TECHNICAL SPECIFICATIONS

SPECIAL PROVISION TO
TxDOT ITEM 340 – Dense-Graded Hot-Mix Asphalt (Method)

The following sections of the referenced TxDOT specification are hereby clarified and/or modified as follows and made part of the contract documents and included herein:

Article 340 2. – Materials

Add the following sentence to the end of the second paragraph, "The Engineer retains the right to waive sampling and testing provided reputable evidence is supplied regarding material sources and quality."

Article 340 2.4 – Asphalt Binder

Asphalt binder shall be PG 64-22.

Article 340 2.7 – Recycled Materials

Maximum total allowable RAP is 10%.
RAS is not allowed.

Article 340 4.3 – Mixture Design

A mix design may be waived in lieu of the use of an existing design that is current, and has been locally and historically proven to perform well in the area.

Article 340 4.9.5 – Irregularities

Contractor to use proper equipment, manpower and processes to maintain a straight outer edge to within 1-inch of alignment. Where alignment is outside the limit and not acceptable to Owner, saw cut edge to provide straight alignment and remove material and provide edge treatment at no separate payment.

ITEM 95- ASHPALT PAVEMENT REHABILITATION

95.01 - DESCRIPTION

The Technical Specifications applicable to this project are contained in standard specifications for construction of highways, street and bridges, adopted by the Texas Department of Transportation, 2014 edition. Copies of these specifications are available from the Texas Department of Transportation, 125 E. 11th Street, Austin, Texas 78701-2483 and may be inspected at the offices of Schaumburg & Polk, Inc., 8865 College Street, Beaumont, Texas 77707.

The following sections of Items contained in said Highway Specification are hereby identified, adopted and made part of the contract documents to the extent as if they were reproduced and included herein:

Item 110 Excavation
Item 132 Embankment
Item 134 Backfilling Pavement Edges
Item 204 Sprinkling
Item 210 Rolling
Item 216 Proof Rolling
Item 247 Flexible Base
Item 260 Lime Treatment (Road Mixed)
Item 275 Cement Treatment (Road Mixed)
Item 300 Asphalts, Oils and Emulsions
Item 340 Dense-Graded Hot-Mixed Asphalt
Item 360 Concrete Pavement
Item 440 Reinforcing Steel
Item 502 Barricades, Signs and Traffic Handling
Item 666 Pavement Markings
Item 678 Pavement Preparation for Markings

NOTE: The portion of specifications listed above do not include the sections dealing with measurement and payment. Payment for each bid item will be as shown in the Bid Proposal, with any measurement limits shown on the plans.

ITEM 97 - SUBSURFACE CONDITIONS

97.01 - DESCRIPTION

A soil investigation report has been prepared by Tolunay-Wong Engineers, Inc., hereinafter referred to as the Soil Engineer; a copy of the soil boring logs and test data is included in this document for the Contractor's convenience.

This report was obtained only for the Owner's use in design and is not a part of the Contract Documents; the report and log of borings are for Contractors' information but are not a warrant of subsurface conditions.

97.02 - ADDITIONAL INFORMATION

The Contractor should visit the site and acquaint himself with all existing conditions. Prior to bidding, bidders may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the Engineer.

ITEM 98 –ABANDONMENT OR REMOVAL OF OLD STRUCTURES

98.01 - DESCRIPTION

This item shall provide for the removal of and disposal of old structures, as noted on the plans, and shall include all excavation and backfilling necessary to complete the removal.

98.02 - METHOD OF REMOVAL

1. **Culverts or Sewers**. Pipe shall be removed by careful excavation of all dirt on top and the sides in such manner that the pipe will not be damaged. Those pipes which are deemed unsatisfactory for re-use by the Engineer may be removed in any manner the Contractor may select. Those pipes which are to be crushed in place shall be thoroughly crushed and may not be used as fill material within the eighteen (18") inches of the finished grade. Those pipes which are to be abandoned in place shall be sealed at both ends with concrete unless otherwise approved by the Engineer.

2. **Concrete or Brick Structures**. Concrete or brick structures (or portions of structures) shall be removed by chipping and/or sledging the structure into sizes not larger than one cubic foot.

3. **Steel Structures**. Steel structures (or steel portions of structures) shall be dismantled in sections as determined by the Engineer. The sections shall be of such weight and dimensions as will permit convenient handling, hauling, and storing. All necessary severing of connections between members, or between members and supports, shall be done in a manner which will not injure the members for reuse. Flame-cutting of members will be permitted only with the written permission of the Engineer.

4. **Timber Structures**. Timber structures or timber portions of structures shall be removed in such manner as to avoid damage to the timber. All bolts and nails shall be removed from lumber deemed salvageable by the Engineer.

   Unless otherwise specified on the plans, timber piles shall be either pulled or cut off at a point not less than two (2) feet below ground line, with the choice between these two methods resting with the Contractor.

98.03 - UNDERGROUND PORTIONS OF STRUCTURES

Portions of structures below the permanent ground line, which will not interfere in any manner with the proposed construction, may be left in place. These structures shall be removed at least two feet (2') below the permanent ground line and neatly squared off. Reinforcement shall be cut off close to the concrete.

When a sewer, lift station, or other structure is to be constructed on the site of a structure to be removed, removal shall extend at least two feet below and outside the proposed structure. If the old structure is located under a proposed road excavation, removal shall extend at least two feet below the proposed undercut. The excavation shall be backfilled according to the requirements of the new structure or roadway.

98.04 - BACKFILL

All excavation made in connection with this item and all openings below the natural ground line caused by the removal of old structures or portions thereof shall be backfilled to the level of the permanent ground line, unless otherwise provided on the plans.

That portion of the backfill which will support any portion of the roadbed or embankment shall be placed in layers of the same depth as those required by embankment. Material in each layer shall be wetted uniformly if required and shall be compacted to the density required in the adjoining embankment. In places inaccessible to blading and rolling equipment, mechanical or hand tamps or rammers shall be used to obtain the required compaction.

Backfill which will support any portion of a structure or an underground pipe shall be placed in layers and compacted to the same density as the surrounding undisturbed soil. Special backfill material may be required by the specifications for the structure.

That portion of the backfill which will not support any portion of the roadbed or embankment shall be placed as directed by the Engineer in such manner and to such state of compaction as will preclude objectionable amounts of settlement.

98.05 - SALVAGE

Any materials which are designated in the plans for salvage by the Owner, and which the Engineer deems as salvage for reuse, shall be carefully placed in neat piles. These piles shall be located on or near the construction site at convenient loading points which will not interfere with traffic or construction. All such materials shall be handled, transported, and stacked so as to avoid damage.

All materials not designated or acceptable for salvage shall become the property of the Contractor. The Contractor shall remove these materials from the construction site as soon as practical.

98.06 - PAYMENT

No separate payment will be made for this item.

ITEM 104 - FINE GRADING AND SEEDING

104.01 - DESCRIPTION

This item shall provide for furnishing sod and planting seed of the kind that exist along and across the areas disturbed during installation of the proposed work. These areas shall be seeded and/or have sod placed to establish pre-construction conditions. This item also includes preparation of the ground (including fine grading) and all required fertilizer, sod, or seeding.

The Contractor shall broadcast seed (of like kind) or place sod (of like kind) as directed by the Owner/Engineer.

104.02 - FINISH GRADING

Finish grading shall include all filling and the moving of all earth necessary to bring the disturbed area to its original condition or better. Grading shall be such as to assure positive drainage away from structures and to promote uniformity with existing drainage patterns.

Grading shall be done with selected materials as directed by the Engineer and the top soil of the finished graded area shall be good selected earth suitable for promoting the growth of vegetation.

Prior to final completion of the work, the Contractor shall refill and dress any areas which may have settled or washed away.

104.03 - SEEDING MATERIALS

All seed used must meet the requirements of the Texas Seed Law including the labeling requirements for showing purity, germination, name, and type of seed. Seed furnished shall be of the previous season's crop and the date of analysis shown on each tag shall be within 9 months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Engineer.

The specified seed shall be equal to or exceed the quality of the existing vegetation prior to construction.

104.04 - SOD

All sod used must meet or exceed the quality of the existing sod prior to construction.

104.05 - CONSTRUCTION METHODS

A. General. After the designated areas have been completed to the lines, and grades required under the project, seeding or sodding shall be performed as hereinafter described.

All areas to be seeded shall be cultivated to a depth of at least 4 inches. The seed-bed shall be cultivated sufficiently to reduce the soil to a state of good tilth. The seed-bed shall be deemed in a state of good tilth when the soil particles on the surface are small enough and lie closely enough together to prevent the seed from being covered too deep for optimum germination. Cultivation of seed-bed will not be required in loose sand where depth of sand is four inches or more.

All areas to be sodded shall be cultivated to a depth of at least 4 inches. The sod-bed shall be cultivated sufficiently to reduce the soil to a state of good tilth in order to stimulate root growth.

B. Watering. Water shall be used to moisten the seed-bed or sod-bed as required to promote growth.

C. Finishing. The ground surface that existed prior to construction shall be maintained throughout the process of cultivation, and any necessary shaping shall be done prior to any planting of seed or placing sod.

D. **Planting Seed.** The seed mixture specified shall be planted at the rate required and the application shall be made uniformly. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. Seed and fertilizer may be distributed at the same time provided the specified uniform rate of application for both is obtained. When seed and fertilizer are to be distributed as water slurry, the mixture shall be applied to the area to be seeded within 30 minutes after all components are placed in the equipment.

E. **Covering Seed.** The seed shall be covered according to the seeding method selected, as described below.

104.05 – PAYMENT

No separate payment for work performed under this item. Include cost of same in contract price bid for work of which this is a component part.

ITEM 110 - EXISTING UTILITIES

110.01 - DESCRIPTION

In general, the Contractor shall be responsible for locating and protecting all utility lines during the construction and for support and maintenance in position of all ducts and conduits, except for those specifically shown to be relocated or removed by others. Contractor shall be responsible for any damage to existing utilities and shall promptly repair same, or make arrangements for such repair with the Owner of the utility involved.

110.02 - CONSTRUCTION METHOD

In all cases the Contractor shall co-ordinate his work with the Owners of the various utilities and shall notify their proper representative not less than forty-eight (48) hours in advance of any work which might damage, interfere with or require adjustments to utilities along or adjacent to the work.

All utility adjustment other than those shown on the plans to be done by the Contractor, shall be the responsibility of the Owners of the utilities and if in the opinion of the Engineer adjustment is required, the Contractor will be responsible for notifying the respective owner.

110.03 - PAYMENT

Payment for this item will be subsidiary to other items.

ITEM 130 - STORM WATER PROLLUTION PREVENTION

130.01 - DESCRIPTION

This item describes the installation and implementation of Storm Water Pollution Prevention (erosion and sedimentation) control devices and procedures which shall be utilized during construction. This item shall cover the use of filter fabric fences, reinforced filter fabric barriers, inlet protection barriers, the prevention of tracking and street pollution, and other measures to prevent pollution of the surrounding environment.

130.02 - GENERAL

No clearing and grubbing or rough cutting, other than as specifically directed by the Owner to allow soil testing and surveying, shall be permitted until erosion and sedimentation control systems are in place. For excavation in roadside ditches or other areas prone to experiencing conditions of concentrated flow, the reinforced fabric barriers shall be used.

130.03 - INSPECTION AND REPAIR

Inspect and repair or replace components of all erosion and sedimentation control systems as for each type of system. Maintain the erosion and sedimentation control systems until, in the opinion of the Engineer, the disturbed area has been stabilized. Remove erosion and sedimentation control systems promptly when directed by the Engineer. Discard removed materials offsite.

Pollution prevention devices shall be inspected within 24 hours after each rainfall of 0.5 inches or more; daily during periods of prolonged rainfall; and minimally, at least once a week. Repair or replacement should be made immediately. Sediment deposits should be removed after each storm event and before deposits reach one-third the height of the fence.

130.04 - WASTE COLLECTION AND DISPOSAL

Remove and dispose of the sediment deposits at the site designated by the Owner. If no site is designated by the Owner, the disposal will be the responsibility of the Contractor. In such case, disposal shall be off-site and not in or adjacent to a stream or in the floodplain. Sediment to be placed along the project site should be spread, compacted, and stabilized in accordance with Item 104 (Fine Grading and Seeding) of these specifications. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local regulations.

130.05 - EQUIPMENT MAINTENANCE AND REPAIR

Maintenance and repair of construction machinery and equipment shall be confined to an area approved by the Engineer. This area shall be kept clean and arranged so as to prevent oils, gasoline, grease, solvents, and any other potential pollutants from being washed directly into receiving streams or storm water conveyance systems. These areas shall be provided with adequate waste disposal receptacles by the Contractor at no additional cost to the Owner.

130.06 - WASTE COLLECTION AND DISPOSAL

A plan shall be formulated by the Contractor for the collection and disposal of waste materials on a construction site. Such a plan should designate locations for trash and waste receptacles and establish a special collection schedule. Methods for ultimate disposal of waste should be specified and carried out in accordance with applicable local, state, and federal health and safety regulations. Special provisions should be made for the collection and disposal of liquid wastes and toxic or hazardous materials. Waste should not be allowed to overflow its container or accumulate for excessively long periods of time. Trash collection points should be located where they will least likely be affected by concentrated storm water runoff.

130.07 - WASHING AREAS

Vehicles such as cement or dump trucks and other construction equipment should not be washed at locations where the runoff will flow directly into a watercourse or storm water conveyance system. Washing of vehicles and equipment should be done in an area where the wash water will spread out and evaporate or seep directly into the ground, or where the runoff can be collected in a temporary holding or seepage basin.

130.08 - STORAGE OF MATERIALS AND HAZARDOUS SUBSTANCES

Sites where oil, gasoline, grease, chemicals, cements, solvents, or other potential water pollutants are to be stored should be isolated in areas where they will not cause runoff pollution.

Toxic and/or hazardous chemicals and materials should be stored in accordance with the manufacturer's guidelines and applicable local, state, and federal regulations. Groundwater resources should be protected from leaching where toxic and/or hazardous liquids are to be opened or stored.

Spills of toxic and/or hazardous substances are to be cleaned and treated according to local, state, and federal regulations.

130.09 - FILTER FABRIC BARRIERS

A. General. This item describes the installation of reinforced filter fabric barriers in order to control storm water pollution and sedimentation due to excavations in minor ditches, and areas with concentrated storm water runoff.

B. Materials.

1. Filter Fabric:

   The Contractor shall provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material. Geotextile fabric shall have a grab strength of 100 psi in any principal direction (ASTM D-4632) and mullen burst strength exceeding 200 psi (ASTM D-3786). Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life at a temperature range of 0ºF to 120ºF.

2. Wire Support Fencing:

   The support fencing shall consist of galvanized wire fencing with a minimum of 14 gauge and a maximum mesh spacing of six (6) inches.

3. Support Posts:

   The support posts shall consist of four (4) inch diameter wooden posts or approved equivalent.

C. Installation. Reinforced filter fabric barrier systems shall be installed in such a manner that surface runoff will percolate through the system and allow sediment to be retained and accumulated. The fencing shall be placed downstream of the excavated area. The length of the fencing shall be controlled by the depths of the ditch. The ends of the fencing shall be extended upwards until the top of the bottom section of the fencing is lower than the bottom of the turned up sections or in the case of a shallow swale, the ground levels off the fencing is extended five (5) feet from where the swale levels off.

The full height of the filter fabric barrier shall be supported by 4 foot long, 3 inch diameter wooden posts or steel posts and a wire fence 42 inches in height. The posts shall be driven at least 18 inches into the ground. The maximum spacing of the posts shall be 6 feet. The wire mesh shall be stapled using at least one (1) inch heavy duty staples to the upslope

side of the posts. The filter fabric shall be attached to the wire mesh with wire tires. The filter fabric fencing shall be 24 inches in height above natural ground.

The filter fabric shall be anchored by spreading the fabric in a 6 inch by 6 inch trench on the upslope side of the fence as shown in enclosed drawings. The wire mesh shall extend at least two (2) inches into the trench. The trench shall be backfilled and compacted.

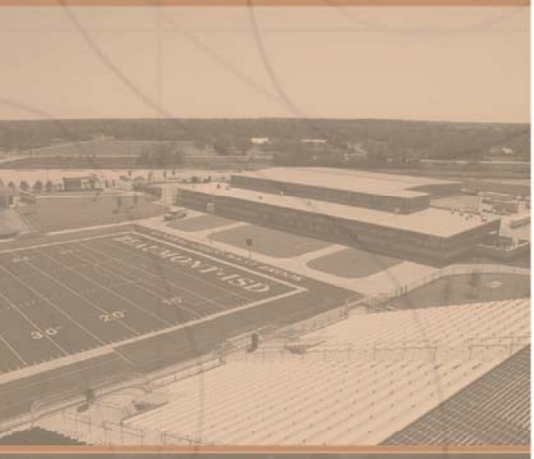
The filter fabric should be provided in continuous rolls and cut to the length of the silt fence to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum six (6) inch overlap, and sealed around inlets, the posts shall be located at all corners of the inlet at 90º angles to each other. The distance from the edge of the inlet to the filter barrier shall be at least 24 inches.

130.10 - TRACKING PREVENTION

Sediment stuck to vehicle tires, axles, and other under carriage components shall be removed from the vehicles before they exit the project area. This shall be done in accordance with Item 130.07 of this specification. Any sediment reaching a public or private road should be removed by street cleaning (**not flushing**).

130.11 - PAYMENT

Payment shall be as shown in the Bid Proposal.



Tolunay-Wong Engineers, Inc.

REPORT OF GEOTECHNICAL SERVICES
PROPOSED PAVEMENT IMPROVEMENTS
SIX MILE BOAT LAUNCH
TOLEDO BEND RESERVOIR
SABINE RIVER AUTHORITY
SABINE COUNTY, TEXAS

Prepared for:

Schaumburg & Polk, Inc.
8865 College Street, Suite 100
Beaumont, Texas 77707

Prepared by:

Tolunay-Wong Engineers, Inc.
2455 West Cardinal Drive, Suite A
Beaumont, Texas 77705

May 11, 2020

TWE Project No. 20.23.012 / Report No. 113909 (Revision 1)

Tolunay-Wong Engineers, Inc.

2455 West Cardinal Drive, Suite A • Beaumont, Texas 77705 • Phone: (409) 840-4214 • Fax: (409) 840-4259

May 11, 2020

Schaumburg & Polk, Inc.
8865 College Street, Suite 100
Beaumont, Texas 77707

Attn: Mr. Mark Mann, P.E.
mmann@spi-eng.com

Ref: Report of Geotechnical Services
Proposed Pavement Improvements
Six Mile Boat Launch
Toledo Bend Reservoir
Sabine River Authority
Sabine County, Texas
TWE Project No. 20.23.012 / Report No. 113909 (Revision 1)

Dear Mr. Mann,

Tolunay-Wong Engineers, Inc. (TWE) is pleased to submit this revised report of our geotechnical services performed for the referenced project. This revised report contains a project overview, our scope of services provided and our geotechnical recommendations for the referenced project.

Project Overview

The project includes pavement improvements at the Six Mile Boat Launch at Toledo Bend Reservoir for Sabine River Authority in Sabine County, Texas. The project consists of repaving an existing asphalt parking area and the addition of a new pavement section to the east of similar size. Both flexible and rigid pavement sections are being considered for the pavement improvements. The eastern area could require areal fill on the order of 3-ft to 4-ft thick. The project site is shown on the aerial image provided by the Client attached to this final report.

Scope of Services

The purpose of our geotechnical services was to investigate the existing pavement sections within the project site and to provide geotechnical recommendations to assist the Client in the design and construction of the proposed pavement improvements. Our scope of services included a field program, laboratory testing and engineering analysis/report preparation.

Field Program

Test Borings

TWE conducted an exploration of existing pavement sections and subsurface soil conditions within the project site by performing five (5) test borings to depths of 6-ft below existing grade. The test boring locations are presented on TWE Drawing No. 20.23.012-1 in Appendix A of this report. Our field personnel coordinated the field activities, drilled, sampled and logged the boreholes.

Drilling Methods

Field operations were performed in general accordance with the Standard Practice for Soil Investigation and Sampling by Auger Borings (ASTM D1452). The test borings were cored (if applicable) and drilled using conventional highland buggy-mounted drilling equipment. The boreholes were advanced using dry-auger drilling methods. Subgrade samples were obtained continuously to the completion depths from cuttings from the flight auger, thin-walled tubes and/or split spoon samplers.

Soil Sampling

Fine-grained, cohesive subgrade samples were recovered from the test borings by hydraulically pushing 3-in diameter thin-walled tubes a distance of about 24-in. The field sampling procedures were conducted in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587). Our Geotechnician visually classified the recovered soils and obtained field strength measurements of the recovered soils using a pocket penetrometer or hand torvane. The samples were extruded in the field, wrapped in foil, placed in moisture-sealed plastic bags and protected from disturbance prior to transport to the laboratory. The recovered soil sample depths and field strength measurements are shown on the boring logs in Appendix B.

Cohesive soils thought to be coarse-grained were collected with the Standard Penetration Test (SPT) sampler driven 18-in by blows from a 140-lb hammer falling 30-in in accordance with the Standard Test Method for Standard Penetration Test (SPT) and Spilt-Barrel Sampling of Soils (ASTM D1586). The number of blows required to advance the sampler three (3) consecutive 6-in depths are recorded for each corresponding sample on the boring logs. The N-value, in blows per foot, is obtained from SPTs by adding the last two (2) blow count numbers. The consistency of cohesive soils can be inferred from the N-value. The samples obtained from the split-barrel sampler were visually classified, placed in moisture-sealed plastic bags and transported to our laboratory. SPT sampling intervals and blow counts are presented on the project boring logs in Appendix B.

Boring Logs

Our interpretations of general pavement and subgrade conditions at the test boring locations are included on the boring logs in Appendix B. Our interpretations of the soil types throughout the boring depths and the locations of strata changes were based on visual classifications during field sampling and laboratory testing in accordance with the Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) (ASTM D2487) and the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM D2488). The boring logs include the type and interval depth for each sample along with their corresponding field strength values. A key to terms and symbols used on boring logs is also presented in Appendix B.

Laboratory Testing

Laboratory tests were performed in general accordance with ASTM International standards. The types and brief descriptions of the laboratory tests performed are presented in Table 1 below.

Table 1: Laboratory Testing Program	
Test Description	**Test Method**
Sieve Analysis (Particle Size Distribution)	ASTM D422
Amount of Material in Soils Finer than No. 200 Sieve	ASTM D1140
Water (Moisture) Content of Soil	ASTM D2216
Liquid Limit, Plastic Limit and Plasticity Index of Soils	ASTM D4318
Density (Unit Weight) of Soil Specimens	ASTM D7263

Standard laboratory test results are presented on the test boring logs included in Appendix B. Sieve analysis reports are provided in Appendix C for selected samples.

Surface and Subsurface Conditions

Our interpretations of surface and subsurface conditions within the project site are based on information obtained at the project boring locations shown on TWE Drawing No. 20.23.012-1 in Appendix A. Visual condition surveys and other pavement condition assessments were outside of our scope of services. However, we obtained photographic documentation (Figure 1 through Figure 8 below and on the following pages) of the site conditions as well as the cores gathered while drilling.

Figure 1: Current paved area

Figure 2: Undeveloped area being cleared.

Figure 3: Existing Conditions (Current Paved Boat Ramp Area)

Figure 4: Sample Core from Existing Section

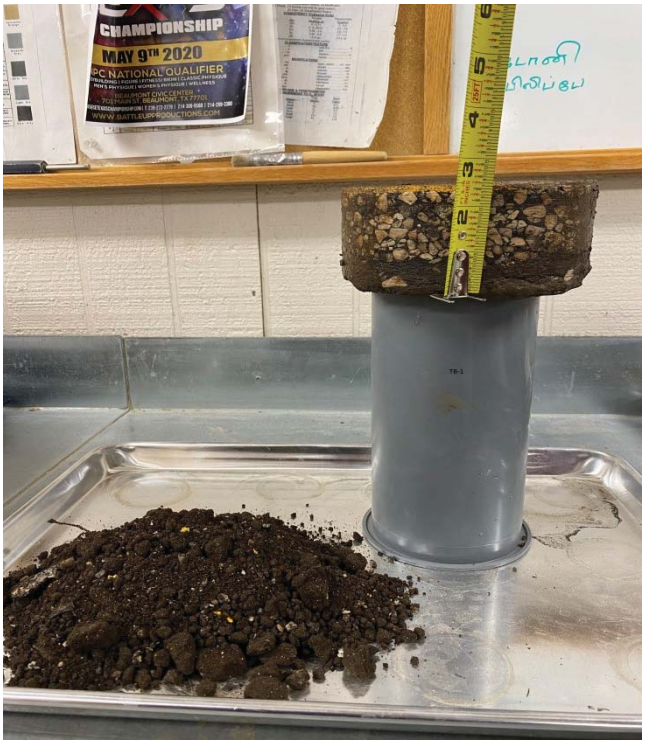


Figure 5: TB-1 Core from existing section.

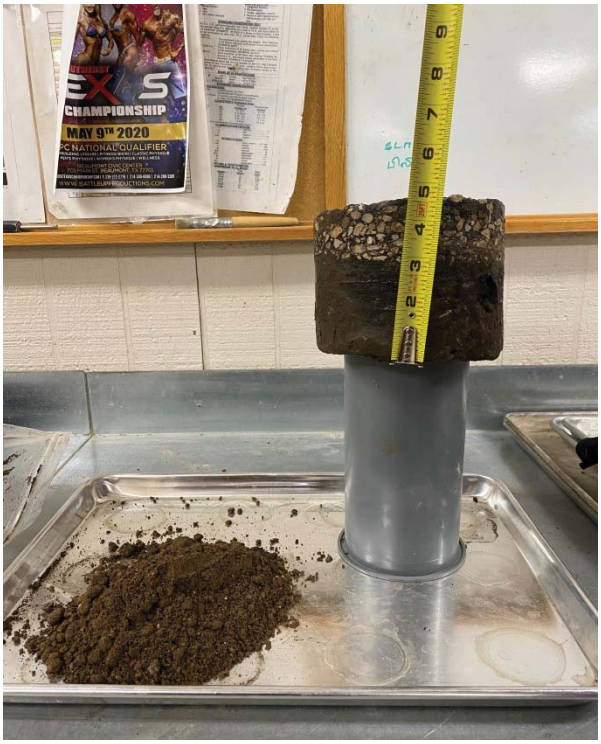


Figure 6: TB-2 Core from existing section.

Figure 7: Current surface condition within existing section.

Figure 8: Current surface condition within existing section.

Detailed descriptions of the existing pavement sections and subgrade conditions are provided on the logs in Appendix B of this report. Below is a brief synopsis of the generalized conditions encountered at each boring location:

- **Existing Section (Current Paved Boat Ramp Area)**
  - TB-1
    - 1.5-in of Asphaltic Concrete
    - 2.5-in of Emulsified Sand/Gravel Base
    - Firm to Stiff Sandy Clay
  - TB-2
    - 1.5-in of Asphaltic Concrete
    - 3-in of Emulsified Sand/Gravel Base
    - Stiff to Very Stiff Sandy Clay/Clay with Sand
- **New Section (Undeveloped Area)**
  - TB-3
    - Firm to Stiff Sandy Clay
  - TB-4
    - Soft to Stiff Clay/Clay with Sand/Sandy Clay
  - TB-5
    - Firm to Stiff Clay with Sand/Loose Clayey Sand

Pavement Design Recommendations

Pavement Design

We understand both flexible and rigid pavement systems are being considered for the pavement improvements at the Six Mile Boat Launch at Toledo Bend Reservoir. We understand final grade within the existing paved boat ramp area will be raised approximately 4-in above existing top of asphalt elevation. Final grade within the new undeveloped area will be raised 3-ft to 4-ft from existing grade using structural select or general fill prior to pavement installation.

Traffic Volume and Loading

Based on information provided, the Six Mile Boat Launch at Toledo Bend Reservoir is primarily used by light trucks and cars with no regular heavy vehicle traffic. Since specific traffic counts, vehicle classifications and design service periods were not indicated at the time of this final report, we referenced Chapter 4 "Low Volume Road Design" of Part II of the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures (1993). From the previous reference, Table 4.7 provides a Flexible Pavement Design Catalog for Low-Volume Roads and Table 4.9(b) provides a Rigid Pavement Design Catalog for Low-Volume Roads along with various design parameter considerations provided below.

Pavement Design Parameters

Using Tables 4.1 through 4.3 and 4.7 of the reference indicated above, we considered the following pavement design parameters in our evaluation for determining suitable flexible pavement sections for this project.

Table 2: Flexible Pavement Design Parameters

Description	Parameter
U.S. Climatic Region	II
Relative Quality of Roadbed Soil	Fair
Effective Roadbed Soil Resilient Modulus (M_R)	4,500-psi (CBR = 3)
Traffic Level	Low (50,000 to 300,000 18-kip ESALs)
Inherent Reliability	75%
Recommended Range of Structural Number (SN)	2.2 – 2.8

U.S. Climatic Region II assumes 7.0-mo of Spring/Fall seasons with wet roadbed soil and 3.5-mo of Summer season with dry roadbed soil. The suggested M_R values for a "fair" relative quality of roadbed soil and each season type were 4,500-psi and 6,500-psi for Spring/Fall and Summer, respectively. However, a design M_R value of 4,500-psi was used which relates to a California Bearing Ratio (CBR) value of about 3.0 for the subgrade conditions encountered in the test borings.

Using Tables 4.9(b) of the reference indicated above, we considered the following pavement design parameters in our evaluation for determining suitable rigid pavement sections for this project.

Table 3: Rigid Pavement Design Parameters	
Description	**Parameter**
Inherent Reliability	75%
Granular Subbase	No/Yes
Edge Support	No
Concrete Flexural Strength (S'_c)	600-psi
Relative Quality of Roadbed Soil	Fair
Traffic Level	Low (50,000 to 300,000 18-kip ESALs)

Suggested Pavement Section Options

In Tables 4 through Table 7 below on the following pages, our suggested flexible and rigid pavement sections are provided. For flexible pavement, sections are provided which meet or exceed the recommended SN range indicated in Table 2 previously.

Table 4: Proposed Flexible Pavement Sections – Existing Section (Current Paved Area)					
Flexible Pavement Section Option	**Pavement Layer**	**Material Description**	**Layer Thickness (in)**	**Layer Structural Coefficient**	**Layer Structural Number**
Option 1	Surface	Hot Mix Asphaltic Concrete	2	0.44	0.88
	Subbase	Cement-Treated Site Materials*	9	0.15	1.35
	Subgrade	Existing Site Soils	-	-	-
	Option 1 Structural Number				**2.23**
Option 2	Surface	Hot Mix Asphaltic Concrete	2	0.44	0.88
	Base	Crushed Aggregate	4	0.14	0.56
	Subbase	Cement-Treated Site Materials*	6	0.15	0.90
	Subgrade	Existing Site Soils	-	-	-
	Option 2 Structural Number				**2.34**
Option 3	Surface	Hot Mix Asphaltic Concrete	2	0.44	0.88
	Base	Crushed Aggregate	8	0.14	1.12
	Subbase	Lime-Treated Site Soils	8	0.11	0.88
	Subgrade	Existing Site Soils	-	-	-
	Option 3 Structural Number				**2.88**

**2" New Crushed Aggregate / 1.5" Existing HMAC / 2.5" Existing Emulsified Sand/Gravel Base/Existing Subgrade*

Table 5: Proposed Rigid Pavement Sections – Existing Section (Current Paved Area)			
Rigid Pavement Section Option	**Pavement Layer**	**Material Description**	**Layer Thickness (in)**
Option 1	Surface	Reinforced Concrete	6
	Subbase	Pulverized/Compacted Site Soils*	6
	Subgrade	Existing Site Soils	-
Option 2	Surface	Reinforced Concrete	6
	Base	Crushed Aggregate	4
	Subgrade	Existing Site Soils	-

**Existing HMAC / Existing Emulsified Sand*

Table 6: Proposed Flexible Pavement Sections – New Section (Undeveloped Area)					
Flexible Pavement Section Option	**Pavement Layer**	**Material Description**	**Layer Thickness (in)**	**Layer Structural Coefficient**	**Layer Structural Number**
Option 1	Surface	Hot Mix Asphaltic Concrete	2	0.44	0.88
	Base	Crushed Aggregate	6	0.14	0.84
	Subbase	Lime-Treated General Fill	6	0.11	0.66
	Subgrade	General Fill/Existing Site Soils	-	-	-
	Option 1 Structural Number				**2.38**
Option 2	Surface	Hot Mix Asphaltic Concrete	2	0.44	0.88
	Base	Crushed Aggregate	8	0.14	1.12
	Subbase	Structural Select Fill	12	0.05	0.60
	Subgrade	General Fill/Existing Site Soils	-	-	-
	Option 2 Structural Number				**2.60**
Option 3	Surface	Hot Mix Asphaltic Concrete	2	0.44	0.88
	Base	Crushed Aggregate	8	0.14	1.12
	Subbase	Lime-Treated General Fill	8	0.11	0.88
	Subgrade	General Fill/Existing Site Soils	-	-	-
	Option 3 Structural Number				**2.88**

Table 7: Proposed Rigid Pavement Sections – New Section (Undeveloped Area)			
Rigid Pavement Section Option	**Pavement Layer**	**Material Description**	**Layer Thickness (in)**
Option 1	Surface	Reinforced Concrete	6
	Base	Crushed Aggregate	4
	Subgrade	Structural Select Fill	-
Option 2	Surface	Reinforced Concrete	6
	Subbase	Lime-Treated General Fill	8
	Subgrade	General Fill	-

Flexible Pavement Section Materials

Hot-Mix Asphaltic Concrete Surface Course

HMAC should be a plant-mixed, hot-laid, dense-graded mixture of aggregate and asphalt binder having a fine surface meeting the requirements of TxDOT 2014 Standard Specifications Item 341 and specific criteria for the job mix formula. The HMAC mix should be compacted uniformly to contain between 3% to 8% in-place air voids (92% to 97% of the maximum theoretical density) as measured by ASTM D2041. Pneumatic-tired rollers should be used to seal the surface unless excessive pickup of fines occurs.

On the first day of production, rolling patterns should be established which produce the desired in-place air voids. All compaction operations should be completed before the pavement temperature drops below 160°F unless otherwise directed by the project specifications. The compacted pavement should be allowed to cool to 160°F or lower before opening to traffic. After final compaction, field density tests should be performed at locations representative of the entire pavement area.

Reinforced Concrete

Concrete should be designed to exhibit a flexural strength [three (3) point loading] of at least 600-psi at twenty-eight (28) days. Flexural strength (M_r) can be approximated by the following formula from ACI 330R: $M_r=2.3(f_c^{2/3})$ where f_c is the compressive strength of the concrete. The actual relationship between flexural and compressive strength for the proposed mix should be evaluated in the laboratory. In general, 600-psi flexural strength can be typically achieved with a concrete mix designed for a minimum twenty-eight (28) day compressive strength of 4,000-psi.

Crushed Aggregate Flexible Base Course

Flexible base course material should be composed of crushed limestone meeting the requirements of TxDOT 2014 Standard Specifications Item 247, Type A, Grade 1-2. Base material should be compacted in maximum 6-in compacted lifts to a minimum of 95% of the maximum density as determined by ASTM D1557 and moisture-conditioned to within -2% to +3% of optimum moisture content. After final compaction, field density tests should be performed at locations representative of the entire pavement area.

Cement-Treated Subbase Course

Cement-treated reclaimed site soils (existing asphalt, aggregate and subgrade materials) should be road-mixed in accordance with TxDOT Item 275 "Cement Treatment (Road-Mixed)". Hydraulic cement should be in accordance with TxDOT DMS-4600 "Hydraulic Cement". We anticipate 6% cement by dry weight of material will be sufficient to develop the proposed subbase course and to achieve a design 7-day compressive strength of 150-psi. It should be noted that laboratory strength treatability studies were not performed for this project nor were included in our scope of services.

The existing site material should be pulverized or scarified so that 100% passes a 2.5-in sieve. If the material cannot be uniformly processed to the required depth in a single pass, excavate and windrow the material to expose a secondary grade to achieve processing to plan depth. Cement should be uniformly applied using dry or slurry placement techniques to the percentage recommended herein. Cement should only be applied on an area where mixing, compacting and finishing can be completed during the same working day. Vertical joints should be constructed between new cement-treated base which has been in-place 4-hrs or longer by cutting back the face to approximately vertical.

The pulverized site material and cement should be thoroughly mixed until a homogenous mixture is obtained. The treated materials should be sprinkled with water during the mixing operation, to maintain optimum mixing moisture. The completed mixture should be spread and shaped in a uniform layer and compacted in lifts (maximum 8-in loose measure) within 2-hr after the application of water to the mixture of material and cement. Moisture content of the treated material should be adjusted so that it is within 2% of optimum during compaction as determined by ASTM D1557. The mixture should be compacted to at least 95% of the maximum dry density as determined by ASTM D1557. In-place density tests should be performed per lift in accordance with ASTM D6938 at locations representative of the cement-treated areas.

Once the cement-treated reclaimed material is compacted and finished, the moisture content of the finished cement-treated base should be maintained for a period of 24-hrs to 48-hrs. During this time, but no sooner than 24-hr, the finished course should be rolled with a vibratory roller to induce microcracking. Microcracking is effective in delaying the occurrence and deterioration of reflective cracking through the new asphaltic concrete surface.

The roller should travel at a speed of 2-mph, vibrating at maximum amplitude, and make two (2) to four (4) passes with 100% coverage. When a section is microcracked, the section should be cured an additional 2-days after microcracking. The moisture content during curing should be maintained at no lower than 2% below optimum. Curing should be continued until placing surface course material.

Lime-Stabilized Clay Subbase (Existing Site Soils or New General Fill)

Lime stabilization of clay subgrade soils is recommended for the proposed pavement improvement areas. Proper preparation and lime stabilization of the pavement subgrade soils will improve long-term pavement performance.

Assuming lime-stabilized subbase soils will be road-mixed on-site, we recommend the exposed subgrade surface, at final subgrade elevation, be scarified and pulverized to the depths indicated in Tables 3 and 4 and uniformly-mixed with hydrated lime in conformance with TxDOT 2014 Standard Specification Item 260 "Lime Treatment (Road-Mixed)". We estimate 8% hydrated lime by dry unit weight of soil will be required. The actual quantity of lime required and optimum moisture content of the stabilized material should be determined after the site is stripped and subgrade soils are exposed by use of a laboratory soil treatability study.

Dry hydrated lime or hydrated lime slurry used during chemical stabilization should meet the requirements of TxDOT Department Material Specification (DMS) 6350 "Lime and Lime Slurry." Before applying lime in dry form, the prepared subgrade should be moisture-conditioned to approximately 2% above optimum moisture content. When necessary, sprinkling should be performed in accordance with TxDOT Standard Specification Item 204, "Sprinkling." If the slurry placement method will be used, slurry should be free of objectionable materials and of uniform consistency during application. Slurry should be distributed uniformly by making successive passes over the prepared section of roadway until the specified lime content is reached.

Thorough initial mixing of the subgrade material and lime should be performed within 6-hr of application of lime using appropriate equipment. It is imperative that the moisture content of the material being treated is above the optimum moisture content to ensure adequate chemical reaction of the lime and subgrade materials. The treated mixture should be allowed to mellow for 1 to 4-days with sprinkling performed during both the mixing and mellowing operations to achieve adequate hydration and continuously moist conditions.

After mellowing, final mixing should be performed until a homogeneous, friable mixture is obtained prior to compaction. The lime-stabilized subbase materials should then be compacted (maximum 8-in loose measure lifts) to a minimum 95% of the maximum dry density as determined by ASTM D698 to within 1% below and 2% above optimum moisture content. A minimum of one (1) in-place density test should be performed per lift every 500-ft^2 in accordance with ASTM D6938 at locations representative of the lime-stabilized subbase areas. A minimum curing time of 5-days is recommended unless proofrolling indicates adequate curing has been achieved.

Lime stabilization should extend at least 1-ft beyond the roadway edge to reduce effects of seasonal shrinking and swelling. Routine sampling and laboratory classification testing (moisture content and Atterberg limits) should be performed to verify the resulting plasticity indices (PI) of the stabilized materials is at/or below 25 or that maximum PI reduction has been achieved. Mechanical lime stabilization of the roadway subbase will not prevent normal seasonal movement of the underlying untreated clay subgrade materials. Therefore, good perimeter surface drainage with a minimum 2% slope away from the roadway is recommended.

Select Structural Fill

If considered, select structural fill for the project should consist of a clean sandy lean clay (CL) or lean clay with sand (CL) material having a liquid limit (LL) less than 40 and a plasticity index (PI) between 10 and 20. Select fill should be placed in thin lifts, moisture-conditioned to within ±3% of optimum moisture content and compacted to a minimum 95% of the maximum dry density as determined by ASTM D698.

Granular soils such as sands and clean gravels are not recommended for use as select fill due to the potential to trap water or create paths for moisture to penetrate into the high plasticity subgrade soils. Excess moisture could result in softening of the pavement bearing soils causing a loss of support and possible heaving from soil swelling.

General Fill

General fill should be free of organics, deleterious or otherwise unsuitable materials and should consist of lean clay (CL) or fat clays (CH)) having a maximum particle size of 3-in or less. Sands, silts or silty soils classifying as (SP, SW, SW-SC, SP-SC, SM, SP-SM, SC-SM or SW-SM) should not be used as general fill material for this project. General fill should be placed in thin lifts, not exceeding 8-in loose measure, moisture-conditioned between -2% and +3% of optimum moisture content and compacted to a minimum 95% of the maximum dry density as determined by ASTM D698 (standard Proctor).

General fill can be used for raising site grade within the new pavement area. When general fill is used beneath pavements, we recommend the general fill be lime-stabilized to the depths specified in Table 4 or covered with a minimum of 12-in layer of select structural fill to mitigate potential shrink/swell movements.

Pavement Maintenance and Drainage

Maintaining flexible pavement systems to prevent infiltration of water into the pavement section is essential. Water and increases in moisture content within pavement structures have long been recognized as a primary cause of distress. Allowing water to enter the pavement section will result in high maintenance costs and premature pavement failure.

Periodic maintenance should be performed to seal any surface cracks using commonly available and accepted sealant materials. Appropriate longitudinal and transverse slopes can serve to propagate water off the roadway to minimize ponding. We recommend positive drainage be established away from the pavement system so that perched or ponded water does not collect on or near the pavement section.

Limitations

This report has been prepared for the exclusive use of Schaumburg & Polk, Inc. and their project team for specific application to the pavement improvements at the Six Mile Boat Launch at Toledo Bend Reservoir for Sabine River Authority in Sabine County, Texas. This report has been prepared in accordance with generally-accepted geotechnical engineering practices common to the local area. No other warranty, express or implied, is made.

The information contained in this report is based on the data obtained from the referenced subsurface explorations within the project site. TWE is not responsible for any claims, damages or liability associated with interpretation or reuse of the information contained in this report without the expressed written authorization of TWE.

Closing

We appreciate the opportunity to provide our services for this project. If you have any questions regarding this report or if we can be of further assistance, please contact us.

Sincerely,

TOLUNAY-WONG ENGINEERS, INC.
TBPELS Firm Registration No. 124

Berenice Villalpando
Staff Professional
Beaumont, Texas

Tyler G. Henneke, P.E.
Branch Manager
Beaumont, Texas

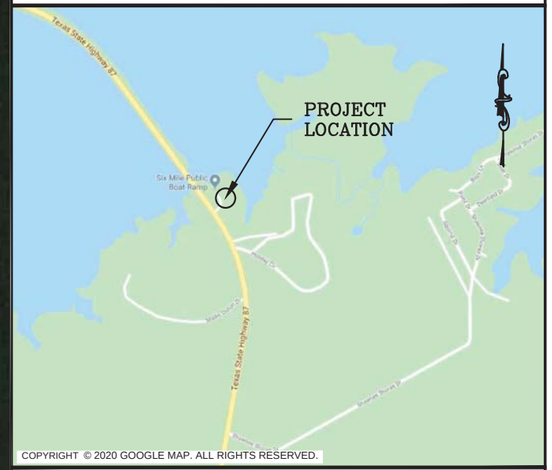
BV/TGH/bv

Appendices: A) Boring Location Plan
B) Test Boring Logs
C) Sieve Analysis Reports

APPENDIX A

BORING LOCATION PLAN

VICINITY MAP



TEST BORING COORDINATES

BORING	DEPTH	LATITUDE	LONGITUDE
TB–1	6’	31° 14’ 19.10” N	93° 45’ 20.89” W
TB–2	6’	31° 14’ 17.99” N	93° 45’ 20.23” W
TB–3	6’	31° 14’ 20.21” N	93° 45’ 19.75” W
TB–4	6’	31° 14’ 19.35” N	93° 45’ 18.99” W
TB–5	6’	31° 14’ 18.52” N	93° 45’ 18.25” W

LEGEND

SYMBOL	DESCRIPTION
⊕	TEST BORING LOCATION

Tolunay-Wong Engineers, Inc.

TEST BORING LOCATION PLAN
PROPOSED PAVEMENT IMPROVEMENTS
SIX MILE BOAT LAUNCH
TOLEDO BEND RESERVOIR
SABINE RIVER AUTHORITY
SABINE COUNTY, TEXAS

Drawn	*B.V.*	*02–28–2020*
Checked	*A.G.*	*02–28–2020*
Approved	*T.G.H.*	*02–28–2020*
Scale	*N.T.S.*	

TWE DRAWING NO. 20.23.012–1

APPENDIX B

LOGS OF TEST BORINGS

LOG OF BORING TB-1

PROJECT: Six Mile Boat Launch - Pavement Improvements
Toledo Bend Reservoir - Sabine River Authority

CLIENT: Schaumburg & Polk, Inc.
Beaumont, Texas

COORDINATES: N 31° 14' 19.10"
W 93° 45' 20.89"

SURFACE ELEVATION: --

DRILLING METHOD:
Dry Augered: 0' to 6'
Wash Bored: -- to --

ELEVATION (FT) / DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			ASPHALTIC CONCRETE (1.5")			8								20	
			FILL: EMULSIFIED SAND/GRAVEL BASE (2.5")												
			Gray and red SANDY FAT CLAY (CH)												
			-becomes firm at 2'	(P)1.25		14		63	49					64	
3			Stiff, brown and gray SANDY LEAN CLAY (CL)	(P)2.25		20	110								
			-with calcareous nodules from 4' to 6'												
6			Bottom @ 6'												
9															
12															
15															
18															
21															

COMPLETION DEPTH: 6 ft
DATE BORING STARTED: 01/31/20
DATE BORING COMPLETED: 01/31/20
LOGGER: Noah R.
PROJECT NO.: 20.23.012

NOTES: Free water was not encountered during dry-auger drilling. Borehole was backfilled with soil cuttings and capped with asphalt patch material.

LOG OF BORING TB-2

PROJECT: Six Mile Boat Launch - Pavement Improvements
Toledo Bend Reservoir - Sabine River Authority

CLIENT: Schaumburg & Polk, Inc.
Beaumont, Texas

COORDINATES: N 31° 14' 17.99"
W 93° 45' 20.23"

SURFACE ELEVATION: --

DRILLING METHOD:
Dry Augered: 0' to 6'
Wash Bored: -- to --

ELEVATION (FT) / DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			ASPHALTIC CONCRETE (1.5")												
			FILL: EMULSIFIED SAND/GRAVEL BASE (3")			12		34	18					56	
			Brown and gray SANDY LEAN CLAY (CL)												
			Stiff, gray and red FAT CLAY with SAND (CH)	(P)2.00		19	106	50	35					79	
3			-becomes very stiff, brown and gray at 4'	(P)3.00											
6			Bottom @ 6'												
9															
12															
15															
18															
21															

COMPLETION DEPTH: 6 ft
DATE BORING STARTED: 01/31/20
DATE BORING COMPLETED: 01/31/20
LOGGER: Noah R.
PROJECT NO.: 20.23.012

NOTES: Free water was not encountered during dry-auger drilling. Borehole was backfilled with soil cuttings and capped with asphalt patch material.

LOG OF BORING TB-3

PROJECT: Six Mile Boat Launch - Pavement Improvements
Toledo Bend Reservoir - Sabine River Authority

CLIENT: Schaumburg & Polk, Inc.
Beaumont, Texas

COORDINATES: N 31° 14' 20.21"
W 93° 45' 19.75"

SURFACE ELEVATION: --

DRILLING METHOD:
Dry Augered: 0' to 6'
Wash Bored: -- to --

ELEVATION (FT) / DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Firm brown SANDY LEAN CLAY (CL) -with organics from 0' to 2'	(P)1.25		21								53	
			-becomes stiff at 2'	(P)1.50		25		42	27						
3															
			-becomes brown and gray at 4'	(P)2.50		19								57	
6			Bottom @ 6'												
9															
12															
15															
18															
21															

COMPLETION DEPTH: 6 ft
DATE BORING STARTED: 01/31/20
DATE BORING COMPLETED: 01/31/20
LOGGER: Noah R.
PROJECT NO.: 20.23.012

NOTES: Free water was not encountered during dry-auger drilling. Borehole was backfilled with soil cuttings.

LOG OF BORING TB-4

PROJECT: Six Mile Boat Launch - Pavement Improvements
Toledo Bend Reservoir - Sabine River Authority

CLIENT: Schaumburg & Polk, Inc.
Beaumont, Texas

COORDINATES: N 31° 14' 19.35"
W 93° 45' 18.99"

SURFACE ELEVATION: --

DRILLING METHOD:
Dry Augered: 0' to 6'
Wash Bored: -- to --

ELEVATION (FT) / DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Soft, brown and gray LEAN CLAY (CL), with silt pockets and organics	(T)0.15		25		38	20						
3			Stiff, gray and red LEAN CLAY with SAND (CL)	(P)2.00		21								76	
6			Firm, brown and gray SANDY LEAN CLAY (CL)	(T)0.40		22		37	21						
			Bottom @ 6'												
9															
12															
15															
18															
21															

COMPLETION DEPTH: 6 ft
DATE BORING STARTED: 01/31/20
DATE BORING COMPLETED: 01/31/20
LOGGER: Noah R.
PROJECT NO.: 20.23.012

NOTES: Free water was not encountered during dry-auger drilling. Borehole was backfilled with soil cuttings.

LOG OF BORING TB-5

PROJECT: Six Mile Boat Launch - Pavement Improvements
Toledo Bend Reservoir - Sabine River Authority

CLIENT: Schaumburg & Polk, Inc.
Beaumont, Texas

COORDINATES: N 31° 14' 18.52"
W 93° 45' 18.25"

SURFACE ELEVATION: --

DRILLING METHOD:
Dry Augered: 0' to 6'
Wash Bored: -- to --

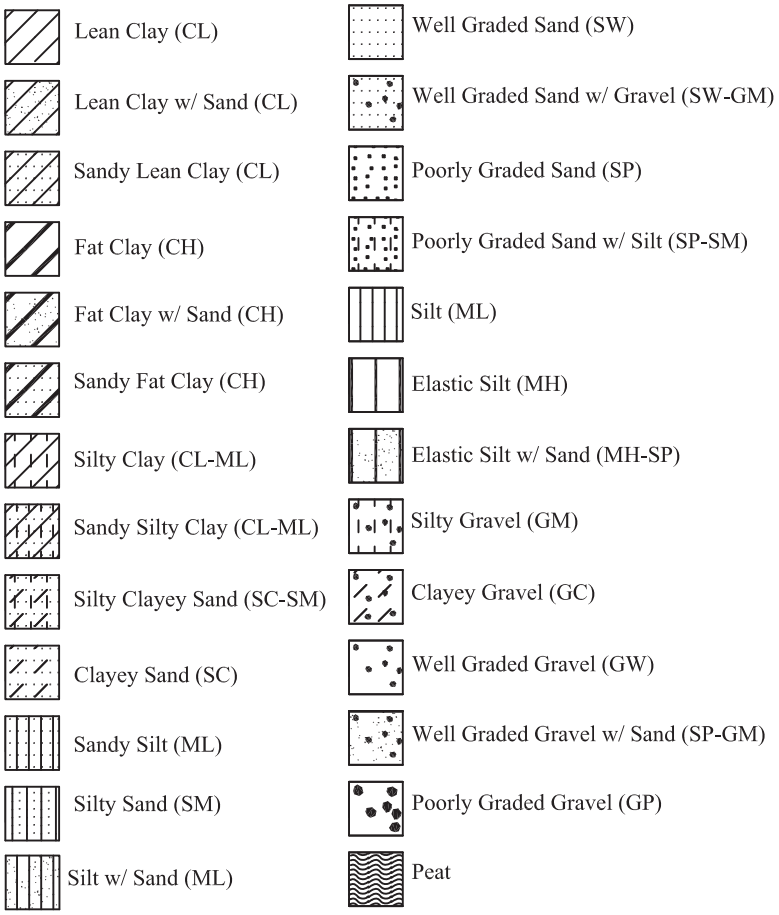
ELEVATION (FT) / DEPTH (FT)	SAMPLE TYPE	SYMBOL	MATERIAL DESCRIPTION	(P) POCKET PEN (tsf) (T) TORVANE (tsf)	STD. PENETRATION TEST BLOWCOUNT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LAB MINI VANE SHEAR (tsf)	COMPRESSIVE STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	PASSING #200 SIEVE (%)	OTHER TESTS PERFORMED
0			Firm, gray and red LEAN CLAY with SAND (CL), with organics	(T)0.30		31								78	
3			Stiff, gray and red FAT CLAY with SAND (CH)	(P)1.75		26		61	42						
6			Gray and red CLAYEY SAND (SC)	(P)1.25		19								38	
			Bottom @ 6'												
9															
12															
15															
18															
21															

COMPLETION DEPTH: 6 ft
DATE BORING STARTED: 01/31/20
DATE BORING COMPLETED: 01/31/20
LOGGER: Noah R.
PROJECT NO.: 20.23.012

NOTES: Free water was not encountered during dry-auger drilling. Borehole was backfilled with soil cuttings.

KEY TO SYMBOLS AND TERMS USED ON BORING LOGS FOR SOIL

Most Common Unified Soil Classifications System Symbols



Miscellaneous Materials

Sampler Symbols	Meaning
	Pavement core
	Thin - walled tube sample
	Standard Penetration Test (SPT)
	Auger sample
	Sampling attempt with no recovery
	TxDOT Cone Penetrometer Test

Field Test Data

2.50	Pocket penetrometer reading in tons per square foot
(T)1.13	Torvane Measurement in tons per square foot
8/6"	Blow count per 6 - in. interval of the Standard Penetration Test
	Observed free water during drilling
	Observed static water level

Laboratory Test Data

Wc (%)	Moisture content in percent
Dens. (pcf)	Dry unit weight in pounds per cubic foot
Qu (tsf)	Unconfined compressive strength in tons per square foot
UU (tsf)	Compressive strength under confining pressure in tons per square foot
Str. (%)	Strain at failure in percent
LL	Liquid Limit in percent
PI	Plasticity Index
#200 (%)	Percent passing the No. 200 mesh sieve
( )	Confining pressure in pounds per square inch
*	Slickensided failure
**	Did not fail @ 15% strain

RELATIVE DENSITY OF COHESIONLESS & SEMI-COHESIONLESS SOILS

The following descriptive terms for relative density apply to cohesionless soils such as gravels, silty sands, and sands as well as semi-cohesive and semi-cohesionless soils such as sandy silts, and clayey sands.

Relative Density	Typical N_{60} Value Range*
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	Over 50

* N_{60} is the number of blows from a 140-lb weight having a free fall of 30-in. required to penetrate the final 12-in. of an 18-in. sample interval, corrected for field procedure to an average energy ratio of 60% (Terzaghi, Peck, and Mesri, 1996).

CONSISTENCY OF COHESIVE SOILS

The following descriptive terms for consistency apply to cohesive soils such as clays, sandy clays, and silty clays.

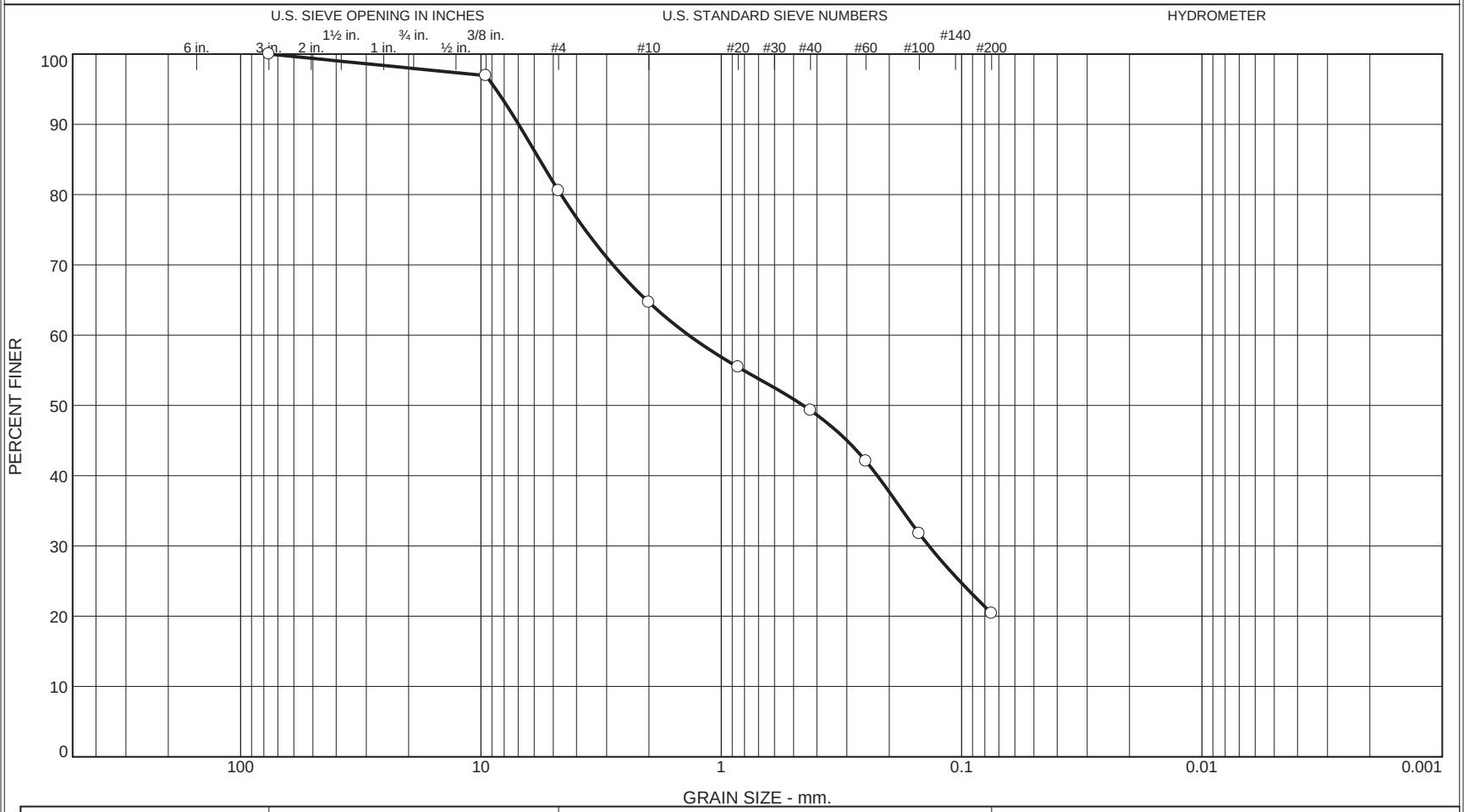
Typical Compressive Strength (tsf)	Consistency	Typical SPT "N_{60}" Value Range**
$q_u < 0.25$	Very soft	≤ 2
$0.25 \leq q_u < 0.50$	Soft	3-4
$0.50 \leq q_u < 1.00$	Firm	5-8
$1.00 \leq q_u < 2.00$	Stiff	9-15
$2.00 \leq q_u < 4.00$	Very Stiff	16-30
$q_u \geq 4.00$	Hard	≥ 31

** An "N_{60}" value of 31 or greater corresponds to a hard consistency. The correlation of consistency with a typical SPT "N_{60}" value range is approximate.

APPENDIX C

SIEVE ANALYSIS REPORTS

Particle Size Distribution Report (ASTM D 422)

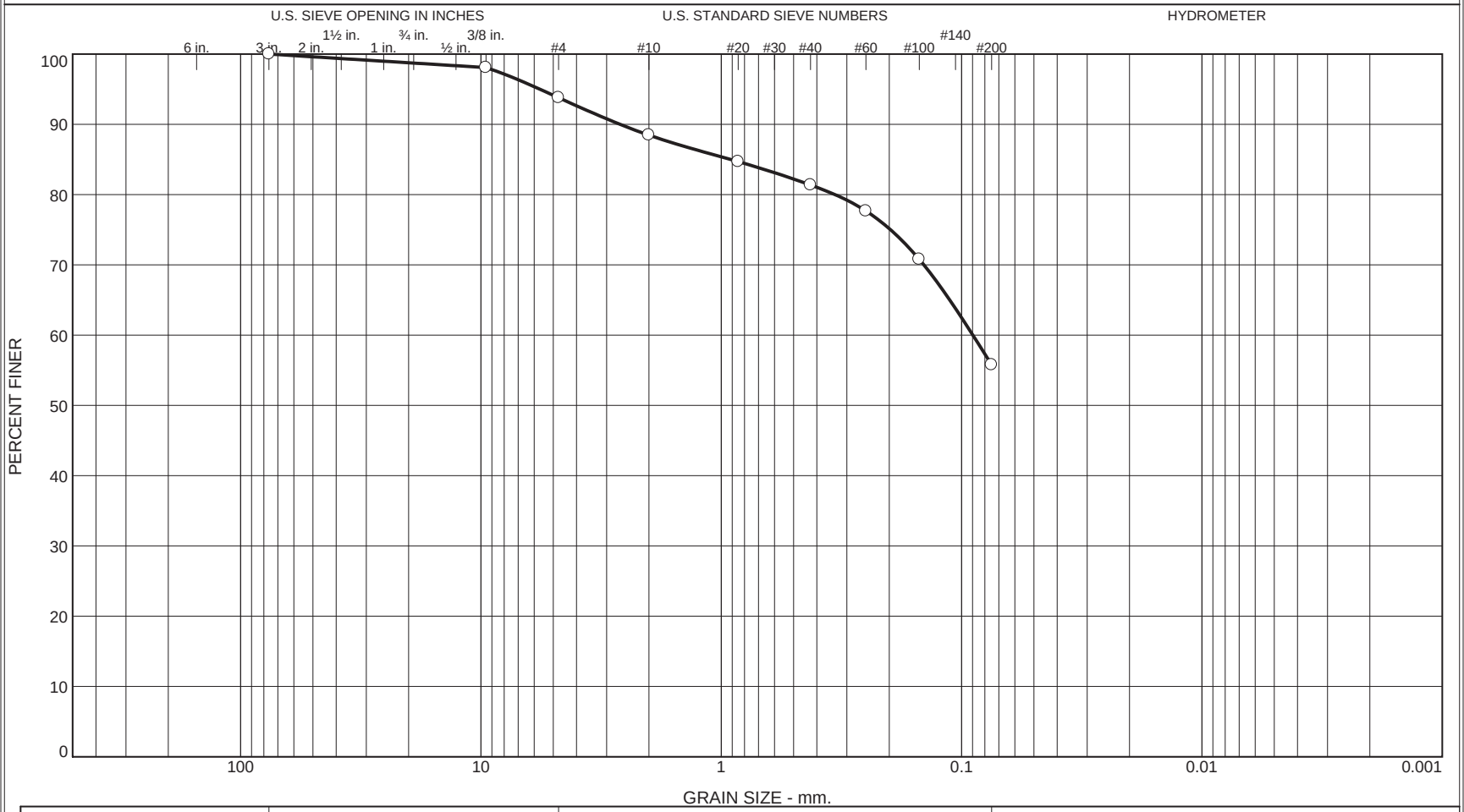


	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	2	17	16	16	29	20	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: TB-1 Depth: 0.1			

Client Schaumburg & Polk, Inc.	**Tolunay-Wong Engineers, Inc.**	○ FILL: EMULSIFIED SAND/GRAVEL BASE (2.5")
Project Six Mile Boat Launch - Pavement Improvements		
Toledo Bend Reservoir - Sabine River Authority		
Project No. 20.23.012 Figure	**Beaumont, TX**	

Particle Size Distribution Report (ASTM D 422)



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	1	5	6	7	25	56	

Identification	Date Sampled	Date Received	Date Tested
Source of Sample: TB-2 Depth: 0.4			

Client Schaumburg & Polk, Inc.

Project Six Mile Boat Launch - Pavement Improvements

Toledo Bend Reservoir - Sabine River Authority

Project No. 20.23.012 Figure

Tolunay-Wong Engineers, Inc.

Beaumont, TX

○ Brown and gray SANDY LEAN CLAY (CL)