seasonally based on rainfall quantities, area geology, surface drainage conditions and other factors. The Soil Survey of Pinellas County indicates that the site is in Urban Land (covered with buildings and pavements and contains soils altered by development so that their identification is not feasible) and seasonal high water tables are not provided. However, we estimate the seasonal high groundwater level to be at a depth of about 1.0 foot below the existing surface.

Dewatering will be required and the pump station design should take into account the effect of buoyancy. The buoyancy analysis should include determination of additional methods of restraint, such as increased bottom slab thickness or slab extension, if necessary.

EVALUATION AND RECOMMENDATIONS

General Site Development Considerations

We understand that about 25 feet of soil may be excavated to construct the wet well and influent pipes. Based on the findings of our test borings, our understanding of the proposed structures, and our geotechnical engineering evaluation, monolithically poured foundations can be used for the proposed construction. However, there are some issues that will need to be addressed during design and construction, especially with regards to the somewhat high groundwater table at this location.

The following sections further discuss specific geotechnical, foundation, design, and site grading concerns at the site.

Site Preparation

Prior to construction, the site should be stripped of any surface vegetation and any organic soil should be removed extending out at least 10 feet beyond the construction limits. Any areas requiring at grade structures or areas requiring fill should be proofrolled with a heavily loaded dump truck if accessible, to determine areas that may need additional removal of unsuitable bearing materials. In addition to stripping the site, the location of any existing underground utility lines within the construction area should be established. Provisions should then be made to relocate any interfering utility lines within the construction area to appropriate locations. In this regard, it should be noted that if abandoned underground pipes are not properly removed or plugged, they may serve as conduits for subsurface erosion which subsequently may result in excessive settlement. Any underground utility pipes not removed and being greater than 4 inches in diameter should be filled with "flowable" fill (lean concrete grout), while the ends of utility pipes less than 4 inches in diameter should be plugged with concrete to prevent the inadvertent introduction of fluids into the construction area. All utility lines that are removed outside of the excavation limits should be backfilled with acceptable fill material. Fill placement and subgrade preparation recommendations are presented in the Construction Considerations, Fill Placement and Subgrade Preparation Section of this report.

In addition, organic and clayey soils (if encountered) should be removed within 36 inches from the bottom of the wet well and replaced with properly compacted clean sands (SP/SP-SM).

Groundwater Considerations and Dewatering

The groundwater level encountered during drilling at the locations of the SPT and hand auger borings was 3.5 feet. We estimate the SHWT to be at 1 to 1.5 feet below the existing ground surface at the site. The contractor should determine the actual groundwater levels at the time of construction. The contract documents should indicate that dewatering design and implementation is the sole responsibility of the Contractor and should also contain the performance criteria for assessing the effectiveness of the dewatering system actually installed. Dewatering consisting of cutoff walls (temporary shoring), cased well points and/or vacuum well points or a combination thereof, should be designed and installed to lower the groundwater table to a depth of at least 3 or more feet below the bottom of the excavation. The dewatering should be maintained continuously (7 days per week/ 24 hours per day) throughout the construction period, until the backfill has reached the existing grade, and until sufficient structural weight is in place to resist uplift pressures due to the existing groundwater levels. Soil parameters to be used by others to design temporary shoring, if required, are included in **Table 1** in **Appendix A.**

In addition to the primary dewatering system, pumping of miscellaneous inflow of water should be performed from sumps excavated and placed outside and just below the elevation of the proposed foundation areas for the structures. Placement of compacted

No. 57 stone wrapped in geo/filter fabric in the bottom of the excavation, beneath a pre-cast or cast in place concrete slab, will act as a medium for rainwater and groundwater inflows which will be pumped out of the recommended sump areas.

We recommend the use of 18 inches of No. 57 Stone wrapped in geo/filter fabric be placed on the approved subgrade to support the structures foundation concrete. The No. 57 stone should be extended 3 feet beyond the perimeter of the foundation footprint. The gravel will provide a stable working platform, will help to preserve the subgrade and will be used to facilitate dewatering of the excavation.

Depending upon shallow groundwater levels and the effectiveness of dewatering at the time of construction, seepage may enter the excavated trenches from the bottom and sides. Such seepage will act to loosen soils and create difficult working conditions. Groundwater levels should be determined immediately prior to construction.

Excavation Considerations

Excavation will be required to construct the wet well, man hole and pipelines associated with the project. The dewatering system should be in place and functioning prior to any excavation taking place. Piezometers installed prior to excavation should be used to verify that the dewatering system is performing adequately.

The existing soils being excavated at this site generally consist of very loose to medium dense fine sands (SP/SP-SM/SP-SC). We do not anticipate that excavation of these materials will be a problem. Soil parameters to be used by others to design temporary shoring, if required, are included in **Table 1** in **Appendix A.**

We recommend that the bottom of the structures be overexcavated approximately 18 inches and 3 feet wider than the perimeter of the foundation and replaced with compacted No. 57 stone, wrapped in geo/filter fabric.

All structure excavations should be observed by the Geotechnical Engineer or his representative to explore the extent of any fill and excessively loose, soft, or otherwise undesirable materials. If the excavation appears suitable as load bearing materials, the soils should be prepared for construction by compaction to a dry density of at least 98% of the modified Proctor maximum dry density (ASTM D-1557) for a depth of at least 1 foot below the compacted No. 57 stone wrapped in geo/filter fabric, which will serve as a foundation base.

If soft pockets are encountered in the bottom of the structure excavations, the unsuitable materials should be removed and the proposed foundation elevation re-established by backfilling after the undesirable material has been removed. This backfilling may be done with a very lean concrete or with a well-compacted, suitable fill such as clean sand, gravel, or crushed #57 or #67 stone. Sand backfill should be compacted to a dry density of at least 98% of the modified Proctor maximum dry density (ASTM D-1557), as previously

described. Gravel, or crushed #57 or #67 stone, if used, should be compacted and the compaction confirmed by visual observation.

It is possible that the proposed construction will consist of both open sloped excavation and the installation of bracing and/or sheet walls. Our scope of services did not include analysis of slope stability or sheet piling; however, for soils of the type present at the site, we recommend that all excavations be sloped no steeper than 3H:1V. Please refer to the Federal Temporary Excavation Regulations reported below.

Federal Temporary Excavation Regulations

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

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

We are providing this information solely as a service to our client. **MC²** is not assuming responsibility for construction site safety or the contractor’s activities; such responsibility is not being implied and should not be inferred.

Uplift Resistance

The structures should be designed to resist the hydrostatic pressure and uplift of the anticipated maximum groundwater levels. Maximum groundwater levels should be the highest of the proposed seasonal high groundwater level or the 100 year flood level for this site. Uplift resistance can be created by both the dead weight of the structure as well as any backfill on any projecting parts of the base slab.

Uplift resistance from extension of the pump station slab should be calculated using a wedge from the outside upper edge of the base of the extended slab upward at a 30 degree angle to the ground surface. Below the water table, the backfills buoyant weight should be used. We estimate, based on other projects in this area, that the buoyant

weight of the fine sands is approximately 48 pcf.

Foundation Recommendations

In general, the soil beneath the proposed bottom of the structure (25 feet deep) consist of loose fine sands, slightly slity fine sand to slightly clayey fine sand (SP/SP-SM/SP-SC). We anticipate that the structures will impose less foundation pressure than the weight of the material being removed. Based on the anticipated construction, a **maximum net allowable bearing pressure of 2,000 psf** is available for support of the structures. Any structures or utilities founded within excavated areas placed on properly compacted structural fill should be designed for a net allowable bearing capacity of 2,000 psf.

We recommend that 18 inches of No. 57 stone wrapped in geo/filter fabric be placed on the approved subgrade to support the structures foundation concrete. The No. 57 stone should be extended 3 feet beyond the perimeter of the foundation footprint. The gravel will provide a stable working platform, will help to preserve the subgrade and will be used to facilitate dewatering of the excavation.

Earth Slope and Retaining Wall Recommendations

Formal analysis of slope stability was beyond the scope of work for this project. Based on the soil types encountered at the site, we recommend that temporary or permanent slopes not exceed 3(H) to 1(V) for this project. The crest or toe of slopes should be no closer than 10 feet to any structure foundation and no closer than 5 feet to the nearest edge of pavement.

Below grade walls must be designed to resist lateral earth pressures. The "at rest" earth pressure state should be used for soils supporting rigidly restrained walls such as those for the wet well structure. The soils at the site consisting of fine sands (SP/SP-SM/SP-SC) are suitable materials for use as backfill. The **Soil Parameters** included in **Table 1, Appendix A** should be used for the design of the wall**.**

On Site Soil Suitability and Structural Fill

Soil Types SP/SP-SM/SP-SC, which were encountered in the borings performed, can be categorized as relatively clean fine sands or slightly silty fine sands based on the Unified Soil Classification System (USCS). Typically, these materials are deemed suitable for reuse as fill. These soils can be used for grading purposes, site leveling, general engineered fill, structural fill and backfill against the structure wall. These soils can be used in other areas, provided the fill is free of organic materials, clays, debris or any other material deemed unsuitable for construction. These soil types will possess improved permeability or drainage characteristics as compared to the underlying soils with increased fines content. These fine sands should require minimal processing in order to properly place and compact. Moisture contents will probably require adjustment in order to affect maximum densification, depending upon specification requirements. It

is anticipated that the majority of these soil types will be excavated below the water table and can occur in a relatively saturated state, but should effectively drain within stockpiles. Soils not meeting these requirements will need to be evaluated by **MC²** during construction.

If off-site sources of fill are needed, they should consist of fine sand (SP/SP-SM/SP-SC) with less than 12% passing the No. 200 sieve, free of rubble, organics, clays, debris and other unsuitable material. The moisture content of fill soils at the time of placement and compaction should generally be within 2 percentage points of their optimum moisture content. All materials to be used for backfill or compacted fill should be evaluated. If necessary, the soils should be tested by **MC²** prior to placement to determine if they are suitable for the intended use. In general, based on the boring results, the majority of the on-site sandy materials to be excavated are suitable for use as structural fill, general subgrade fill, and backfill.

The fill material placed around the pump station structures is critical to support any upper piping. Proper compaction and control of the fill being placed will be required from the bottom of the excavation to the surface in order to properly support utility or other structures.

Fill material placed adjacent to the walls and beneath structures and piping should be placed in 6 to 8 inch loose lifts compacted using a static roller, if near existing structures. Within small excavations, such as, in utility trenches, around manholes, or within 5 feet of any of the structure walls, we recommend the use of smaller hand or remote-guided equipment. Placement of loose lift thickness of 4 inches is recommended when using such equipment. All structural fill should be compacted to a dry density of at least 98 percent of the modified Proctor maximum dry density (ASTM D-1557). A representative of **MC²** should perform field density tests on each lift as necessary to assure that adequate compaction is achieved.

Construction Considerations

GENERAL

It is recommended that **MC²** be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project to ensure that the recommendations contained herein are properly interpreted and implemented. If **MC²** is not retained to perform these functions, we cannot be responsible for the impact of those conditions on the performance of the project.

FILL PLACEMENT AND SUBGRADE PREPARATION

The following is our general recommendations for overall site preparation and mechanical densification work for the proposed project. Our recommendations are based on the anticipated construction, as wells as, our boring results. These recommendations should

be used as a guideline for the project general specifications by the Design Engineer.

1. The excavated subgrade (dewatered trench bottom) for the pipes and associated structures should be leveled, cut to grade, if necessary, and then compacted with a vibratory compactor. Careful observations should be made during compaction to help identify any areas of soft yielding soils that may require overexcavation and replacement. If unsuitable material, such as organic or clayey soils, is encountered at the bottom of the pipe or structure embedment depth, overexcavation of an additional 2 and 3 feet of the material is recommended for the pipe and structure, respectively. The excavation should then be backfilled to foundation grade with clean sands in controlled lifts not exceeding 6-inches and compacted to a density of at least 98 percent of the maximum density as determined by ASTM D-1557. Care should be used when operating the compactor to avoid transmission of vibrations to existing structures or other construction operations that could cause settlement damage or disturb occupants. Dewatering may also have an effect on adjacent structures. A preconstruction survey with video and/or photographs of adjacent residences/structures is recommended to check for existing cracking prior to construction and during construction. Vibration and groundwater levels monitoring are also recommended.

2. Prior to beginning compaction, soil moisture contents may need to be controlled in order to facilitate proper compaction. A moisture content within 2 percentage points of the optimum indicated by the modified Proctor test (ASTM D-1557) is recommended.

3. Following satisfactory completion of the initial compaction on the excavation bottom, the construction areas may be brought up to finished subgrade levels. Fill should consist of fine sand with less than 12% passing the No. 200 sieve, free of rubble, organics, clay, debris and other unsuitable material. Fill should be tested and approved prior to acquisition and/or placement. Approved sand fill should be placed in loose lifts not exceeding 6-inches in thickness and should be compacted to a minimum of 98% of the maximum modified Proctor dry density (ASTM D-1557). Density tests to confirm compaction should be performed in each fill lift before the next lift is placed.

4. It is recommended that a representative from our firm be retained to provide on-site observation of earthwork activities. The field technician would monitor the placement of approved fills and compaction and provide compaction testing. Density tests should be performed in subgrade sands after rolling and in each fill lift. It is

important that **MC²** be retained to observe that the subsurface conditions are as we have discussed herein, and that construction and fill placement is in accordance with our recommendations.

REPORT LIMITATIONS

The recommendations detailed herein are based on the available soil information obtained by **MC²** and information provided by **Kimley-Horn & Associates, Inc.** for the proposed project. If there are any revisions to the plans or if deviations from the subsurface conditions noted in this report are encountered during construction, **MC²** should be notified immediately to determine if changes in the foundations or other recommendations are required. In the event that **MC²** is not retained to perform these functions, **MC²** can't be responsible for the impact of those conditions on the performance of the project.

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

After the plans and specifications are more complete, the geotechnical engineer should be provided the opportunity to review the final design plans and specifications to assess that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of **Kimley-Horn & Associates, Inc.**

APPENDIX A

Boring Location Plan and Report of Core Borings - Sheet 1

Soil Parameters - Table 1

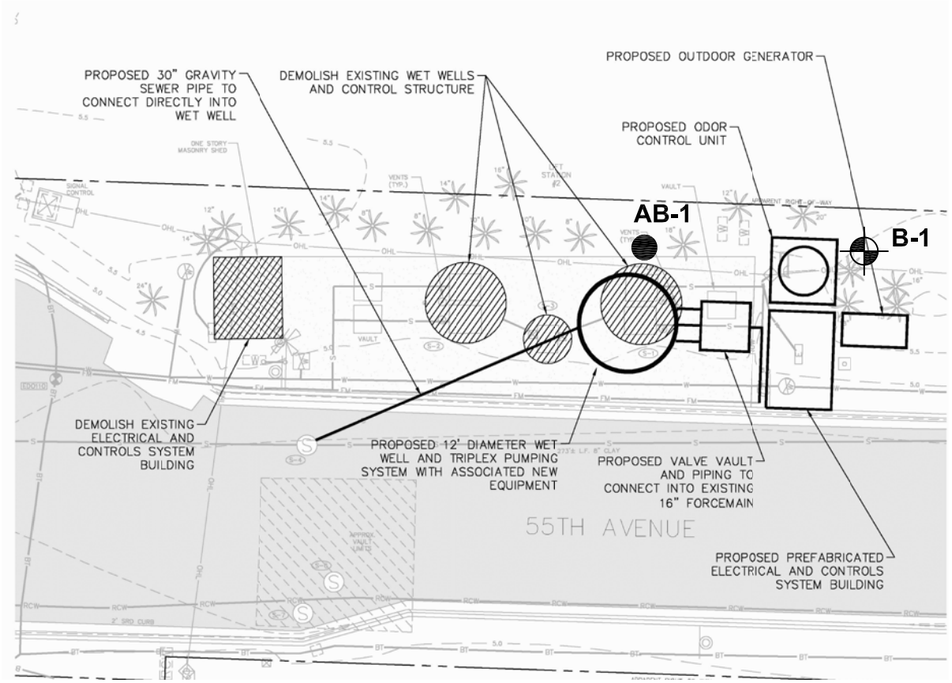
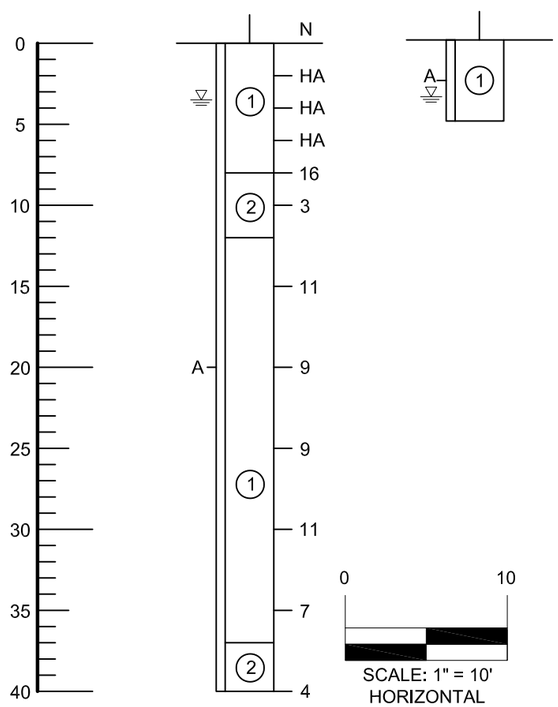


TABLE SOIL PARAMETERS										
BORING ID	ELEV. RANGE NGVD, FT	DEPTH RANGE, FT	SPT "N" VALUE RANGE	UNIFIED SOIL CLASSIFICATION	APPROXIMATE SOIL UNIT WEIGHT (PCF)		SOIL ANGLE OF FRICTION (DEGREES)	COHESION (PSF)	EARTH PRESSURE COEFFICIENT	
					SATURATED	SUBMERGED			ACTIVE (Ka)	PASSIVE (Kp)
B-1	–	0-6	HA	SP/SP-SM/SP-SC*	100.0	37.6	28	0	0.361	2.77
	–	6-8	16	SP/SP-SM/SP-SC*	110.0	47.6	30	0	0.333	3.00
	–	8-12	3	SM*	100.0	37.6	28	0	0.361	2.77
	–	12-37	7-11	SP/SP-SM/SP-SC*	105.0	42.6	29	0	0.347	2.88
	–	37-40	4	SM*	100.0	37.6	28	0	0.361	2.77

* with traces to some shell fragments

BORING NO. = B-1
DATE = 07/26/13

BORING NO. = AB-1
DATE = 07/26/13



LEGEND

(1) (SP/SP-SM/SP-SC) PALE BROWN OR GRAY FINE SAND, SLIGHTLY SILTY FINE SAND, TO SLIGHTLY CLAYEY FINE SAND.

(2) (SM) GRAY SILTY FINE SAND.

APPROXIMATE SPT BORING LOCATION.

APPROXIMATE HAND AUGER BORING LOCATION.

NOTES:

N SPT N-VALUE

WATER TABLE

A WITH TRACES TO SOME SHELL FRAGMENTS

GRANULAR MATERIALS- RELATIVE DENSITY	SPT (BLOWS/FT)
VERY LOOSE	LESS THAN 4
LOOSE	5-10
MEDIUM	11-30
DENSE	31-50
VERY DENSE	GREATER THAN 50

SILTS AND CLAYS CONSISTENCY	SPT (BLOWS/FT)
VERY SOFT	LESS THAN 2
SOFT	3-4
FIRM	5-8
STIFF	9-15
VERY STIFF	16-30
HARD	30-50
VERY HARD	GREATER THAN 50

DATE	NAME	REVISION	APPROVED BY:

MC SQUARED, INC.
Geotechnical Consultants
5808 Breckenridge Parkway, Suite-A
Tampa, Florida 33610
Ph:813-623-3399 Fax:813-623-6636
GEOTECHNICAL • ENVIRONMENTAL MATERIALS TESTING

FLORIDA ENGINEERING CERTIFICATE OF AUTHORIZATION No. 9191
Amanda S. Pereira, P.E.
FLORIDA LICENSE No. 67784

	NAME	DATE
DESIGNED BY:	AS	07/13
DRAWN BY:	AS	07/13
CHECKED BY:	KS	07/13
SUPERVISED BY:		

REPORT OF CORE BORINGS/BORING LOCATION PLAN	PROJECT NO.	SHEET NO.
City of St. Pete Beach Pump Station No. 2 City of St. Pete Beach, FL	T061317.148	1

Table 1
Summary of Soil Parameters
City of St. Pete Beach Pump Station No. 2
City of St. Pete Beach, Florida
MC Squared No. T061317.148

Boring No.	Depth range, ft	SPT "N" Value Range	Unified Soil Classification	Approximate Soil Unit Weight (pcf)		Soil Angle of Friction (degrees)	Cohesion (psf)	Earth Pressure Coefficient	
				Saturated	submerged			Active (K_a)	Passive (K_p)
B-1	0 – 6	HA	SP/SP-SM/SP-SC with traces to some shell fragments	100.0	37.6	28	0	0.361	2.77
	6 – 8	16	SP/SP-SM/SP-SC with traces to some shell fragments	110.0	47.6	30	0	0.333	3.00
	8 – 12	3	SM with traces to some shell frags	100.0	37.6	28	0	0.361	2.77
	12 – 37	7 – 11	SP/SP-SM/SP-SC with traces to some shell fragments	105.0	42.6	29	0	0.347	2.88
	37 – 40	4	SM with traces to some shell frags	100.0	37.6	28	0	0.361	2.77

APPENDIX B

Test Procedures

TEST PROCEDURES

The general field procedures employed by MC Squared, Inc. (**MC^2**) are summarized in the American Society for Testing and Materials (ASTM) Standard D420 which is entitled "Investigating and Sampling Soil and Rock". This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in-situ methods as well as borings.

Standard Drilling Techniques

To obtain subsurface samples, borings are drilled using one of several alternate techniques depending upon the subsurface conditions. Some of these techniques are:

In Soils:

a) Continuous hollow stem augers.
b) Rotary borings using roller cone bits or drag bits, and water or drilling mud to flush the hole.
c) "Hand" augers.

In Rock:

a) Core drilling with diamond-faced, double or triple tube core barrels.
b) Core boring with roller cone bits.

The drilling method used during this exploration is presented in the following paragraph.

<u>Hollow Stem Augering:</u> A hollow stem augers consists of a hollow steel tube with a continuous exterior spiral flange termed a flight. The auger is turned into the ground, returning the cuttings along the flights. The hollow center permits a variety of sampling and testing tools to be used without removing the auger.

<u>Core Drilling</u>: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound, continuous rock. Material which cannot be penetrated by auger or rotary soil-drilling methods at a reasonable rate is designated as “refusal material”. Core drilling procedures are required to penetrate and sample refusal materials.

Prior to coring, casing may be set in the drilled hole through the overburden soils, to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D-2113 using a diamond-studded bit fastened to the end of a hollow, double or triple tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovery is measured, and the core is placed, in sequence, in boxes for storage and transported to our laboratory.

Sampling and Testing in Boreholes

Several techniques are used to obtain samples and data in soils in the field; however the most common methods in this area are:

a) Standard Penetration Testing
b) Undisturbed Sampling
c) Dynamic Cone Penetrometer Testing
d) Water Level Readings

The procedures utilized for this project are presented below.

Standard Penetration Testing: At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2 inch diameter split tube sampler connected to an A or N-size rod. The sampler is first seated 6 inches to penetrate any loose cuttings, then driven an additional 12 inches with blows of a 140 pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, in blows per foot (bpf). The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split barrel sample are placed in jars, sealed and transported to our laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D1586. The depths and N-values of standard penetration tests are shown on the Boring Logs. Split barrel samples are suitable for visual observation and classification tests but are not sufficiently intact for quantitative laboratory testing.

Water Level Readings: Water level readings are normally taken in the borings and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water level at the time of our field exploration. In clayey soils, the rate of water seepage into the borings is low and it is generally not possible to establish the location of the hydrostatic water level through short-term water level readings. Also, fluctuation in the water level should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water levels reported on the Boring Logs are determined by field crews immediately after the drilling tools are removed, and several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the groundwater level that may have been disrupted by the drilling operation.

Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone.

BORING LOGS

The subsurface conditions encountered during drilling are reported on a field boring log prepared by the Driller. The log contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of groundwater. It also contains the driller's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the drilling is completed a geotechnical professional classifies the soil samples and prepares the final Boring Logs, which are the basis for our evaluations and recommendations.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our Boring Logs.

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary; grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties are presented in this report.

The following table presents criteria that is typically utilized in the classification and description of soil and rock samples for preparation of the Boring Logs.

Relative Density of Cohesionless Soils From Standard Penetration Test	
Very Loose	≤ 4 bpf
Loose	5 - 10 bpf
Medium Dense	11 - 30 bpf
Dense	31 - 50 bpf
Very Dense	> 50 bpf
(bpf = blows per foot, ASTM D 1586)	

Consistency of Cohesive Soils	
Very Soft	≤ 2 bpf
Soft	3 - 4 bpf
Firm	5 - 8 bpf
Stiff	9 - 15 bpf
Very Stiff	16 - 30 bpf
Hard	30 – 50 bpf
Very Hard	> 50 bpf

Relative Hardness of Rock	
Very Soft	Hard Rock disintegrates or easily compresses to touch; can be hard to very hard soil.
Soft	May be broken with fingers.
Moderately Soft	May be scratched with a nail, corners and edges may be broken with fingers.
Moderately Hard	Light blow of hammer required to break samples.
Hard	Hard blow of hammer required to break sample.

Particle Size Identification	
Boulders	Larger than 12"
Cobbles	3" - 12"
Gravel	
Coarse	3/4" - 3"
Fine	4.76mm - 3/4"
Sand	
Coarse	2.0 - 4.76 mm
Medium	0.42 - 2.00 mm
Fine	0.42 - 0.074 mm
Fines (Silt or Clay)	Smaller than 0.074 mm

Rock Continuity

$$\textbf{RECOVERY} = \frac{\text{Total Length of Core}}{\text{Length of Core Run}} \times 100\ \%$$

Description	Core Recovery %
Incompetent	Less than 40
Competent	40 - 70
Fairly Continuous	71 - 90
Continuous	91 - 100

Relative Quality of Rocks

$$\textbf{RQD} = \frac{\text{Total core, counting only pieces > 4" long}}{\text{Length of Core Run}} \times 100\ \%$$

Description	RQD %
Very Poor	0 - 25 %
Poor	25 - 50 %
Fair	50 - 75 %
Good	75 - 90 %
Excellent	90 - 100 %