GEOTECHNICAL ENGINEERING REPORT

Haskell WWTP – Tank Replacement
4100 Delta Drive
El Paso, Texas

PSI Project No. 06252257

PREPARED FOR:

El Paso Water Utilities -
Public Service Board
1154 Hawkins Boulevard
El Paso, Texas 79925

June 4, 2021

BY:

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El Paso Water Utilities – Public Service Board
1154 Hawkins Boulevard
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Attn: Ms. Rose Guevara

RE: GEOTECHNICAL ENGINEERING REPORT
HASKELL WWTP – TANK REPLACEMENT
4100 DELTA DRIVE
EL PASO, TEXAS
PSI Project No. 06252257

Dear Mr. Delgado:

Professional Service Industries, Inc. (PSI), an Intertek company, is pleased to submit this Geotechnical Engineering Report for the referenced project. This report includes the results from the field exploration and laboratory testing along with recommendations for use in preparation of the appropriate design and construction documents for this project.

PSI appreciates the opportunity to provide this Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. PSI also has great interest in providing materials testing and inspection services during the construction of this project and will be glad to meet with you to further discuss how we can be of assistance as the project advances.

If there are questions pertaining to this report, or if PSI may be of further service, please contact us at your convenience.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

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1 PROJECT INFORMATION

1.1 Project Authorization

Professional Service Industries, Inc. (PSI), an Intertek company, has completed a field exploration and geotechnical evaluation for the proposed Haskell WWTP – Tank Replacement to be installed within the wastewater treatment plant located at 4100 Delta Drive in El Paso, Texas. The services were authorized by Ms. Rose Guevara, Senior Purchasing Agent of El Paso Water Utilities-Public Service Board, by providing Task Order 3 under the Contract Agreement dated August 21,2020.

PSI's proposal contained a proposed scope of work, lump sum fee, and PSI's General Conditions.

1.2 Project Description

Based on information provided by the Client, a summary of our understanding of the proposed project is provided below in the following Project Description table.

Table 1.1: General Project Description

Project Items	Installation of a new 13.5' diameter tank with a 18,000-gallon capacity. The improvement will also include a new 4' CMU block wall.
Approx. Current Grade Change within Tank Pad Area	2 feet estimate (Google Earth Pro Data)
Approximate Grade Change within Project Site Area	2 feet estimate (Google Earth Pro Data)
Finished Floor Elevation	Assumed within 2 feet of existing grade
Requested Foundation Type	Shallow Foundation System and Slab on Grade
Design Maximum Loading (Assumed)	1,100 psf from tank

The geotechnical recommendations presented in this report are based on the available project information, structure locations, and the subsurface materials encountered during the field investigation. If the noted information or assumptions are incorrect, please inform PSI so that the recommendations presented in this report can be amended as necessary. PSI will not be responsible for the implementation of provided recommendations if not notified of changes in the project.

1.3 Purpose and Scope of Services

The purpose of this study is to evaluate the subsurface conditions at the site and develop geotechnical engineering recommendations and guidelines for use in preparing the design and other related construction documents for the proposed project. The scope of services included drilling soil borings, performing laboratory testing, and preparing this geotechnical engineering report.

This report briefly outlines the available project information, describes the site and subsurface conditions, and presents the following:

- subsurface soil conditions, including depth and consistency of soilstrata;
- groundwater levels as observed during field work, excluding quantitative determinations of flow or dewatering rates;

- recommendations for treatment and/or removal of unsuitable bearing soils, if encountered;
- recommendations for foundations suitable for the planned development including allowable soil bearing and uplift capacities and estimated movements;
- slab-on-grade construction;
- seismic site class in accordance with IBC 2015;
- suitability of on-site material for engineered structural fill;
- recommendations for engineered structural fill;
- utility bedding recommendations;
- temporary unsupported excavation recommendations; and
- lateral earth pressures.

The scope of services for this geotechnical exploration did not include an environmental, mold nor detailed seismic/fault 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. Statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The following table provides a generalized description of the existing site conditions based on visual observations during the field activities, as well as other available information.

TABLE 2.1: SITE DESCRIPTION

Site Location	4100 Delta Drive Latitude; Longitude: 31.76256, -106.44123
Site History	Existing Haskell WWTP
Existing Site Ground Cover	Gravel Surfacing
Existing Grade/Elevation Changes	2 feet estimate (Google Earth Pro Data)
Description of Adjacent Property	North: Delta Drive East: Laydown Yard South: Loop 375 West: WWTP Structures
Ground Surface Soil Support Capability	Dry, Firm Enough for Field Equipment

2.2 FIELD EXPLORATION

Field exploration for the project consisted of drilling a total of 1 soil test boring. The boring design element, boring label, approximate depth and drilling footage are provided in the following table.

TABLE 2.2: FIELD EXPLORATION SUMMARY

Design Element	Number of Borings	Boring Depth (ft)	Drilling Footage (feet)
Tank	1	16½	16½
TOTAL:	**1**	---	**16½**

The boring locations and depths were selected by the client and located in the field by PSI personnel using a recreational-grade GPS system. Elevations of the ground surface at the boring locations were not provided and should be surveyed by others prior to construction. The references to elevations of various subsurface strata are based on depths below existing grade at the time of drilling. The approximate boring locations are depicted on the Boring Location Plan provided in the Appendix.

TABLE 2.3: FIELD EXPLORATION DESCRIPTION

Drilling Equipment	CME-85 Truck Mounted Drilling Rig
Drilling Method	Hollow Stemmed Augers
Drilling Procedure	Applicable ASTM and PSI Safety Manual
Field Testing	Standard Penetration Test (ASTM D1586)
Sampling Procedure	Soils: ASTM D1587/1586
Sampling Frequency	At intervals of 2½-feet to a depth of 10 feet and at 5-foot intervals thereafter.
Frequency of Groundwater Level Measurements	During and after drilling
Boring Backfill Procedures	Soil Cuttings

During field activities, the encountered subsurface conditions were observed, logged, and visually classified (in general accordance with ASTM D2488/D2487). Field notes were maintained to summarize soil types and descriptions, water levels, changes in subsurface conditions, and drilling conditions.

2.3 LABORATORY TESTING PROGRAM

PSI supplemented the field exploration with a laboratory testing program to determine additional engineering characteristics of the subsurface soils encountered. The laboratory testing program included:

TABLE 2.4: LABORATORY TESTING PROGRAM

Laboratory Test	Procedure Specification
Visual Classification	ASTM D2487/D2488
Moisture Content	ASTM D2216
Atterberg Limits	ASTM D4318
Material Finer than No. 200 Sieve	ASTM D1140
Particle Size Analysis	ASTM D6913

The laboratory testing program was conducted in general accordance with applicable ASTM Test Methods. The results of the laboratory tests are provided on the Boring Logs in the Appendix. Portions of samples not altered or consumed by laboratory testing will be discarded 30 days from the date shown on this report.

2.4 SUBSURFACE CONDITIONS

The results of the field exploration and laboratory testing have been used to generalize a subsurface profile at the project site. The soils encountered generally consist of black loose to medium dense FILL, classified as Silty Sand (SM) in the upper 8 feet, underlain by medium dense Silty Sand (SM) to a depth of 15 feet. Below 15 feet, the soils encountered consist of medium dense Poorly Graded Sand with Silt (SP-SM) to boring termination. Debris was encountered in the upper 8 feet. Overall, the soils were brown, and dry to moist at the time of the field exploration.

The following subsurface descriptions provide a highlighted generalization of the major subsurface stratification features and material characteristics.

TABLE 2.5: GENERALIZED SOIL PROFILE

Stratum	Top (ft)	Bot. (ft)	Soil Type	LL (%)	PI	% Passing #200 Sieve	N (Range/ Avg)
1	0	8	Loose to medium dense black **FILL**, classified as Silty Sand (SM)	-	NP	21-23 (22)	4-19 (12)
2	8	15	Medium dense Silty Sand (SM)	-	NP	24	12-22 (17)
3	15	16½	Medium dense Poorly Graded Sand with Silt (SP-SM)	-	NP	7	12

Where: LL= Liquid limit (%)
PI = Plasticity Index
N = Standard Penetration Test blow count (blows/foot)
() = Average

The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. The boring logs include soil descriptions, stratifications, locations of the samples, and field and laboratory test data. The descriptions provided on the logs only represent the conditions at that actual boring location; the stratifications represent the approximate boundaries between subsurface materials. The actual transitions between strata may be more gradual and less distinct. Variations will occur and should be expected across the site.

2.4.1 GROUNDWATER INFORMATION

Groundwater was not encountered at the project site. Although groundwater was not encountered at this time, discontinuous zones of perched water could develop within the overburden materials at the contact with clay lenses or other impervious materials during climatically wet periods.

3 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

3.1 GEOTECHNICAL DISCUSSION

Based upon the information gathered from the soil borings and laboratory testing, the soils encountered at this site within the seasonally active zone have a low potential for expansion and are not considered a design concern for this project. However, the site has low blow count fill soils in the upper 4 feet and will require remediation. The structure can be placed on conventional spread footings with a soil supported floor slab.

The following design recommendations have been developed based on the previously described project characteristics and subsurface conditions encountered. If there are changes in the project criteria, PSI should be retained to determine if modifications in the recommendations will be required. The findings of such a review would be presented in a supplemental report. Once final design plans and specifications are available, a general review by PSI is recommended to observe that the conditions assumed in the project description are correct and to verify that the earthwork and foundation recommendations are properly interpreted and implemented within the construction documents.

3.2 FOUNDATION RECOMMENDATIONS DISCUSSION

We recommend that the native soils at the site be over-excavated as shown in Table 3.1 below. After the exposed subgrade is proof rolled, scarified, moisture conditioned and compacted, select fill should then be placed up to the bottom of the floor slab.

3.2.1 TANK PAD EARTHWORK RECOMMENDATIONS

Building pad improvement should consist of removing the upper soils to the recommended minimum over-excavation depth, compacting the exposed subgrade, and placement and compaction of the select fill to finish floor grade. This procedure is outlined in the following sections.

3.2.1.1 TANK PAD EARTHWORK RECOMMENDATIONS

The following illustrations and tables provide general requirements for the installation of a foundation pad that should provide a PVM magnitude of 1 inch or less using the *Undercut/Replace Method.*

TABLE 3.1: TANK PAD RECOMMENDATIONS FOR UNDERCUT AND SUBGRADE REQUIREMENTS

Application	Soil Supported Floor Slab, Spread Footings
Site Stripping Removal	The site in the tank area should be cleared and grubbed of the existing vegetation, roots, trash and other deleterious materials in the construction areas. All deleterious material should be removed and disposed of off the site.
Foundation Improvement Method	Remove and replace existing soils with engineered structural fill.
Over-excavation below tank footprint (the greater of)	Four (4) feet below the existing grade elevation at the time of the geotechnical investigation, or, four (4) feet below the bottom of the tank element
Over-excavation below foundation elements (the greater of)	Four (4) feet below the existing grade elevation at the time of the geotechnical investigation, or at least four (4) feet below the bottom of any foundation element.

Proof-rolling Requirements	After over-excavation and surface preparation, the site should be proof-rolled with a loaded tandem axle dump truck (20+ tons), water truck or equivalent. Soils which are observed to rut or deflect excessively (greater than 1 inch) under the moving load should be undercut and replaced with properly compacted select fill. The proof-rolling activities should be witnessed by a representative of the Geotechnical Engineer and should be performed during a period of dry weather.
Exposed Subgrade Treatment	Following proof-rolling, the exposed native soil surface should be scarified an additional eight (8) inches, brought uniformly to optimum moisture content and then compacted
Horizontal Undercut Extent	Below all tank areas and at least 3 feet beyond the tank perimeter and at least 3 feet beyond all sides of footing

TABLE 3.2: TANK PAD RECOMMENDATIONS – FILL REQUIREMENTS

Existing Soils Used as Structural Fill	To properly prepare the native soils to receive fill or support various project elements, over-excavated soil that can be used as engineered structural fill should be stockpiled on the site. The on-site material proposed for reuse as structural fill should be verified by the Geotechnical Engineer to meet structural fill requirements prior to placement.
Structural Fill Thickness	**4 feet minimum + as required to achieve bottom of tank slab elevation**
Engineered Structural Fill Material Requirements	Materials to be used for engineered structural fill should be free of organic or other deleterious materials and should have a maximum particle size less than three (3) inches. They should be classified in accordance with procedures stated in ASTM D2487. Soils will be considered satisfactory for engineered structural fill when classified as follows: GW, GP, GC, GM, GC-GM, GP-GM, GP-GC, SW, SP, SC, SM, SC-SM, SP-SM, SP-SC.
Materials Unsatisfactory for Use as Structural Fill	PT, OL, OH, MH, ML, CL, CH, or, any soil having a plasticity index exceeding 15.
Maximum Loose Lift Thickness	8 inches
Compaction Considerations	Compaction of the fill material should be performed with appropriate types of power, pneumatic or tamping equipment. Monitoring of the backfilling should include sufficient compaction testing by the Geotechnical Engineering representative to document that each lift of fill has been compacted to the required density prior to placement of subsequent lifts. Any lift or portion of a lift does not conform to the density requirements, should be thoroughly scarified and re-compacted until the required density is obtained. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Care should be taken to apply compactive effort throughout the extent of the fill including any fill slope areas.
Moisture Control	The soils at the site tend to be dry and could dry quickly as a result of low humidity, wind, and/or high temperatures. It is recommended that the moisture content of the prepared soils at the site be maintained throughout construction. Excessive drying (or wetting) can cause surface instability of the native soils.

3.2.2 COMPACTION AND TESTING RECOMMENDATIONS FOR TANK PAD AREAS

The following table outlines foundation pad compaction recommendations in consideration of appropriate vertical movement reduction method.

TABLE 3.3: COMPACTION RECOMMENDATIONS

Location	Material	Density Test Method	Percent Compaction	Optimum Moisture Content	Testing Frequency
Foundation Pad Areas	Subgrade	ASTM D 1557	≥ 95%	-2 to +2%	1 per 5,000 SF; min. 3 per lift
	Engineered Structural Fill – *Cohesionless Soils*	ASTM D 1557	≥ 95%	-2 to +2%	
	Engineered Structural Fill – *Cohesive Soils*	ASTM D 1557	≥ 95%	0 to +3%	

3.3 FOUNDATION DESIGN RECOMMENDATIONS

The following sections outline geotechnical design requirements for the recommended foundation options.

3.3.1 SPREAD FOOTING FOUNDATION RECOMMENDATIONS

As previously mentioned, the tank can be supported by isolated spread footings as shown in the illustration and described in the table below:

FIGURE 3.1: SPREAD FOOTING SYSTEMS

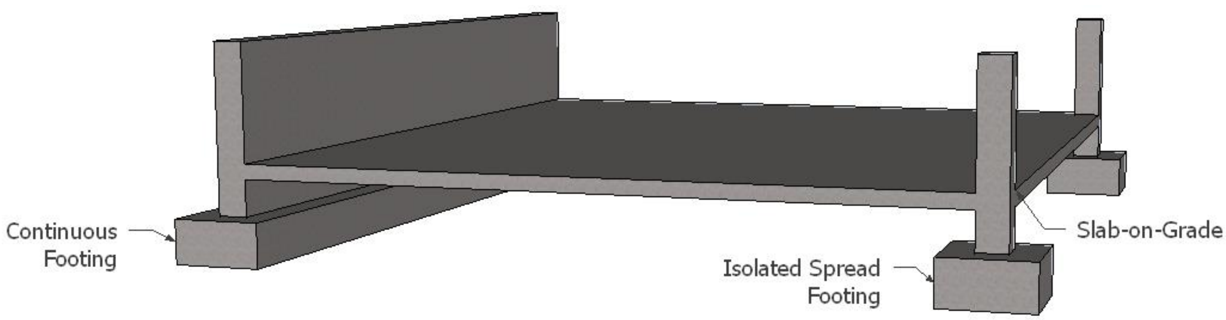


TABLE 3.4: SPREAD FOOTING DESIGN PARAMETERS

Depth of Footing	Minimum 1.5 feet below lowest adjacent finished grade
Allowable Bearing Pressure	Isolated Footing: 2,000 psf Continuous Footing: 2,000 psf
Factor of Safety	3.0
Post Construction Settlement	Less than 1 inch
Modulus of Subgrade Reaction (k_1)	200 pci
Sliding Resistance (ultimate)	Utilize a coefficient of friction of 0.30 between the base of the foundation element and underlying material
Passive Resistance (ultimate)	An equivalent fluid weighing 320 pcf may be used to resist lateral forces. Passive resistance within the upper two (2) feet of soil should be neglected if the footings are placed using form boards. If the footings are cast against competent natural soils or properly compacted fill soils and the soils above the footings are paved or consist of concrete floor slabs, the passive resistance within the upper two (2) feet can be considered. The passive resistance of any un-compacted fill material or loose natural soils should be neglected.
Uplift Resistance (ultimate)	Utilize the weight of the foundation concrete and the soil above it. The ultimate uplift resistance can be based on unit weights of 110 and 150 pcf for the soil above the footing and concrete, respectively. If there is a chance of submergence, the buoyant unit weights should be used.
Footing Exposed Subgrade Treatment	Free of soft/loose soil, wet materials, and debris. Geotechnical Engineer's representative should observe bearing surface prior to forming footings.
Minimum footing widths (ft)	Continuous Footing: 18" Isolated Footing: 24"
* Spread footings should bear on similar material for a given building	

3.4 IMPROVEMENT BELOW RINGWALL FOUNDATION ELEMENTS

As an option, the tank may be supported by a ringwall foundation system. Below the ringwall foundation elements and tank footprint, the existing soils should be over-excavated to a depth that is the greater of four (4) feet below existing grade at the time of the field investigation, or, four (4) feet below the bottom of foundation elements.

Once over-excavated, the exposed native soil surface should be brought uniformly to optimum moisture content then compacted, as described in Table 3.1. The excavation may then be brought to finished subgrade elevation with engineered fill meeting the requirements of and placed in accordance with the recommendations outlined in Table 3.2.

Once properly prepared, material meeting the requirements of structural fill described below may be placed to a point twelve (12) inches below bottom of tank elevation. Material to be used as structural fill within twelve (12) inches of finished subgrade elevation should be tested for sulfate and chloride content to evaluate corrosivity and concrete degradation susceptibility. Once it has been determined the soils are nonreactive, the fill material may be placed to finished subgrade elevation. All fill material placed below the tank should be treated placed and compacted as described in Table 3.2.

Ringwall backfill material should meet the requirements of structural fill materials outlined in Table 3.2. When backfilling the ringwall, it is recommended that the fill be placed at approximately equal elevations on the interior and exterior of the ringwall as the materials are brought to grade. Placing material in this manner will reduce differential lateral loads on the ringwall.

3.5 Floor Slab

The floor slabs can be grade supported provided the slab supporting soils have been treated as described previously (Tables 3.1 and 3.2).

We recommend that a minimum four-inch thick free draining granular cushion (in accordance with ACI 302.1R-15) be placed beneath the floor slab to promote uniform concrete curing, enhance drainage and provide a capillary break. If the floor coverings are considered moisture sensitive or if the floors will be used to store moisture-sensitive materials, the floor covering manufacturer should be consulted regarding the placement of a vapor retarder. If the vapor retarder is used, then a 4-inch thick granular cushion layer should be placed over the sheet to allow for more uniform concrete curing in the local dry environment. The granular cushion material should be moisture conditioned and compacted immediately prior to concrete placement. The granular cushion should be moist, but not saturated at the time of concrete placement.

The slab areas should be cured such that the upper concrete surface does not dry too quickly relative to the bottom of the slab. Rapid differential drying of materials can lead to slab curling and associated cracking. We recommend proper surface curing techniques be employed to reduce the risk of slab curling in the local dry climate. The floor slabs should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage. The floor slab should not be rigidly connected to columns, walls, or foundations. It is recommended that utility perforations through slabs be designed to allow for independent movement of slabs and utilities.

Floor slab design can consider the following modulus of subgrade reaction, k (pci) considering at least three (3) feet of the compacted material exists immediately under the floor.

Table 3.5: Recommended k Values

Floor Support Material	k, pci
Prepared Subgrade	200

3.6 Sidewalks and Flatwork

For sidewalks or other flatwork located adjacent to grade-supported foundations, the undercutting and select fill placement operations for the building should extend beyond the perimeter of the building and pavements to at least the width of the adjacent sidewalk or flatwork. Subgrade material below exterior flatwork, and other non-structural elements beyond the exterior walls of the buildings should be treated beginning with proof-rolling, scarification of a minimum of 8 inches, moisture treated and compacted to a minimum of 95%. Any other sidewalks or flatwork not adjacent to buildings should be placed on an improved subgrade meeting or exceeding the pavement subgrade improvement methods discussed in Table 4.4 of this report.

Proper drainage around grade-supported sidewalks and flatwork is also very important to reduce potential movements. Elevating the sidewalks where possible and providing rapid, positive drainage away from them will reduce moisture variations within the underlying soils and will therefore provide valuable benefit in reducing the full magnitude of potential movements from being realized.

3.7 Site Seismic Design Recommendations

We understand that the project is governed by the International Building Code (IBC), 2015 edition. As part of is code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the seismic event as well as the properties of the soils that underlie the site.

Part of the IBC code procedure to evaluate seismic forces requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. To define the Seismic Site Class for this project, we have interpreted the results of our soil test borings drilled within the project site and estimated appropriate soil properties below the bottom of the boring to a depth of 100 feet, as permitted by the code. The estimated soil properties were based on data available in published geologic reports as well as our experience with subsurface conditions in the general site area.

Based on our evaluation, our opinion that the subsurface conditions within the site are consistent with the characteristics of the **Specific Site Class D** as defined by the building code. The USGS-NEHRP probabilistic ground motion values (IBC-2015 option) for the subject site were obtained from the USGS geohazards web page (https://hazards.atcouncil.org/) as follows:

Table 3.6: Ground Motion Values

Period (sec)	Mapped MCE Spectral Response Acceleration** (g)		Site Coefficients		Adjusted MCE Spectral Response Acceleration (g)		Design Spectral Response Acceleration (g)	
0.2	S_s	0.364	F_a	1.509	S_{Ms}	0.549	S_{Ds}	0.366
1.0	S_1	0.111	F_v	2.355	S_{M1}	0.262	S_{D1}	0.175

2% Probability of Exceedance in 50 years for Latitude 31.76256° and Longitude -106.44123°
***At B-C interface (i.e. top of bedrock).*
MCE = Maximum Considered Earthquake

If a thorough evaluation of the Seismic Site Class is desired, PSI can conduct a Refraction Microtremor (ReMi) study of the site to evaluate the shear wave velocity profile to a depth of 100 feet below the surface. This study involves the placement of geophones on the ground surface and recording vibrations. Through integration of the data, the characteristic shear wave velocity of each below-grade stratum can be interpreted and used to determine the Site Class in accordance with the provisions of the International Building Code 2015.

3.8 Lateral Earth Pressure Information

Retaining walls will be required to resist lateral earth pressures. The actual earth pressure on the walls will vary according to the backfill material types used, how the backfill is compacted and the allowable movement at the top of the wall. The equivalent fluid pressures tabulated below (Table 3.7) provide recommended lateral earth pressures for design of these walls. Cohesive soils are not recommended for retaining wall backfill. This table assumes that positive foundation drainage and drainage behind the wall is provided to prevent buildup of hydrostatic pressure.

TABLE 3.7: LATERAL EARTH PRESSURE

LATERAL EARTH PRESSURE IN TERMS OF EQUIVALENT FLUID PRESSURES					
MATERIAL	ESTIMATED ϕ VALUE	AT REST		ACTIVE	
		ABOVE THE WATER TABLE	BELOW THE WATER TABLE	ABOVE THE WATER TABLE	BELOW THE WATER TABLE
In-situ or recompacted soils classified as clayey sand (SC), (cont. next page) silty clayey sand (SC-SM), and silty sand (SM) (Est. Wet Unit Weight 125 pcf)	28°	65 PCF	35 PCF*	45 PCF	25 PCF*
In-situ or recompacted soils classified as Silty to Clayey Gravel (GC, GC-GM)(Est. Wet Unit Weight 125 pcf)	31°	60 PCF	30 PCF*	40 PCF	20 PCF*
ASTM C33 Fine Aggregate (sub-angular concrete sand) (120 pcf)	34°	55 PCF	25 PCF*	35 PCF	15 PCF*
ASTM C33 Coarse Aggregate size 67 consisting of crushed angular limestone (135 pcf)	35°	60 PCF	30 PCF*	35 PCF	20 PCF*

*In addition to hydrostatic pressure of 62.4 pcf

The recommendations presented in the table above are for a drained and level backfill condition and the above the water table parameters assume that water will not be allowed to accumulate behind the wall using a drainage system(s) as well as the use of granular fill material. Drainage systems should be provided to collect/remove water and to reduce infiltration of surface water around the perimeter of the wall. The grades should be sloped away from the wall and drainage should be collected and discharged such that water is not permitted to accumulate behind the retaining wall. If provisions to prevent accumulation of water behind the walls are not provided, the walls should be designed to resist the hydrostatic head in addition to the buoyant lateral earth pressures.

PSI should be consulted during the design of the retaining walls to verify that the appropriate parameters are utilized. PSI should provide periodic observation during construction of the retaining walls to verify that the design parameters and the soil materials used during construction correspond. The values presented in Table 3.10 should be adjusted based on the results of laboratory Proctor maximum dry density and optimum moisture contents, determined at the time of construction, for the selected materials. The values presented in the table are ultimate and appropriate factors of safety should be applied in the retaining structure design process.

The coefficient of friction between mass concrete cast on the sandy soils for the below grade walls of 0.30 is recommended. Lateral loads transferred to shallow foundation elements from structural members can be resisted by the available passive earth pressure. The actual earth pressure resistance will vary according to material types and backfill materials used and how the backfill is compacted.

The values are valid for in-situ soils exhibiting medium dense or greater relative density or properly moisture conditioned and compacted engineered structural fill materials placed in accordance with the following recommendations. Again, appropriate factors of safety should be applied in the wall design process.

The backfill materials should be placed in maximum 8-inch thick loose layers and compacted to at least 95 percent of the maximum dry density as determined by the modified Proctor (ASTM D 1557). PSI recommends that backfill placed directly behind the walls be compacted with relatively light compactors. Heavy compactors and grading equipment should not be allowed to operate within three (3) feet of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures. Retaining walls should be properly braced during backfilling operations. We recommend that a representative of the geotechnical engineer be present to monitor foundation excavations and fill placement.

3.8.1 UTILITY BEDDING AND TRENCHES

The soils at the site are anticipated to fall into OSHA Type C soil. The excavations for the utility trenches should be constructed having sidewalls not exceeding slopes with horizontal to vertical ratios steeper than 1½(H):1(V). Other soil types may be encountered on the site requiring flatter slopes and OSHA guidelines should be followed by the excavation contractor. Applicable OSHA excavation standards are detailed in 29 CFR, Part 1926. Additional information concerning excavations are addressed in section 4.3 of this report. It is the contractor's responsibility to assure that personnel working in the area are adequately protected against sudden cave-in or sloughing by using steel trench boxes or other slope protection methods during construction.

The soils encountered typically classify as Class III and Class IV material, according to ASTM D 2321, Table 2 Soil Classes. Where Class I soils are required for bedding or haunching, imported materials may be required.

Utilities should be bedded on fine-grained granular material such as fine, Poorly Graded (uniform) sand (SP, SP-SM) or such as concrete fine aggregate, mortar sand or equivalent, in a fashion to avoid the development of any voids around pipe, cable or conduit. It is important that the utilities and buried conduits be properly bedded to reduce the possibility of stress cracking in the future or fracture during backfilling.

The conduit should be carefully bedded on fine-grained sandy materials in a trench that is pre-shaped by means of a template to fit the lower part of the conduit exterior width of at least 60% if the conduit breadth. It is recommended, however, that all bedding extend six (6) inches in all directions around the utility.

The minimum depth of the top of the utility should be (24) inches below grade. Bedding backfill material should be compacted within the range of 2 percentage points below to 2 percentage points above the optimum moisture content value (-2% to +2% of OMC) and each lift of fill should be compacted to a density which is not less than 95 percent of maximum dry density. Maximum dry density should be determined in accordance with ASTM D 1557.

4 CONSTRUCTION CONSIDERATIONS

Geotechnical Engineer Involvement at the Time of Construction – *It is recommended that the foundation pad recommendations presented in this report be confirmed immediately prior to construction by the Geotechnical Engineer of Record (GER).*

Having a Geotechnical Engineer retained to review the earthwork recommendations in the Contract Documents and be an active participant in team meetings near the time of construction can often result in project cost savings. Therefore, PSI recommends that an AASHTO accredited 3rd party laboratory with qualified professional engineers who specialize in geotechnical engineering be retained to provide observation and testing of construction activities involved in the foundations, earthwork, and related activities of this project. As the Geotechnical Engineer of Record, PSI's services can be retained as the 3rd party laboratory. PSI's participation would be advantageous to the project flow and value engineering during construction since we are most familiar with the existing soil conditions at the site.

The geotechnical engineer often does not have available all design information at the time of writing the original report since the report is done very early in the design process. The GER can be of great benefit immediately prior to construction since definitive information regarding the location of the building, surrounding flatwork, pavements, planned landscaping, and drainage features is available. The GER can then write supplement letters to the original geotechnical report based on this updated information often resulting in less risk and project cost savings.

PSI cannot accept responsibility for conditions which deviate from those described in this report, nor for the performance of the foundations or pavements if not engaged to also provide construction observation and materials testing for this project. The PSI geotechnical engineer of record must also be engaged by the Design Team, even if periodic on-call testing is contracted with PSI Construction Services.

4.1 INITIAL SITE PREPARATION CONSIDERATIONS

4.1.1 SUBGRADE PREPARATION FOR SITE WORK OUTSIDE TANK PAD

Grade adjustments outside of the foundation pad areas can be made using select or general fill materials. The clean excavated onsite soils may also be reused in areas not sensitive to movement.

TABLE 4.1: SUBGRADE PREPARATION FOR NON-STRUCTURAL - GENERAL FILL

Minimum Undercut Depth	8 inches or as needed to remove roots, organic and/or deleterious materials
Exposed Subgrade Treatment	Proof-roll subgrade with rubber tired 20-ton (loaded) construction equipment
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Type	Any clean material free of roots, debris and other deleterious material with a maximum particle size of 3 inches
Maximum General Fill Loose Lift Thickness	8 inches

TABLE 4.2: FILL COMPACTION RECOMMENDATIONS OUTSIDE OF BUILDING AND PAVEMENT AREAS

Location	Material	Test Method for Density Determination	Plasticity Index	Percent Compaction	Optimum Moisture Content	Testing Frequency
Outside of Structure / Pavement Areas	General Fill	ASTM D 1557	Cohesive	≥ 95%	0 to +3%	1 per 10,000 SF; min. 3 per lift
			Cohesionless	≥ 95%	-2 to +2%	

4.1.2 EXISTING SITE CONDITIONS – DEMOLITION AND REMEDIATION MEASURES

The following table outlines construction considerations in consideration of demolition of existing structures, demolition of existing paving, procedures for abandoning old utility lines and removing trees.

TABLE 4.3: CONSIDERATIONS FOR DEMOLITION AND REMEDIATION MEASURES

Existing Structures	
Foundations of former structures located below new structure	Impact of foundation of former structures should be evaluated on a case by case basis
Foundations for former structures located below new paving	Cut off at least 3 feet below finished paving grade
Existing Pavement	
Former paving located within footing of proposed structures	Remove concrete and/or HMAC surface course and base entirely or review impact on case by case basis
Former paving located within footprint of proposed new paving	Remove concrete and/or HMAC surface course and evaluate if base can be reused
Abandoned Utilities	
Utilities of former structures located within new foundation pad/footprint of proposed structure	Remove pipe, bedding and backfill and then replace with select fill placed using controlled compaction
Utilities of former structures located outside of foundation pad footprint	Abandon in place using a grout plug
Tree Removal	
Trees located within proposed building footprint; roadways, parking, and sidewalk areas; and 5 feet of building area	Remove root system for full vertical and lateral extent and extend removal for at least 3 feet beyond presence of root fragments and replace void with compacted general fill or flowable fill

4.2 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS

Soils are sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork, foundation, and construction activities during dry weather. A relatively all-weather compacted crushed limestone cap having a thickness of at least 6 inches should be provided as a working surface.

4.3 EXCAVATIONS

Excavations should be observed by a representative of PSI prior to continuing construction activities in those areas. PSI needs to assess the encountered materials and confirm that site conditions are consistent with those discussed in this report. This is especially important to identify the condition and acceptability of the exposed subgrades under foundations and other structures that are sensitive to movement. Soft or loose soil zones encountered at the bottom of the excavations should be removed to the level of competent soils as directed by the Geotechnical Engineer or their representative. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted select fill or lean concrete.

After opening, excavations should be observed, and concrete should be placed as quickly as possible to avoid exposure to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. Excavations left open for an extended period of time (greater than 24 hours) should be protected to reduce evaporation or entry of moisture.

It should be noted that excavation equipment capabilities and field conditions may vary. Geologic processes are erratic and large variations can occur in small vertical and/or lateral distances. Details regarding “means and methods” to accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor. The comments contained in this report are based on small diameter borehole observations. The performance of large excavations may differ as a result of the differences in excavation sizes.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. PSI understands that these regulations are being strictly enforced, and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

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

PSI is providing this information as a service to the client. PSI does not assume responsibility for construction site safety or the contractor's or other parties’ compliance with local, State, and Federal safety or other regulations. A trench safety plan was beyond the scope of our services for this project.

4.4 DRAINAGE CONSIDERATIONS

Water should not be allowed to collect in foundation excavations, on foundation surfaces, or on prepared subgrades within the construction area during or after construction. Proper drainage around grade supported sidewalks and flatwork is important to reduce potential movements. Excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Providing rapid, positive drainage away from the building reduces moisture variations within the underlying soils and will aid in reducing the magnitude of potential movements.

4.5 Recommended Minimum Sampling and testing Frequencies

It is recommended that PSI be retained to provide observation and testing of construction activities involved in the foundations, earthwork, and related activities of this project. PSI cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundations if not engaged to also provide construction observation and testing for this project. The following are recommended minimum sampling and testing frequencies. The following table outlines our recommended minimum sampling and testing frequencies.

Table 4.4: Recommended Minimum Sampling and Testing Frequencies

Earthwork	
Proctor Requirements	At least one (1) moisture-density (Proctor) test, Atterberg limits test and percent finer than #200 sieve test should be performed per soils type for subgrade, backfill, fill and base materials.
Building Area Density Testing Requirements	In building areas, at least one (1) density and moisture content test per 5,000 square feet of surface area should be performed on the subgrade soils for each compacted 6-inch thickness of fill. Testing of backfilled trenches should be at least one (1) density and moisture content test per 100 linear feet of trench per 8-inch compacted fill thickness.
Pavement Area Density Testing Requirements	In pavement areas, at least one (1) density and moisture content test per 10,000 square feet of surface area should be performed on the subgrade soils for each compacted 6-inch thickness of fill.
Utility Backfill Requirements	Testing of backfilled trenches should be at least one (1) density and moisture content test per 100 linear feet of trench per 8-inch compacted fill thickness.
Concrete	
Slump, Air Content and Temperature	1 per 30 cubic yards of concrete
Sets of cylinders	1 set of 4 concrete cylinders molded for each type of concrete per 100 cubic yards or fraction thereof placed in a day
Compressive Strength	Each set of cylinders should be tested for compressive strength with two (2) of the cylinders tested at seven (7) days and two (2) of the cylinders tested at 28 days.
Reinforcing Steel	Reinforcing steel should be checked for size and placement prior to concrete placement.

5 REPORT LIMITATIONS

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

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed. This report may not be copied without the expressed written permission of PSI.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that the engineering recommendations have been properly incorporated in the design documents. At this time, it may be necessary to submit supplementary recommendations. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

This report has been prepared for the exclusive use of El Paso Water Utilities – Public Service Board, for specific application to the Haskell WWTP – Tank Replacement project to be installed within the wastewater treatment plant located at 4100 Delta Drive in El Paso, Texas.

APPENDICES

intertek psi
5044 Doniphan Drive, Bldg. D
El Paso, TX 79932
(915)584-1317

Site Vicinity Map
PSI Project No.: 06252257

Haskell WWTP – Tank Replacement
4100 Delta Drive
El Paso, Texas

intertek psi

5044 Doniphan Drive, Bldg. D
El Paso, TX 79932
(915)584-1317

Boring Location Plan
PSI Project No.: 06252257

Haskell WWTP – Tank Replacement
4100 Delta Drive
El Paso, Texas

Boring Logs

BORING B1

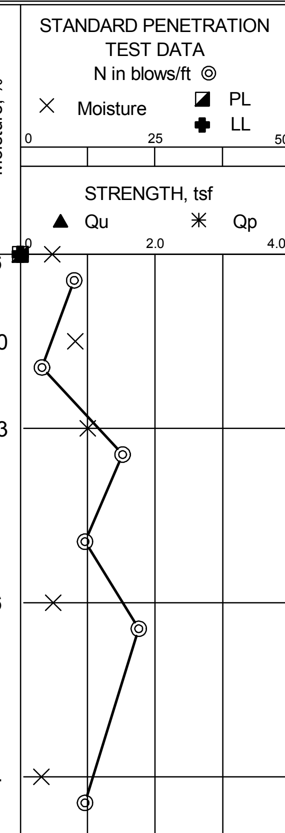
DATE STARTED:	5/21/21	**DRILL COMPANY:**	PSI, Inc.
DATE COMPLETED:	5/21/21	**DRILLER:** AR **LOGGED BY:**	RR/FQ
COMPLETION DEPTH	16.5 ft	**DRILL RIG:**	CME-85
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS
LATITUDE:	31.76256°	**HAMMER TYPE:**	Automatic
LONGITUDE:	-106.44122°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	Ruben Barrientos, Jr., PE

REMARKS: None

Water		
While Drilling	None	feet
Upon Completion	None	feet
Delay		N/A

BORING LOCATION:
See attached boring plan, Figure 2

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	Additional Remarks
	0			SS1	18	**FILL** - Silty Sand with Gravel, black, loose, moist	SM	9-6-4 N=10	6	Non-Plastic Fines=20.6%
				SS2	18	very loose, with ceramic tile pieces		1-2-2 N=4	10	Fines=22.8%
	5			SS3	18	medium dense, no ceramic tile		5-9-10 N=19	13	
				SS4	18	**SILTY SAND** - with Gravel, black to gray, medium dense, moist	SM	7-5-7 N=12		
	10			SS5	18	no Gravel, multicolored		10-10-12 N=22	6	Fines=23.5%
	15			SS6	18	**POORLY GRADED SAND** - with Silt, multicolored, medium dense, moist	SP-SM	4-5-7 N=12	4	Fines=7.4%
						Boring terminated at 16.5 feet				



Professional Service Industries, Inc.
5044 Doniphan Drive, Bldg D
El Paso, TX 79932
Telephone: (915) 584-1317

PROJECT NO.: 06252257
PROJECT: Haskell WWTP FOG
LOCATION: 4100 Delta Drive, El Paso, Texas

The stratification lines represent approximate boundaries. The transition may be gradual.

KEY TO TERMS AND SYMBOLS USED ON LOGS

ROCK CLASSIFICATION

RECOVERY

DESCRIPTION OF RECOVERY	% CORE RECOVERY
Incompetent	< 40
Competent	40 TO 70
Fairly Continuous	70 TO 90
Continuous	90 TO 100

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION OF ROCK QUALITY	RQD
Very Poor (VPo)	0 TO 25
Poor (Po)	25 TO 50
Fair (F)	50 TO 75
Good (Gd)	75 TO 90
Excellent (ExInt)	90 TO 100

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	N-VALUE (Blows/Foot)	SHEAR STRENGTH (tsf)	HAND PEN VALUE (tsf)
Very Soft	0 TO 2	0 TO 0.125	0 TO 0.25
Soft	2 TO 4	0.125 TO 0.25	0.25 TO 0.5
Firm	4 TO 8	0.25 TO 0.5	0.5 TO 1.0
Stiff	8 TO 15	0.5 TO 1.0	1.0 TO 2.0
Very Stiff	15 TO 30	1.0 TO 2.0	2.0 TO 4.0
Hard	>30	>2.0 OR 2.0+	>4.0 OR 4.0+

SOIL DENSITY OR CONSISTENCY

DENSITY (GRANULAR)	CONSISTENCY (COHESIVE)	THD (BLOWS/FT)	FIELD IDENTIFICATION
Very Loose (VLo)	Very Soft (VSo)	0 TO 8	Core (height twice diameter) sags under own weight
Loose (Lo)	Soft (So)	8 TO 20	Core can be pinched or imprinted easily with finger
Slightly Compact (SlCmpt)	Stiff (St)	20 TO 40	Core can be imprinted with considerable pressure
Compact (Cmpt)	Very Stiff (VSt)	40 TO 80	Core can only be imprinted slightly with fingers
Dense (De)	Hard (H)	80 TO 5"/100	Core cannot be imprinted with fingers but can be penetrated with pencil
Very Dense (VDe)	Very Hard (VH)	5"/100 to 0"/100	Core cannot be penetrated with pencil

DEGREE OF PLASTICITY OF COHESIVE SOILS

DEGREE OF PLASTICITY	PLASTICITY INDEX (PI)	SWELL POTENTIAL
None or Slight	0 to 4	None
Low	4 to 20	Low
Medium	20 to 30	Medium
High	30 to 40	High
Very High	>40	Very High

BEDROCK HARDNESS

MORHS' SCALE	CHARACTERISTICS	EXAMPLES	APPROXIMATE THD PEN TEST	
5.5 to 10	Rock will scratch knife	Sandstone, Chert, Schist, Granite, Gneiss, some Limestone	Very Hard (VH)	0" to 2"/100
3 to 5.5	Rock can be scratched with knife blade	Siltstone, Shale, Iron Deposits, most Limestone	Hard (H)	1" to 5"/100
1 to 3	Rock can be scratched with fingernail	Gypsum, Calcite, Evaporites, Chalk, some Shale	Soft (So)	4" to 6"/100

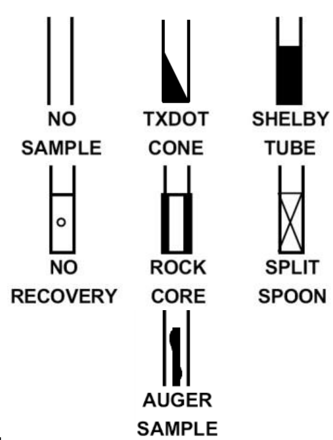
MOISTURE CONDITION OF COHESIVE SOILS

DESCRIPTION	CONDITION
Absence of moisture, dusty, dry to touch	DRY
Damp but no visible water	MOIST
Visible free water	WET

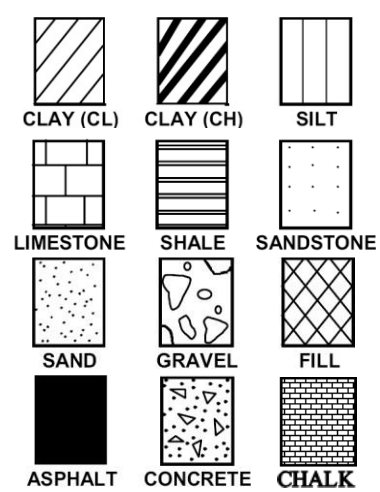
RELATIVE DENSITY FOR GRANULAR SOILS

APPARENT DESNITY	SPT (BLOWS/FT)	CALIFORNIA SAMPLER (BLOWS/FT)	MODIFIED CA. SMAPLER (BLOWS/FT)	RELATIVE DENSITY (%)
Very Loose	0 to 4	0 to 5	0 to 4	0 to 15
Loose	4 to 10	5 to 15	5 to 12	15 to 35
Medium Dense	10 to 30	15 to 40	12 to 35	35 to 65
Dense	30 to 50	40 to 70	35 to 60	65 to 85
Very Dense	>50	>70	>60	85 to 100

SAMPLER TYPES



SOIL TYPES



ABBREVIATIONS

PL – Plastic Limit
LL – Liquid Limit
WC – Percent Moisture

Q_P – Hand Penetrometer
Q_U – Unconfined Compression Test
UU – Unconsolidated Undrained Triaxial

Note: Plot Indicates Shear Strength as Obtained By Above Tests

∇ WATER SEEPAGE

▼ WATER LEVEL AT END OF DRILLING

CLASSIFICATION OF GRANULAR SOILS

U.S. STANDARD SIEVE SIZE(S)

	6"		3"		3/4"		4		10		40		200		
BOULDERS		COBBLES		GRAVEL COARSE		GRAVEL FINE		SAND COARSE		SAND MEDIUM		SAND FINE		SILT OR CLAY	CLAY
	152		76.2		19.1		4.76		2.0		0.42		0.074		0.002