TEXAS PARKS AND WILDLIFE

TECHNICAL SPECIFICATIONS

FOR

PROJECT NUMBER 1111298
LAKE DUNLAP I-35 BOAT RAMP REPLACEMENT
COMAL COUNTY, TEXAS

3-28-2025

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TEXAS PARKS & WILDLIFE

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INFRASTRUCTURE DIVISION

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02 41 00 DEMOLITION

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary for every type of required demolition.

B. Furnish equipment of every type required to demolish and transport construction debris away from the Site.

1.02 STANDARDS

A. Work shall be performed in accordance with the codes and ordinances of the agency having authority over the Place of Record.

B. Resilient Floor Covering Institute (RFCI) publication “Recommended Work Practices for the Removal of Resilient Floor Coverings”

C. Occupational Safety and Health Association (OSHA), 29 CFR Parts 1010 and 1926, “Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite”, 40 CPR Part 61 - “National Emission Standard for Hazardous Air Pollutants”

1.03 DELIVERY AND STORAGE

A. Stockpile construction debris at the Site only as long as necessary to haul to a disposal site. Stack materials neatly and handle in an orderly manner until removed from the Site.

1.04 JOB CONDITIONS

A. Contractor shall visit the Site and determine the extent of demolition required and the Site conditions that might affect its proposal. Include costs of covering all aspects of the demolition as part of the proposal.

B. The Drawings shall be carefully reviewed to determine the extent of necessary demolition and to identify elements of the existing construction which are to remain in place. Report any discrepancies to Owner and Engineer before disturbing existing conditions. Property lines and limits of demolition shall be accurately located prior to beginning site demolition. Start of demolition activities shall represent confirmation by Contractor that existing conditions are as presented in the Contract Documents. Demolition outside the limits indicated on the Drawings, or outside the property lines shall not be performed.

C. Material removed during demolition, and any equipment not otherwise designated to remain the property of the Owner, shall become the property of the Contractor, and shall be promptly removed from the Site.

D. Equipment and material designated as remaining the property of the Owner shall be removed from the structure and transported to a designated location on the Site and stored for the Owner’s use. Store on wood runners raised above the surrounding grade and cover with weather resistant covering that is tied securely in place.

E. Take necessary precautions in removing Owner designated property to prevent damage during the demolition process. Equipment shall be removed in one piece. Loose

components may be removed separately. Controls and electrical equipment may be removed from the equipment and handled separately. Large units, such as motor driven pumps, may be dismantled and motors handled separately. Do not use a cutting torch to separate the Owner's equipment or material. Salvaged piping shall be taken apart at flanges or fittings and removed in sections.

F. The Owner's designated property shall include:

1. Any item to remain as part of the existing building and removed and reinstalled within the building as part of the renovated structure.

2. Light fixtures.

1.05 HAZARDOUS MATERIALS

A. Hazardous materials will be removed by Owner before start of the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.

2.00 PRODUCTS

2.01 MATERIALS

A. New materials and equipment for patching and extending work shall meet the requirements of the individual Sections in these Contract Documents. For materials not addressed in these documents, materials used shall meet or exceed the dimensions and quality of the existing work.

3.00 EXECUTION

3.01 SITE CLEARING

A. Perform site clearing to the limits indicated on the Drawings. Scrape the Site, removing brush, trees, weeds and trash. Haul debris away from the Site to an approved site as it accumulates.

B. Grub out tree and brush roots within the limits of buildings, parking lots, driveways and other structures. Remove rock out-croppings and boulders from any area within the limits of grading or structures. Remove roots and backfill any excavation resulting from tree removal with suitable soil for final grading plan.

C. Trees not located within the construction limits, or otherwise indicated for removal, shall remain in place. Visit the Site with the Engineer or Owner and identify those trees that are to remain. Mark all other trees with yellow paint to indicate removal. Protect remaining trees during construction. Wrap the tree trunks with 2 x 4 timbers if construction equipment must operate in close proximity to them.

D. Only designated trees shall be removed. In the event that trees other than those designated are erroneously removed or damaged to the point of distress, install replacement trees of equal size and number to compensate for those destroyed, at no additional cost to the Owner.

E. Provide dust control as needed or requested by the Owner.

3.02 REMOVAL OF CONCRETE SLABS

A. Remove parts of the existing concrete floor slab as indicated on the Drawings. Saw-cut the existing slab with two parallel lines around the area to be removed to the depth of the reinforcing. Do not cut reinforcing. Break out the remainder of the slab using jackhammers or by manual means. Cut reinforcing at a distance of 24 inches from the cut edge of the slab and bend back out of the way. Perform the remainder of the demolition, removing underground piping, or installing new Work. Provide dust control as needed or as requested by the Owner.

B. After buried Work has been completed, bend the reinforcing bars back into proper place and add new reinforcing of the same size and number as the remaining dowels. Lap the joints a minimum of 18 inches and securely tie in place. Replace concrete as required to repair the slab. Concrete shall be Type A as specified in Section 03 30 00 “Cast-In-Place Concrete.”

3.03 REMOVAL OF EXISTING SITE STRUCTURES

A. Remove concrete structures located below the ground line where indicated or where such structures will interfere with new construction. Where structures are a part of an active underground utility system, repair piping to prevent blockage in the flow.

B. Remove abandoned manholes, basins, or similar structures. With the Engineer’s approval, and if structures will not interfere with any other proposed construction, they may be abandoned in place. Remove the top part of the structure so that it is a minimum of 2 feet below the new finish grade. Remove part of the floor system of basins, manholes and other such structures to prevent entrapment of water. Fill remaining cavities with approved backfill material.

C. Provide dust control as needed or as requested by the Owner.

3.04 BACKFILLING

A. Backfill cavities resulting from demolition. Fill cavities occurring within the limits of buildings, structures, or pavements in accordance with the requirements of other Sections of the Specifications. Backfill and compact cavities outside the construction limits to the same density as the surrounding earth. No testing is required for backfill outside the limits of new construction.

3.05 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Lights: Use mild detergent to clean all exterior and interior surfaces. Rinse with clean water and wipe dry. Replace lamps and broken electrical parts impacted by the demolition processes.

END OF SECTION

03 30 00 CAST-IN-PLACE CONCRETE

1.00 GENERAL

1.01 SUMMARY

A. This Section specifies normal weight, cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.02 SUBMITTALS

A. Product Data and Material Certifications: For each product or material indicated in Part 2.00 "Products," excluding formwork.

B. Design Mixture: For each concrete mixture submit:

1. Mix design proportions and characteristics.
2. Certifications indicating conformance of aggregate and cementitious materials.
3. Admixture data sheets.
4. Field test data or trial batch mixture data to validate specified compressive strength in accordance with ACI 301, latest edition.

C. Reinforcing bar layout drawing with bar lists clearly marked and referenced to the Drawings.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

B. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

C. Comply with ACI 301, "Specification for Structural Concrete," including the following sections, unless modified by requirements in the Contract Documents:

1. "General Requirements."
2. "Formwork and Formwork Accessories."
3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."
5. "Handling, Placing, and Constructing."

2.00 PRODUCTS

2.01 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301.

1. Form ties shall leave no material within 1-1/2 inches of concrete surface.

2. For fluid bearing and below grade walls, provide single tie rods with midpoint washer to prevent water seepage. Systems that result in a through wall hole are not permitted.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A1064, fabricated from as-drawn steel wire into flat sheets.

C. Supports:

1. Unexposed Surface: CRSI Class 3 – No Protection.

2. Exposed Surface: CRSI Class 1 – Maximum Protection – uniform high density polyethylene (plastic) or fiberglass reinforced plastic (FRP). Plastic protected wire bar supports are not allowed.

2.03 CONCRETE MATERIALS

A. Cementitious Material:

1. Cement:

a. Type IL blended hydraulic cement, conforming to ASTM C595.

2. Fly Ash: ASTM C618, Class F. No more than 25 percent of the cement may be replaced with fly ash.

B. Coarse Aggregate:

1. In conformance with ASTM C33, uniformly graded, as indicated in “Concrete Mixtures.”

2. Class: Moderate weathering region, but not less than 3M.

C. Fine Aggregate: Washed and screened natural sands or sands manufactured by crushing stones; conforming to ASTM C33.

D. Water: Potable and complying with ASTM C1602 and ASTM C1602 Table 2.

2.04 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

2.05 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.

B. Repair Materials: Pre-packaged, low-shrink, non-slump, non-metallic, quick setting patching mortar, as approved by the manufacturer for each application.

1. Sikatop 123 by Sika Corporation.

2. Five Star Structural Concrete by Five Star Products, Inc.

3. Approved equal.

C. Non-Shrink Grout: Pre-packaged, non-metallic, precision, non-shrink grout conforming to ASTM C1107/C1107M.

D. Normal Shrinkage Grout: One part cement to three parts of ASTM C33 fine aggregate; proportioning on a volumetric basis. Install for grouted areas not required to be non-shrink grout.

E. Waterstops: Place in joints where indicated and any intersecting construction joints to provide a continuous barrier to prevent passage of fluids through joints.

1. Flexible PVC Waterstops: 6 inches, ribbed, with a minimum thickness of 3/8 inch, USACE CRD-C-572 compliant.

F. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion.

G. Zinc Richer Primer: Coat aluminum surfaces embedded or in contact with concrete. Primer shall be Tneme-Zinc or approved equal.

H. Vapor Barriers: ASTM E1745, Class A. Include manufacturer's recommended pressure-sensitive tape.

1. Stego Wrap Vapor Barrier (15-mil), Stego Tape, and Stego Crete Claw; Stego Industries, LLC.

2. Approved equal.

2.06 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Waterproof Sheet: In accordance with ASTM C171.

D. Water: Potable and complying with ASTM C1602 and ASTM C1602 Table 2.

2.07 CONCRETE MIXTURES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

Use	Min. 28-Day Compressive Strength	Coarse Aggregate	Max. Water/ Cement Ratio	Max Slump
General	5000 psi	#57	0.45	5”* (+/- 1”)
Pipe blocking, lean concrete	1500 psi	#57	0.70	---

*Slump may be increased to 8 inches with the addition of a HRWR.

C. Air Content:

1. Air entrain exposed concrete within range permitted by ACI 301 for Exposure Class **[F1]**.
2. Do not allow entrapped air to exceed 3 percent in floor slabs to receive troweled finish.

2.08 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M, and furnish batch ticket information.

3.00 EXECUTION

3.01 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.02 STEEL REINFORCEMENT

A. Comply with CRSI’s “Manual of Standard Practice” for fabricating, placing, and supporting reinforcement.

1. Fabricate reinforcement steel to provide lapped connections, bends, and transitions in reinforcement as required for continuity of the typical reinforcement specified on the Drawings.
2. Unless otherwise detailed, intersecting wall and/or beam reinforcement shall extend to the far face and terminate in a standard hook. Reinforcement at the outside face of corners shall be continuous or provide tension lap splices at each side of the corner.

B. Do not weld reinforcement.

3.03 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Purposefully roughen joints to a 1/4-inch amplitude and clean.

B. Construction Joints: Locate joints as indicated or as approved by Owner’s Representative.

C. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, and as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.04 WATERSTOPS

A. Install in construction joints as indicated to form a continuous obstruction to prevent fluids passing through the joint.

B. Secure waterstops to concrete or reinforcing as recommended by the manufacturer.

C. Install and protect waterstops as recommended by the manufacturer and as indicated here.

D. PVC Waterstops:

1. All fittings and changes in direction shall be factory fabricated.

2. Only straight, butt splices shall be made in the field. Field splices shall be in accordance with manufacturer's instructions.

3. Secure waterstop in place using hog rings or grommets at the outermost rib. Except as recommended by the manufacturer, do not pierce, notch, or cut waterstop.

3.05 CONCRETE PLACEMENT

A. Comply with ACI 301 for measuring, batching, mixing, transporting, and placing concrete.

B. Additional water may only be added to concrete prior to placement and only at Project Site. Slump shall be evaluated prior to and after the addition of all water. Do not take strength cylinders until after addition of all water.

1. Quantity of water shall not exceed the amount withheld at the batch plant. Quantity withheld shall be indicated on the batch ticket. Addition of water shall not result in a slump or water-cement ratio greater than that specified.

C. Do not allow concrete to free fall more than 5 feet. With HRWR concrete may free fall a maximum of 10 feet.

D. Consolidate concrete with mechanical vibrating equipment.

3.06 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Apply float finish to surfaces to receive trowel finish or nonslip broom finish. Except as indicated below, apply a final "light float" finish to the surface as the concrete hardens. Surface shall have a uniform granular texture and shall meet the straightness requirements.

D. Trowel Finish: Apply a normal steel trowel finish to interior surfaces exposed to view and grouted surfaces in junction boxes.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete sidewalk and ramp surfaces. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.07 FINISHING FORMED SURFACES

A. No Finish: After forms are removed, repair or patch tie-holes and defects. Otherwise, no additional finish is required. Apply to surfaces which are not visible from the inside or outside of the completed structure or less than 12 inches below finish grade (i.e. back of retaining walls below embankment, etc.).

B. Smooth-Formed Finish: As-cast surface texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch. Apply to surfaces exposed to view and 12 inches below finish grade.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.08 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 301. Additionally, comply with ACI 306.1 for cold-weather protection and with ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least 7 days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:

    a. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than 7 days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.09 MISCELLANEOUS CONCRETE ITEMS

A. Non-Shrink Grout: Install and cure as recommended by manufacturer, and as required here:

1. Clean and roughen exposed concrete surface; remove laitance. Saturate the foundation 24 hours before installation. Surface shall be clear of standing water. Baseplates shall be free of oil, grease, and other objectionable substances.

2. Steel trowel exposed edges.

3. Moist cure as specified by manufacturer, but not less than 3 days.

B. Normal Shrinkage Grout:

1. Clean and roughen exposed concrete surface, remove laitance. Saturate the foundation 24 hours before installation. Surface shall be clear of standing water. Apply scrub coat of grout immediately prior to grout placement. While scrub coat is still moist install grout.

2. Wet cure as specified for concrete.

C. Vapor Barrier:

1. Install in accordance with manufacturer's recommendations including seams, penetrations, and repairs.

2. At perimeter of concrete, secure vapor barrier to concrete with Stego Crete Claw.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

B. Tests: Perform according to ACI 301.

1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

3.11 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

B. Repair materials and surface preparation shall be completed in accordance with manufacturer recommendations. Coordinate with Owner's Representative prior to beginning any demolition of defective area.

END OF SECTION

31 05 13 SOILS FOR EARTHWORK

1.00 GENERAL

1.01 WORK INCLUDED

A. This Section of the specifications describes the various classes of Earth Fill. All of the classes of Earth Fill contained in this specification may not be used on this project. The classes of Earth Fill used on this project are shown on the drawings or specified in other sections of the specifications. This Section does not include specifications for placement and compaction of Earth Fill. Specifications for placement and compaction of Earth Fill are included in other sections of the specifications and/or shown on the drawings.

1.02 STANDARDS

A. Soil materials shall be classified into the appropriate class of Earth Fill shown below according to ASTM D2487 "Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)" or other appropriate methods as designated by the Engineer.

2.00 PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

A. Class 1 Earth Fill: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60 percent passing the No. 200 sieve, which are free of organic materials.

B. Class 2 Earth Fill: Limited to clays and sandy clays classified as CH and CL materials with a coefficient of permeability less than or equal to 1.0×10^{-7} cm/sec, a liquid limit greater than or equal to 30, a plasticity index greater than or equal to 15, and more than 50 percent passing the No. 200 sieve, which are free of organic materials.

C. Class 3 Earth Fill: Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.

D. Class 4 Earth Fill: Consist of materials which are classified as SP, SM, SC, CL, or dual classifications thereof, which have a liquid limit less than or equal to 35 and a plasticity index of a minimum of 4 and a maximum of 15, which are free of organic materials.

E. Class 5 Earth Fill: Consist of materials classified as SP or SP-SM which have a plasticity index less than or equal to 4 and a maximum of 12 percent passing the No. 200 sieve, which are free of organic materials.

F. Class 12 Earth Fill: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 05 16 AGGREGATES FOR EARTHWORK

1.00 GENERAL

1.01 WORK INCLUDED

A. This Section of the specifications describes the various classes of Aggregate Fill. All of the classes of Aggregate Fill contained in this specification may not be used on this project. The classes of Aggregate Fill used on this project are shown on the drawings or specified in other sections of the specifications. This Section does not include installation. Installation of Aggregate Fill is included in other sections of the specifications and/or on the drawings.

1.02 QUALITY ASSURANCE

A. Classification Testing:

1. Contractor Testing:

a. Arrange and pay for the services of an independent testing laboratory to sample and test proposed Aggregate Fill materials.

b. Submit the test results to the Engineer and obtain approval prior to providing Aggregate Fill.

2. Owner Testing: The Owner shall arrange and pay for additional testing on the Aggregate Fill after delivery to the project site as determined necessary by the Engineer.

B. Contamination Certification:

1. Obtain a written, notarized certification from the Supplier of each proposed Aggregate Fill source stating that to the best of the Supplier's knowledge and belief there has never been contamination of the source with hazardous or toxic materials.

2. Submit these certifications to the Engineer prior to proceeding to furnish Aggregate Fill to the site. The lack of such certification on a potential Aggregate Fill source shall be cause for rejection of that source.

1.03 STANDARDS

A. Aggregate Fill shall be classified into the appropriate class listed below according to ASTM testing procedures as specified for the various classes.

1. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Specification for Concrete Aggregates
ASTM C88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium sulfate
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM C131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D448	Classification for Sizes of Aggregate for Road and Bridge Construction

2.00 PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

A. Class 1 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 57:

Sieve Size Square Opening	Percent Passing
1-1/2”	100
1”	95-100
1/2”	25-60
No. 4	0-10
No. 8	0-5

B. Class 2 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 67:

Sieve Size Square Opening	Percent Passing
1”	100
3/4”	90-100
3/8”	20-55
No. 4	0-10
No. 8	0-5

C. Class 3 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 7:

Sieve Size Square Opening	Percent Passing
3/4”	100

1/2”	90-100
3/8”	40-70
No. 4	0-15
No. 8	0-5

D. Class 4 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 467:

Sieve Size Square Opening	Percent Passing
2”	100
1-1/2”	95-100
3/4”	35-70
3/8”	10-30
No. 4	0-5

E. Class 5 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 357:

Sieve Size Square Opening	Percent Passing
2-1/2”	100
2”	95-100
1”	35-70
1/2”	10-30
No. 4	0-5

F. Class 6 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 1:

Sieve Size Square Opening	Percent Passing
4”	100
3-1/2”	90-100
2-1/2”	25-60
1-1/2”	0-15
3/4”	0-5

G. Class 7 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 6:

Sieve Size Square Opening	Percent Passing
1”	100
3/4”	90-100
1/2”	20-55
3/8”	0-15
No. 4	0-5

H. Class 8 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 56:

Sieve Size Square Opening	Percent Passing
1-1/2”	100
1”	90-100
3/4”	40-85

1/2”	10-40
3/8”	0-15
No. 4	0-5

I. Class 9 Aggregate Fill:

1. Consist of washed and screened gravel and natural sands or sands manufactured by crushing stones complying with the requirements of ASTM C33, except that the gradation shall be as follows:

Sieve Size Square Opening	Percent Passing
1/2”	100
3/8”	95-100
No. 4	80-95
No. 8	65-85
No. 16	50-75
No. 30	25-60
No. 50	10-30
No. 100	0-10

2. Class 9 Aggregate Fill shall have not more than 45 percent passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

J. Class 10 Aggregate Fill:

1. Consist of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of ASTM C33. The gradation as included in ASTM C33 is as follows:

Sieve Size Square Opening	Percent Passing
3/8”	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	0-10

2. Class 10 Aggregate Fill shall have not more than 45 percent passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

K. Class 11 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-3/4"	100
7/8"	65-90
3/8"	50-70
No. 4	35-55
No. 40	15-30
No. 100	0-12 (Wet Sieve Method)

L. Class 12 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-1/2"	100
1"	85-100
3/4"	60-95
3/8"	50-80
No. 4	40-65
No. 16	20-40
No. 100	0-12 (Wet Sieve Method)

M. Class 13 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and shall meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-3/4"	100
7/8"	65-90

3/8”	50-70
No. 4	35-55
No. 40	15-30
No. 100	0-3 (Wet Sieve Method)

N. Class 14 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-1/2”	100
1”	85-100
3/4”	60-95
3/8”	50-80
No. 4	40-65
No. 16	20-40
No. 100	0-3 (Wet Sieve Method)

O. Class 15 Aggregate Fill: Consist of durable particles of silica sand, washed clean, chemically inert, and packaged by the Supplier. The material shall meet applicable regulatory requirements for monitor well filter pack. The source of the material shall be approved by the Engineer and shall meet the following gradation requirements:

Sieve Size Square Opening	Percent Passing
No. 20	98-100
No. 40	0-2

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 11 00 CLEARING AND GRUBBING [CIVIL]

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide labor, materials, equipment and incidentals necessary to perform operations in connection with clearing, grubbing, and disposal of cleared and grubbed materials.

1.02 QUALITY ASSURANCE; DEFINITIONS

A. Clearing: Clearing is defined as the removal of trees, shrubs, bushes, and other organic matter at or above original ground level.

B. Grubbing: Grubbing is defined as the removal of stumps, roots, boards, logs, and other organic matter found at or below ground level.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 PREPARATION

A. Mark areas to be cleared and grubbed prior to commencing clearing operations. The Owner's Representative shall approve clearing and grubbing limits prior to commencement of clearing operations.

B. Trees and shrubs outside of the clearing limits, which are within 10 feet of the clearing limits, shall be clearly marked to avoid damage during clearing and grubbing operations.

C. Remove trees and brush outside the clearing limits, but within the immediate vicinity of the work, upon receipt of approval by the Owner's Representative, when the trees or brush interfere with the progress of construction operations.

D. Clearly mark trees and shrubs within the clearing limits, which are to remain, and protect the trees and shrubs from damage during the clearing and grubbing operations.

E. The clearing limits shall not extend beyond the project limits.

F. Establish the clearing limits as follows:

1. Embankments plus 10 feet beyond the toe of the embankment.
2. Excavations plus 5 feet beyond the top of the excavation.
3. Concrete structures plus 2 feet beyond the edge of the footing.

G. Establish the grubbing limits as follows:

1. Embankments plus 2 feet beyond the toe of the embankment.
2. Concrete structures plus 2 feet beyond the edge of the footing.

3.02 NSTALLATION

A. Clearing: Clearing shall consist of the felling, cutting up, and the satisfactory disposal of trees and other vegetation, together with the down timber, snags, brush, rubbish, fences, and debris occurring within the area to be cleared.

B. Grubbing:

1. Grubbing shall consist of the removal and disposal of stumps and roots larger than 1 inch in diameter.

2. Extend grubbing to the depth indicated below: In the case of multiple construction items, the greater depth shall apply.

a. Footings: 18 inches below the bottom of the footing.

b. Walks: 12 inches below the bottom of the walk.

c. Embankments: 24 inches below existing ground.

d. Concrete Structures: 18 inches below the bottom of the concrete.

e. Retaining Walls: 18 inches below the bottom of the footing.

3.03 FIELD QUALITY CONTROL

A. Completely remove timber, logs, roots, brush, rotten wood, and other refuse from the Owner's property. Disposal of materials in streams shall not be permitted and no materials shall be piled in stream channels or in areas where it might be washed away by floods. Timber within the area to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of the Owner's property, provided timber and waste material is disposed of in a satisfactory manner. Materials shall be removed from the site daily, unless permission is granted by the Engineer to store the materials for longer periods.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

A. Measurement is not required.

A1.02 PAYMENT

A. Payment for the work specified will be made at the lump sum price bid for "Clearing and Grubbing", which payment shall constitute full compensation for labor, equipment, tools, and incidentals necessary to complete the specified work, including refilling of depressions. No payment will be made for clearing and grubbing in the borrow or waste disposal areas, and all costs thereof shall be included in the appropriate bid price of the type of work involved.

B. The amount bid for "Clearing and Grubbing" shall not exceed 1 percent of the total amount bid, exclusive of "Mobilization" and "Clearing and Grubbing."

END OF APPENDIX A

31 23 10 STRUCTURAL EXCAVATION AND BACKFILL

1.00 GENERAL

1.01 SUMMARY

A. This Section specifies excavation, backfill materials, backfill placement and compaction procedures, and other construction activities incidental to project structures.

1.02 DEFINITIONS

A. Cofferdams: Any temporary or removable structure constructed to hold the surrounding earth and/or water out of the excavation, whether the structure is formed of soil, timber, steel, concrete, or a combination thereof, including the use of pumping wells or well points as required by design.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design of cofferdams, including comprehensive engineering analysis by a qualified professional engineer for project specific site conditions. Design shall comply with AASHTO LRFD Bridge Design Specifications, latest addition.

1.04 QUALIFICATION ASSURANCE

A. Cofferdam Designer: A professional engineer licensed in the state in which the Project occurs.

B. Testing Agency: An independent testing agency that is AASHTO accredited.

1.05 SUBMITTALS

A. Submittals shall be in accordance with Uniform General Conditions and shall include:

1. Qualification Data: For professional engineer responsible for cofferdam design and testing agency.

2. Shop Drawings: Cofferdam placement and details for record purposes.

3. Calculations: For cofferdam indicated to comply with project specific site conditions, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Submittal shall be for record purposes.

4. Provide list of compaction equipment to be used.

5. Backfill material classifications: For each soil or aggregate backfill material provide a certification by the testing agency.

6. Compaction Test Results: Submit test results within 24 hours of successful testing.

1.06 STANDARDS

A. Material classification, placing, and testing shall be in compliance with the latest revisions of the following standards, unless otherwise noted in the Contract Documents.

1. ASTM International (ASTM) Standards:

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.

1.07 DELIVERY AND STORAGE

A. Deposit material to be used for backfill in storage piles at points convenient for handling of the material during the backfilling operations and as required to prevent contamination with other materials.

1.08 JOB CONDITIONS

A. Review subsurface investigations. A limited subsurface investigation has been performed by Freese and Nichols, Inc. Boring logs and a geotechnical report from that investigation area part of the Construction Documents for information purposes only. The precise profile of soil and rock strata beneath this Site is not known.

B. Review the Site and determine the conditions which may affect the structural excavation, prior to the commencement of the excavation.

2.00 PRODUCTS

2.01 BACKFILL MATERIALS

A. Select Fill: Structural fill shall be Class 4 Earth Fill as specified in Section 31 05 13 “Soils for Earthwork**”.**

B. Clay Cap: Clay cap shall be Class 2 Earth Fill as specified in Section 31 05 13 “Soils for Earthwork” orexcavated onsite fat clays that are free of organic materials and particles larger than 3 inches in diameter.

C. Structural Aggregate Backfill: Structural aggregate backfill shall be Class 1 Aggregate Fill as specified in Section 31 05 16 “Aggregates for Earthwork.”

D. Lean Concrete Backfill: Lean concrete in accordance with Section 03 30 00 “Cast-In-Place Concrete.”

E. Mud Slab: Lean concrete in accordance with Section 03 30 00 “Cast-In-Place Concrete.”

F. Flowable Fill: Flowable fill shall be in accordance with Section 31 23 23.34 “Flowable Fill.”

G. Topsoil: Topsoil shall be Class 12 Earth Fill as specified in Section 31 05 13 “Soils for Earthwork.”

H. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand, or recycled, crushed concrete in accordance with TxDOT Item 247, Type D; ASTM D448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and 5 to 15 percent passing No. 200 sieve; maximum plasticity index of 7; complying with deleterious substance limits of ASTM C33 for fine aggregates.

2.02 COMPACTION EQUIPMENT

A. Compaction equipment shall conform to the following requirements.

1. Heavy Compaction Equipment:

a. Tamping Compactor: Steel wheels with rectangular face, tapered pads that prevent fluffing the soil. Compactor shall be equipped with cleaning fingers to remove soil accumulation from between pads.

1). Operating Weight, Minimum: 30,000 pounds.

2). Wheels or Drum Size, Minimum: 4 feet diameter.

3). Travel Speed, Maximum: 10 mph.

b. Pneumatic Rollers: Minimum eight-tire, pneumatic roller with a modular ballast system and flexible operating weight, and which will equally distribute load between tires to provide compaction uniformity.

1). Operating Weight Range: As required for specified compaction, 36,000 to 50,000 pounds.

2). Tire Pressure Range: 80 psi to 100 psi.

3). Travel Speed, Maximum: 10 mph.

4). Distance Between Edges of Adjacent Tires: Less than 50 percent of tire width.

c. Vibratory Rollers: Smooth drum roller with 90 percent of the static weight transmitted through a single drum.

1). Static Weight, Minimum: 20,000 pounds

2). Centrifugal Force Per Drum, Minimum: 40,000 pounds

3). Frequency: 1400 v/min

4). Drum Size: Diameter 5 feet, +/- 1 foot; width between 6 and 9 feet.

5). Travel Speed: 5 mph for self-propelled; 2 mph for towed.

6). No backing up of the vibratory roller will be allowed on an embankment unless the vibrating mechanism is capable of being reversed.

2. Hand-Directed Compaction Equipment: Use power tampers and vibratory plate compactors in areas where it is impracticable or unacceptable to use heavy compaction equipment.

2.03 COFFERDAMS

A. Interior Dimensions: Of sufficient size to allow for all construction and inspection activities.

B. Walls: Watertight. Extend below proposed subgrade as required to prevent water infiltration through subgrade. Extend above 100-year water surface elevations, but not less than that required by design.

C. Provide pumping or bailing system as required by cofferdam design and/or Construction Document requirements.

D. Provide aggregate work platform as required by cofferdam design and/or as indicated on the Drawings. Aggregate work platform shall be installed as indicated on the drawings.

3.00 EXECUTION

3.01 PREPARATION

A. Clear and grub the area to be excavated prior to the start of excavation in accordance with Section 31 11 00 “Clearing and Grubbing.

3.02 EXCAVATION FOR FOUNDATIONS

A. General: Excavate subgrade to the depth indicated on Drawings, +/- 0.1 feet tolerance Extend limits of the excavation beyond the perimeter of the foundations as indicated on the Drawings.

1. Exposed subgrade surfaces shall be level and of sound, stable material; free of mud, frost, snow, or ice. Testing agency or Owner’s representative shall confirm exposed subgrade is a suitable bearing material based on the Construction Documents.

2. Proof roll the exposed subgrade in accordance with TxDOT Item 216. Do not proof roll wet or saturated subgrades.

3. Where unsound or unstable material is uncovered, notify Owner’s representative Remove objectionable material and replace after approval is received from Owner’s representative. Replacement material shall be as indicated here unless otherwise indicated on Drawings:

a. Rock subgrade replacement material: Lean concrete.

b. Soil subgrade replacement material: Compacted structural fill**.**.

B. Aggregate Work Platform: Where indicated, install work platform on exposed foundation subgrade prior to allowing any vehicular traffic on subgrade.

C. When the material encountered at footing bearing elevation is found to be partially rock or incompressible material, but otherwise satisfactory for the foundation, remove the incompressible material to a depth of 6 inches below the footing grade and 12 inches on each side and backfill with compacted select fill.

D. Excavation Safety: All excavations shall be in accordance with OSHA requirements.

3.03 COFFERDAMS

A. Install and remove cofferdams without disturbing the subgrade or marring the structure.

B. Pump or bail water as required for construction and inspection work, and to prevent hydrostatic uplift pressures when not accounted for in the cofferdam design.

3.04 WATER IN FOUNDATION EXCAVATIONS

A. General:

1. Prevent water infiltration into foundation excavations. Remove standing water from excavation prior to placing concrete. If removal of standing water is not possible due to continuous water infiltration, then contact Owner's representative for additional direction regarding placing concrete underwater.

2. Do not dewater a foundation excavation while placing concrete or for a period of at least 24 hours after concrete placement.

B. Rock Foundation Subgrade: If rock material becomes weathered due to water infiltration, then remove weathered material and provide rock replacement material to restore foundation subgrade elevation.

C. Soil Foundation Subgrade: If foundation subgrade becomes saturated do not disturb the subgrade. Wait for water to evacuate the subgrade and subgrade surface to adequately stiffen prior to placing concrete. If subgrade is disturbed, then wait until subgrade has dried out, excavate disturbed subgrade and provide replacement material as indicated above.

3.05 COMPACTED BACKFILL

A. General: Backfill excavated spaces and areas not occupied by the permanent structure.

1. Backfill behind a retaining wall or basement-type wall shall not be placed until the concrete has reached its 28-day compressive strength or 7 days, whichever is longer.

2. Unless otherwise indicated on Drawings, structures with a top slab shall not backfilled until the top slab has been in place at least 4 days.

3. Structures with soil on opposing (opposite) sides shall be backfilled to prevent uneven loading of the structure – evenly raise backfill on opposing sides of the structure. The maximum differential backfill height between opposing sides is 1 foot.

4. Do not permit rollers to operate within 3 feet of structures.

5. Maximum Loose Lift Height:

a. Heavy Compaction Equipment: 8 inches.

b. Hand-Directed Compaction Equipment: 4 inches.

6. Previous Compacted Layer: If backfill placement occurs over a period of time greater than 24 hours, then scarify and recompact the previous day's final compacted layer.

a. Scarify and Recompact: 6-inch depth; adjust the moisture content; recompact.

b. Saturated subgrades shall not be worked on until sufficiently dry and harden so as not to be rutted with compaction equipment. Scarify and recompact layers damaged by weather or construction equipment.

B. Moisture: Prior to compacting backfill, mix and aerate or water the loose lift backfill material as necessary to adjust the moisture content and evenly distribute throughout. The material shall contain moisture within the limits specified below.

1. In accordance with ASTM D6938, determine the optimum moisture content for the maximum dry density.
2. Backfill moisture content shall be as indicated in Table 1, "Compacted Fill."
3. Aggregate fill: Completely cohesionless materials, shall be at a moisture content which will allow use of the specified compaction equipment and consistent achievement of the specified density.

C. Compaction: As required to achieve the specified density, increase the number of passes above the minimum specified and/or modify the weight of the equipment.

1. Determine the maximum dry density in accordance with ASTM D698 for cohesive soils and ASTM D4253 for cohesionless soils.
2. Minimum number of passes for all compacted fill types: 8.
3. Cohesive Soils: A tamping compactor or tamping compactor followed by a pneumatic roller shall be used.
4. Cohesionless or low cohesive soils: A vibratory roller or vibratory plate compactors shall be required if the material is cohesionless or with less than 15 percent passing the No. 200 sieve. Confirm applicability of vibratory compaction equipment in the field.
5. Overlap passes a minimum of 1 feet for heavy compaction equipment and 50 percent of the baseplate width for hand-directed equipment.
6. Backfill density shall be as indicated in Table 1, "Compacted Fill."

Table 1: Compacted Fill

Backfill Type	Density[1,2]	Moisture Content[3, 4]	Comments
Classes 1 & 2	95%	-0% to +5%	N/A
Classes 3, 4, & 5	95%	-2% to +5%	N/A

[1] The percentage indicated is the minimum required percentage of the maximum dry density as determined by the applicable ASTM.
[2] Below Vehicular Pavement: Scarify to a depth of 8, moisture condition, and recompact to not less than 100 percent of the maximum dry density.
[3] Range indicated is the acceptable tolerance with respect to the optimum moisture content.
[4] Completely cohesionless materials, shall be at a moisture content which will allow use of the specified compaction equipment and result in consistent achievement of the specified density.

3.06 FIELD QUALITY CONTROL

A. Owner is responsible for the costs involved in providing an approved testing agency to perform quality control testing of backfill operations and verification of subgrade bearing material. The testing laboratory shall make tests of in-place density and moisture in accordance with ASTM Standards previously mentioned in this Section. The testing agency shall monitor backfill operations continuously or at intervals acceptable to the Owner's representative. It shall be the responsibility of the Contractor to notify the testing agency a minimum of 2 business days before backfill operations begin.

1. Unless noted otherwise, in-place density tests shall be conducted at a rate of one test per 1500square feet for every lift.

END OF SECTION

31 23 19.01 CARE OF WATER DURING CONSTRUCTION

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to operate pumps, piping and other facilities to assist in the removal of surface water, stormwater runoff, and ground water, and provide protection of the work site from water of any source. Build and maintain the necessary temporary cofferdams, berms, diversions, impounding works, channels and ditches to protect the work site from lake levels and spillway discharges, streamflow, and stormwater runoff. Remove the temporary works, equipment, and materials after completion in accordance with this Section and the applicable Drawings.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Uniform General Conditions and shall include:

1. Plans and procedures for handling flood flows, stormwater runoff, and dewatering excavations for approval by the Engineer. Modifications to these plans shall also be submitted for approval by the Engineer. If the Project contains separate phases that require different steps in the diversion of streamflow, then the submitted plans must clearly distinguish the differences in each phase. Plans for each phase in the sequence may be submitted separately.

2. Plans shall include a demonstration that any coffer dams or diversions provide at least 10-year flood protection for protected structures under construction.

B. Approval of submittals does not relieve the Contractor of full responsibility and liability for care of water during construction.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 FLOOD FLOWS AND OTHER SURFACE WATER

A. The Contractor is responsible for handling and diverting any flood flows, stormwater runoff, stream flows, or any other water, including groundwater encountered during the progress of the work. Build, maintain, and operate cofferdams, channels, flumes, sumps, berms, ditches, and other temporary works as needed to pass spillway discharge and divert stream flow or stormwater runoff water through or around the construction site and away from construction work while it is in progress. Unless otherwise approved by the Owner, a diversion must discharge into the same natural watercourse in which its headworks are located. Construct permanent Work in areas free from water. Full responsibility for the successful dewatering of the work areas rests with the Contractor. Remove protective works, after they have served their purpose, in a manner satisfactory to the Owner or its representative.

3.02 DEWATERING EXCAVATED AND OTHER FOUNDATION AREAS

A. Contractor is responsible for dewatering foundations for all areas during construction of the Project, including areas of required backfills. Lower the water table as needed to keep work areas free of standing water or excessively muddy conditions as needed for proper performance of the construction work. Furnish, prepare, and maintain drains, sumps, casings, well points, and other equipment needed to dewater areas for required construction work. Any dewatering method that causes a loss of fines from foundation areas shall not be permitted. Keep available standby equipment to ensure the proper and continuous operation of the dewatering system. Provide continuous monitoring (24 hours per day) of the dewatering system to ensure continuous operation.

B. Construction modifications in the dewatering system may be required by the Engineer to provide adequate performance. In the event of failure of the system, flooding of the excavation may be ordered by the Engineer until the system is operative.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

A. No measurements are required.

A1.02 PAYMENT

A. Payment for the work covered under this Section will be made at the lump sum price bid for "Care of Water During Construction", which payment shall constitute full compensation for all costs of furnishing the labor, equipment, and materials for any temporary diversions and drainage channels, installing pumps and other dewatering equipment as required, maintaining the work area free from water, and removing the temporary protective works as needed to comply with this Section. Partial payments will be made based upon the number of days identified for the Contract and the number of contract days completed. If the contract term is changed by Change Order, the remaining portion of the lump sum will be divided over the remaining term of the Contract for partial payments.

END OF APPENDIX A

31 23 23.34 FLOWABLE FILL

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, and incidentals necessary to mix and place flowable fill, consisting of Portland cement, fine aggregate, fly ash, and water in the proper proportions as specified hereinafter. Flowable fill (Controlled Low-Strength Material, CLSM) shall be used to bed and backfill around piping, utilities, and structures where indicated.

1.02 QUALITY ASSURANCE

A. Design Criteria – Flowable Fill Proportions and Consistency: Flowable fill shall be proportioned to give the necessary workability, strength, and consistency, and shall conform to the following governing requirements:

1. Permeability: Maximum permeability limit of $1x10^{-6}$ cm/sec. This limit shall apply at all locations where flowable fill is used as a utility trench plug (dam) within trench backfill materials.
2. Subsidence: Evaporation of bleed water shall not result in shrinkage of more than 10.4 mm per m (1/8 inch per ft.) of flowable fill depth. Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C940.
3. Strength for Excavatable Flowable Fill: Unconfined compressive strength at 28-days when tested in accordance with ASTM D4832: 100 psi (+/- 50 psi).
    a. Long-term strengths (greater than 90 days) shall not exceed 150 psi.
    b. Where indicated provide Excavatable Flowable Fill around utilities, unless noted otherwise.
    c. Excavatable Flowable Fill shall be excavatable with hand tools and conventional machinery such as backhoes.
4. Strength for Non-Excavatable Flowable Fill: Unconfined compressive strength at 28-days when tested in accordance with ASTM D4832: 150 psi minimum.
    a. Where indicated provide Non-Excavatable Flowable Fill below structures and/or around structures, unless noted otherwise.
5. Fluidity: Flowable fill shall be self-consolidating and non-segregating in accordance with ASTM C1611:
    a. Slump Flow Test: Minimum 20-inch mean spread.
    b. Visual Stability Index (VSI) Test: Less than or equal to 1.
6. Density, minimum: 100 pcf

B. Factory Testing: The Contractor shall be responsible for the design of the material. A trial mix shall be designed by an independent testing laboratory, retained by the Contractor. The testing laboratory shall submit verification that the materials and proportions of the trial mix design meets the requirement of the Specifications. In lieu of trial mix design, Contractor may submit historical data for a mix design used successfully in previous similar

work. The Contractor shall not make changes in materials, either in gradation, source, or brand, or proportions of the mixture after having been approved, except by specific approval of the Engineer.

C. Owner Testing: It is the responsibility of the Contractor to achieve and maintain the quality of material required by this Section. However, the Owner may secure the services of an independent testing laboratory to verify the quality of the flowable fill. The Owner shall have the right to require additional testing, strengthening, or replacement of flowable fill which has failed to meet the minimum requirements of this Section.

1.03 SUBMITTALS

A. Submit mix design on each material required. Provide backup data as required below.

B. Submit historical or trial mix data and test results as a basis for mix design approval. Required data shall include:

1. Permeability test results if plugs are required on Project.
2. Subsidence test results.
3. Strength test results for Excavatable and Non-Excavatable Flowable Fill if used on Project.
4. Fluidity test results.

1.04 STANDARDS AND REFERENCES

A. Materials shall meet recommendation for mix design and placement, as published by National Ready Mixed Concrete Association.

B. The applicable provisions of the following references and standards shall apply to this Section as if written herein in their entirety.

1. ASTM International (ASTM) Standards:

ASTM C33	Specification for Concrete Aggregates
ASTM C40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C150	Specification for Portland Cement
ASTM C618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as Mineral Admixture in Portland Cement Concrete
ASTM C 940	Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 1611	Standard Test Method for Slump flow of Self Consolidating Concrete
ASTM D 4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

2.00 PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C150, Type I or II; or ASTM C595, Type IL.

B. Fly Ash/Pozzolans: ASTM C618, Class F or C.

C. Fine Aggregate: ASTM C33, fine aggregate.

1. ASTM C40: Aggregate shall not contain strong alkali, or organic material which gives a color darker than the standard color.

D. Water: Potable and in conformance with ASTM C1602 and ASTM C1602, Table 2.

E. Performance Additive: As required to meet specification requirements:

1. DaraFill by GCP Applied Technologies.

2. MasterCell 25 by Master Builders Solutions US LLC.

3. Sika Lightcrete Powder by Sika Corporation.

4. Approved equal.

F. Chemical Admixtures for Concrete per ASTM C 494, as required by performance requirements.

2.02 MIXES

A. In the determination of the amount of water required for mix, consideration shall be given to the moisture content of the aggregate. The net amount of water in the mix will be the amount added at the mixer; plus the free water in the aggregate; and minus the absorption of the aggregate, based on a 30 minute absorption period. No water allowance shall be made for evaporation after batching.

B. The methods of measurement of materials shall be such that the proportions of water to cement are closely controlled during the progress of the Work and easily checked at any time by the Owner's representative. To avoid unnecessary or haphazard changes in consistency, the aggregate shall be obtained from sources which will insure a uniform quality and grading during any single day's operation and they shall be delivered to the Work and handled in such a manner that the variation in moisture content will not interfere with the steady production of flowable fill of reasonable degree of uniformity. Sources of supply shall be approved by the Owner's representative.

C. All material shall be separately and accurately measured. All equipment for measurement of materials shall be subject to approval by the Owner's representative.

3.00 EXECUTION

3.01 INSTALLATION

A. Contractor shall give the Owner's representative sufficient advance notice before starting to place material in any area, to permit inspection of the area, and preparation for pouring.

B. Conduct the operation of depositing the material so as to form a well consolidated mass and so as not to develop air pockets in confined spaces.

C. Unless specified otherwise, flowable fill shall be uniformly placed to the depth shown on the Drawings. The fill shall be brought up uniformly to the top of excavation elevation or as otherwise indicated on the Drawings. Placement of flowable fill shall then cease and the fill protected from traffic for a period of not less than 72 hours.

1. To prevent pipe flotation place material in lifts or provide alternate means.
2. Around structures, material shall be placed in lifts. Lift depth shall not exceed 4 feet.
3. When multiple lifts are required, material shall be allowed to harden before placing next lift. Hardening time varies with each mix. Verify flowable fill has reached a penetration number of 1500, in accordance with ASTM C 403, but not less than 3 hours.

D. The material shall be placed against undisturbed trench walls, and shall not be placed on or against frozen ground.

E. At time of placement the ambient temperature shall be 35 F and rising.

3.02 FIELD QUALITY CONTROL

A. An approved testing laboratory shall perform the quality control testing of backfill operations. The testing laboratory shall sample material in accordance with ASTM D5971. The testing laboratory shall monitor backfill operation continuously or at intervals acceptable to the Owner and Engineer at structures. It shall be the responsibility of the Contractor to provide sufficient advance notification to the testing laboratory before backfill operations begin.

1. Strength: A strength test is the average of two cylinders per ASTM D4832.
2. Fluidity: A fluidity test is a Slump Flow Test and a VSI Test per ASTM C1611.
3. For all tests required, at a minimum perform one test per day, but not less than one per 150 cubic yards.

END OF SECTION

31 23 36 TRENCH SAFETY

1.00 GENERAL

1.01 WORK INCLUDED

A. This specification is for the purpose of providing minimum performance specifications and consists of the basic requirements which the Contractor must comply with in order to provide for the safety and health of workers in a trench.

B. Contractor shall develop, design, and implement the trench safety system and will be solely responsible for the adequacy of the trench safety system and providing “a safe place to work” for the workman.

C. Should the trench safety protection system require wider trenches than specified elsewhere, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, including the purchase and installation of alternate materials.

D. Contractor shall comply with all applicable federal, state, and local rules, regulations, and ordinances related to trench excavation and safety.

1.02 STANDARDS

A. The following standard shall be the minimum governing requirement of this specification and is hereby made a part of this specification as if written in its entirety.

1. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926 - Safety and Health Regulations for Construction, Subpart P – Excavations.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 25 13.13 SEEDING FOR EROSION CONTROL

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide labor, materials, equipment and incidentals necessary to seed the slopes and other areas as specified. This specification includes seedbed fertilization, watering, mulching, and emulsifying or tacking the mulch and maintenance until final acceptance by the Owner.

1.02 QUALITY ASSURANCE (NOT USED)

1.03 STANDARDS

A. The seed used on this project will conform to ITEM 164.2 Standard Specifications for Construction of Highways, Streets and Bridges, Texas Department of Transportation.

1.04 DELIVERY AND STORAGE

A. Deliver seed with each variety separately bagged.

1.05 OPTIONS

A. If dry mechanical methods are used, the fertilizer may be spread at the same time as the seed. After sowing, straw mulch will be mechanically spread over the seeded area.

B. When seed and fertilizer are to be distributed as a water slurry, apply the mixture within 30 minutes of mixing.

2.00 PRODUCTS

2.01 MATERIALS

A. Seed: From the previous season's crop, labeled in accordance with the Texas Seed Law.

1. Seed for Fall planting (temporary) shall be one or more of the following small grains as designated by the Engineer: Wheat, oats, rye, or barley.

2. Seed for spring planting (permanent) shall be Bermuda grass.

B. Mulch:

1. Consisting of straw, wood-fiber, mulch nettings, wood chips or other suitable material approved by the Engineer and free of Johnson grass and other noxious weed seeds.

2. Straw mulch shall be oat, wheat or rice straw, prairie hay, Bermuda grass hay, or other hay harvested before seed production and approved by the Engineer. The straw mulch will be kept dry and shall not be rotted or molded. A minimum of 50 percent by weight of the herbage making up the hay shall be 10 inches in length or longer.

C. Topsoil: As specified for Class 12 earth fill in Section 31 05 13 "Soils for Earthwork."

D. Herbicide: Contractor shall be responsible for using herbicides in a manner consistent with label requirements and precautions. Only registered herbicides having a minimal residual

effect shall be used. Contractor shall strictly adhere to all federal, state, and local laws governing herbicide usage.

3.00 EXECUTION

3.01 TOPSOIL PLACEMENT

A. Place topsoil as specified for Class 12 earth fill in Section 31 23 23.16 "Compacted Earth Fill [Landfills and Heavy Earthwork Projects, Excluding Dams]."

3.02 FALL PLANTING

A. Fall planting will be temporary only and will be required if construction is completed between May 15 and November 30. The fall planting is to be followed by a spring planting of perennial vegetation.

B. Seedbed Preparation: Use a one-way plow, tandem disk, bedder, or equipment which will accomplish similar results. Break or mix the surface of the soil with the tillage equipment. Additional tillage operations will be necessary if required so planting can be on a clean, firm seedbed. Chiseling will be necessary on areas which have been severely compacted.

C. Seeding:

1. Seeding will be required on disturbed or excavated areas and on new embankments of whatever nature unless requested otherwise by the Engineer.

2. Optimum fall planting dates are September 1 to November 30. Accomplish the seeding for fall planting within these dates unless approval to do otherwise is obtained from the Engineer. Planting rates when drilled or broadcast are as follows:

Seeding	lb./acre
Wheat	120 lb./acre
Oats	128 lb./acre
Rye	112 lb./acre
Barley	114 lb./acre

3.03 SPRING PLANTING

A. Follow procedures for spring planting if construction is completed between November 30 and May 15, or after a temporary fall planting has been made:

1. Seedbed Preparation: Seedbed preparation for Spring planting is the same as that stated in the Fall planting of temporary cover with one addition: Any temporary cover crop must be top killed using an approved contact herbicide or by mechanically undercutting the growing cover crop, leaving residues on or near the soil surface.

2. Mulching:

a. Spread mulch material on the area to be planted if construction was completed too late for planting a temporary fall crop or if insufficient residues are produced by the fall planting. Mulch the planting areas to control soil erosion and seed loss by wind and water and to promote grass establishment. Apply Mulch hay at the rate of 2

tons per acre and spread uniformly so that about 25 percent of the ground surface is uniformly visible through the mulch.

b. Anchor the mulch hay by treading into the soil with a straight disk type mulch tiller. Perform disking across the slope along contours. Other types of mulch such as wood cellulose fiber or cotton bur mulch may be used at recommended rates, if approved by the Engineer. Apply mulch in a manner that will not hinder emergence of seedlings.

c. Other methods of mulch anchoring are available, including mulch netting, peg and twine, pick chain, slit, and asphalt mulch tie-down. Descriptions of these methods are available in the 1976 Soil Conservation Service report entitled, "Erosion and Sediment Control Guidelines for Developing Areas in Texas."

3. Seeding:

a. Plant Bermuda grass seed between March 1 and May 15. Sow the seed at the rate of 50 pounds of pure live seed (PLS) per acre, or more if required to obtain a complete stand of grass. The PLS content is determined by multiplying the seed package weight by the product of the percent purity and the percent germination, which are contained on the seed label.

b. Accomplish seeding by mechanical means using either broadcasting or drilling type equipment to provide uniform distribution of the seed in the planting areas. Cover Bermuda grass seed by 1/4 to 1/2 inch of soil. If seed is drilled, the distance between drill rows shall not exceed 12 inches. Hydro seeding may be used to apply seed, fertilizer, and wood-fiber mulch with the approval of the Engineer.

3.04 MAINTENANCE

A. Irrigation: Supply the seeded areas with adequate moisture (3- to 4-inch penetration) at 10-day intervals, if needed, for seed germination and plant growth until acceptance by the Owner. Water the seed in a manner which will prevent erosion of the soil. Furnish all water to be used.

B. Repair: Repair washouts and other bare soil areas in a seeded area either by re-seeding, sprigging, or spot sodding, and perform maintenance as needed to establish grass in the area.

C. Weed Control:

1. Control competitive weed growth during the establishment period by mowing and/or with herbicides. Chemical usage shall be in accordance with the current recommendations of the Texas Agricultural Experiment Station or local Soil Conservation Service Field Office Technical Guides. Strictly adhere to all federal, state, and local laws governing herbicides.

2. Weed control shall be the Contractor's responsibility whether topsoil is from on-site or off-site sources and also for seeded areas which are specified not to receive topsoil.

3.05 SEEDING OF DISTURBED AREAS

A. Disturbed areas will require seeding as specified in this Section unless requested otherwise by the Engineer or shown otherwise on the drawings or in the specifications.

B. Any areas which are disturbed by the Contractor which are not shown on the drawings or specified to require disturbance including any approved areas not shown on the drawings, shall be considered as unauthorized disturbed areas. Any such areas shall be seeded as specified in this Section at the Contractor's expense and shall not be measured or paid under this Section.

3.06 FIELD QUALITY CONTROL; OBSERVATION AND ACCEPTANCE

A. Observation: Upon completion of the site preparation, mulching, fertilizing, seeding, and maintenance of seeded areas, the Engineer will observe the seeded areas periodically to determine the establishment success. Engineer will consider soil coverage, purity of the grass stand, and maturity of the plants.

B. Establishment of Stand and Acceptance:

1. The Engineer will determine that a grassed area is established upon fulfillment of the following conditions:

2. The permanent grass stand uniformly covers the planting area, with no exposed soil areas more than 36 inches across in any dimension.

3. The permanent grass stand is free of over-topping weed species which would compete for sunlight, moisture, and nutrients. In addition, no area of pure weed species greater than 36 inches across in any dimension shall occur within a permanent grass stand.

4. The majority of the grass plants in a stand shall have a well-established root system to survive if irrigation is discontinued.

5. Establish the permanent grass stand before October 1 to preclude having to perform a temporary Fall seeding. In the event a fall seeding must be performed, follow-up the temporary seeding with a permanent seeding as specified. Upon final acceptance of the work under this contract, the Owner will assume the responsibility of maintaining the grassed areas.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

A. Areas seeded shall be measured to nearest 0.1 acre by a survey performed by the Contractor. The Contractor shall cooperate with the Engineer to determine the adequacy and accuracy of the survey.

A1.02 PAYMENT

A. Payment for seeding will be made on the basis of the unit price bid per acre for "Seeding for Erosion Control." A maximum of 50 percent completion of any area will be approved for completion of seedbed preparation, mulching, and temporary and permanent seeding. The remaining percentage will be approved after stand establishment.

END OF APPENDIX A

31 32 19.15 GEOTEXTILE

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install geotextile. Use geotextile to provide for the following applications:

1. Stabilization:

a. Use in conjunction with aggregate to stabilize soft soils for roads, storage yards, parking areas or other areas as specified; or

b. Under ballast and/or subballast for mainlines, secondary rail lines, switches, crossings and retarders as specified.

2. Protection/Erosion Protection:

a. Use as a cushion to protect geomembrane liners;

b. Under bedding stone or riprap along channels, shores and waterways; or

c. Under slope protection along highway cut or fill slopes as specified for erosion control applications.

1.02 QUALITY ASSURANCE

A. Design Criteria:

1. The geotextile fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet light exposure, insect and rodent resistant, and conform to the properties in the following table.

2. The minimum average roll value (MARV) in the weakest principle direction for strength properties of any individual roll tested from the manufacturing lot or lots of a particular shipment shall be in excess of the minimum average roll value (MARV) in the weakest principle direction stipulated herein.

Geotextile			
Property	**Test Method**	**Units**	**MARV**
Grab Tensile Strength	ASTM D4632-91	lb.	
Grab Tensile Elongation	ASTM D4632-91	%	
Trapezoid Tear Strength	ASTM D4533-91	lb.	
CBR Puncture Strength	ASTM D6241	lb.	
AOS	ASTM D4751-87	U.S. Standard Sieve Size	
Permittivity	ASTM D4491-92	Sec-1	
UV Resistance (@ 500 hours)	ASTM D4355	% Retained	

B. Packing and Identification Requirements: Provide the geotextile in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, and debris. The fabric shall be free of defects or flaws which significantly affect its physical properties. Label each roll of fabric in the shipment with a number or symbol to identify that production run.

C. Sampling and Compliance Requirements: A competent laboratory must be maintained by the producer of the fabric at the point of manufacture to ensure quality control in accordance with ASTM testing procedures. The laboratory shall maintain records of its quality control results and provide a manufacturer's certificate upon request to the Engineer prior to shipment. The certificate shall include:

1. Name of manufacturer.
2. Chemical composition.
3. Product description.
4. Statement of compliance to specification requirements.
5. Signature of legally authorized official attesting to the information required.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Uniform General Conditions and shall include:

1. Submit Manufacturer's certificate.
2. Samples.

2.00 PRODUCTS

2.01 MATERIALS

A. Geotextile: Non-woven fabric composed of polypropylene fibers, formed into a stable network by needle punching.

3.00 EXECUTION

3.01 INSTALLATION

A. Drainage/Filtration:

1. Exposure of geotextiles to the elements between laydown and cover shall be a maximum of 14 days to minimize potential damage. Install the geotextile fabric in accordance with the Drawings and manufacturer's recommendations. Construction vehicles will not be allowed to traffic directly on the fabric. In trenches, after placing the backfill material, fold the geotextile over the top of the backfill material to produce a minimum overlap of 12 inches for trenches greater than 12 inches wide. In trenches less than 12 inches in width, the overlap shall be equal to the width of the trench. Cover geotextile with the subsequent course of backfill. Overlap successive sheets of geotextile a minimum of 12 inches in the direction of flow.
2. Where seams are required in the longitudinal trench direction, join them by either sewing or overlapping. Seams shall be subject to the approval of the Engineer. Overlap seams a minimum overlap equal to the width of the trench.

3. Repair damaged geotextile with a geotextile patch placed over the damaged area and extended 3 feet beyond the perimeter of the tear or damage.

B. Stabilization:

1. Install the geotextile on the prepared subgrade in accordance with the Drawings and manufacturer's recommendations. Overlaps when necessary shall be 36 inches minimum. The aggregate should be back dumped onto the fabric and spread in a uniform lift maintaining the design aggregate thickness at all times. Construction vehicles will not be allowed to traffic directly on the fabric.

2. Avoid over-stressing the soil by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. Severe rutting at the time of placement is an indication of over-stressing the soil. Such soil over-stressing must be avoided. Increasing aggregate depths and reducing loads are two methods of reducing the pressures on the soil.

3. Fill any ruts which develop during spreading or compacting with additional aggregate rather than blading from surrounding areas.

4. Thoroughly compact the aggregate with vibratory rollers after placement.

C. Protection/Erosion Protection:

1. Install the geotextile fabric in accordance with the Drawings and manufacturer's recommendations. Construction vehicles will not be allowed to traffic directly on the fabric. Individual panels of the geotextile shall be overlapped a minimum of 18 inches or overlapped a minimum of 3 inches and heat bonded. Overlaps shall be oriented in the same direction for all laps in a particular area. Geotextiles may be heat bonded only if the material is 8 ounces per square yard or heavier. Prior to heat bonding, the geotextile installer must demonstrate to the Engineer the ability to perform this type of joining. Areas burned through or damaged by heat bonding shall be repaired. Torn or punctured material shall be patched with sufficient overlap to prevent separation. All geotextile panels shall be temporarily secured from the wind by use of sand bags placed on the overlaps at the perimeters of the geotextile. All geotextiles shall be covered within 1 week with the aggregate or protective cover soil.

2. Aggregate and protective cover soil shall be spread in the direction with the overlaps. Placement of aggregate and protective cover soil on slopes shall begin at the toe and proceed up the slope. Back-dump the aggregate and protective cover soil onto the fabric and spread in a uniform lift maintaining design thickness at all times. Maintain a minimum of 2 feet of aggregate or protective cover soil between the geotextile and the equipment. Avoid over-stressing the soil by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. Severe rutting at the time of placement is an indication of over-stressing the soil. Such soil over-stressing must be avoided. Increasing depths and reducing loads are two methods of reducing pressures on the soil. Fill any ruts which develop during spreading or compacting with additional aggregate or soil rather than blading from surrounding areas.

3. Exposure of geotextiles to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential. Install the geotextile fabric in accordance with the Drawings. Construction vehicles will not be allowed to traffic directly on the fabric. Place and anchor geotextile on a smooth graded surface

approved by the Engineer. The geotextile shall be placed so that placement of the overlying materials will not excessively stretch or tear the fabric. Anchoring of the terminal ends of the geotextile shall be accomplished through the use of key trenches or aprons at the crest and the toe of the slope. Successive geotextile sheets shall be overlapped so that the upstream sheet is placed over the downstream sheet and/or upslope over downslope. In underwater applications, the geotextile and required thickness of backfill material shall be placed the same day. The geotextile shall be placed so that placement of the overlying materials will not excessively stretch or tear the fabric. Overlaps when necessary shall be 12 inches minimum except when placed under water where the overlap shall be a minimum of 36 inches. Use securing pins when necessary to ensure proper anchoring of the fabric, with securing pins spaced at 5- to 10-foot centers. Securing pins shall be 3/16-inch steel bars, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1-1/2 inches. The pin length shall not be less than 19 inches. U-shaped pins or special staples shall be an acceptable option, if approved by the Engineer. Damaged geotextile shall be repaired with geotextile patch placed over the damaged area and extended 3 feet beyond the perimeter of the tear or damage.

4. The backfill placement shall begin at the toe and proceed up the slope. Back-dump the aggregate onto the fabric and spread in a uniform lift maintaining design aggregate thickness. Avoid over-stressing the soil by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. Severe rutting at the time of placement is an indication of over-stressing the soil. Such soil over-stressing must be avoided. Increasing aggregate depths and reducing loads are two methods of reducing pressures on the soil. Fill any ruts that develop during spreading or compacting with additional aggregate rather than blading from surrounding areas.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

A. Geotextile shall be measured to the neat lines and grades indicated on the Drawings for payment by the square yard in place. Measurement will be the nearest square yard. No allowance will be made for material in laps and seams.

A1.02 PAYMENT

A. Payment will be made at the contract unit price bid for "Geotextile", which price and payment shall constitute full compensation for furnishing labor, material, equipment, and performing operations in connection with placing the geotextile as shown on the Drawings. No measurement nor payment will be made for damaged fabric due to the fault or negligence of the Contractor.

END OF APPENDIX A

31 37 00 ROCK RIPRAP

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, tools and incidentals necessary to produce and place the rock riprap and gravel bedding material.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Uniform General Conditions.

B. Certified Test Reports: soundness (ASTM C88), gradation (ASTM C136/ASTM D5519), and unit weight (ASTM C127).

1.03 STANDARDS

A. Sampling and testing of material shall comply with the latest revision of the following except where specifically modified:

1. ASTM International (ASTM):

ASTM C88	Standard Specification for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium sulfate
ASTM C127	Standard Specification for Specific Gravity and Absorption of Coarse Aggregates
ASTM C136	Standard Specification for Sieve Analysis of Fine and Coarse Aggregates
ASTM D5519	Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials

1.04 DELIVERY AND STORAGE; ROCK RIPRAP STOCKPILE

A. Rock Riprap temporarily stockpiled for construction purposes shall be located in an area approved by the Owner. Rock riprap materials shall not be located so as to block or restrict equipment and vehicle access to existing structures.

2.00 PRODUCTS

2.01 MATERIALS

A. Gravel Bedding Material:

1. Gravel bedding material shall be crushed stone, gravel or a blend of crushed stone and gravel. Bedding material shall be composed of tough durable particles; shall be free from thin, flat, and elongated pieces; shall be well graded between the prescribed limits; and shall contain no organic matter or soft, friable particles in quantities considered objectionable by the Owner.

2. Gravel bedding material shall have a loss of less than 18 percent weighted average at five cycles when tested for soundness in magnesium sulfate in accordance with ASTM

C88. The test shall be run using normalized gradation and standardized aggregate sizes. A minimum of one soundness test shall be performed on materials delivered to the Site.

3. Gravel bedding material shall have a gradation as shown on the Drawings when tested in accordance with ASTM C136. The material shall not be skip graded, scalped of certain sizes, or have other irregularities which would be detrimental to the proper functioning of the bedding. Acceptance of bedding material shall be based on in-place gradations.

B. Rock Riprap:

1. Stone for rock riprap shall be durable and of a suitable quality for permanence in the structure and in the climate which it is to be used. The stone shall be free from cracks, seams, and other defects which would tend to increase unduly its deterioration from natural causes and shall be reasonably well graded between the prescribed limits as specified herein.

2. Except as otherwise specified, the rock fragments shall be angular to subrounded. The least dimension of an individual stone fragment shall be not less than one-third the greatest dimension of the stone.

3. Rock riprap shall have a minimum unit weight of 145 pounds per solid cubic foot based upon the bulk specific gravity (saturated surface dry) when tested in accordance with ASTM C127. A minimum of one bulk specific gravity (saturated surface dry) shall be performed on rock riprap material delivered to the Site.

4. Rock riprap shall have a loss of less than 18 percent after five cycles when tested for soundness in magnesium sulfate in accordance with ASTM C88. A minimum of one soundness-in-magnesium sulfate test shall be performed on rock riprap material delivered to the Site.

2.02 MANUFACTURED PRODUCTS

A. Geotextile Fabric: Refer to Section 31 32 19.15 “Geotextile.”

3.00 EXECUTION

3.01 FOUNDATION PREPARATION

A. Trim and dress areas on which gravel bedding and rock riprap are to be placed to conform to cross-sections shown on the Drawings within an allowable tolerance of plus or minus 2 inches from the slope lines and grades shown on the Drawings. Where such areas are below the allowable minus tolerance limit, bring areas to grade with compacted fill similar to the adjacent material in accordance with Section 35 73 13.16 “Compacted Fill [Dams]” or with well compacted gravel bedding material.

3.02 GEOTEXTILE FABRIC

A. Store and place fabric as specified by the manufacturer. Place the geotextile fabric after the foundation is prepared and cover immediately with gravel bedding material.

B. Place fabric with the length running up and down the slope unless otherwise approved. The geotextile shall be placed so that placement of the overlying materials will not excessively

stretch or tear the fabric. Anchoring of the terminal ends of the geotextile shall be accomplished through the use of key trenches or aprons at the crest and the toe of the slope.

C. Make a minimum 24-inch lap on all joints. Secure fabric with nails or pins. Use nails at least 2 inches long with washers or U-shaped pins with legs at least 9 inches long. Space nails or pins at a maximum of 10 feet in each direction and 5 feet along the seams. Alternative anchor spacing may be used when approved.

D. Construction vehicles will not be allowed to traffic directly on the fabric. Damaged geotextile shall be repaired with geotextile patch placed over the damaged area and extended 3 feet beyond the perimeter of the tear or damage.

3.03 GRAVEL BEDDING PLACEMENT

A. Uniformly spread gravel bedding material on the prepared surface, in a satisfactory manner, to the slope lines and grades indicated on the Drawings. Placing of material by dumping from top of slope or by any method which tends to segregate particle sizes within the layer shall not be permitted. Repair any damage to the prepared surface or geotextile fabric during placing of the gravel bedding before proceeding with the Work. Compaction of the gravel bedding will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.

3.04 ROCK RIPRAP PLACEMENT

A. Place stone for rock riprap on the gravel bedding in such manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and construct within the specified tolerance to the lines and grades shown on the Drawings or staked in the field. A tolerance of plus 6 or minus 0 inches from the slope lines and grades shown on the Drawings shall be allowed in the finished surface of the rock riprap. Place rock riprap to its full course thickness at one operation and in such a manner as to avoid displacing the gravel bedding material. Distribute the larger stones evenly and conform the entire mass of stones in their final position to the specified gradation.

B. The finished rock riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Place rock riprap loads along horizontal rows and progress up the slope. Place each load against previously placed rock riprap. Placing rock riprap in layers shall not be permitted. Placing rock riprap by dumping from top of slope, dumping into chutes, or by similar methods likely to cause segregation of the various sizes shall not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by methods of placement which produces the specified results. Rearrange individual stones by mechanical equipment or by hand to the extent necessary to obtain a reasonably well graded distribution of stone sizes. Maintain the rock riprap protection until accepted and replace any material displaced by any cause to the lines and grades shown on the Drawings.

C. Rock riprap shall be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to any new and existing structures.

3.05 EROSION PROTECTION

A. In the event rain is forecasted and a section of the embankment is exposed during rock riprap replacement work, Contractor shall cover the exposed section of the embankment

with geotextile fabric and gravel bedding or plastic tarps to prevent erosion of the embankment material.

3.06 FIELD QUALITY CONTROL TESTING

A. Contractor shall be responsible for providing all testing, including gradation, unit weight, and soundness tests, for the Owner's review of the rock riprap and gravel bedding source prior to approval of the rock riprap for use. Owner will be responsible for the gradation testing of materials in place to determine compliance with the requirements of the Contract Documents. Gradation testing of the rock riprap and gravel bedding materials shall be timed such that each test represents no greater than 1/3 of the material placed. The in-place gradation will be taken using rock riprap and gravel bedding material within a 10-foot by 10-foot square area designated by the Engineer. Contractor shall provide labor and equipment (excluding weight scales and dimension gages) to remove and transport the rock riprap and gravel bedding materials to a suitable site for testing**.**Contractor shall bear all costs, including additional testing, of the correction of materials which fail to meet the requirements of the Contract Documents.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

A. Measurement for Rock Riprap (or Gravel Bedding) shall be to the neat lines and grades indicated on the Drawings or as modified by the Owner, and on the basis of the prescribed thickness measured perpendicular to the slope or surface on which it is placed.

B. Measurement for Rock Riprap (or Gravel Bedding) shall be per ton of material. Provide certified delivery tickets on each load of rock riprap (or gravel bedding). The ticket shall show the truck number, time and date the load was dispatched, tare weight, loaded weight, and net weight of material shipped. The basis of payment shall be the net weight of material shipped. Weight measurements shall be made on state certified scales. Proof of State Certification on scales shall be provided prior to the first shipment.

B. Geotextile fabric shall be measured by the square yard of material placed in accordance with the Contract Documents. No allowance will be made for material in laps, seams or anchor trenches.

A1.02 PAYMENT

A. Gravel Bedding: Payment for the gravel bedding material shall be made at the unit price bid per tonbid for “Gravel Bedding” which payment shall be full compensation for labor, equipment, and materials, and for performing all operations necessary to furnish, transport, haul, handle, place, and test the gravel bedding as specified and as indicated on the Drawings.

B. Rock Riprap: Payment for rock riprap material shall be made at the unit price bid per ton for “Rock Riprap” which payment shall be full compensation for labor, equipment and materials, and for performing all operations necessary to furnish, transport, haul, handle, place, and test the rock riprap as specified and as indicated on the Drawings.

END OF APPENDIX A

32 01 29 RIGID PAVING REPAIR

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to repair and resurface pavement. This section shall govern for the repair or replacement of pavement or other improved surfaces damaged or destroyed in performing the construction of water and sewer lines.

1.02 SUBMITTALS

A. Submittals shall be in accordance Uniform General Conditions and shall include:

1. Proposed material list and sources as Record Data.

2. Experience record of proposed paving subcontractor as Record Data.

1.03 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. Texas Department of Transportation (TXDOT), Standard Specifications for Construction of Highways, Streets, and Bridges, latest edition.

1.04 JOB CONDITIONS

A. Do not place materials when, in the opinion of the Owner's Representative, weather conditions are unsuitable. Do not place concrete when the temperature is 40 F and falling. Concrete may be placed when temperature is above 35 F and rising. Do not place asphalt or asphaltic concrete when the temperature is below 50 F and falling. Asphalt or asphaltic concrete may be placed when temperature is above 40 F and rising.

2.00 PRODUCTS

2.01 MATERIALS

A. Concrete Pavement:

1. Concrete: 5000 psi conforming to Section 03 30 00 "Cast-In-Place Concrete."

2. Reinforcing Steel: Of the same size and spacing as in the existing concrete pavement unless otherwise indicated. New billet steel, deformed bars, conforming to ASTM A615, Grade 60.

B. Asphalt Pavement:

1. Hot Mix Asphaltic Concrete:

a. HMAC Surface Course: Conforming to TXDOT Standard Specifications, Item 340, Type D.

b. Asphaltic Materials Used in the Mix: Conforming to TXDOT Standard Specifications, Item 300. The grade of asphalt shall be AC-10. Other grades of asphalt will be considered if weather conditions or mix design appear to warrant a change.

c. Aggregate: Conforming to TXDOT Standard Specification, Item 340.2.

d. Prime Coat: Conforming to TXDOT Standard Specifications, Item 300, Grade MC-30, or an appropriate asphalt emulsion.

e. Tack Coat: Cut-back asphalt RC-250 or MC-30 conforming to TXDOT Standard Specification, Item 300 unless otherwise approved by the Owner's Representative.

2. Flexible Base: Of the depth and to the extent shown on the plans. Unless otherwise shown on plans, flexible base shall be one or more of the following listed options:

a. Flexible Base Material: Conforming to TXDOT Standard Specifications, Item 247, Type A, Grade 1 or Grade 2.

b. Full Depth Asphaltic Concrete: Conforming to TXDOT Standard Specifications, Item 340, Type A (Coarse Base), B (Fine Base), or C (Coarse Surface).

3.00 EXECUTION

3.01 PREPARATION

A. Concrete Pavement: Cut pavement in parallel straight lines a minimum of 1 foot outside trench walls on each side to permit pavement removal before trench excavation. Make cuts by sawing partial pavement depth to avoid cutting reinforcing steel. After concrete pavement is broken up and removed, cut off existing reinforcing steel to provide a minimum of 30 bar diameters lap with new reinforcing steel on each side and bent back to clear the trench for excavation and pipe laying.

B. Asphalt Pavement: Cut paved surface in parallel straight lines outside trench walls prior to trench excavation. Before pavement replacement has begun, make additional straight line cuts and remove pavement a minimum of 1 foot outside trench walls.

C. Subgrade: The subgrade, including granular trench backfill, shall be approved by the Owner's Representative before any base or pavement surface is replaced. Moisten, reshape, and re-compact subgrade as necessary to receive the base material.

3.02 INSTALLATION

A. Concrete Pavement Replacement:

1. Install reinforcing steel on the approved subgrade and securely tie in place. Bend down existing reinforcing into proper position and securely tie each bar to new reinforcing bars. Support and tie reinforcing to steel bar chairs or other suitable supporting devices. New reinforcement shall be of equal size and spacing to existing steel, unless otherwise indicated. Install substantial forms to proper grade at pavement edges.

2. Rapidly deposit concrete on the subgrade in successive batches and distribute to the required depth and for the entire width of the pavement by shoveling or other approved methods. Do not use rakes in handling concrete. The placing operation shall be continuous. Level the concrete, as soon as placed, and then struck off and screed to

such elevation above grade that when consolidated and finished the surface of the pavement shall be at the proper elevation. Tamp the entire surface and consolidate the concrete so as to insure maximum compaction and a minimum of voids.

3. After final floating and while the concrete is still workable, finish the surface to provide a uniform surface of gritty texture by brooming, use of belting, burlap drags or other approved methods.

4. Cure the concrete with an approved curing compound or other approved means. Concrete pavement shall not be opened to traffic until it has gained sufficient strength to withstand traffic without damage unless approved protective devices are provided. Concrete pavement at an age of 7 days or a strength of 4000 psi may be opened to traffic.

B. Flexible Base:

1. Where the base course exceeds 6 inches in thickness, construct the flexible base in two or more courses of equal thickness. Wet, manipulate, and compact material to 95 percent maximum density as determined by ASTM D698. Where deemed necessary by the Owner's Representative, apply a uniform application of prime coat asphaltic material to the surface of the prepared subgrade, applied at a rate of not less than 0.30 gallon per square yard of surface.

C. Asphalt Pavement Replacement:

1. Hot Mix Asphaltic Concrete: Apply prime coat to base or tack coat base as indicated. Coat contact surfaces of pavement edges and structures with asphalt before any pavement is placed. Do not place pavement until the Owner's Representative has approved the base. Hauling or transporting of the material to the project site, placing, compaction, and shaping shall be in accordance with TXDOT Standard Specification Item 340.6 as applicable for small areas. After final compaction of the pavement, no vehicular traffic of any kind shall be permitted until the pavement has cooled and hardened for at least 6 hours. Smooth the finished surface course, upon completion of final rolling true to grade and cross-section. Immediately correct low or defective areas by cutting out the faulty areas and replacing with fresh, hot mixture. Compact the area to conform to the remainder of the pavement.

D. Other Improved Surfaces: Where water, storm drains, or sewer lines to be constructed traverse or cross through gravel surfaced public roads or shoulders, or private dirt or gravel driveways or parking areas, replace the surface with a quality material, workmanship and at a thickness at least equal to the existing surfaces.

END OF SECTION

DISCLAIMER OF LIABILITY

The Owner and Architect/Engineer disclaim any responsibility for the accuracy, true location and extent of the soils investigation that has been prepared by others. They further disclaim responsibility for interpretation of that data by Bidders. Report of the soils investigation is bound in this project manual for the Bidders' convenience only and IS NOT AND SHALL NOT CONSTITUTE PART OF THE BIDDING AND CONTRACT DOCUMENTS.

Innovative approaches
Practical results
Outstanding service

Lake Dunlap I-35 Boat Ramp Replacement Geotechnical Data Report

Prepared for:

Texas Parks and Wildlife Department (TPWD)

Project No. 1111298

November 2024

Prepared by:

FREESE AND NICHOLS, INC.
10431 Morado Circle, Suite 300
Austin, Texas 78759
512-617-3100

FNI Project No. TPW24561

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APPENDICES

1.0 INTRODUCTION

The Texas Parks and Wildlife Department (TPWD) maintains an existing boat ramp on the Guadalupe River where it crosses beneath Interstate Highway 35 (I-35) in New Braunfels, Texas, near Exit 188 of I-35. The subject boat ramp is located approximately 1.25 miles southeast of downtown New Braunfels, Texas, and it is owned by the TPWD. **Appendix A** shows a vicinity map for the Project site. In May of 2019, a failure of a gate at Lake Dunlap Dam reduced the water level of the river and exposed the existing condition of the subject boat ramp. The end of the ramp is currently undermined with missing foundation material, causing it to cantilever over the riverbed.

TPWD contracted Freese and Nichols, Inc. (FNI) to recommend possible repair alternatives that would address the unsatisfactory existing condition of the subject boat ramp. FNI delivered a preliminary engineering report (PER) in April 2023 and provided repair alternatives.

TPWD chose to pursue the repair alternative "Option 3" presented in the PER, which consists of replacing the existing ramp with a new inset ramp. The proposed repair alternative addresses the issues with the existing boat ramp and adds resiliency to the site against erosion and related adverse impacts.

This geotechnical data report (GDR) is part of the Phase 2 services focusing on the final design of the inset ramp alternative.

1.1 AUTHORIZATION AND SCOPE

The subject Project involved coordination with Beyond Engineering & Testing, LLC (Beyond) to provide preliminary geotechnical services for the evaluation of existing geotechnical subsurface conditions at the Project site. These services included the following actions:

- Prepare for, supervise, drill and log one (1) geotechnical borehole (boring) near the top of the existing boat ramp.
- Collect and transport soil and rock (if applicable) samples from the boring to a laboratory testing facility for testing of specific samples.
- Prepare a geotechnical data report (GDR) to document existing geotechnical subsurface conditions, including a summary of the field exploration and laboratory testing. FNI will use the GDR to design the proposed boat ramp repair alternative.

2.0 FIELD EXPLORATION

Beyond drilled one boring for this Project, and FNI assigned laboratory testing to specific samples from the boring. This section of the GDR describes the details of the field exploration.

2.1 BORING LOCATION

Table 1 summarizes information of the boring drilled by Beyond. The Boring Location Map in **Appendix A** shows the location of the boring.

Table 1: Informational Data for Geotechnical Boring

Boring No.	General Description of Location	Latitude [degrees]	Longitude [degrees]	Date Drilled	Boring Depth [ft]	Elevation (1) [feet NAVD88]
B-1	Northeast corner of the existing boat ramp	29.69263	-98.10751	9/23/2024	31.5	578.6

(1) Ground surface elevation at the top of the borehole.
(2) Boring coordinates and elevation were estimated from the topographic information provided by TPDW (Dec 2022)

2.2 DRILLING AND SAMPLING

Beyond drilled and sampled from one boring (Boring B-1) at the Project site. Beyond used hollow-stem auger (HSA) and wash/wet rotary (WR) drilling methods to perform the borehole using a B-46 mobile truck-mounted drilling rig. Standard penetration test (SPT) split-spoon sampling. The borehole was tremie grouted using cement-bentonite hole plug material and patched with 8-inches thick asphalt.

Beyond logged soil samples and relevant information under the supervision of an FNI geotechnical engineer. After logging, moisture sensitive samples were sealed in plastic bags, and the samples were then placed in sample boxes for transport. All samples were transported to Beyond's laboratory for classification testing in their Round Rock, Texas laboratory.

2.3 BORING LOG

Appendix A contains the boring log and an explanation of the symbols and terms used on the log. Stratigraphic break lines are shown on the boring log, which correspond to the approximate boundaries between the strata or layers encountered within the subsurface. The actual transitions between the strata may be gradual and vary with vertical depth and horizontal extent.

3.0 LABORATORY TESTING

The laboratory testing results are provided in **Appendix B**. Laboratory testing results are also reported on the boring log at the corresponding depths.

Beyond classified the materials according to the Unified Soil Classification System, which is based on ASTM D2487. The laboratory testing program included the following:

- Moisture Content Tests, ASTM D2216, "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass."
- Atterberg Limits, ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils."
- Particle Size Analysis/Gradation, ASTM D6913, "Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis."
- Unconfined Compressive Strength (UCS) of Soil, ASTM D2166, "Standard Test Method for Unconfined Compressive Strength of Cohesive Soil."

Beyond also measured the unit dry weight (UDW) and moisture content of the UCS samples. The UDW tests were performed in accordance with ASTM D7263, "Standard Test Methods for Laboratory Determination of Density and Unit Weight of Soil Specimens."

4.0 SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

Beyond drilled Boring B-1 on the eastern side of the Guadalupe Riverbank at the Project site. The site geology generally consists of fluviatile terrace deposits (Qt) underlain by Pecan Gap Chalk (Kpg), according to **Map 3** in **Appendix A** of this report (Source: the U.S. Geological Survey (USGS), TNRIS, and The University of Texas Bureau of Economic Geology, "Geologic Atlas of Texas (1987)," digitized in 2002, https://txpub.usgs.gov/txgeology/).

The USGS describes Qt as "Gravel, sand, silt, and clay; adjacent to Edwards Plateau, predominantly gravel, limestone, dolomite, and chert; southeastward in vicinity of Tertiary rocks, increasing amounts of sand, silt, and clay; contiguous terraces are separated by a solid line. On the previous edition of the San Antonio Sheet low terrace deposits composed of gravel, sand, silt, clay, and organic material were shown in a separate color. These low terrace deposits are mostly above flood level along entrenched streams; fluviatile morphology well preserved with point bars, oxbows, and abandoned channel segments; most rivers below Balcones escarpment are entrenched and do not have active floodplains; some exceptions are Nueces River, part of Medina River, and San Antonio River below mouth of Medina."

The USGS describes Kpg as "chalk and chalky marl, more calcareous westward, very light yellow to yellowish brown, weathers to form moderately deep soil, seldom exposed; Exogyra ponderosa common; thickness 100-400 feet, thins westward to eastern Medina County where it is overlain by Anacacho Limestone, beyond this point included with Austin Chalk."

4.2 GENERALIZED STRATIGRAPHY

The subsurface stratigraphy encountered in Boring B-1 during the field exploration consists of 6 inches of hot-mix asphalt concrete (HMAC) pavement underlain by approximately 3.5 feet of medium stiff (firm) to very stiff clays and loose clayey sand. Approximately 6 feet of medium dense sand with fines (SM/SC) with gravel were found under the clays. Shaley fat clay (CH) to clay shale was encountered below the sand layer and extending to the borehole termination depth of 31.5 feet below the existing ground surface (bgs).

4.3 GROUNDWATER

Observations were made during the field exploration for the occurrence of seepage and/or the collection of groundwater in the boreholes. Seepage was observed 3.5 feet bgs during drilling and remained at 3.5 feet bgs after 15 minutes delayed reading. The boring log shows the groundwater noted in the field.

5.0 SUMMARY OF LABORATORY TESTING RESULTS

Laboratory testing results are summarized in the following sections. Laboratory testing data sheets and a summary of results are provided in **Appendix B.**

5.1 ATTERBERG LIMITS AND MOISTURE CONTENT

Beyond performed Atterberg Limits and moisture content testing on specific soil samples. **Table 2** summarizes these laboratory testing results. The Liquid Limit (LL) and Plasticity Index (PI) laboratory testing results indicate that shaley clay encountered approximately 10 feet bgs could be classified as fat clay (CH).

Table 2: Atterberg Limits and Moisture Content Laboratory Testing Results

Boring No.	Material Description from Boring Log	Sampling Depth [ft bgs]	Moisture Content, ω [%]	Liquid Limit, LL [%]	Plastic Limit, PL [%]	Plasticity Index, PI [%]
B-1	Shaley clay	10	19.0	53	21	32
	Clay shale	15	18.9	---	---	---
		20	21.8	---	---	---
		25	16.4	---	---	---

5.2 UNCONFINED COMPRESSIVE STRENGTH

Beyond performed unconfined compressive strength (UCS) tests on two clay shale samples from the bottom of Boring B-1. **Table 3** summarizes the unconfined compressive strength results. Unconfined compression test reports are provided in **Appendix B**.

Table 3: Unconfined Compressive Strength (UCS) Test Results

Boring No.	Material Description from Boring Log	Sampling Depth [ft bgs]	Unconfined Compressive Strength, UCS [tsf]	Undrained Shear Strength, S_u [tsf]	Strain at Failure of UCS Lab Test [%]
B-1	Clay shale	20	6.7	3.33	15.0
		25	16.3	8.14	11.6

Table 4 summarizes the unit dry weight values. SPT-N blow counts, in terms of blows per foot (bpf) as measured during drilling, for the samples tested in the laboratory are also shown in this table.

Table 4: Unit Weight and In-situ SPT Resistance Results

Boring No.	Material Description from Boring Log	Sampling Depth [ft bgs]	Unit Dry Weight, γ_d [pcf]	SPT-N Blow Count [bpf]
B-1	Sandy Silt and Clay, with trace gravel	2.5	---	19
	Sand with fines (SM/SC), with gravel	5.5	---	14
	Shaley clay	10	---	51
	Clay shale	15	---	54
		20	104.0	60
		25	114.8	24 - 36 - 50/5"

5.3 GRAIN SIZE DISTRIBUTION

Beyond performed grain size distribution (GSD) or sieve analysis on two soil samples from the top of Boring B-1. The percent silt and clay is also called the percent passing the No. 200 sieve (P-200) or fines content. **Table 5** summarizes the GSD results for this Project.

Table 5: Grain Size Distribution (GSD) Laboratory Testing Results

Boring No.	Material Description from Boring Log	Sampling Depth [ft bgs]	Percent Gravel [%]	Percent Sand [%]	Percent Fines, P-200 (Silt and Clay) [%]
B-1	Sandy Silt and Clay, with trace gravel	2.5	2.0	35.1	62.9
	Sand with fines (SM/SC), with gravel	5.5	36.3	43.8	19.9

6.0 LIMITATIONS

This Geotechnical Data Report was prepared specifically for use by Freese and Nichols, Inc. and the Texas Parks and Wildlife Department for the aforementioned Lake Dunlap I-35 Boat Ramp Replacement Project and should not be used for other projects or purposes. The intent of this report is to present the data obtained during the field exploration and laboratory testing programs and does not contain conclusions or recommendations based on the data collected. Freese and Nichols, Inc. makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report, and any future addenda or reports regarding the site specific to the subject Project, may be made available to bidders to supply them with the data contained in this report regarding probable subsurface conditions and laboratory test results at the location and time noted; however, additive conclusions or recommendations made from the information presented by others are their responsibility. Paragraphs, statements, test results, boring logs, figures, etc., should not be taken out of context, nor utilized without a knowledge and awareness of their intent within the purpose of this report.

APPENDIX A

FIELD EXPLORATION DATA

FNI PROJECT:	TPW24561
FILE:	TPW24561 GDR Maps.pub
DATE:	November 2024
PREPARED BY:	JJG

FREESE AND NICHOLS

10431 MORADO CIRCLE, SUITE 300
AUSTIN, TEXAS 78759

TEXAS PARKS AND WILDLIFE DEPARTMENT (TPWD)

LAKE DUNLAP I-35 BOAT RAMP REPLACEMENT

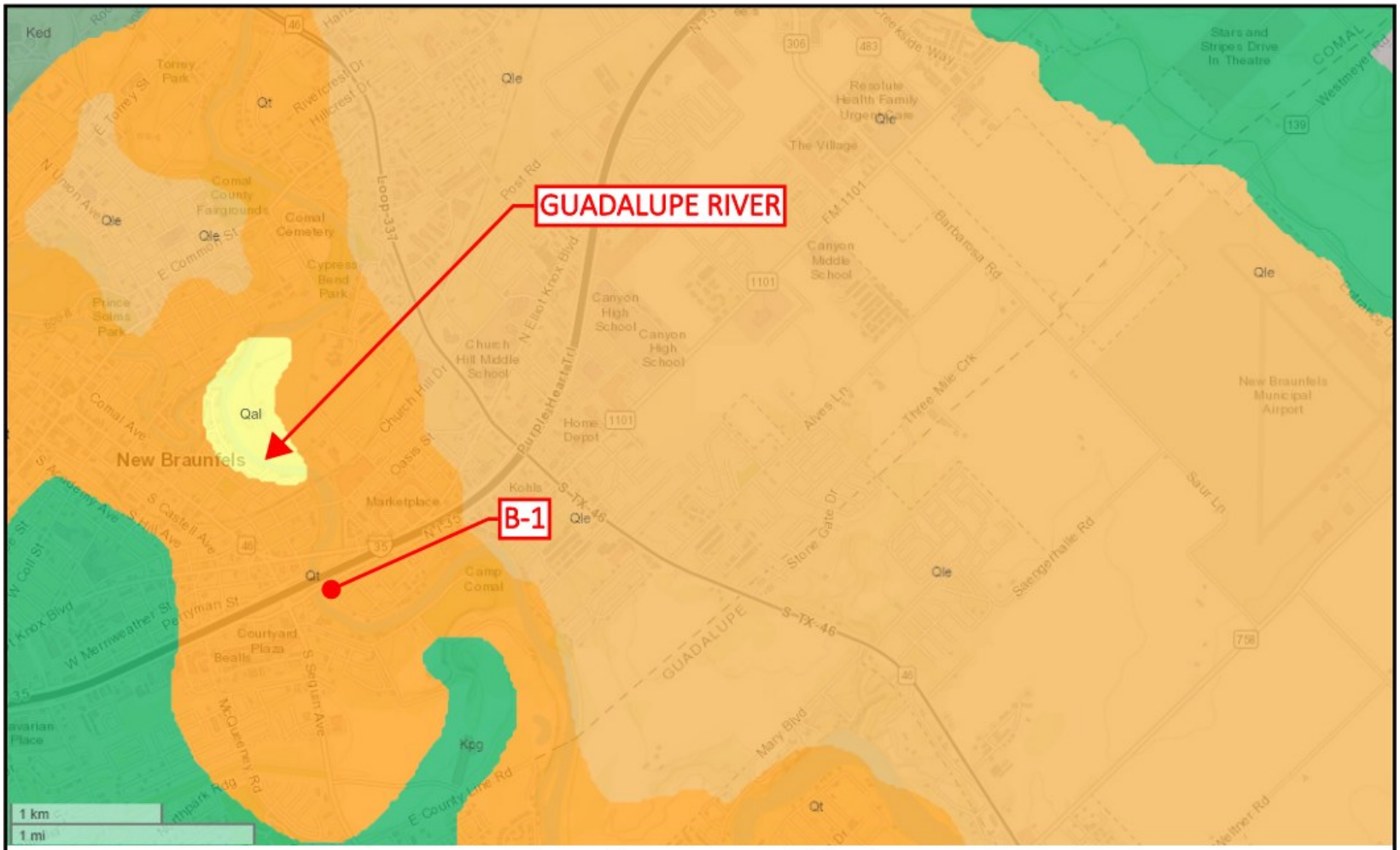
APPENDIX A: FIELD EXPLORATION DATA

VICINITY MAP

MAP

1

FNI PROJECT: TPW24561	FREESE AND NICHOLS	TEXAS PARKS AND WILDLIFE DEPARTMENT (TPWD)	MAP
FILE: TPW24561 GDR Maps.pub		**LAKE DUNLAP I-35 BOAT RAMP REPLACEMENT**	
DATE: November 2024	10431 MORADO CIRCLE, SUITE 300	APPENDIX A: FIELD EXPLORATION DATA	2
PREPARED BY: JJG	AUSTIN, TEXAS 78759	**BORING LOCATION MAP**	



LEGEND (Youngest to Oldest)

Symbol	Name	Age
Qal	Alluvium	Quaternary Period / Holocene Epoch
Qt	Fluviatile terrace deposits	Quaternary Period / Pleistocene Epoch
Qle	Leona Formation	Quaternary Period / Pleistocene Epoch
Kpg	Pecan Gap Chalk	Cretaceous Period (Upper/Late)
Ked	Edwards Limestone	Cretaceous Period (Lower/Early)

FNI PROJECT: TPW24561	FREESE AND NICHOLS	TEXAS PARKS AND WILDLIFE DEPARTMENT (TPWD)	MAP
FILE: TPW24561 GDR Maps.pub		**LAKE DUNLAP I-35 BOAT RAMP REPLACEMENT**	
DATE: November 2024	10431 MORADO CIRCLE, SUITE 300	APPENDIX A: FIELD EXPLORATION DATA	3
PREPARED BY: JJG	AUSTIN, TEXAS 78759	**USGS GEOLOGIC MAP**	

LOG OF BORING NO. B-1

Project Description: Lake Dunlap I-35 Boat Ramp Replacement
Project Location: New Braunfels, Texas
Project No.: TPW24561
Date Drilling Started: 9/23/2024
Phase No.: ****
Logged By: Beyond
Drilling Co.: Beyond Engineering and Testing
Date Drilling Completed: 9/23/2024
Rig Type: B-46 Mobile Truck
Hammer Type: Automatic
Drill Method: CFA & Rotary Wash
Latitude: 29.692630
Longitude: -98.107510
Elevation: 578.6 ft.

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
							6 inches hot mix asphalt concrete (HMAC), no base 0.5/578.1									
	SPT-1	8-9-10 (19)					CLAY, brown, tan and dark brown, very stiff, moist, with scattered limestone gravel (Qt, Fluviatile terrace deposits) 2.5/576.1									
	SPT-2	1-1-6 (7)					SANDY SILT AND CLAY, brown and dark brown, medium stiff, wet, with trace gravel (Qt, Fluviatile terrace deposits) 3.8/574.8			63						
5	SPT-3	3-6-8 (14)					SAND WITH FINES (SM/SC), tan, medium dense, wet, with gravel (Qt, Fluviatile terrace deposits)			20						574
	SPT-4	3-6-8 (14)														
10	SPT-5	14-21-30 (51)					SHALEY FAT CLAY (CH) to CLAY SHALE, gray, hard, moist (Kpg, Pecan Gap Chalk?) 9.5/569.1	19			53	21	32			569
15	SPT-6	13-20-34 (54)						19								564
20	SPT-7	20-24-36 (60)						22	104					6.7	15	559
25	SPT-8	24-36-50/5.00"						16	115					16.3	11.6	554
30	SPT-9	24-38-50/5.00"														549
							Total boring depth 31.5 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)	3.5	3.5	
NOTES		After 15 minutes	

Remarks:

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

BORING LOG LEGEND AND NOMENCLATURE

Abbreviations		
U – Undisturbed Sample (tube)	SPT – Standard Penetration Test	NT – Not Testable
A – Auger Sample	TCP – Texas Cone Penetration	NP – Non Plastic
CS – Continuous Sample	CFA – Continuous Flight Auger	ATD – At Time of Drilling
C – Rock Core	HSA – Hollow Stem Auger	AD – After Drilling

General Terms

Term	*Description*
Blow Counts	Results from either the Standard Penetration Test (SPT) or the Texas Cone Penetration (TCP) test.
Recovery	Length of sample or core recovered divided by the total length pushed, driven, or cored (expressed as a %)
Rock Quality Designation (RQD)	Cumulative length of unfractured pieces of core material more than 4 inches in length divided by the total length of material cored (expressed as a percentage)

Consistency of Fine Grained Soil

Description	*Unconfined Compressive tsf*	*Pocket Penetrometer tsf*
Very Soft	< 0.25	—
Soft	≥ 0.25 – < 0.5	< 1
Medium Stiff	≥ 0.5 – < 1.0	1—2
Stiff	≥ 1.0 – < 2.0	2—3
Very Stiff	≥ 2.0 – < 4.0	3—4.5
Hard	≥ 4.0	4.5+

Apparent Density of Coarse Grained Soil

Description (Density)	*Standard Penetration N—Valve*	*Texas Cone Blow Count*
Very Loose	0—4	0 – 8
Loose	>4—10	9—20
Medium Dense	>10—30	21-80
Dense	>30—50	81—≥ 5”
Very Dense	> 50	0” - < 5”

Soil Structure

Description	*Criteria*	*Thickness*
Stratified	Alternating layers of varying material/color with layers ≥ 1/4-inch thick	Parting—paper thin
Laminated	Alternating layers of varying material/color with layers < 1/4-inch thick	Seam—1/8—3”
Fissured	Breaks along definite planes with little resistance	Layer—3” - 12”
Slickensided	Fracture planes appear polished or glossy; shows movement direction	Stratum—> 12”
Blocky	Cohesive soil that can be broken into small, angular lumps	
Lensed	Inclusion of small pockets of soil that is different from dominate type	
Homogenous	Same color and appearance throughout	

Moisture Condition

Description	*Criteria*
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

Textural Adjectives

Textural Item	*Description*
Pit	*Pinhole* sized openings
Vug	*Small* openings up to 4 inches in size
Cavity	*Opening* larger than 4 inches
Honeycomb	Numerous and grouped pits and vugs
Vesicle	Small openings in volcanic rocks

BORING LOG LEGEND AND NOMENCLATURE

Rock Hardness Descriptors			
Grade	*Approx. Comp. Strength, tsf*	*Approx. TCP Range*	*Field Test*
Very Soft	< 10 - 100	>6”	Can be peeled with pocket knife, crumbles under firm blows of geological hammer
Soft	100 - 500	4” - 6”	Can be peeled with pocket knife with difficulty, indented by firm blows of geological hammer
Hard	500 - 1000	1” - 5”	Cannot be peeled with pocket knife, can be fractured by single firm blow of hammer
Very Hard	1000 - 2000	0” - 2”	Specimen requires more than one blow of geological hammer to fracture it
Extremely Hard	> 2000	0”	Specimen requires many blows of geological hammer to fracture it

Degree of Rock Weathering	
Description	*Criteria*
Unweathered	No evidence of chemical or mechanical alteration
Slightly Weathered	Slight discoloration of surface or discontinuities; < 10% volume altered
Weathered	Discoloring evident; 10 to 50% of volume altered
Highly Weathered	Entire mass discolored; alteration through majority of rock
Decomposed	Rock reduced to soil consistency with some rock-like texture

Rock Bedding Structure	
Description	*Criteria*
Laminated	< 3/8 inch
Very Thinly Bedded	3/8—1 inch
Thinly Bedded	1 inch—4 inches
Moderately Bedded	4 inches—1 foot
Thickly Bedded	1 foot—3 feet
Very Thickly Bedded	3– 10 feet
Massive	> 10 feet

Soil Column Graphic Symbols*

		Graphic	*Represented Soil Types*
Silts & Clays	CH		Fat Clay, Fat Clay with sand, Sandy Fat Clay
	CL		Lean Clay, Lean Clay with sand, Sandy Lean Clay, Silty Clay
	MH-ML		Inorganic Silt and Organic Silt
Sands	SC		Clayey Sand, Clay-Sand Mixtures
	SM		Silty Sands, Sand-Silt Mixtures

		Graphic	*Represented Soil Types*
Sands	SW-SP		Well-Graded Sand or Poorly-Graded Sand; little to no fines
Gravel	GC		Clayey Gravel, Gravel-Sand-Clay Mixtures
	GM		Silty Gravel, Gravel-Sand-Silt Mixtures
	GW-GP		Well-Graded Gravel or Poorly-Graded Gravel; little to no fines
			Fill with Significant Debris or Deleterious Material

Rock Column Graphic Symbols*

Graphic	Represented Rock Types	Graphic	Represented Rock Types
	Limestone, Shaly/Marly Limestone, Limestone with Shale		Marl, Marl with Limestone, Marl with Shale
	Shale, Shale with Limestone		Sandstone, Shaly Sandstone, Sandstone with Shale
	Mudstone		Generic Bedrock Symbol

* Combined graphics may be used for dual classifications. Not all graphics represented. Refer to lithology description for soil classification or rock type.

APPENDIX B

LABORATORY TESTING DATA

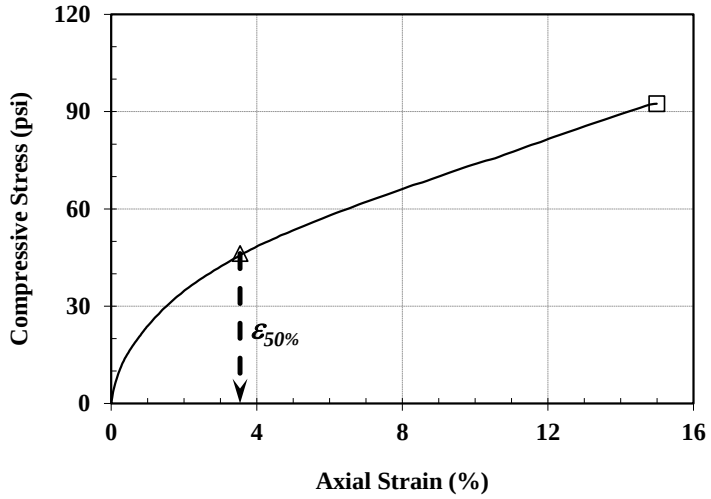
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Lake Dunlap Boat Ramp (PN: TPW24561)
Sample I.D.: B-1 at 20-21.5 ft

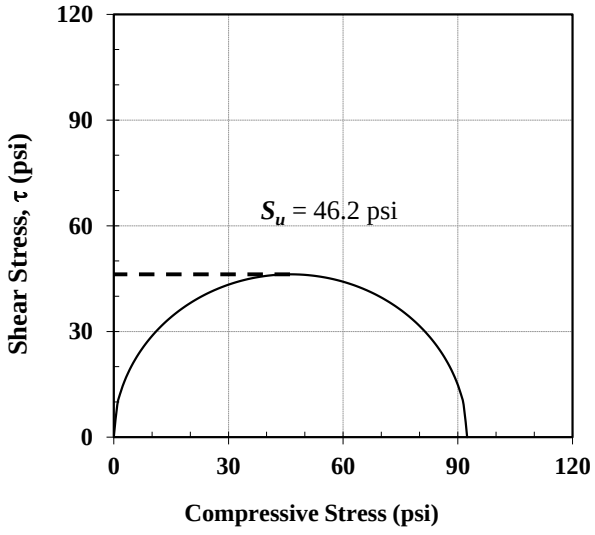
Project No.: DT2409035
Test Method: ASTM D2166

Type of Specimen: Spilt Spoon
Strain Rate: 1.0 %/min
Test Date: 9/27/2024



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	1.44
Avg. Height (in)	H_o	3.96
Water Content (%)	w_o	21.8
Total Unit Weight (pcf)	γ_{total}	126.8
Dry Unit Weight (pcf)	γ_{dry}	104.0
Saturation (%)	S_r	95.1
Void Ratio	e_o	0.62
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	6.7
Axial Strain at Failure (%)	15.0
Axial Strain at 50 % of q_u (%)	3.5
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	92.4
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	3.33

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 10/01/24
Quality Review/Date
Specimen prepared & tested by: J.D.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Lake Dunlap Boat Ramp
(PN: TPW24561)
Specimen: B-1 at 20-21.5 ft

Project No.: DT2409035
Test Method: ASTM D2166
Test Date: 09/27/24

Failure Mode: Single Inclined Failure Plane

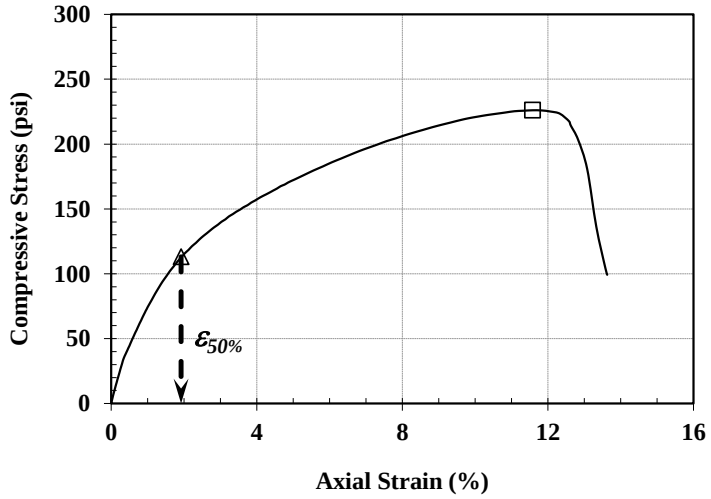
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Lake Dunlap Boat Ramp (PN: TPW24561)
Sample I.D.: B-1 at 25-26.5 ft

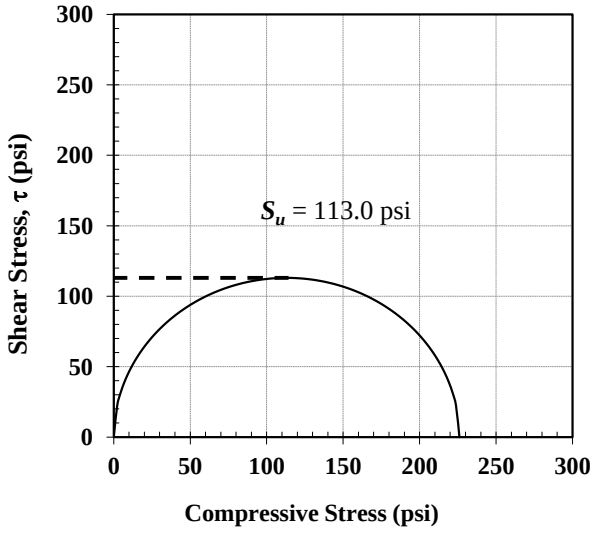
Project No.: DT2409035
Test Method: ASTM D2166

Type of Specimen: Spilt Spoon
Strain Rate: 1.0 %/min
Test Date: 9/27/2024



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	1.38
Avg. Height (in)	H_o	3.83
Water Content (%)	w_o	16.4
Total Unit Weight (pcf)	γ_{total}	133.6
Dry Unit Weight (pcf)	γ_{dry}	114.8
Saturation (%)	S_r	94.3
Void Ratio	e_o	0.47
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	16.3
Axial Strain at Failure (%)	11.6
Axial Strain at 50 % of q_u (%)	1.9
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	226.0
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	8.14

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

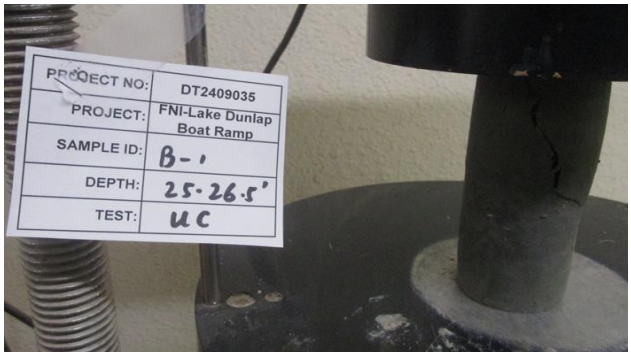
Te-An Wang, EIT, 10/01/24
Quality Review/Date
Specimen prepared & tested by: J.D.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Lake Dunlap Boat Ramp
(PN: TPW24561)
Specimen: B-1 at 25-26.5 ft

Project No.: DT2409035
Test Method: ASTM D2166
Test Date: 09/27/24

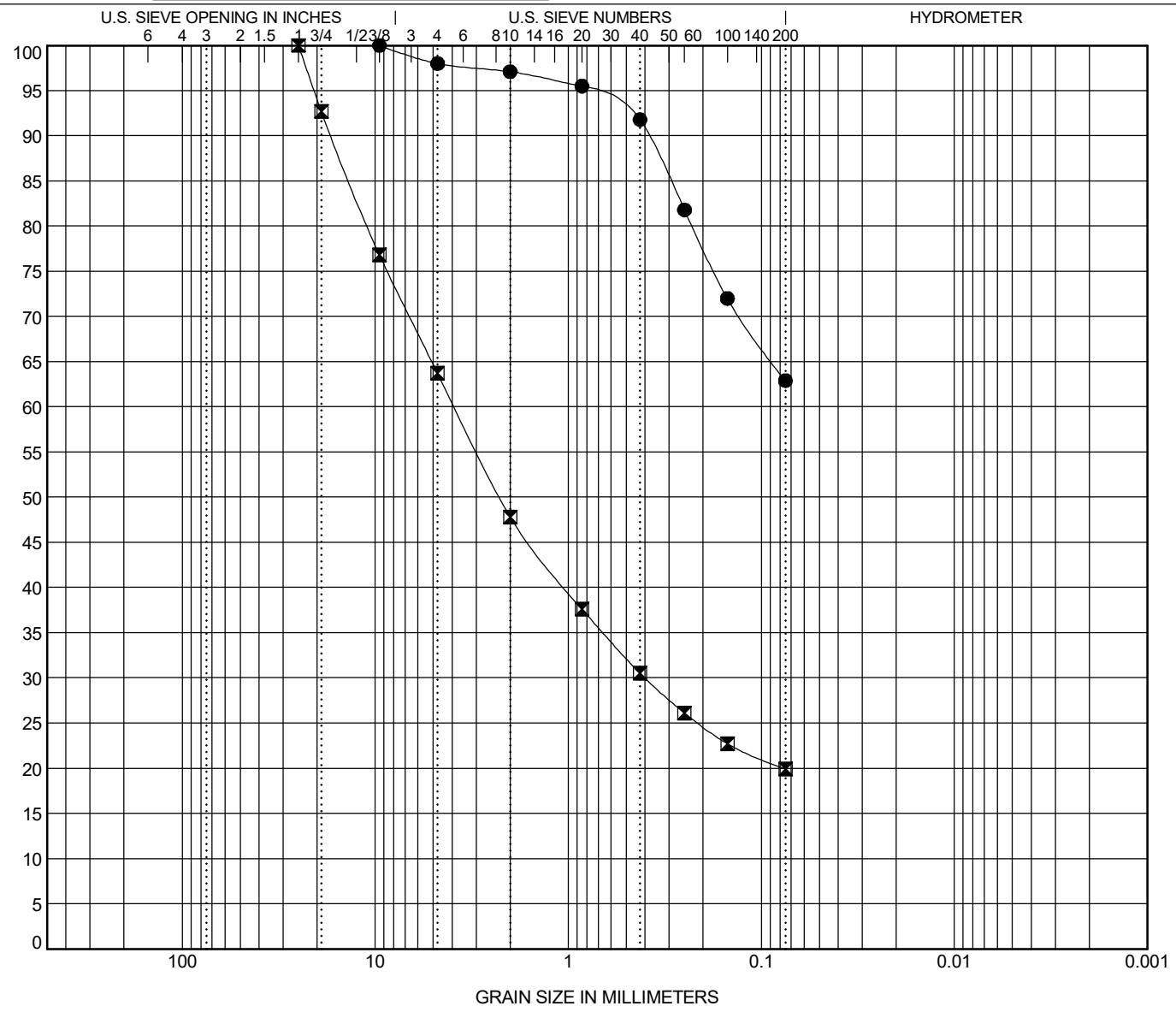


Failure Mode: Single Inclined Failure Plane

GRAIN SIZE DISTRIBUTION

PROJECT NAME Lake Dunlap Boat Ramp **PROJECT NUMBER** TPW24561 **PROJECT PHASE** _____

PROJECT LOCATION _____ **TESTING PERFOMED BY:** _____



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**2.5**						
⊠	**B-1**	**5.5**						

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**2.5**	**9.5**				**2.0**	**35.1**	**62.9**	
⊠	**B-1**	**5.5**	**25**	**3.884**	**0.4**		**36.3**	**43.8**	**19.9**	

GRAIN SIZE - FNI ROCK LOG.GDT - 10/2/24 16:17 - C:\USERS\HUAMIAOCAO\DESKTOP\DT2409035-FNI-IH-35 NEW BRAUNFELS\DT2409035-FNI-LAKE DUNLAP BOAT RAMP.GPJ

SUMMARY OF LABORATORY RESULTS

PROJECT NAME Lake Dunlap Boat Ramp **PROJECT NUMBER** TPW24561 **PROJECT PHASE** _____

PROJECT LOCATION _____ **TESTING PERFOMED BY:** _____

Borehole	Depth, ft	Water Content, %	Unit Dry Weight lb/ft^3	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index	Unconfined Compressive Strength, tsf	Strain at Failure, %
B-1	2.5			63					
B-1	5.5			20					
B-1	10.0	19.0			53	21	32		
B-1	15.0	18.9							
B-1	20.0	21.8	104.0					6.7	15
B-1	25.0	16.4	114.8					16.3	11.6