

BID DOCUMENTS AND
TECHNICAL SPECIFICATIONS

FOR



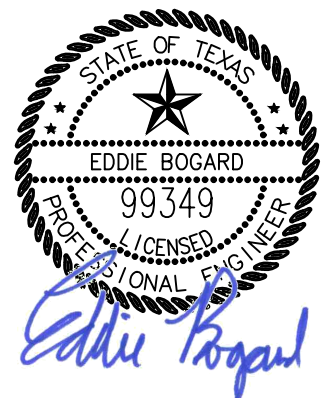
WILLIAMSON COUNTY
Mitigation for Cambria Cavern, Cambria Drive and Ephraim Road

Prepared by:



Job#: B004339.001
Texas Registered Engineering Firm No: F-1114

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Building 2, Suite 250
Austin, TX 78735
512.306.8252



05/04/2018

QUALIFICATIONS STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT PERMITTED BY LAWS AND REGULATIONS

1. SUBMITTED BY:

Official Name of Firm: _____

Address: _____

2. SUBMITTED TO: _____

3. SUBMITTED FOR: _____

Owner: _____

Project Name: _____

TYPE OF WORK: _____

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person: _____

Title: _____

Phone: _____

Email: _____

5. AFFILIATED COMPANIES:

Name: _____

Address: _____

6. TYPE OF ORGANIZATION:

SOLE PROPRIETORSHIP

Name of Owner: _____

Doing Business As: _____

Date of Organization: _____

PARTNERSHIP

Date of Organization: _____

Type of Partnership: _____

Name of General Partner(s): _____

CORPORATION

State of Organization: _____

Date of Organization: _____

Executive Officers:

- President: _____

- Vice President(s): _____

- Treasurer: _____

- Secretary: _____

LIMITED LIABILITY COMPANY

State of Organization: _____

Date of Organization: _____

Members: _____

JOINT VENTURE

Sate of Organization: _____

Date of Organization: _____

Form of Organization: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

Joint Venture Managing Partner

- Name: _____

- Address: _____

7. **CONSTRUCTION EXPERIENCE:**

Previous Experience:

List on **Schedule A** similar projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HEREWITH, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

REQUIRED ATTACHMENTS

1. Schedule A (Previous Experience).

SCHEDULE A

PREVIOUS EXPERIENCE (Include **similar** Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Item No.	Qty	Unit	Description	Unit Price	Total Price
1	40	SY	Removal of exiting concrete sidewalk per TCEQ regulations for: _____ Dollars and _____ Cents		
2	80	SY	Demolition (Sawcut curb & gutter, existing wood cover, miscellaneous items) needed prior to reconstruction for: _____ Dollars and _____ Cents		
3	70	SY	Excavation of full depth pavement removal to 24" for: _____ Dollars and _____ Cents		
4	410	SY	Remove existing asphalt pavement for: _____ Dollars and _____ Cents		
5	160	CY	Excavation of material to 1" or less diameter within Karst and disposal per TCEQ regulations for: _____ Dollars and _____ Cents		
6	15	SY	Block Sod for: _____ Dollars and _____ Cents		
7	90	SY	Provide and install 8" crushed limestone base material TxDOT (Item: 247, Type A, Grade 1) for: _____ Dollars and _____ Cents		
8	410	SY	Provide and install 2" HMA (Type B) for: _____ Dollars and _____ Cents		
9	60	LF	Furnish and install 6" curb & gutter for: _____ Dollars and _____ Cents		
10	40	SY	Furnish and install 4" concrete sidewalk (3,000 psi) for: _____ Dollars and _____ Cents		
11	2	EA	Relocate /re-install existing sign(s), complete in place for: _____ Dollars and _____ Cents		

Item No.	Qty	Unit	Description	Unit Price	Total Price
12	240	LF	Structural support system for concrete lifts including installation and materials for Tensar Uniaxial Geogrid UX14000MSE, Welded Wire Form (10'x'18"x18") 90 degree bend, 4" x 4" – W4.5xW4.5 with support strut, and generic pea-gravel bags for: _____ Dollars and _____ Cents		
13	800	CY	Provide and install concrete fill (4,500 psi, 6sk, 20% ash, HRWR) for: _____ Dollars and _____ Cents		
14	125	CY	Provide and install 3"-5" diameter gravel (min 2' depth & Ave 3' depth) for: _____ Dollars and _____ Cents		
15	45	CY	Provide and install ½" – 1" diameter gravel (1' depth) for: _____ Dollars and _____ Cents		
16	125	SY	Provide and install Mirafi 160N Geotextile filter fabric between ½" – 1" gravel layer and concrete layer for: _____ Dollars and _____ Cents		
17	90	LF	Provide and install 8" water line DR-14 (C-900) for: _____ Dollars and _____ Cents		
18	2	EA	Remove plug and connect to existing 8" waterline for: _____ Dollars and _____ Cents		
19	60	LF	Provide and install trench safety and protection for: _____ Dollars and _____ Cents		
20	150	LF	4" gas line; protect in place, including bedding and backfill for: _____ Dollars and _____ Cents		
21	140	LF	Provide and install perimeter security fence with privacy screen (include one (1) 12' double gate and two (2) man-way gates) for: _____ Dollars and _____ Cents		
22	290	LF	Furnish silt fence for: _____ Dollars and _____ Cents		

Item No.	Qty	Unit	Description	Unit Price	Total Price
23	1	LS	Mobilization / Demobilization for: _____ Dollars and _____ Cents		
24	1	LS	Bonds and Insurance for: _____ Dollars and _____ Cents		
25	8	WK	24-hour unarmed uniformed security (weekly) for: _____ Dollars and _____ Cents		

Total Base Bid Items 1-24

TOTAL BASE BID

Notes:

1. Bidder understands the Owner/Agent reserves the right to reject any irregular bids. The bidder agrees this bid shall be good and may not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving bids.
2. The bidder shall submit a unit price on all items of the proposal, failure to submit a unit bid price for any item in either bid schedule may result in a disqualification of the bidder.
3. If during the investigation of the submitted bid, the Engineer encounters computational errors, the total price for submitted item(s) will be evaluated by the Engineer using the Unit Price submitted and the quality shown on the proposal.
4. In the event that a discrepancy occurs between the number Unit Price and the worded Unit Price, the worded Unit Price will prevail.
5. The Owner/Agent reserves the right to award each bid schedule, alternate bid items, or combination of bid schedules and alternate bid items in the manner that is deemed to be most beneficial and advantageous to the Owner.

Total of All Lump Sums \$ _____

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. List of Project References;
 - B. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
 - C. Required Bidder Qualification Statement with supporting data; and Defined Terms
- 7.02 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.
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TECHNICAL SPECIFICATIONS

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.
- B. Observe and report on the following:
 - 1. Number and size of bars
 - 2. Bending and lengths of bars
 - 3. Splicing
 - 4. Clearance to forms including chair heights
 - 5. Clearance between bars or spacing
 - 6. Rust, form oil, and other contamination
 - 7. Grade of Steel
 - 8. Securing, tying and chairing of bars
 - 9. Excessive congestion of reinforcing steel
 - 10. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.2 CONCRETE INSPECTION AND TESTING

- A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.
- B. Mold and cure three specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.
- C. Test specimens in accordance with ASTM C39. First specimen shall be tested at 24 hour, one specimen shall be tested at 48 hours, and one specimen shall be tested at 28 days for acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28 day break does not meet strength requirements.
- D. Make one strength test (four or five cylinders) for each:
 - 1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
 - 2. OR, for each 5000 sq. ft. of horizontal area placed in one day.
 - 3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.
- E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Engineer. Slump tests corresponding to samples from which

strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.

- F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- G. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.
- H. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Engineer, the Contractor, and the Concrete Supplier.
- I. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications, and shall be rejected.
- J. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.
- K. Laboratory reports shall contain the following information:
 - 1. Class of concrete and specific location.
 - 2. Specified strength of concrete.
 - 3. Air temperature.
 - 4. Batch time.
 - 5. Specified time that discharge of concrete must be completed, based on air temperature.
 - 6. Time concrete is placed.
 - 7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
 - 8. Amount of water added at the site.
 - 9. Allowable slump range on the approved mix design.
 - 10. Slump.
 - 11. Maximum and minimum allowable concrete temperature on the approved mix design.
 - 12. Temperature of the concrete mix.
 - 13. Air content range on the approved mix design.
 - 14. Air content.
 - 15. Statement that concrete is in compliance with the project documents and the approved mix designs.
- L. Evaluation and Acceptance:
 - 1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
 - 2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.
- M. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the

Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

- N. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).
- O. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Engineer.

3.3 EXCAVATION

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.
- C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.
- D. Review required submittals as they pertain to geotechnical requirements.
- E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.
- F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

3.4 FILLING AND BACKFILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
- C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:
 - 1. Test for liquid limit in accordance with ASTM D423.
 - 2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
 - 3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.
- D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.
- E. Inspect underslab drainage material and placement for compliance with specified gradation, quality and compaction.

- F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:
1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
 2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
 3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

END OF SECTION 01 45 23

SECTION 02 41 00

SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition of structures, paving, and utilities.
 - 2. Filling voids created as a result of removals or demolition.

- B. Related Requirements:
 - 1. Section 31 1000 - Site Clearing: Clearing of trees and other plant vegetation
 - 2. Section 31 2000 - Earthwork: Placement of fill material
 - 3. Storm Water Pollution Prevention Plan (SWPPP)

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, runoff control, and pollution prevention.
- B. Obtain required permits and licenses from appropriate authorities. Pay associated fees including disposal charges.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct public or private roadways, sidewalks, or fire hydrants without appropriate permits or written authorization.
- E. If hazardous, contaminated materials or other environmental related conditions are discovered, stop work immediately and notify the Owner's Construction Manager for action to be taken. Do not resume work until specifically authorized.
- F. Comply with the requirements for hazardous construction and demolition waste management and disposal in accordance with specifications.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit record as part of closeout submittals.

1.4 PROJECT CONDITIONS

- A. Structures to be demolished will be discontinued in use and vacated prior to start of work.
- B. Owner assumes no responsibility for condition of structures to be demolished.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

- D. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified.
- E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Fill material shall be aggregate fill materials as specified in Section 31 2000.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide, erect, and maintain erosion control devices, temporary barriers, and security devices at locations indicated on Construction Drawings.
- B. Protect existing landscaping materials, appurtenances, and structures, which are not to be demolished. Repair damage to existing items to remain caused by demolition operations.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.
- D. Mark location of utilities. Protect and maintain in safe and operable condition utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and Owner.
- E. Notify adjacent property owners of work that may affect their property, potential noise, utility outages, or other disruptions. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property. Coordinate notice with Owner.

3.2 GENERAL DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures or pavements to remain.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed by authority.
- C. Conduct operations with minimum of interference to public or private access. Maintain ingress and egress at all times.
- D. Sprinkle work with water to minimize dust. Provide hoses and water connections for this purpose.
- E. Comply with governing regulations pertaining to environmental protection.
- F. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

3.3 DEMOLITION

- A. Demolish site improvements designated to be removed as shown on the drawings. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.
- B. Locate demolition equipment and remove materials to prevent excessive loading to supporting walls, floors, or framing.
- C. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2-feet or more below proposed subgrade to permit moisture drainage. Remove slabs-on-grade and below grade construction within 2-feet of proposed subgrade.

3.4 FILLING BASEMENTS AND VOIDS

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, wells, cisterns, etc., using aggregate fill materials consisting of stone, gravel, or sand free from debris, trash, frozen materials, roots, and other organic matter.
- B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.
- C. Place fill materials in accordance with Section 31 2000 unless subsequent excavation for new work is required.
- D. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from site debris, rubbish, and other materials resulting from demolition operations. Leave areas of work in clean condition.
- B. No burning of any material, debris, or trash on-site or off-site will be allowed except when allowed by appropriate governing authority and Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.
- C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and appropriate property owners.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Void infill
- B. Related Sections:
 - 1. Section 01 45 23 "Structural Testing and Inspection Services".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. ACI 301 – Specification for Structural Concrete.
 - 2. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 3. ACI 305 – Hot Weather Concreting.
 - 4. ACI 306 – Cold Weather Concreting.
 - 5. ACI 308 – Guide to Curing Concrete.
 - 6. ACI 309 – Guide for Consolidating Concrete.
 - 7. ACI 311 – ACI Manual for Concrete Inspection.
 - 8. ACI 318 – Building Code Requirements for Reinforced Concrete.
 - 9. ACI 347 – Guide to Concrete Formwork.
 - 10. ACI 207 – Mass Concrete.
 - 11. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 12. ACI 212.3 – Chemical Admixture for Concrete.
 - 13. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
 - 14. ACI 214 – Evaluation of Strength Test Results of Concrete.
 - 15. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
 - 2. Proportions of cement, fine, and coarse aggregate, and water.
 - 3. Design strength.
 - 4. Maximum slump.
 - 5. Air Content.
 - 6. Maximum water / cement ratio.
 - 7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
 - 8. Type cement and aggregates.
 - 9. Type and quantities of all admixtures.
 - 10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
 - 11. Type, color, and quantities of integral coloring compounds, where applicable.
 - 12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.
 - 4. Bonding agents.
 - 5. Adhesives.
 - 6. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. **Testing Agency Qualifications:** See Section 01 45 23.
 - 1. Contractor's responsibility to testing laboratory.
 - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
 - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
 - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. **Preinstallation Conference:** Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. **Steel Reinforcement:** Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. **Recycled Content of Steel Products:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. **Reinforcing Bars:** ASTM A 615, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.
- C. **Plain-Steel Welded Wire Reinforcement:** ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 1602.

2.4 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

CONCRETE MIX DESIGNS

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions

shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'_c by the amount defined in ACI 301.

- C. Required minimum concrete compressive strength shall be 4,500 psi at 28 days and 2,500 psi at 24 to 48 hours. The mix shall be 6-sack with a slump of 8 +/- 1-1/2" and contain a maximum of 20% fly ash.

CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.

- n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.
 - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
 - 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Formed edge of void infill: Design of temporary retaining wall will be required through contract with GeoSolutions, Inc. at 4417 Burleson Road, Austin, Texas 78744.
 1. The retaining wall consists of Tensar welded wire forms, Tensar Uniaxial Geogrid, and Tencate Mirafi 160N Geotextile filter fabric
- B. Install formwork assembly in 18" lifts in accordance with the construction sequence specified in the contract documents

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture filter fabric barrier. Repair damage to filter fabric barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the contract documents.
- G. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- H. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork and reinforcement is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section

cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.5 FINISHING

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

3.6 Concrete Floor Finish Tolerances

- A. Floor Elevation Tolerance Envelope:
 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - a. Top surfaces of all slabs: +/- 3/4"

3.7 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed 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. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. 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 seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 3. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 02 41 00

SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition of structures, paving, and utilities.
 - 2. Filling voids created as a result of removals or demolition.
- B. Related Requirements:
 - 1. Section 31 1000 - Site Clearing: Clearing of trees and other plant vegetation
 - 2. Section 31 2000 - Earthwork: Placement of fill material
 - 3. Storm Water Pollution Prevention Plan (SWPPP)

1.2 REGULATORY REQUIREMENTS

- A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, runoff control, and pollution prevention.
- B. Obtain required permits and licenses from appropriate authorities. Pay associated fees including disposal charges.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not close or obstruct public or private roadways, sidewalks, or fire hydrants without appropriate permits or written authorization.
- E. If hazardous, contaminated materials or other environmental related conditions are discovered, stop work immediately and notify the Owner's Construction Manager for action to be taken. Do not resume work until specifically authorized.
- F. Comply with the requirements for hazardous construction and demolition waste management and disposal in accordance with specifications.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit record as part of closeout submittals.

1.4 PROJECT CONDITIONS

- A. Structures to be demolished will be discontinued in use and vacated prior to start of work.
- B. Owner assumes no responsibility for condition of structures to be demolished.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.

- D. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified.
- E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Fill material shall be aggregate fill materials as specified in Section 31 2000.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide, erect, and maintain erosion control devices, temporary barriers, and security devices at locations indicated on Construction Drawings.
- B. Protect existing landscaping materials, appurtenances, and structures, which are not to be demolished. Repair damage to existing items to remain caused by demolition operations.
- C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary.
- D. Mark location of utilities. Protect and maintain in safe and operable condition utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and Owner.
- E. Notify adjacent property owners of work that may affect their property, potential noise, utility outages, or other disruptions. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property. Coordinate notice with Owner.

3.2 GENERAL DEMOLITION REQUIREMENTS

- A. Conduct demolition to minimize interference with adjacent structures or pavements to remain.
- B. Cease operations immediately if adjacent structures appear to be in danger. Notify authority having jurisdiction. Do not resume operations until directed by authority.
- C. Conduct operations with minimum of interference to public or private access. Maintain ingress and egress at all times.
- D. Sprinkle work with water to minimize dust. Provide hoses and water connections for this purpose.
- E. Comply with governing regulations pertaining to environmental protection.
- F. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

3.3 DEMOLITION

- A. Demolish site improvements designated to be removed as shown on the drawings. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.
- B. Locate demolition equipment and remove materials to prevent excessive loading to supporting walls, floors, or framing.
- C. Demolish concrete and masonry in small sections. Break up concrete slabs-on-grade that are 2-feet or more below proposed subgrade to permit moisture drainage. Remove slabs-on-grade and below grade construction within 2-feet of proposed subgrade.

3.4 FILLING BASEMENTS AND VOIDS

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, wells, cisterns, etc., using aggregate fill materials consisting of stone, gravel, or sand free from debris, trash, frozen materials, roots, and other organic matter.
- B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.
- C. Place fill materials in accordance with Section 31 2000 unless subsequent excavation for new work is required.
- D. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove from site debris, rubbish, and other materials resulting from demolition operations. Leave areas of work in clean condition.
- B. No burning of any material, debris, or trash on-site or off-site will be allowed except when allowed by appropriate governing authority and Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.
- C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and appropriate property owners.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Void infill
- B. Related Sections:
 - 1. Section 01 45 23 “Structural Testing and Inspection Services”.

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. ACI 301 – Specification for Structural Concrete.
 - 2. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 3. ACI 305 – Hot Weather Concreting.
 - 4. ACI 306 – Cold Weather Concreting.
 - 5. ACI 308 – Guide to Curing Concrete.
 - 6. ACI 309 – Guide for Consolidating Concrete.
 - 7. ACI 311 – ACI Manual for Concrete Inspection.
 - 8. ACI 318 – Building Code Requirements for Reinforced Concrete.
 - 9. ACI 347 – Guide to Concrete Formwork.
 - 10. ACI 207 – Mass Concrete.
 - 11. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 12. ACI 212.3 – Chemical Admixture for Concrete.
 - 13. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
 - 14. ACI 214 – Evaluation of Strength Test Results of Concrete.
 - 15. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.
- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
 - 2. Proportions of cement, fine, and coarse aggregate, and water.
 - 3. Design strength.
 - 4. Maximum slump.
 - 5. Air Content.
 - 6. Maximum water / cement ratio.
 - 7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
 - 8. Type cement and aggregates.
 - 9. Type and quantities of all admixtures.
 - 10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
 - 11. Type, color, and quantities of integral coloring compounds, where applicable.
 - 12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.
 - 4. Bonding agents.
 - 5. Adhesives.
 - 6. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. **Testing Agency Qualifications:** See Section 01 45 23.
 - 1. Contractor's responsibility to testing laboratory.
 - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
 - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
 - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.
- D. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. **Preinstallation Conference:** Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. **Steel Reinforcement:** Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. **Recycled Content of Steel Products:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. **Reinforcing Bars:** ASTM A 615, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.
- C. **Plain-Steel Welded Wire Reinforcement:** ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 1602.

2.4 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

CONCRETE MIX DESIGNS

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions

shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'_c by the amount defined in ACI 301.

- C. Required minimum concrete compressive strength shall be 4,500 psi at 28 days and 2,500 psi at 24 to 48 hours. The mix shall be 6-sack with a slump of 8 +/- 1-1/2" and contain a maximum of 20% fly ash.

CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.

- n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.
 - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
 - 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Formed edge of void infill: Design of temporary retaining wall will be required through contract with GeoSolutions, Inc. at 4417 Burleson Road, Austin, Texas 78744.
 1. The retaining wall consists of Tensar welded wire forms, Tensar Uniaxial Geogrid, and Tencate Mirafi 160N Geotextile filter fabric
- B. Install formwork assembly in 18" lifts in accordance with the construction sequence specified in the contract documents

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture filter fabric barrier. Repair damage to filter fabric barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the contract documents.
- G. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- H. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork and reinforcement is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section

cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.5 FINISHING

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

3.6 Concrete Floor Finish Tolerances

- A. Floor Elevation Tolerance Envelope:
 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - a. Top surfaces of all slabs: +/- 3/4"

3.7 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed 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. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. 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 seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 3. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
 - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 10 89 00

24-HOUR UNARMED UNIFORMED SECURITY GUARD SERVICES

PART 1 GENERAL

1.1 SCOPE OF WORK:

Specific Bidder Requirements: The successful bidder will demonstrate understanding of, and compliance with, all specifications set forth in this section in the proposal. The weekly rates submerged within the proposal of the successful bidder will be all inclusive regarding the requirements of the specifications.

A. Guard

Alertness personnel on duty shall remain awake at all times and shall be alert to any unusual noises, odors or smoke which may be indicative of a fire or some untoward incident occurring on Williamson County property.

B. Incident Reporting

The guard on duty shall be responsible for notifying the appropriate agency (fire, police, paramedics) when an incident occurs. Additionally, the guard will immediately notify the security supervisor and complete an incident report detailing the circumstances surrounding the incident. Incident reports will be submitted to the security supervisor with copies submitted to the County Engineer. Reports shall include any actions taken regarding

1. any office found open afterhours;
2. any unusual activity; and
3. any Safety-Hazard Discovery and actions taken.

C. Hourly Rounds

Guards will make rounds at least once each hour. In cases where detex/time clocks are provided, they will be activated using the key located at each key station, thereby recording the time on the clock tape. Guards not having detex/time clocks will make appropriate notations of their rounds in the security log. During each round, guards will check all exterior fencing to assure they are locked and have not been tampered with.

D. Visitors

Logs will be maintained by the guard on duty. Guards will assure that all visitors sign in and out prior to entering and before leaving the facility, with exception of contractor's personnel.

E. End Of Shift Procedures

1. At the end of each shift each security office shall complete a narrative report detailing all incidents occurring during his/her tour of duty. In the event nothing significant has occurred during the shift, the report will so indicate.
2. At the end of each shift, before being the end of each shift, before being relieved, security officers will prepare and sign all security check sheets and incident reports, brief the officer and sign over the keys and other equipment to the relieving officer.

- G. Images Security officers represent Williamson County to the public. It is, therefore, essential that they project a neat, well-groomed appearance at all times. Uniforms must be clean and pressed, shoes polished and hair neatly groomed.
- H. Equipment
The following is a list of equipment used by security personnel:
 - 1. Keys
 - 2. Flashlight
 - 3. Walkie-Talkie or other 2-way telecommunications device
 - 4. Other items only if approved by the security director.
- I. Firearms or other weapons will not be carried by Williamson County-assigned security personnel at any time.
- J. Use of Force
Security personnel may occasionally find it necessary to resort to the use of force in the performance of their duties. It should be clearly understood that force may be used only when all other measures have failed, and then only the minimum force necessary to accomplish the objective may be used..
- K. Facility Knowledge
Security Personnel must be thoroughly familiar with the following at all sites:
 - 1. Emergency turn offs contacts:
 - a. Water
 - b. Gas
 - 2. Emergency Telephone Numbers

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cleaning site of debris, grass, trees, and other plant life in preparation for site or building earthwork.
 - 2. Protection of existing structures, trees, or vegetation indicated on the Construction Drawings to remain.
- B. Related Requirements:
 - 1. Section 02 4100 – Site Demolition: Demolition and removal of structures, paving, utilities and other improvements.
 - 2. Section 31 2000 – Earthwork: Stripping and removal of topsoil.
 - 3. Storm Water Pollution Prevention Plan (SWPPP)

1.2 ENVIRONMENTAL REQUIREMENTS

- A. Construct temporary erosion and sediment control systems as shown on Construction Drawings and as directed by the "Storm Water Pollution Prevention Plan" (SWPPP) to protect adjacent properties and water resources from erosion and sedimentation.
- B. In event that sitework on this project will disturb one or more acres, starting work shall be strictly governed by the sequence of construction as specified in the SWPPP and SWPPP site maps. Contractor shall not begin construction without "National Pollution Discharge Elimination System" (NPDES) permit governing discharge of storm water from site for entire construction period. NPDES permit requires SWPPP to be in place during construction.
- C. Clearing and grubbing shall commence in the proper sequence as stated in the SWPPP and on the SWPPP site map and subsequent to the halt in construction for performance of the inspection and certification of BMPs as stated.
- D. Contractor shall conduct storm water management practices in accordance with the project SWPPP and applicable NPDES permit and shall enforce action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of NPDES permit.

1.3 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify existing plant life that is to remain and verify clearing limits are clearly tagged, identified, and marked in such manner as to ensure their protection throughout construction operations.

3.2 PROTECTION

- A. Locate, identify, and protect existing utilities that are to remain.
- B. Protect trees, plant growth, and features designated to remain as part of final landscaping.
- C. Conduct operations with minimum interference to public or private accesses and facilities. Maintain ingress and egress at all times and clean or sweep roadways daily as required by SWPPP or governing authority. Dust control shall be provided with sprinkling systems or equipment provided by Contractor.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, in kind.
- E. Provide traffic control as required, in accordance with the US Department of Transportation's "Manual on Uniform Traffic Control Devices" and applicable state highway department requirements.

3.3 EQUIPMENT

- A. Material shall be transported to and from the project site using well-maintained and operating vehicles. Transporting vehicles operating on site shall stay on designated haul roads and shall not endanger improvements by rutting, overloading, or pumping.

3.4 CLEARING

- A. Clear areas required for access to site and execution of work.
- B. Unless otherwise indicated on Construction Drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations shall be filled to subgrade elevation to avoid ponding of water. Satisfactory fill material shall be placed in accordance with Section 31 2000.
- C. Remove grass, trees, plant life, stumps, and other construction debris from site to dump site that is suitable for handling such material according to state laws and regulations.
- D. Cut heavy growths of grass from areas before stripping and topsoil removal and remove cuttings with remainder of cleared vegetative material.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, filling, and backfilling for structures, pavement, and outparcels.
 - 2. Trenching and backfilling for utilities.
 - 3. Dewatering.
 - 4. Boring under crossings.

- B. Related Requirements:
 - 1. Section 31 2316 - Rock Excavation.
 - 2. Section 31 3200 - Soil Stabilization.
 - 3. Section 3 of the SWPPP book- Erosion Control and Sedimentation.
 - 4. Division 3 - Subbase requirements for granular subbase below building slabs.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.

- B. ASTM International (ASTM)
 - 1. ASTM D422 - Particle Size Analysis of Soil.
 - 2. ASTM D698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN.m/m³)).
 - 3. ASTM D1557 - Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 Kn.m/m³)).
 - 4. ASTM D2487 - Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 5. ASTM D2488 - Description and Identification of Soils (Visual-Manual Procedures).
 - 6. ASTM D4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 7. ASTM D6938 – In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

- C. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO T 88 - Particle Size Analysis of Soils.

- D. State Department of Transportation (TxDOT):
 - 1. Standard Specifications for Construction and Materials.

- E. National Fire Protection Association (NFPA)
 - 1. NFPA 70 - National Electrical Code.

- F. American Water Works Association (AWWA)
 - 1. AWWA C200 - Standard for Steel Water Pipe - 6 In. (150 mm) and Larger.
 - 2. AWWA C206 - Field Welding Of Steel Water Pipe.

1.3 DEFINITIONS

- A. Satisfactory Materials: ASTM D2487 soil classification groups SC, GC, or a combination of these group symbols.
 - 1. Fill material shall further conform to the plasticity index and liquid limits (PI and LL) specified in Paragraph FILLING hereinafter.
 - 2. Satisfactory materials shall be free of rock or gravel larger than allowed for fill or backfill material as specified hereinafter or as shown on the drawings.
 - 3. Satisfactory materials shall contain no debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 4. Unless specifically stated otherwise in "Geotechnical Report AAA16-012-00", the following table stipulates maximum allowable values for plasticity index (PI) and liquid limit (LL) of satisfactory materials to be used as fill in specified areas:

<u>Location</u>	<u>PI</u>	<u>LL</u>
Building area (below upper four feet)	7-20	40
Building area (upper four feet)	12	40
Areas outside the building pad (Below upper two feet)	20	50
(Upper two feet, except for depth to receive topsoil)	15	40

(References to depth are to proposed subgrade elevations)

- B. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials are unsatisfactory.
 - 1. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory materials which contains root and other organic matter or frozen material. The CTL shall be notified of any contaminated materials.
 - 2. Unsatisfactory materials also include satisfactory materials not maintained within 2 percent of optimum moisture content at time of compaction.
- C. Rock: Rock shall be as defined in Section 31 2326.

1.4 SUBMITTALS

- A. Submit 30-pound sample of each type of off-site fill material that is to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.
- B. Submit name of each material supplier and specific type and source of each material. Change in source throughout project requires approval of Owner.
- C. Submit Dewatering Plans upon request by Owner.
- D. Shop drawings or details pertaining to excavating and filling are not required unless otherwise shown on the Drawings or if contrary procedures to Construction Documents are proposed.
- E. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless uses of materials, methods, equipment, or procedures that are contrary to The Drawings or Specifications are proposed. Do not perform work until Owner has accepted required shop drawings.

- F. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.

PART 2 - PRODUCTS

2.1 SOIL AND ROCK MATERIALS

- A. Fill and Backfill. Satisfactory materials excavated from the site.
- B. Imported Fill Material: Satisfactory material provided from offsite borrow areas when sufficient satisfactory materials are not available from required excavations.
- C. Trench Backfill: ASTM D2321 unless otherwise specified or shown on the drawings.
- D. Building Subbase Material: Subbase for building and appurtenances slabs on ground is specified in Section 31 3200.
- E. Bedding: Aggregate Type as indicated on the plans or naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No.200 sieve.
- F. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No.8 sieve.
- G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No.4 sieve.
- H. Topsoil: Topsoil shall consist of stripping material excavated from the site. Topsoil shall consist of organic surficial soil found in depth of not more than 6-inches.

2.2 APPURTENANT MATERIALS

- A. Stabilization fabrics and geogrids:
- B. Filter and drainage fabrics:
- C. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on The Drawings.
- D. Trench Utility Locator Tape: Heavy duty 6" wide underground warning tape. Tape shall be made from polyethylene material, 3.5 mils thick, with a minimum tensile strength of 1,750 psi. Place the tape at one-half the minimum depth of cover for the utility line or a maximum of 3 feet, whichever is the less, but never above the top of subgrade. Color of tape shall be determined by as follows:
 - 1. Natural Gas or Propane – Yellow.
 - 2. Electric – Red.
 - 3. Telephone – Orange.
 - 4. Water – Blue.
 - 5. Sanitary Sewer – Green.

2.3 EQUIPMENT

- A. Transport off-site materials to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

2.4 SOURCE QUALITY CONTROL

- A. Laboratory testing of materials proposed for use in the project shall be by the Owner's Construction Testing Laboratory at no cost to Contractor. The Contractor shall provide samples of material obtained off-site.
- B. Perform California Bearing Ratio (CBR) or Limerock Bearing Ratio (LBR) tests in outparcels and areas to receive pavement for each type of material that is imported from off-site. CBR or LBR value shall be equal to or above pavement design subgrade CBR or LBR value indicated on Construction Drawings.
- C. Following tests shall be performed on each type of on-site or imported soil material used as compacted fill:
 - 1. Moisture and Density Relationship: ASTM D698 or ASTM D1557.
 - 2. Mechanical Analysis: AASHTO T88 or ASTM D422.
 - 3. Plasticity Index: ASTM D4318.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, datum, elevations, and grades necessary for construction as shown on the drawings.
- B. Notify utility companies to remove or relocate public utilities that are in conflict with proposed improvements.
- C. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs, unless otherwise noted on the drawings from excavating equipment and vehicular traffic.
- D. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.
- E. Remove from site, material encountered in grading operations that is unsatisfactory material or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner and local governing agencies. Backfill areas with layers of satisfactory material and compact as specified herein.
- F. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:
 - 1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.
 - 2. After drainage of low area is complete, remove muck, mud, debris, and other unsatisfactory material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.
 - 3. All muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation. Material shall be inspected and, if found to be satisfactory for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under

building subgrade or within 5'-0" of perimeter of building subgrade, paving or outparcel subgrade. If, after observation, material is found to be unsatisfactory, it shall be removed from site.

- G. Locate and identify utilities that have previously been installed and protect from damage.
- H. Locate and identify existing utilities that are to remain and protect from damage.
- I. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on the Drawings.
- J. Verify location, size, elevation, and other pertinent data required making connections to existing utilities and drainage systems as indicated on the Drawings.
- K. Over excavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or aggregate material placed and compacted.

3.2 DEWATERING

A. General:

1. Provide dewatering systems as required for excavations.
2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a "quick" or "boiling" condition. System shall not be dependent solely upon sumps or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation's stability.
3. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow Work to be installed in a dry condition.
4. Control, by acceptable means, all water regardless of source. Contractor shall be responsible for disposal of the water.
5. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary, lower water level in advance of excavation utilizing wells, wellpoints, jet educators, or similar positive methods. The water level as measured by piezometers shall be maintained a minimum of 3 feet below prevailing excavation level.
6. Commence dewatering prior to any appearance of water in excavation and continue until Work is complete to the extent that no damage results from hydrostatic pressure, flotation, or other causes.
7. Open pumping with sumps and ditches will be allowed provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes.
8. Install wells or wellpoints, if required, with suitable screens and filters so that continuous pumping of fines does not occur. Arrange discharge to facilitate collection of samples by the Owner. During normal pumping and upon development of wells, levels of fine sand or silt in the discharge water shall not exceed 5 ppm. Install sand tester on discharge of each pump during testing to verify that levels are not exceeded.
9. Control grading around excavations to prevent surface water from flowing into excavation areas.
10. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head.

B. Design:

1. Designate and obtain the services of a qualified dewatering specialist to provide dewatering plan as may be necessary to complete the Work.

2. Contractor shall be responsible for the accuracy of the drawings, design data, and operational records required.
 3. Contractor shall be responsible for the design, installation, operation, maintenance, and any failure of any component of the system.
- C. Damages:
1. Contractor shall be responsible for and shall repair any damage to work in place, other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation. Contractor responsibility shall also include, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.
 2. Remove subgrade materials rendered unsatisfactory by excessive wetting and replace with approved backfill material at no additional cost to the Owner.
- D. Maintaining Excavation in Dewatering Condition:
1. Dewatering shall be a continuous operation. Interruptions due to power outages or any other reason will not be permitted.
 2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance.
 3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner.
 4. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components and any other work required to maintain excavation in dewatered condition.
- E. System Removal: Upon completion of the work, remove dewatering equipment from the site, including related temporary electrical service.
- F. Wells shall be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction.

3.3 TOPSOIL EXCAVATION

- A. Cut heavy growths of grass from areas before stripping and remove cuttings with remainder of cleared vegetative material.
- B. Strip topsoil to a depth of not less than 6 inches from areas that are to be filled, excavated, landscaped, or re-graded to such depth that it prevents intermingling with underlying subsoil or questionable material.
- C. Stockpile topsoil in storage piles in areas shown on The Drawings or where directed by Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by Owner. Remove excess topsoil from site unless specifically noted otherwise on the Drawings.

3.4 GENERAL EXCAVATION

- A. Classification of Excavation: The Contractor shall assure himself by site investigation or other necessary means that he is familiar with the type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated in the Contract Documents.
- B. When performing grading operations during periods of wet weather, provide adequate dewatering, drainage and ground water management to control moisture of soils.
- C. Shore, brace, and drain excavations as necessary to maintain excavation as safe, secure, and free of water at all times.
- D. Excavate building areas to line and grade as shown on the Drawings being careful not to over excavate beyond elevations needed for building subgrades.
- E. Place satisfactory excavated material into project fill areas.
- F. Unsatisfactory excavated material shall be disposed of in manner and location that is acceptable to Owner and local governing agencies.
- G. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.5 ROCK EXCAVATION

- A. Rock excavation is specified in Section 31 2316.

3.6 TRENCHING EXCAVATION FOR UTILITIES

- A. Contact local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to avoid point-bearing. Over-excavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding. Replace over-excavation with satisfactory material and dispose of unsatisfactory material.
- B. Trench excavation sidewalls shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25 feet in trenches 4 feet or deeper.
- C. Perform trench excavation as indicated on the Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.
- D. Remove excavated materials not required or not satisfactory as backfill or embankments and waste off-site or at on-site locations approved by the Owner and in accordance with governing regulations. Dispose of structures discovered during excavation as specified in Section 31 2316.
- E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches and other excavations as specified.

- F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill.
- G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.
- H. Trench width below top of pipe shall not be less than 12 inches nor more than 18 inches wider than outside surface of pipe or conduit that is to be installed to designated elevations and grades. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.
- I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes and ordinances, whichever is more stringent:
 1. Water Mains: 30 inches to top of pipe barrel or 6 inches below frost line, established by local building official, whichever is deeper.
 2. Sanitary Sewer: Elevations and grades as indicated on the drawings and as specified in Section 02535.
 3. Storm Sewer: Elevations and grades as indicated on the Drawings.
 4. Electrical Conduits: 24 inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.
 5. TV Conduits: 18 inches minimum to top of conduit or as required by local utility company, whichever is deeper.
 6. Telephone Conduits: 18 inches minimum to top of conduit, or as required by local utility company, whichever is deeper.
 7. Gas Mains and Service: 30 inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

3.7 SUBGRADE PREPARATION

- A. Scarification and Compaction: Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8 inches and compacted as specified hereinafter.
- B. Proofrolling: Subgrades shall be proofrolled to detect areas of insufficient compaction and soft pocket, or areas of excess yielding. Proofrolling shall be accomplished by making minimum of two complete passes with fully-loaded tandem-axle dump truck with a minimum weight of 20 tons, or approved equal, in each of two perpendicular directions. Limit vehicle speed to three mph. Areas of failure such as soft spots, unsatisfactory soils, and areas of excessive pumping or rutting shall be excavated and re-compacted as specified herein. Continual failure areas shall be stabilized in accordance with Section 02340 at no additional cost to Owner. Subgrade exposed longer than 48 hours or on which precipitation has occurred shall be re-proofrolled. Document proofrolling procedure, specific locations, deficiencies, and corrective measures for review by Owner or Owner's CTL upon request.

3.8 FILLING

- A. Fill areas to contours and elevations shown on the Drawings with materials deemed satisfactory.
- B. Place fills in continuous lifts specified herein.
- C. Fill within proposed building subgrade, paving subgrade, and outparcel subgrades shall not contain rock or stone greater than 4 inches in any dimension.

- D. Unless otherwise specified for rock fill, rock or stone less than 4-inches in largest dimension may be used in fill below structures, paving, and graded areas, up to 24 inches below surface of proposed subgrade or finish grade of graded areas when mixed with satisfactory material. Rock or stone less than 2 inches in largest dimension may be used in fill within the upper 24 inches of proposed subgrade or finish grade of graded areas when mixed with satisfactory material.
- E. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8 inches loose measure and compacted as specified hereinafter.
- F. Material imported from off-site shall have CBR or LBR value equal to or above pavement design subgrade CBR or LBR value indicated on The Drawings.
- G. Building area subgrade pad shall be that portion of site directly beneath and 5 feet beyond building and appurtenances, including limits of future building expansion areas as shown on the Drawings.
- H. Prepare building area subgrade pad in strict accordance with Geotechnical Report dated 03/18/16 by Raba Kistner. The Geotechnical Report shall take precedence over the provisions of this section whenever duplication or conflict occurs.

3.9 ROCK FILL

- A. Rock fill shall include on-site excavated material classified as rock excavation as specified in Section 31 2316. Rock fill may be utilized in fill up to 48 inches below top of subgrade or finish grade of graded areas outside the proposed building, paving, and outparcel areas. Rock fill shall consist of rock having a maximum dimension not greater than 4 inches in any dimension. Rock fill shall be placed in successive horizontal layers of loose material having a thickness of approximately the maximum size of the larger rock in the lift, but not greater than 4 inches. Each layer of material shall be spread uniformly, completely saturated, and compacted. Shot rock shall not be dumped into place, but shall be distributed in horizontal lifts by blading and dozing in such a manner as to ensure proper placement into final position in the embankment. Voids shall be filled with finer material including shot rock fines and limited soil fines during the spreading operation. Successive layers shall not be placed until all voids of the current lift are filled and the lift is compacted. Each successive layer of material shall adequately bond to the material on which it is placed. Compaction shall be accomplished with vibratory compactors, heavy rubber-tired rollers, or steel-wheeled rollers. Compaction shall be by uniform passes of compaction equipment in sufficient number of passes, but not less than two passes, such that no further consolidation is evident.

3.10 PIPE BEDDING

- A. Excavate trenches for pipe or conduit to 6 inches below bottom of pipe and to the width as specified herein. Place 6 inches of bedding material, compact in bottom of trench, and shape to conform to lower portion of pipe barrel.

3.11 TRENCH BACKFILLING

- A. Materials used for trench backfill shall comply with requirements as specified herein.
- B. Backfill and compact in accordance with fill and compaction requirements in ASTM D2321 unless otherwise shown on the drawings.
- C. Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities.
- D. Backfill trenches to contours and elevations shown on the Drawings.

- E. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

3.12 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

- A. When indicated by the Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.
- B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 98 percent of maximum density in accordance with ASTM D698, (or 95 percent of maximum density, in accordance with ASTM D1557) obtained at optimum moisture as determined by AASHTO T180. Mechanical tampers may be used after cover of 6 inches has been obtained over top of barrel of pipe.
- C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade. Bore hole shall be within 2 inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.
- D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks. If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area.
- E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt coating in accordance with and governing authorities.
- F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206.
- G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

3.13 COMPACTION

- A. Compact as follows:

<u>Location</u>	Percent of Maximum Laboratory Density	
	<u>ASTM D698</u>	<u>ASTM D1557</u>
Subgrade & Fill below Structures, Pavement and Outparcels	98	95
Subgrade & Fill in All other Areas	95	92

- B. Maintain moisture content of not less than 1 percent below and not more than 3 percent above optimum moisture content of fill materials to attain required compaction density.
- C. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.
- D. Corrective Measures for Non-Complying Compaction: Remove and recompact deficient areas until proper compaction is obtained. Continual failure areas shall be stabilized at no additional cost to Owner.

3.14 MAINTENANCE OF SUBGRADE

- A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.
- B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.
- C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material with CBR or LBR equal to or better than that specified on the drawings. Surface of subgrade after compaction shall be firm, uniform, smooth, stable, and true to grade and cross-section.
- D. Construct temporary ditches and perform such grading as necessary to maintain positive drainage away from subgrade at all times.

3.15 BORROW AND SPOIL SITES

- A. Comply with NPDES and local erosion control permitting requirements for any and all on-site and off-site, disturbed spoil and borrow areas. Upon completion of spoil or borrow operations, clean up spoil or borrow areas in a neat and reasonable manner to the satisfaction of Owner or off-site property owner, if applicable.

3.16 FINISH GRADING

- A. Check grading of building subgrades by string line from grade stakes (blue tops) set at not more than 50-foot centers. Allowable tolerance shall be plus or minus 0.10 feet from plan grade. Provide engineering and field staking as necessary for verification of lines, grades, and elevations.
- B. Grade areas where finish grade elevations or contours are indicated on the Drawings, other than paved areas, outparcels, and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Ground surfaces shall vary uniformly between indicated elevations. Grade finished ditches to allow for proper drainage without ponding and in manner that will minimize erosion potential.
- C. Correct settled and eroded areas within 1 year after date of completion at no additional expense to Owner. Bring grades to proper elevation.

3.17 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor. Except for specified mandatory testing, field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements. Owner T&I specified below shall not be considered a substitute for the Contractor's responsibility to perform similar routine, necessary, and customary testing and inspection of the methods and frequency suitable for the type of work involved.
- B. The Owner will perform testing and inspection (T & I) but only as a means of verification to the Owner of Contractor quality control performance.
- C. Owner T&I specified herein below will be performed by the Owner's Construction Testing Laboratory (CTL)
- D. Testing and inspection shall be either continuous or periodic and as follows:
 - 1. Continuous: Perform in areas supporting a structure including, but not limited to, building pad area, retaining walls, etc. When continuous testing and inspection is in progress, conduct testing

- and inspection in areas outside building pad or structure at the frequencies stated herein. This shall include, but not limited to, the CTL requesting and reviewing GC proofrolling documentation to assure correctness and completeness of proofrolling and any associated corrective actions taken by the Contractor.
2. Periodic: In addition to continuous inspections specified above, perform unannounced periodic testing visits as follows when continuous testing is not being performed as described above:
 - a. Two days during the first week when earthwork starts in a paved area.
 - b. Two days each week thereafter until earthwork is complete.
- E. Test Frequency:
1. Number of tests to be taken at each site visit shall be the test frequencies stated based on quantities or occurrences which have accumulated up to, in between, or during each periodic visit.
 2. Not less than one specified test shall be conducted each periodic visit when material has been placed since last visit.
 3. In addition, at least one specified test shall be conducted on work being placed during each periodic visit.
- F. Field testing, frequency, and methods may vary as determined by and between the Owner and the CTL.
- G. Work shall be performed by a Special Inspector – Technical I unless specified otherwise. Report of testing and inspection results shall be made upon the completion of testing.
- H. Classification of Materials: Perform test for classification of materials used and encountered during construction in accordance with ASTM D2488 and ASTM D2487.
- I. Laboratory Testing Of Materials: Perform laboratory testing of materials (Proctor, Sieve Analysis, Atterberg Limits, Consolidation Test, etc.) as specified.
- J. Proofrolling: Document and explain proofrolling inspection procedures and results in the laboratory inspection report.
- K. Field Density Tests
1. Building Subgrade Areas, Including 5'-0" Outside of Exterior Building Lines: In cut areas, not less than one compaction test for every 2,500 sq. ft and at locations along all continuous wall footings with intervals not exceeding 100 feet and at each column spread footing. In fill areas, same rate of testing for each 8-inch lift, measured loose and at locations along continuous wall footings with intervals not exceeding 100 feet and at each column spread footing.
 - a. Density tests on top of building subgrade shall be performed within 48 hours prior to placement of overlying materials. If inclement weather occurs after testing, retest prior to placement of overlying materials.
 2. Paving Areas and other Areas of Construction Exclusive of Building Subgrade:
 - a. In cut areas, not less than one compaction test for every 10,000 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 - b. Outparcels: In cut areas, not less than one compaction test for every 2,500 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.
 - c. Utility Trench Backfill: Intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill.
 3. Test Method: In-place nuclear density, ASTM D6938.
- L. Observation and Inspection:
1. Observe all subgrades/excavation bases below footings and slabs and verify design bearing capacity is achieved as required. Work shall be performed by a Special Inspector – Technical II.
 2. Observe and document presence of groundwater within excavations.

3.18 RETESTING AND RE-INSPECTION BY OWNER CTL

- A. CTL will conduct retesting and re-inspection as necessary until corrections are fully completed by the Contractor.

END OF SECTION

SECTION 31 2316

ROCK EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal including, drilling, blasting, and protection of rock excavation.
- B. Related Requirements:
 - 1. Section 31 2000 – Earthwork: Excavation, filling, and compaction of earth materials and rock fill.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. National Fire Protection Association (NFPA)
 - 1. NFPA495 - Code for Manufacturing, Transportation, Storage, And Use of Explosive Material
- C. United States Department of Interior, Bureau of Mines
 - 1. Seismic Effects of Blasting
- D. Occupational Safety & Health Administration (OSHA)
 - 1. 29CFR1910.109 - Explosives and Blasting Agents

1.3 DEFINITIONS

- A. Rock Excavation: Removal of igneous, metamorphic, or sedimentary rock or stone, boulders over two cubic yards in volume in open areas and one cubic yard in volume in trenches; and masonry, concrete, or solid frozen soil that cannot be removed by rippers or other mechanical methods and, therefore, requires drilling and blasting.
 - 1. If "Rock Excavation" is required that is not indicated by the Soils Report, the Owner shall be notified prior to such rock excavation, and he must then visit the site and verify the necessity for excess "Rock Excavation," determine an estimated quantity and provide the Contractor written approval to proceed. In the event the estimated quantity is exceeded, the Owner shall again be notified to establish a revised estimated quantity and authorize the Contractor to proceed. Payment for the authorized work shall be by a Change Order to the Contract.
- B. Trenches: Excavations having vertical sides whose depths exceed its width, made for storm water drainage, sanitary sewer, water, and gas pipes, electric, communications, and steam conduits, and related uses.

1.4 SUBMITTALS

- A. Submit Blasting Plan prior to any blasting and Monitoring Reports to the Owner and Governing Agencies for review.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA495, Bureau of Mines Seismic Effects of Blasting, and OSHA 29CFR1910.109 as applicable.
- B. Comply with all applicable laws, rules, ordinances and regulations of the Federal, State and local regulatory authorities and insurers that govern the licensing, transportation, storage, handling, use, and disposition of explosives.
- C. Prior to rock excavation, obtain and pay for all powder and blasting permits and licenses from regulatory agencies.
- D. If blasting is required or undertaken, the responsible Subcontractor shall be licensed in the State and shall possess a current blasting license issued by the appropriate regulatory authority and be permitted for the transportation of explosives if required.
- E. In case of conflict between regulations or between regulations and Specifications, the Contractor shall comply with the strictest applicable codes, regulations or Specifications.

1.6 SITE CONDITIONS

- A. Environmental Requirements: Determine environmental effects associated with proposed work and safeguard those concerns as regulated by law and local governing agencies by reasonable and practical methods.
- B. Existing Conditions: The Contractor shall be responsible for any and all damage and/or injury from the use of explosives. The Contractor shall save and hold harmless the Owner, Architect and Engineer from any and all claims from the use of explosives. Removal of materials of any nature by blasting shall be done in such a manner and at such times as to avoid damage affecting integrity of existing construction and damage to new or existing dwellings, structures and water wells in or adjacent to the area of the work. It shall be the Contractor's responsibility to determine the method of operation to ensure desired results and integrity of completed work. All damage caused by the Contractor's blasting operations shall be repaired to the full satisfaction of the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Explosives, detonator/delay device, and blast mat materials shall be type recommended by explosive supplier and shall comply with requirements specified herein.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify site conditions and note subsurface conditions affecting work of this section.
- B. Identify required lines, levels, and elevations that will determine extent of proposed removals.

3.2 ROCK EXCAVATION

- A. Cut rock to form level bearing at bottom of footing and trench excavations. Remove shaled layers to provide sound and unshattered base for footings or foundations. Contractor shall consider reuse of excavated materials on site in accordance with Section 31 2000. If material cannot be utilized on site, dispose of material offsite.

- B. If placed in embankments, perform rock excavation in manner that will produce material of such size as in accordance with Section 31 2000. Remove rock to allow for construction and/or installation of the site and building improvements as indicated on Construction Drawings. Remove loose or shattered rock, overhanging ledges and boulders which might dislodge.
- C. Use lean concrete or suitable materials as directed by registered geotechnical engineer to replace rock overblast or over excavation in building and expansion area to facilitate placement of utilities and foundations systems.

3.3 ROCK CUT FACE EXCAVATION

- A. The slope of the soil above the top of any permanently exposed rock cut face shall be no steeper than 3(H):1(V) unless otherwise noted on the Construction Drawings. Slope of the rock face shall meet the requirements below.

<u>TYPE OF ROCK</u>	<u>SLOPE (Horizontal to Vertical)</u>
Solid limestone or sandstone	3:1
Interbedded limestone, sandstone or shale	3:1
Layered shale (no hard rock)	3:1

- B. Benches of at least ten feet in width at a maximum of twenty feet in elevation intervals or as noted on the Construction Drawings. The benches shall serve to provide rock traps and divert water from the rock face.

3.4 ROCK TRAP

- A. Locate rock traps at the base of permanently exposed rock slopes and construct as indicated in the Construction Documents or Blasting Plan.

3.5 OVEREXCAVATION AND BACKFILL

- A. Over excavation which is required to remove unsuitable natural undisturbed bedrock weakened by weathering or other cause not inflicted by the Contractor shall be immediately reported to the Owner and performed as directed by the Owner, and the theoretical lines and grades will be adjusted accordingly. Material outside the excavation limits which are disturbed due to the fault or negligence of the Contractor or due to his failure to exercise sound construction practices, shall be either replaced by the Contractor with suitable materials (earth or concrete), or bolted, or both as directed, at no cost to the Owner.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Implementation of the project's Storm Water Pollution Prevention Plan (SWPPP) and installation, maintenance and removal of erosion and sediment control devices
- B. Deviations from this Standard Specification
 - 1. None.
- C. Related Specification Sections include, but are not necessarily limited to:
 - 1. Part I: Contract Documents – Bidding Requirements, Contract Forms and Agreement
 - 2. Part II: Technical Specifications

1.2 PRICE AND PAYMENT PROCEDURES

- A. Measurement and Payment
 - 1. Storm Water Pollution Prevention Plan <1 acre
 - a. Measurement
 - 1) This Item is considered subsidiary to the various Items bid.
 - b. Payment
 - 1) The work performed and the materials furnished in accordance with this Item are subsidiary to the structure or Items being bid and no other compensation will be allowed.
 - 2. Storm Water Pollution Prevention Plan \geq 1 acre
 - a. Measurement for this Item shall be by lump sum.
 - b. Payment
 - 1) The work performed and the materials furnished in accordance with this Item shall be paid for at the lump sum price bid for "SWPPP \geq 1 acre".
 - c. The price bid shall include:
 - 1) Preparation of SWPPP
 - 2) Implementation
 - 3) Permitting fees
 - 4) Installation
 - 5) Maintenance
 - 6) Removal

1.3 REFERENCES

- A. Reference Standards
 - 1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
 - 2. ASTM Standard:

- a. ASTM D3786, Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method
 - b. ASTM D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - c. ASTM D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile
 - d. ASTM D4833, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- 3. Texas Commission on Environmental Quality (TCEQ) TPDES General Permit No. TXR150000
 - 4. TxDOT Departmental Material Specifications (DMS)
 - a. DMS-6230 “Temporary Sediment Control Fence Fabric”

1.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

1.5 SUBMITTALS

- A. Storm Water Pollution Prevention Plan (SWPPP)
- B. TCEQ Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES General Permit
- C. Construction Site Notice
- D. TCEQ Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under the TPDES General Permit
- E. Notice of Change (if applicable)

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS [NOT USED]

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE AND HANDLING [NOT USED]

1.11 FIELD [SITE] CONDITIONS [NOT USED]

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED [OR] OWNER-SUPPLIED PRODUCTS [NOT USED]

2.2 PRODUCT TYPES AND MATERIALS

- A. Rock Filter Dams
 - 1. Aggregate
 - a. Furnish aggregate with hardness, durability, cleanliness and resistance to crumbling, flaking and eroding acceptable to the Engineer.
 - b. Provide the following:
 - 1) Types 1, 2 and 4 Rock Filter Dams

- a) Use 3 to 6 inch aggregate.
 - 2) Type 3 Rock Filter Dams
 - a) Use 4 to 8 inch aggregate.
 - 2. Wire
 - a. Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams
 - b. Type 4 dams require:
 - 1) Double-twisted, hexagonal weave with a nominal mesh opening of 2½ inches x 3¼ inches
 - 2) Minimum 0.0866 inch steel wire for netting
 - 3) Minimum 0.1063 inch steel wire for selvages and corners
 - 4) Minimum 0.0866 inch for binding or tie wire
- B. Geotextile Fabric
- 1. Place the aggregate over geotextile fabric meeting the following criteria:
 - a. Tensile Strength of 250 pounds, per ASTM D4632
 - b. Puncture Strength of 135 pounds, per ASTM D4833
 - c. Mullen Burst Rate of 420 psi, per ASTM D3786
 - d. Apparent Opening Size of No. 20 (max), per ASTM D4751
- C. Sandbag Material
- 1. Furnish sandbags meeting Section 2.5 except that any gradation of aggregate may be used to fill the sandbags.
- D. Stabilized Construction Entrances
- 1. Provide materials that meet the details shown on the Drawings and this Section.
 - a. Provide crushed aggregate for long and short-term construction exits.
 - b. Furnish aggregates that are clean, hard, durable and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft or flaky materials and organic and injurious matter.
 - c. Use 3 to 5 inch coarse aggregate with a minimum thickness of 12 inches.
 - d. The aggregate shall be placed over a geotextile fabric meeting the following criteria:
 - 1) Tensile Strength of 300 pounds, per ASTM D4632
 - 2) Puncture Strength of 120 pounds, per ASTM D4833
 - 3) Mullen Burst Rate of 600 psi, per ASTM D3786
 - 4) Apparent Opening Size of No. 40 (max), per ASTM D4751
- E. Embankment for Erosion Control
- 1. Provide rock, loam, clay, topsoil or other earth materials that will form a stable embankment to meet the intended use.
- F. Sandbags
- 1. Provide sandbag material of polypropylene, polyethylene or polyamide woven fabric with a minimum unit weight of 4 ounces per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70 percent.
 - 2. Use natural coarse sand or manufactured sand meeting the gradation given in Table 1 to fill sandbags.
 - 3. Filled sandbags must be 24 to 30 inches long, 16 to 18 inches wide, and 6 to 8 inches thick.

**Table 1
Sand Gradation**

Sieve #	Maximum Retained (% by Weight)
4	3 percent
100	80 percent
200	95 percent

G. Temporary Sediment Control Fence

1. Provide a net-reinforced fence using woven geo-textile fabric.
2. Logos visible to the traveling public will not be allowed.
 - a. Fabric
 - 1) Provide fabric materials in accordance with DMS-6230, "Temporary Sediment Control Fence Fabric."
 - b. Posts
 - 1) Provide essentially straight wood or steel posts with a minimum length of 48 inches, unless otherwise shown on the Drawings.
 - 2) Soft wood posts must be at least 3 inches in diameter or nominal 2 x 4 inch
 - 3) Hardwood posts must have a minimum cross-section of 1-1/2 x 1-1/2 inch
 - 4) T- or L-shaped steel posts must have a minimum weight of 1.3 pounds per foot.
 - c. Net Reinforcement
 - 1) Provide net reinforcement of at least 12-1/2 gauge galvanized welded wire mesh, with a maximum opening size of 2 x 4 inch, at least 24 inches wide, unless otherwise shown on the Drawings.
 - d. Staples
 - 1) Provide staples with a crown at least 3/4 inch-wide and legs 1/2 inch long.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION [NOT USED]

3.3 PREPARATION [NOT USED]

3.4 INSTALLATION

A. Storm Water Pollution Prevention Plan

1. Develop and implement the project's Storm Water Pollution Prevention Plan (SWPPP) in accordance with the TPDES Construction General Permit TXR150000 requirements. Prevent water pollution from storm water runoff by using and maintaining appropriate structural and nonstructural BMPs to reduce pollutants discharges to the MS4 from the construction site.

B. Control Measures

1. Implement control measures in the area to be disturbed before beginning construction, or as directed. Limit the disturbance to the area shown on the Drawings or as directed.

2. Control site waste such as discarded building materials, concrete truck washout water, chemicals, litter and sanitary waste at the construction site.
 3. If, in the opinion of the Engineer, the Contractor cannot control soil erosion and sedimentation resulting from construction operations, the Engineer will limit the disturbed area to that which the Contractor is able to control. Minimize disturbance to vegetation.
 4. Immediately correct ineffective control measures. Implement additional controls as directed. Remove excavated material within the time requirements specified in the applicable storm water permit.
 5. Upon acceptance of vegetative cover by Owber, remove and dispose of all temporary control measures, temporary embankments, bridges, matting, falsework, piling, debris, or other obstructions placed during construction that are not a part of the finished work, or as directed.
- C. Do not locate disposal areas, stockpiles, or haul roads in any wetland, water body, or streambed.
- D. Do not install temporary construction crossings in or across any water body without the prior approval of the appropriate resource agency and the Engineer.
- E. Provide protected storage area for paints, chemicals, solvents, and fertilizers at an approved location. Keep paints, chemicals, solvents, and fertilizers off bare ground and provide shelter for stored chemicals.
- F. Installation and Maintenance
1. Perform work in accordance with the TPDES Construction General Permit TXR150000.
 2. When approved, sediments may be disposed of within embankments, or in areas where the material will not contribute to further siltation.
 3. Dispose of removed material in accordance with federal, state, and local regulations.
 4. Remove devices upon approval or when directed.
 - a. Upon removal, finish-grade and dress the area.
 - b. Stabilize disturbed areas in accordance with the permit, and as shown on the Drawings or directed.
 5. The Contractor retains ownership of stockpiled material and must remove it from the project when new installations or replacements are no longer required.
- G. Rock Filter Dams for Erosion Control
1. Remove trees, brush, stumps and other objectionable material that may interfere with the construction of rock filter dams.
 2. Place sandbags as a foundation when required or at the Contractor's option.
 3. For Types 1, 2, 3, and 5, place the aggregate to the lines, height, and slopes specified, without undue voids.
 4. For Types 2 and 3, place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side with wire ties, or hog rings, or as directed.
 5. Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed.
 6. Construct filter dams according to the following criteria, unless otherwise shown on the Drawings:

- a. Type 1 (Non-reinforced)
 - 1) Height - At least 18 inches measured vertically from existing ground to top of filter dam
 - 2) Top Width - At least 2 feet
 - 3) Slopes - At most 2:1
- b. Type 2 (Reinforced)
 - 1) Height - At least 18 inches measured vertically from existing ground to top of filter dam
 - 2) Top Width - At least 2 feet
 - 3) Slopes - At most 2:1
- c. Type 3 (Reinforced)
 - 1) Height - At least 36 inches measured vertically from existing ground to top of filter dam
 - 2) Top Width - At least 2 feet
 - 3) Slopes - At most 2:1
- d. Type 4 (Sack Gabions)
 - 1) Unfold sack gabions and smooth out kinks and bends.
 - 2) For vertical filling, connect the sides by lacing in a single loop–double loop pattern on 4- to 5-inches spacing. At 1 end, pull the end lacing rod until tight, wrap around the end, and twist 4 times. At the filling end, fill with stone, pull the rod tight, cut the wire with approximately 6 inches remaining, and twist wires 4 times.
 - 3) For horizontal filling, place sack flat in a filling trough, fill with stone, and connect sides and secure ends as described above.
 - 4) Lift and place without damaging the gabion.
 - 5) Shape sack gabions to existing contours.
- e. Type 5
 - 1) Provide rock filter dams as shown on the Drawings.

H. Construction Entrances

- 1. When tracking conditions exist, prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction entrances.
- 2. Place the exit over a foundation course, if necessary.
 - a. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the Drawings or as directed.
- 3. At drive approaches, make sure the construction entrance is the full width of the drive and meets the length shown on the Drawings.
 - a. The width shall be at least 14 feet for 1-way and 24 feet for 2-way traffic for all other points of ingress or egress or as directed by the Engineer.

I. Earthwork for Erosion Control

- 1. Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.
 - a. Excavation and Embankment for Erosion Control Measures
 - 1) Place earth dikes, swales or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover.
 - 2) Place swales and dikes at other locations as shown on the Drawings or as directed to prevent runoff spillover or to divert runoff.
 - 3) Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides.

- 4) Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the Drawings or as directed.
 - 5) Where required, create a sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at 1 time, not including offsite areas.
- b. Excavation of Sediment and Debris
 - 1) Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.
- J. Sandbags for Erosion Control
1. Construct a berm or dam of sandbags that will intercept sediment-laden storm water runoff from disturbed areas, create a retention pond, detain sediment and release water in sheet flow.
 2. Fill each bag with sand so that at least the top 6 inches of the bag is unfilled to allow for proper tying of the open end.
 3. Place the sandbags with their tied ends in the same direction.
 4. Offset subsequent rows of sandbags 1/2 the length of the preceding row.
 5. Place a single layer of sandbags downstream as a secondary debris trap.
 6. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.
- K. Temporary Sediment-Control Fence
1. Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow.
 2. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the Drawings, as specified in this Section, or as directed.
 - a. Post Installation
 - 1) Embed posts at least 18 inches deep, or adequately anchor, if in rock, with a spacing of 6 to 8 feet and install on a slight angle toward the run-off source.
 - b. Fabric Anchoring
 - 1) Dig trenches along the uphill side of the fence to anchor 6 to 8 inches of fabric.
 - 2) Provide a minimum trench cross-section of 6 x 6 inches
 - 3) Place the fabric against the side of the trench and align approximately 2 inches of fabric along the bottom in the upstream direction.
 - 4) Backfill the trench, then hand-tamp.
 - c. Fabric and Net Reinforcement Attachment
 - 1) Unless otherwise shown under the Drawings, attach the reinforcement to wooden posts with staples, or to steel posts with T-clips, in at least 4 places equally spaced.
 - 2) Sewn vertical pockets may be used to attach reinforcement to end posts.
 - 3) Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 inches or less.
 - d. Fabric and Net Splices
 - 1) Locate splices at a fence post with a minimum lap of 6 inches attached in at least 6 places equally spaced, unless otherwise shown under the Drawings.
 - a) Do not locate splices in concentrated flow areas.
 - 2) Requirements for installation of used temporary sediment-control fence include the following:

- a) Fabric with minimal or no visible signs of biodegradation (weak fibers)
- b) Fabric without excessive patching (more than 1 patch every 15 to 20 feet)
- c) Posts without bends
- d) Backing without holes

3.5 REPAIR/RESTORATION [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD [or] SITE QUALITY CONTROL [NOT USED]

3.8 SYSTEM STARTUP [NOT USED]

3.9 ADJUSTING [NOT USED]

3.10 CLEANING

A. Waste Management

- 1. Remove sediment, debris and litter as needed.

3.11 CLOSEOUT ACTIVITIES

- A. Erosion control measures remain in place and are maintained until all soil disturbing activities at the project site have been completed.
- B. Establish a uniform vegetative cover with a density of 70 percent on all unpaved areas, on areas not covered by permanent structures, or in areas where permanent erosion control measures (i.e. riprap, gabions, or geotextiles) have been employed.

3.12 PROTECTION [NOT USED]

3.13 MAINTENANCE

- A. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until earthwork construction and permanent erosion control features are in place or the disturbed area has been adequately stabilized as determined by the Engineer.
- B. If a device ceases to function as intended, repair or replace the device or portions thereof as necessary.
- C. Perform inspections of the construction site as prescribed in the Construction General Permit TXR150000.
- D. Records of inspections and modifications based on the results of inspections must be maintained and available in accordance with the permit.

3.14 ATTACHMENTS [NOT USED]

END OF SECTION

SECTION 313200

SOIL STABILIZATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, treatment, and backfilling of subgrade for lime, cement, fly ash, or bridge lift stabilization.
 - 2. Geotextile fabric and geogrid for stabilization of subgrade.
- B. Related Requirements:
 - 1. Section 31 2000 - Earthwork

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM C150 - Portland Cement.
 - 2. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
 - 3. ASTM C977 - Quicklime and Hydrated Lime for Soil Stabilization.
 - 4. ASTM D1633 - Compressive Strength of Molded Soil-Cement Cylinders.
- C. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M216 - Lime for Soil Stabilization.
- D. National Lime Association (NLA):
 - 1. NLA Bulletin 326 - Lime Stabilization Construction Manual.
- E. Texas State Department of Transportation (TxDOT):
 - 1. Standard Specifications for Construction and Materials.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees Fahrenheit.

1.4 SUBMITTALS

- A. Submit gradation and certification of material that is to be used to the Owner for review.
- B. Submit name of each materials supplier and specific type and source of each material. Obtain approval of Owner prior to change in source.
- C. Submit mix designs, materials mix ratio, and laboratory test data to the Owner's Consultant of Record 4 weeks prior to beginning stabilization activities. Certify materials and mix ratios will achieve the specified requirements as indicated in the Construction Documents or as specified by state and local agencies for soil stabilization if not stated in the Construction Documents.

- D. Submit approved mix designs, materials mix ratio, and laboratory test data to the Owner prior to commencing stabilization activities.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide products from one of the following manufacturers as specified in the Materials paragraph below:
 1. TenCate Geosynthetics North America (Mirafi), Pendergrass, GA., (706) 693-2226, www.tencate.com
 2. Hanes Geo Components (WEBTEC), Winston Salem, NC. (336) 747-1600, www.hanesgeo.com
 3. Tensar International Corp., Atlanta, GA. (888) 828-5126, www.tensarcorp.com
 4. Thrace-LINQ Inc., Summerville, SC (843) 873-5800, www.thracelinq.com
 5. DuPont (Tytar). Summerville, SC (843) 832-6860, www.typargeo.com
 6. Synteen Technical Fabrics, Lancaster, SC (800) 796-8336, www.synteen.com

2.2 MATERIALS

- A. Soil Treatment Materials:
 1. Hydrated Lime: ASTM C977 or AASHTO M216.
 2. Portland Cement: ASTM C150, Type I.
 3. Fly Ash: ASTM C618.
- B. Aggregate:
 1. Coarse Aggregate: Crushed carbonate, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slag, or other types of suitable material meeting the following gradation requirements:

Sieve Size	Percent Passing
2 inches	100
1 inch	70-100
3/4 inch	50-90
No. 4	30-60
No. 30	7-30
No. 200	0-5

2. Fine Aggregate: Sand – Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter meeting the following gradation requirements:

Sieve Size	Percent Passing
No. 4	90-100
No. 50	7-40
No. 200	0-5

- C. Subsoil: Existing to be reused.
- D. Bridge Lift Material: Surge stone, granular fill, or shot rock fill.

2.3 ACCESSORIES

- A. Curing Seal: Asphalt Emulsion Primer.

- B. Geotextile Fabric for Stabilization: Provide one of the following:
 1. Mirafi HP 370 or HP 570, by TenCate.
 2. SF40 or SF65, by DuPont.
 3. GTF-200 or 300, by Thrace-LINQ.
 4. TerraTex HD, by Hanes.

- C. Geogrid for Stabilization: Provide one of the following:
 1. Biaxial Geogrid Type 1 (formerly BX 1100), by Tensar.
 2. Biaxial Geogrid Type 2 (formerly BX 1200), by Tensar.
 3. Mirafi BXG 11, by TenCate.
 4. Mirafi BXG 12, by TenCate.
 5. SF 11, by Synteen.
 6. SF 12, by Synteen

PART 3 EXECUTION

3.1 PREPARATION

- A. Obtain approval of mix design before proceeding with placement.
- B. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.
- C. Proofroll subgrade to identify areas in need of stabilization.

3.2 EQUIPMENT

- A. Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidating, and compacting of material.

3.3 EXCAVATION

- A. Excavate subsoil to depth sufficient to accommodate soil stabilization.
- B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.
- C. Do not excavate within normal 45 degree bearing splay of any foundation.
- D. Notify Owner of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.
- E. Correct areas over-excavated in accordance with Section 31 2000.
- F. Remove excess excavated material from site.

3.4 GEOTEXTILE FABRIC AND/OR GEOGRID

- A. Place geotextile fabric and/or geogrid over subsoil surface, lap edges and ends in accordance with manufacturer's recommendations in those areas that are shown on Construction Drawings or in those areas that need additional stabilization prior to placement of base course. Bridge lift sections may require the use of geotextile fabric and/or geogrid for stabilization prior to placement of fill.
- B. Place geotextile fabric and/or geogrid in accordance with manufacturer's recommendations.

3.5 SOIL TREATMENT AND BACKFILLING

- A. Lime Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with hydrated lime in accordance with state highway department specifications.
- B. Cement Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with Portland cement in accordance with state highway department specifications.
- C. Fly Ash Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with fly ash in accordance with state highway department specifications.
- D. Bridge Lifts: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade by application of a bridge lift. Bridging over existing soils shall be acceptable only when approved in writing by the Owner. Place geotextile fabric or geogrid over existing soils to be bridged. The geotextile fabric or geogrid selected shall be appropriate for the bridge lift material being placed. Place bridge lift over geotextile fabric or geogrid. Surge stone and shot rock will be approved by the Owner's representative on a submittal basis. The Owner and the Owner's representative shall have sole discretion as to the acceptability of all submittals.
- E. Backfill and compaction of treated subsoil shall be in accordance with Sections 31 2000.
- F. Maintain optimum moisture of mixed materials to attain required stabilization and compaction.
- G. Finish subgrade surface in accordance with Section 31 2000.
- H. Remove surplus mix materials from site.

3.6 CURING

- A. Immediately following compaction of mix, seal top surface with curing seal.
- B. Do not permit traffic for 72 hours after sealing top surface.

3.7 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with the specifications.

3.8 OWNER TESTING AND INSPECTION (T&I)

- A. The Owner will perform testing and inspection (T & I) but only as a means of verification to the Owner of Contractor quality control performance.

END OF SECTION

SECTION 321600

CURBS AND SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portland cement concrete curbs, gutters, and sidewalks except sidewalks adjacent to building.
- B. Related Requirements:
 - 1. Section 31 2000 - Earthwork: Preparation of subgrades.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. American Concrete Institute (ACI):
 - 1. ACI 305R - Hot Weather Concreting
 - 2. ACI 306R - Cold Weather Concreting
 - 3. ACI 306.1 - Cold Weather Concreting.
 - 4. ACI 308 - Curing Concrete
- C. ASTM International (ASTM):
 - 1. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - 2. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
 - 3. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
 - 4. ASTM C39 - Comprehensive Strength of Cylindrical Concrete Specimens.
 - 5. ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 6. ASTM C94 - Ready-Mixed Concrete.
 - 7. ASTM C138 - Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
 - 8. ASTM C143 - Slump of Hydraulic Cement Concrete.
 - 9. ASTM C231 - Air-Content of Freshly Mixed Concrete by the Pressure Method.
 - 10. ASTM C172 - Sampling Freshly Mixed Concrete.
 - 11. ASTM C173 - Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - 12. ASTM C260 - Air-Entraining Admixtures for Concrete.
 - 13. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
 - 14. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
 - 15. ASTM C989 - Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
 - 16. ASTM C1064 - Temperature of Freshly Mixed Portland Concrete Cement.
 - 17. ASTM C1218 - Water-Soluble Chloride in Mortar and Concrete.
 - 18. ASTM D98 - Calcium Chloride.
 - 19. ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous).
 - 20. ASTM D1190 - Concrete Joint Sealer, Hot Poured, Elastic Type.
 - 21. ASTM D1751 - Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 22. ASTM D2628 - Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- D. Federal Specifications (FS):
 - 1. FS HH-F-341 - Fillers, Expansion Joint: Bituminous (Asphalt & Tar)

- E. Texas State Highway Department (TxDOT) Standard Specifications

1.3 SUBMITTALS

- A. Mix Design:
 - 1. Fill out and submit attached Concrete Mix Design Submittal Form.
 - 2. Submit three copies of each proposed mix.
 - 3. Submit separate mix design for concrete to be placed by pumping in addition to the mix design for concrete to be placed directly from the truck chute.
 - 4. Submit mix design to the Owner.
 - 5. Include applicable information shown on the Mix Design Submittal Form and the following:
 - a. Proportions of cementitious materials, fine and coarse aggregate, and water.
 - b. Water-cementitious material ratio, 28-day compressive design strength, slump, and air content.
 - c. Type of cement, fly ash, slag and aggregate.
 - d. Aggregate gradation.
 - e. Type and dosage of admixtures.
 - f. Special requirements for pumping.
 - g. Range of ambient temperature and humidity for which design is valid.
 - h. Special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product specified.
 - i. Materials and methods for curing concrete.
- B. Submit certified laboratory test data or manufacturer's certificates and data for the items listed below certifying that materials are in conformance requirements specified herein. Submit to the Owner for review and approval and within 7 calendar days after receipt of Notice-to-Proceed.
 - 1. Concrete mix design(s)
 - 2. Type and source of Portland cement, fly ash, and slag
 - 3. Aggregate gradations
 - 4. Preformed expansion joint filler
 - 5. Field molded/poured sealant
 - 6. Dowel bars
 - 7. Expansion sleeves
 - 8. Tie bars
 - 9. Reinforcing steel bars
 - 10. Welded wire fabric
 - 11. Air entraining admixtures
 - 12. Water-reducing, set-retarding and set-accelerating admixtures (if used)
- C. Test Reports: Submit field quality control test reports.

1.4 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Forms shall be of depth equal to depth of curbing or sidewalk, and so designed as to permit

secure fastening together at tops. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.

- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A185. Furnish in flat sheets.
- C. Reinforcing Steel: Deformed steel bars, ASTM A615, Grade 60.
- D. Portland Cement: Shall conform to ASTM C150, Type I.
- E. Fly Ash: ASTM C618, Class C or F. Use only one type and source throughout project.
- F. Slag: ASTM C989, Grade 100 or 120. Use only one type and source throughout project.
- G. Exterior Pavement Joint Materials
 - 1. Joint Back-up Material: Polyethylene foam, 100% closed cell.
 - 2. Sealant:
 - a. Dow 888, by Dow Corning.
 - b. 301 NS by Pecora.
 - c. Spectrum 800 or 900 by Tremco.
- H. Aggregate: ASTM C33.
- I. Water: Clean and potable
- J. Dowel Bars: ASTM A615, grade 60, and plain steel bars.
- K. Air Entrainment: ASTM C260. .
 - 1. Air-Mix or AEA-92, by Euclid Chemical Corp.
 - 2. MasterAir VR 10, MasterAir AE 90, or MasterAir E 200 by BASF Admixtures.
 - 3. Daravair or Darex Series, by W.R. Grace.
 - 4. Equivalent approved products.
- L. Liquid Membrane Curing and Sealing Compound: ASTM C1315, Type I, Class A or B, 25% minimum solids content, clear non-yellowing with no styrene-butadiene.
 - 1. Water Based, VOC less than 350 g/l:
 - a. Super Aqua Cure, by Euclid Chemical Corp.
 - b. MasterKure CC 1315WB by BASF Admixtures.
- M. Dissipating Curing Compound: ASTM C309 Type 1, Class A or B.
 - 1. Solvent base, VOC less than 350 g/l: Cetri Vex EnvioCure 100 by Vexcon.

2.2 CONCRETE MIXING

- A. Mix concrete and deliver in accordance with ASTM C94. Design mix shall produce normal weight concrete consisting of Portland cement, supplementary cementitious materials, aggregates, admixtures and water to produce the following:
 - 1. Compressive Strength: 3,500 psi minimum at 28 days unless otherwise indicated on the Drawings.
 - 2. Slump Range: 2"-4" for hand placed concrete, 1-1/4" to 3" for machine placed (slipform) concrete.
 - 3. Air Entrainment: 5 to 8 percent.
- B. Supplementary Cementitious Materials (SCM):
 - 1. Concrete mix shall contain SCM at the amounts specified unless other amounts are approved by the Owner. Either fly ash or ground granulated blast furnace slag (GGBFS) may be used for the SCM but shall not be used together to form a ternary mix. Use of fly ash or GGBFS in the concrete mix is mandatory.

2. Fly Ash: Substitute fly ash for Portland cement at 15% of the total cementitious content.
 - a. If used to mitigate potential aggregate reactivity, only Type F fly ash may be used and shall have the following maximum properties: 1.5% available alkali and 8.0% CaO. When a maximum of 25% replacement is used, up to 10.0% CaO is permitted.
 3. Ground Granulated Blast Furnace Slag (GGBFS): Substitute GGBFS for Portland cement at 20% of the total cementitious content.
 - a. If required to mitigate potential sulfate exposure or aggregate reactivity, up to 50% substitution of Portland cement is allowed.
 4. Maintain air-entrainment at specified levels.
- C. Calcium chloride:
1. Calcium chloride (Type L) may be used in solution form as part of the mixing water to accelerate concrete setting and early-strength development.
 - a. Amount of calcium chloride added shall not be more than necessary to produce the desired results and shall not exceed 2% by weight of cement.
 - b. The dosage range for the calcium chloride for the entire project shall not vary by more than 1%. Range is defined as the difference between the maximum and minimum dosages of calcium chloride for the entire project.
 - c. Calcium chloride shall not be used in the following applications unless approved by the Owner:
 - 1) concrete containing embedded dissimilar metals or aluminum
 - 2) slabs supported on permanent galvanized steel forms
 - 3) concrete exposed to deicing chemicals
 - 4) prestressed or post-tension concrete
 - 5) concrete containing aggregates with potentially deleterious reactivity and concrete exposed to soil
 - 6) concrete exposed to soil or water containing sulfates.
 2. Use calcium chloride in accordance with manufacturer's recommendation.
 3. Chloride-ion Concentration:
 - a. Maximum water-soluble chloride-ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious material, and admixtures shall not exceed the following limits unless approved by the Owner:

Type of Member	Maximum water-soluble chloride ion (Cl-) content in concrete (percent by weight of cement)
Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	0.30
 4. When using calcium chloride or other admixtures containing chlorides, measure water-soluble chloride-ion content (percent by weight of cementitious materials) per ASTM C1218. Sample shall be from concrete representing the submitted mix design and maximum chloride dosage anticipated for the project.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Begin paving work only after unsuitable areas have been corrected and are ready to receive paving.

- B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.

3.2 INSTALLATION

A. Form Construction

1. Set forms to required grades and lines, rigidly braced and secured.
2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.
3. Check completed formwork for grade and alignment to following tolerances:
 - a. Top of forms not more than 1/8-inch in 10'-0".
 - b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0".
4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

- B. Reinforcement: Fasten reinforcing bars or welded wire fabric (if required) accurately and securely in place with suitable supports and ties. Remove from reinforcement all dirt, oil, loose mill scale, rust, and other substances that will prevent proper bonding of the concrete to the reinforcement.

C. Concrete Placement

1. Concrete shall be mixed and placed when the air temperature in the shade and away from artificial heat is a minimum of 35 degrees F and rising. Hot and cold weather concreting shall be in accordance with ACI 305R (hot weather) and 306.1 and 306R (cold weather). Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until set at required finish elevation and alignment.
2. Place concrete using methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
3. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint. Automatic machine may be used for curb and gutter placement. Machine placement shall be at required cross section, line, grade, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified herein.

D. Joint Construction

1. Contraction Joints: Construct concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, in uniform sections of length specified on Construction Drawings. Form joints between sections either by steel templates, 1/8-inch in thickness, of length equal to width of curb and gutter, and with depth which will penetrate at least 2-inches below surface of curb and gutter; or with 3/4-inch thick performed expansion joint filler cut to exact cross section of curb and gutter; or by sawing to depth of at least 2-inches while concrete is between 4 and 24 hours old. If steel templates are used, they shall be left in place until concrete has set enough to hold its shape, but shall be removed while forms are still in place.
2. Longitudinal Construction Joints: Tie concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, to concrete pavement with 1/2-inch round deformed reinforcement bars of length and spacing shown on Construction Drawings.
3. Transverse Expansion Joints: Concrete curb, combination concrete curb and gutter, or concrete sidewalk shall have filler cut to exact cross section of curb, gutter, or sidewalk. Joints shall be similar to type of expansion joint used in adjacent pavement.

- E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full

width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

- F. Joint Sealants: Install in accordance with manufacturer's recommendations.

3.3 CONCRETE FINISHING

- A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
- B. Work edges of sidewalks, gutters, back top edge of curb, and formed joints with edging tool, rounding edge to 1/2-inch radius. Eliminate tool marks on concrete surface. After completion of floating and trowelling, when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:
 - 1. Curbs, gutters, and sidewalks: Broom finish by drawing fine-hair broom across surface perpendicular to flow of traffic. Repeat operation as necessary to produce fine line texture.
- C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects as directed Owner.
- D. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable work as directed by Owner.

3.4 CURING AND PROTECTION

- A. Protect and cure finished concrete paving using with curing compound or with acceptable moist-curing methods in accordance with "water-curing" section of ACI 308. Cure for a period not less than 7 days.
- B. Use solvent based curing compound when compound is applied below 40 F.

3.5 BACKFILL

- A. After concrete has set sufficiently, spaces on either side of concrete curb, combination concrete curb and gutter, or concrete sidewalk shall be refilled to required elevation with suitable material compacted in accordance with Section 312000.

3.6 CLEANING AND PROTECTION

- A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
- B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

3.7 FIELD QUALITY CONTROL

- A. Field quality control shall be the responsibility of the Contractor in accordance with specifications. Field quality control testing and inspection shall be at the discretion of the Contractor as necessary to assure compliance with Contract requirements.

END OF SECTION

CONCRETE MIX DESIGN SUBMITTAL FORM
(Section 02751 – Concrete Pavement)

Date _____

ADDRESS _____
 CITY, ST _____
 GENERAL CONTRACTOR _____
 COMPANY _____
 JOBSITE PHONE _____

A. CONCRETE INFORMATION

Supplier Mix Design #	_____
Design Strength (f'c)	_____ psi
Water / Cementitious Ratio	_____
Total Air Content	_____ %
Total Est. Volume of Concrete	_____ CY
Mix Developed From:	
<input type="checkbox"/> Trial Mix Test Data (<i>attach test data</i>)	
<input type="checkbox"/> Field Experience	
Density	
Wet	_____ pcf
Dry	_____ pcf
Slump	
“ _____ (± 1”)	WITHOUT WR Admixture
“ _____ (± 1”)	WITH WR Admixture

LEAVE BLANK FOR ENGINEER'S STAMP

B. ADMIXTURE INFORMATION

	ASTM Designation	Product (Manufacturer/Brand)	Dosage (ounces)	
			oz / cy	oz / cwt
Water Reducing				
Accelerating				
Retarding				

C. MIX DESIGN

Mix Proportions (per cubic yard)

	Identification (Type, size, source, etc.)	Weight (pounds)	Density (SSD)	Volume (cubic feet)	% Aggregate Absorption

Cement					
Fly Ash					
Slag					
Coarse Aggregate #1					
#2					
#3					
Fine Aggregate #1					
#2					
Water					
Air Content					
	TOTALS				

Coarse & Fine Aggregate Gradation Information

Sieve Size	% Passing Each Sieve (All Sieve Sizes must be entered)					Combined % Passing	Combined % Retained	
	Coarse Agg. # 1	Coarse Agg. # 2	Coarse Agg. # 3	Fine Agg. # 1	Fine Agg. # 2		Cumulative	Individual
% of								

Aggregate Ratios

Coarseness Factor =	$\frac{\text{Combined \% cumulative retained } 3/8'' \text{ sieve}}{\text{Combined \% cumulative retained } \#8 \text{ sieve}}$	=	
Workability Factor =	Combined % passing #8 sieve	=	
Adj-Workability Factor =	$WF + [(Cementitious \text{ Material} - 564) \div 37.6]$	=	
Allowable Adj-WF=	$Adj-WF = [(11.25 - .15 CF) + 34.5] \pm 2.5$	=	Low High

D. ATTACHMENTS: Include the following with this Mix Design Report.

- Portland Cement mill test reports
- Fly ash mill test reports
- Slag mill test reports
- Designation, type, quality, and source (natural or manufactured) of coarse and fine aggregate materials
- Separate aggregate gradation reports including all required sieve sizes
 - All gradation sieve report tests dated within 60 days of this report

- Report for each coarse and fine aggregate material in mix
- Statement if possible reactivity of aggregate, based on tests or past service
- Statement if possible aggregate pop-outs or their disruptions, based on tests or past service
- Product data for the following admixtures:
 - Chloride ion data and related calculations
 - Water reducing, set retarding, set accelerating, etc.
- Measured water-soluble chloride ion content in concrete (percent by weight of cement)
- Concrete compressive strength data used for standard deviation calculations

E. CONCRETE SUPPLIER INFORMATION

Company Name		Tel. # ()
Address		
City, ST Zip		
Technical Contact		Cell # ()
		e-mail
Sales Contact		Cell # ()

	<u>PRIMARY PLANT</u>	<u>SECONDARY PLANT</u>
Plant Location:		
Miles from Site:		
Travel Time to Site:		
NRMCA Certified:	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
State DOT Certified:	<input type="checkbox"/> YES <input type="checkbox"/> NO	<input type="checkbox"/> YES <input type="checkbox"/> NO
Batch Mixing Type:	<input type="checkbox"/> DRY <input type="checkbox"/> CENTRAL MIX	<input type="checkbox"/> DRY <input type="checkbox"/> CENTRAL MIX

SECTION 323114

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Chain link fences and gates associated with sitework.
- B. Related Requirements:
 - 1. Chain Link Fences and Gates (Building Related): Fences and gates within or adjacent to building.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A 392 - Zinc-Coated Steel Chain-Link Fence Fabric
 - 2. ASTM C 94 - Ready-Mixed Concrete
- B. Chain Link Fence Manufacturers Institute (CLFMI) latest edition Product Manual

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel Posts: Type I or II or roll formed "C" Section steel conforming to CLFMI and as specified hereinafter.
- B. Fabric: No. 9 gage (0.148 nominal) galvanized steel wire in 2 inch mesh; ASTM A 392, top and bottom selvages twisted and barbed, height as shown. Furnish 1-piece fabric widths.
- C. End, Corner, and Pull Posts: Minimum sizes and weights as follows:
 - 1. Up to 13 Foot Fabric Height: Type I or II in accordance with CLFMI Product Manual.
 - 2. 13 foot and over Fabric Height (If required):
 - a. Type I Posts: Round; 4.0 inch outside diameter pipe, 9.10 lbs/lin ft.
 - b. Type II Posts: 4.0 inch outside diameter pipe, 6.56 lbs/lin ft.
- D. Line (Intermediate) Posts: Minimum sizes and weights as follows:
 - 1. Up to 8 Foot Fabric Height: Type I, II, or "C" Section in accordance with CLFMI Product Manual.
 - 2. Over 8 Foot Fabric Height:

- a. Type I Posts:
 - 1) Round: 2.875 inch outside diameter pipe, 5.79 lbs/lin ft.
 - 2) Square: 2.5" x 2.5" outside dimension, 5.10 lbs/lin ft.
 - b. Type II Posts: 2.875 inch outside diameter pipe, 4.64 lbs/lin ft.
- E. Gate Posts: Type I or II in accordance with CLFMI Product Manual.
- F. Top, Bottom, and Intermediate Rails: Type I or II in accordance with CLFMI Product Manual.
- 1. Manufacturer's longest lengths.
 - 2. Couplings: Expansion type, approximately 6 inches long.
 - 3. Attaching Devices: Means of attaching top rail securely to each gate, corner, pull, and end post.
- G. Sleeves: Galvanized steel pipe not less than 6-inches long with inside diameter not less than ½ inch greater than outside diameter of pipe. Provide steel plate closure welded to bottom of sleeve of width and length not less than 1 inch greater than outside diameter of sleeve.
- H. Tension Wire: 7 gage galvanized steel conforming to CLFMI, Marcellled, located at bottom of fabric.
- I. Wire Ties: Class 1 galvanized steel, no less than 9 gage.
- J. Post Brace Assembly: Manufacturer's standard adjustable brace at end of gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375-inch diameter rod and adjustable tightener.
- K. Post Tops: Galvanized steel, weather tight closure cap for each tubular post. Furnish caps with openings to permit passage of top rail.
- L. Stretcher Bars: Galvanized steel, 1 piece lengths equal to full height of fabric, with minimum cross-section of 3/16-inch x 3/4-inch. Provide one stretch bar for each gate and end post, and two for each corner and pull post.
- M. Stretch Bar Bands: Manufacturer's standard
- N. Gate Cross-bracing: 3/8-inch diameter galvanized steel adjustable length truss rods.
- O. Ready Mix Concrete: ASTM C94, mix design as follows:
- 1. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - a. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on Construction Drawings.
 - b. Slump Range: 1 to 3 inches at time of placement
 - c. Air Entrainment: 5 to 8 percent
- P. Swinging Gate Hardware:
- 1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit full 180-degree gate opening. Provide a pair of 1 1/2-inch hinges for each leaf over 6'-0" nominal height.
 - 2. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- Q. Double Gates Hardware: Provide gate stops for double gates, consisting of mushroom type of flush plate with anchors set in concrete, to engage center drop rod or plunger bar. Include locking device and padlock eye as integral part of latch, using 1 padlock for locking both gate leaves.

- R. Sliding Gate Hardware: Provide manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.

2.2 GATE FABRICATION

- A. Fabricate swing gate perimeter frames of 1.90-inch OD pipe, galvanized steel. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members maximum of 8'-0" apart.
- B. Assemble gate frames by welding or special fittings and rivets, for rigid connections. Install same fabric as for fence with stretcher bars at vertical edges. Install diagonal cross-bracing on gates as required ensuring rigid frame without sag or twist. Bars may be used at top and bottom edges. Attach stretchers to gate frame at 15 inches o.c. maximum.
- C. Attach hardware to provide security against removal or breakage.

2.3 FINISH

- A. Fabric, Framing, and Other Iron Parts: Hot dip zinc coated in accordance with CLFMI Product Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install chain link fence in accordance with CLFMI Product Manual unless otherwise specified herein.
- B. Comply with recommended procedures and instructions of fencing manufacturer. Provide secure, aligned installation with line posts spaced at 10'-0" o.c. maximum.
- C. Methods for Setting Posts:
 - 1. Grade-Set Posts:
 - a. Drill or hand excavate to a depth approximately 3 inches lower than post bottom. Set post bottom not less than 36 inches below finish grade.
 - b. Excavate each post hole to 12 inch diameter, or not less than four times diameter of post.
 - c. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Extend concrete footing 2-inches above grade and trowel crown to shed water.
 - d. Post shall be set plumb within 1/4" in 10 feet.
 - 2. Sleeve Set Posts: Anchor posts by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with nonshrink, non-metallic grout, mixed and placed to comply with grout manufacturer's directions.
- D. Top Rails: Run rail continuously, bending to form radius for curved runs. Provide expansion couplings as recommended by manufacturer.
- E. Center Rails: Provide center rails where indicated. Install in 1 piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- F. Brace Assemblies: Install braces so posts are plumb when diagonal rod are under proper tension.

- G. Tension Wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with not less than 6 gauge galvanized wire. Fasten fabric to tension wire using 11 gauge galvanized steel hog rings spaced 24-inches o.c.
- H. Fabric: Leave approximately 2 inches between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- I. Stretcher Bars: Secure at end, corner, pull, and gate posts by threading through or clamping to fabric at 4 inches o.c. and secure to posts with metal bands spaced at 15 inches o.c.
- J. Tie Wires:
 - 1. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly when ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - 2. Tie fabric to line posts with wire ties spaced 12 inches o.c. Tie fabric to rails and braces with wire ties spaced 24 inches o.c. Tie fabric to tension wires with hog rings spaced 24-inches o.c.
 - 3. Manufacturer's standard procedure will be accepted if of equal strength and durability.
- K. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- L. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubrication.

3.2 ADDITIONAL INSTALLATION PROVISIONS

- A. Use U-shape tie wires, conforming to the diameters of pipe, that clasp the pipe and fabric firmly with ends twisted at least 2 full turns.
- B. Bend ends of exposed wires to minimize hazards to persons or clothing.
- C. Install nuts for fasteners on tension bands and hardware bolts on the side of the fence opposite the fabric. The ends of bolts, once secure and checked for smooth operation, shall be peened to prevent removal of nuts.
- D. Repair coatings damaged in the field with methods and techniques as recommended by the manufacturer.

END OF SECTION

SECTION 329213

HYDROMULCHING, SEEDING AND SODDING

PART 1 - GENERAL

1.1 SUMMARY

PART 2 - SECTION INCLUDES:

1. Furnishing and installing grass sod and permanent seeding as shown on Drawings, or as directed.
- B. Deviations from this Owner Standard Specification
 1. None.
- C. Related Specification Sections include, but are not necessarily limited to:
 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract
 - Division 1 - General Requirements
 2. Section 32 91 19 – Topsoil Placement and Finishing of Parkways

2.2 PRICE AND PAYMENT PROCEDURES

- A. Measurement and Payment
 1. Block Sod Placement
 - a. Measurement
 - 1) Measurement for this Item shall be by the square yard of Block Sod placed.
 - b. Payment
 - 1) The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per square yard of Block Sod placed.
 - c. The price bid shall include:
 - 1) Furnishing and placing all sod
 - 2) Rolling and tamping
 - 3) Watering (until established)
 - 4) Disposal of surplus materials
 2. Seeding
 - a. Measurement
 - 1) Measurement for this Item shall be by the square yard of Seed spread.
 - b. Payment
 - 1) The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid per square yard of Seed placed for various installation methods.
 - c. The price bid shall include:
 - 1) Furnishing and placing all Seed
 - 2) Furnishing and applying water for seed fertilizer
 - 3) Slurry and hydraulic mulching
 - 4) Fertilizer
 - 5) Watering and mowing (until established)
 - 6) Disposal of surplus materials

3. Mowing
 - a. Measurement
 - 1) Measurement for this Item shall per each.
 - b. Payment
 - 1) The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid per each.

2.3 REFERENCES [NOT USED]

2.4 ADMINISTRATIVE REQUIREMENTS [NOT USED]

2.5 ACTION SUBMITTALS [NOT USED]

2.6 INFORMATIONAL SUBMITTALS

A. Seed

1. Vendors' certification that seeds meet Texas State seed law including:
 - a. Testing and labeling for pure live seed (PLS)
 - b. Name and type of seed
2. All seed shall be tested in a laboratory with certified results presented to the Owner in writing, prior to planting.
3. All seed to be of the previous season's crop and the date on the container shall be within 12 months of the seeding date.

2.7 CLOSEOUT SUBMITTALS [NOT USED]

2.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

2.9 QUALITY ASSURANCE [NOT USED]

2.10 DELIVERY, STORAGE, AND HANDLING

A. Block Sod

1. Protect from exposure to wind, sun and freezing.
2. Keep stacked sod moist.

B. Seed

1. If using native grass or wildflower seed, seed must have been harvested within 100 miles of the construction site.
2. Each species of seed shall be supplied in a separate, labeled container for acceptance by the Owner.

C. Fertilizer

1. Provide fertilizer labeled with the analysis.
2. Conform to Texas fertilizer law.

2.11 FIELD [SITE] CONDITIONS [NOT USED]

2.12 WARRANTY [NOT USED]

PART 3 - PRODUCTS [NOT USED]

3.1 OWNER-FURNISHED PRODUCTS [NOT USED]

3.2 MATERIALS AND EQUIPMENT

A. Materials

1. Block Sod
 - a. Sod Varieties (match existing if applicable)
 - 1) "Stenotaphrum secundatum" (St. Augustine grass)
 - 2) "Cynodon dactylon" (Common Bermudagrass)
 - 3) "Buchloe dactyloides" (Buffalograss)
 - 4) an approved hybrid of Common Bermudagrass
 - 5) or an approved Zoysiagrass
 - b. Sod must contain stolons, leaf blades, rhizomes and roots.
 - c. Sod shall be alive, healthy and free of insects, disease, stones, undesirable foreign materials and weeds and grasses deleterious to its growth or which might affect its subsistence or hardiness when transplanted.
 - d. Minimum sod thickness: 3/4 inch
 - e. Maximum grass height: 2 inches
 - f. Acceptable growing beds
 - 1) St. Augustine grass sod: clay or clay loam topsoil
 - 2) Bermuda grasses and zoysia grasses: sand or sandy loam soils
 - g. Dimensions
 - 1) Machine cut to uniform soil thickness.
 - 2) Sod shall be of equal width and of a size that permits the sod to be lifted, handled and rolled without breaking.
 - h. Broken or torn sod or sod with uneven ends shall be rejected.
2. Seed
 - a. General
 - 1) Plant all seed at rates based on pure live seed (PLS)
 - a) Pure Live Seed (PLS) determined using the formula:

$$(1) \text{ Percent Pure Live Seed} = \text{Percent Purity} \times [(\text{Percent Germination} + \text{Percent Firm or Hard Seed}) + 100]$$
 - 2) Availability of Seed
 - a) Substitution of individual seed types due to lack of availability may be permitted by the Owner at the time of planting.
 - b) Notify the Owner prior to bidding of difficulties locating certain species.
 - 3) Weed seed
 - a) Not exceed ten percent by weight of the total of pure live seed (PLS) and other material in the mixture
 - b) Seed not allowed:
 - (1) Johnsongrass
 - (2) Nutgrass seed
 - 4) Harvest seed within 1-year prior to planting
 - b. Non-native Grass Seed
 - 1) Plant between April 15 and September 10

Lbs. PLS/Acre	Common Name	Botanical Name	Purity (percent)	Germination (percent)
25	Bermuda (unhulled)	<i>cynodon dactylon</i>	85	90
75	Bermuda (hulled)	<i>cynodon dactylon</i>	95	90

- 2) Plant between September 10 and April 15

Lbs. PLS/Acre	Common Name	Botanical Name	Purity (percent)	Germination (percent)
220	Rye Grass	<i>lolium multiflorum</i>	85	90
75	Bermuda (unhulled)	<i>cynodon dactylon</i>	95	90

c. Native Grass Seed

- 1) Plant between February 1 and October 1.

Lbs. PLS/Acre	Common Name	Botanical Name
1.6	Green Sprangletop	<i>Leptochloa dubia</i>
5.5	Sideoats Grama*	<i>Bouteloua curtipendula</i>
3.7	Little Bluestem*	<i>Schizachyrium scoparium</i>
17.0	Buffalograss	<i>Buchloe dactyloides</i>
1.8	Indian Grass*	<i>Sorghastrum nutans</i>
0.5	Sand Lovegrass*	<i>Eragrostis trichodes</i>
6.0	Big Bluestem	<i>Andropogon gerardii</i>
8.0	Eastern Grama	<i>Tripsacum dactyloides</i>
1.2	Blue Grama	<i>Bouteloua gracilis</i>
1.8	Switchgrass	<i>Panicum virgatum</i>
10.0	Prairie Wildrye*	<i>Elymus canadensis</i>

d. Wildflower Seed

- 1) Plant between the following:
a) March 5 and May 31
b) September 1 and December 1

Lbs. PLS/Acre	Common Name	Botanical Name
3.0	Bush Sunflower	<i>Sinsia calva</i>
5.0	Butterfly Weed	<i>Asclepias tuberosa</i>
2.0	Clasping Coneflower*	<i>Rudbeckia amplexicaulis</i>
3.0	Golden - Wave	<i>Coreopsis basalis</i>
13.4	Illinois Bundleflower	<i>Desmanthus illinoensis</i>
13.6	Partridge Pea	<i>Cassia fasciculata</i>
2.0	Prairie Verbena	<i>Verbena bipinnatifida</i>
8.0	Texas Yellow Star	<i>Lindheimeri texana</i>
8.0	Winecup	<i>Callirhoe involucrata</i>
2.0	Black-eyed Susan	<i>Rudbeckia hirta</i>
18.0	Cutleaf Daisy	<i>Engelmannia pinnatifida</i>
2.0	Obedient Plant	<i>Physostegia intermedia</i>
3.0	Pitcher Sage	<i>Salvia azurea</i>
2.0	Plains Coreopsis	<i>Coreopsis tinctoria</i>
8.0	Scarlet Sage	<i>Salvia coccinea</i>

*not to be planted within ten feet of a road or parking lot or within three feet of a walkway

e. Temporary Erosion Control Seed

- 1) Consist of the sowing of cool season plant seeds.

3. Mulch

- a. For use with conventional mechanical or hydraulic planting of seed.
b. Wood cellulose fiber produced from virgin wood or recycled paper-by-products (waste products from paper mills or recycled newspaper).
c. No growth or germination inhibiting factors.

- d. No more than ten percent moisture, air dry weight basis.
- e. Additives: binder in powder form.
- f. Form a strong moisture retaining mat.
- 4. Fertilizer
 - a. Acceptable condition for distribution
 - b. Applied uniformly over the planted area
 - c. Analysis
 - 1) 16-20-0
 - 2) 16-8-8
 - d. Fertilizer rate:
 - 1) Not required for wildflower seeding
 - 2) Newly established seeding areas - 100 pounds of nitrogen per acre
 - 3) Established seeding areas - 150 pounds of nitrogen per acre
- 5. Topsoil: See Section 32 91 19.
- 6. Water: clean and free of industrial wastes or other substances harmful to the germination of the seed or to the growth of the vegetation.
- 7. Soil Retention Blanket
 - a. "Curlex I" from American Excelsior, 900 Ave. H East, Post Office Box 5624, Arlington, Texas 76001, 1-800-777-SOIL or approved equal.

3.3 ACCESSORIES [NOT USED]

3.4 SOURCE QUALITY CONTROL [NOT USED]

PART 4 - EXECUTION [NOT USED]

4.1 INSTALLERS [NOT USED]

4.2 EXAMINATION [NOT USED]

4.3 PREPARATION

- A. Surface Preparation: clear surface of all material including:
 - 1. Stumps, stones, and other objects larger than one inch.
 - 2. Roots, brush, wire, stakes, etc.
 - 3. Any objects that may interfere with seeding or maintenance.
- B. Tilling
 - 1. Compacted areas: till 1 inch deep
 - 2. Areas sloped greater than 3:1: run a tractor parallel to slope to provide less seed/water run-off
 - 3. Areas near trees: Do not till deeper than 1/2 inch inside "drip line" of trees.

4.4 INSTALLATION

- A. Block Sodding
 - 1. General
 - a. Place sod between curb and walk and on terraces that is the same type grass as adjacent grass or existing lawn.
 - b. Plant between the average last freeze date in the spring and 6 weeks prior to the average first freeze in the fall.

2. Installation
 - a. Plant sod specified after the area has been completed to the lines and grades shown on the Drawings with 6 inches of topsoil.
 - b. Use care to retain native soil on the roots of the sod during the process of excavating, hauling and planting.
 - c. Keep sod material moist from the time it is dug until planted.
 - d. Place sod so that the entire area designated for sodding is covered.
 - e. Fill voids left in the solid sodding with additional sod and tamp.
 - f. Roll and tamp sod so that sod is in complete contact with topsoil at a uniform slope.
 - g. Peg sod with wooden pegs (or wire staple) driven through the sod block to the firm earth in areas that may slide due to the height or slope of the surface or nature of the soil.
 3. Watering and Finishing
 - a. Furnish water as an ancillary cost to Contractor by means of temporary metering / irrigation, water truck or by any other method necessary to achieve an acceptable stand of turf as defined in 3.13.B.
 - b. Thoroughly water sod immediately after planted.
 - c. Water until established.
 - d. Generally, an amount of water that is equal to the average amount of rainfall plus 1/2 inch per week should be applied until accepted. If applicable, plant large areas by irrigation zones to ensure areas are watered as soon as they are planted.
- B. Seeding
1. General
 - a. Seed only those areas indicated on the Drawings and areas disturbed by construction.
 - b. Mark each area to be seeded in the field prior to seeding for Owner approval.
 2. Broadcast Seeding
 - a. Broadcast seed in 2 directions at right angles to each other.
 - b. Harrow or rake lightly to cover seed.
 - c. Never cover seed with more soil than twice its diameter.
 - d. For wildflower plantings:
 - 1) Scalp existing grasses to 1 inch
 - 2) Remove grass clippings, so seed can make contact with the soil.
 3. Mechanically Seeding (Drilling):
 - a. Uniformly distribute seed over the areas shown on the Drawings or as directed.
 - b. All varieties of seed and fertilizer may be distributed at the same time provided that each component is uniformly applied at the specified rate.
 - c. Drill seed at a depth of 1/4 inch to 3/8 inch utilizing a pasture or rangeland type drill.
 - d. Drill on the contour of slopes
 - e. After planting roll with a roller integral to the seed drill, or a corrugated roller of the "Cultipacker" type.
 - f. Roll slope areas on the contour.
 4. Hydromulching
 - a. Mixing: Seed, mulch, fertilizer and water may be mixed provided that:
 - 1) Mixture is uniformly suspended to form a homogenous slurry.

- 2) Mixture forms a blotter-like ground cover impregnated uniformly with grass seed.
- 3) Mixture is applied within 30 minutes after placed in the equipment.
- b. Placing
 - 1) Uniformly distribute in the quantity specified over the areas shown on the Drawings or as directed.
- 5. Fertilizing: uniformly apply fertilizer over seeded area.
- 6. Watering
 - a. Furnish water by means of temporary metering / irrigation, water truck or by any other method necessary to achieve an acceptable stand of turf as defined in 3.13.B.
 - b. Water soil to a minimum depth of 4 inches within 48 hours of seeding.
 - c. Water as direct by the Owner at least twice daily for 14 days after seeding in such a manner as to prevent washing of the slopes or dislodgement of the seed.
 - d. Water until final acceptance.
 - e. Generally, an amount of water that is equal to the average amount of rainfall plus 1/2 inch per week should be applied until accepted.

4.5 REPAIR/RESTORATION [NOT USED]

4.6 RE-INSTALLATION [NOT USED]

4.7 FIELD QUALITY CONTROL [NOT USED]

4.8 SYSTEM STARTUP [NOT USED]

4.9 ADJUSTING [NOT USED]

4.10 CLEANING [NOT USED]

4.11 CLOSEOUT ACTIVITIES

4.12 PROTECTION [NOT USED]

4.13 MAINTENANCE

A. Block Sodding

- 1. Water and mow sod until completion and final acceptance of the Project or as directed by the Owner.
- 2. Sod shall not be considered finally accepted until the sod has started to peg down (roots growing into the soil) and is free from dead blocks of sod.

B. Seeding

- 1. Water and mow sod until completion and final acceptance of the Project or as directed by the Owner.
- 2. Maintain the seeded area until each of the following is achieved:
 - a. Vegetation is evenly distributed
 - b. Vegetation is free from bare areas
- 3. Turf will be accepted once fully established.
 - a. Seeded area must have 100 percent growth to a height of 3 inches with 1 mow cycle performed by the Contractor prior to consideration of acceptance by the Owner.

C. Rejection

- 1. Owner may reject block sod or seeded area on the basis of weed populations.

4.14 ATTACHMENTS [NOT USED]

END OF SECTION

SECTION 330510

UTILITY TRENCH EXCAVATION, EMBEDMENT AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, Embedment and Backfill for:
 - a. Pressure Applications
 - 1) Water Distribution or Transmission Main
 - 2) Wastewater Force Main
 - 3) Reclaimed Water Main
 - b. Gravity Applications
 - 1) Wastewater Gravity Mains
 - 2) Storm Sewer Pipe and Culverts
 - 3) Storm Sewer Precast Box and Culverts
 - 2. Including:
 - a. Excavation of all material encountered, including rock and unsuitable materials
 - b. Disposal of excess unsuitable material
 - c. Site specific trench safety
 - d. Pumping and dewatering
 - e. Embedment
 - f. Concrete encasement for utility lines
 - g. Backfill
 - h. Compaction
- B. Deviations from this Owner Standard Specification
 - 1. None.
- C. Related Specification Sections include, but are not necessarily limited to:
 - 1. Part I: Contract Documents – Bidding Requirements, Contract Forms, and Agreement
 - 2. Part II – Technical Specifications
 - 3. Section 033000 – Cast-in-Place Concrete

1.2 PRICE AND PAYMENT PROCEDURES

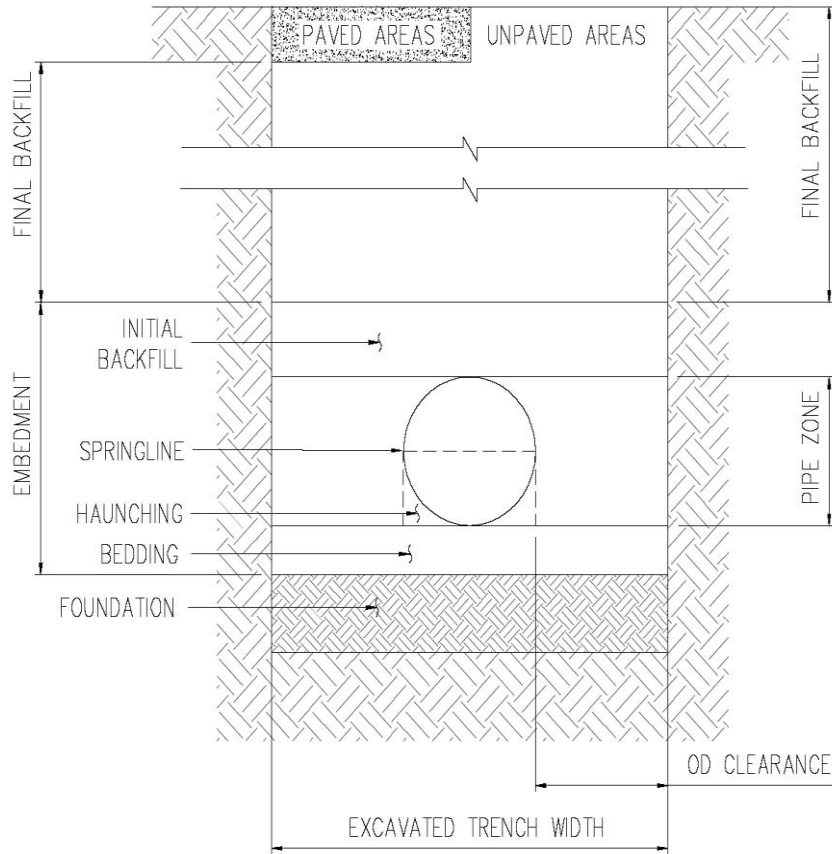
- A. Measurement and Payment
 - 1. Trench Excavation, Embedment and Backfill associated with the installation of an underground utility or excavation
 - a. Measurement
 - 1) This Item is considered subsidiary to the installation of the utility pipe line as designated in the Drawings.
 - b. Payment
 - 1) The work performed and the materials furnished in accordance with this Item are considered subsidiary to the installation of the utility pipe for the type of embedment and backfill as indicated on the plans. No other compensation will be allowed.
 - 2. Imported Embedment or Backfill

- a. Measurement
 - 1) Measured by the cubic yard as delivered to the site and recorded by truck ticket provided to the Owner
 - b. Payment
 - 1) Imported fill shall only be paid when using materials for embedment and backfill other than those identified in the Drawings. The work performed and materials furnished in accordance with pre-bid item and measured as provided under "Measurement" will be paid for at the unit price bid per cubic yard of "Imported Embedment/Backfill" delivered to the Site for:
 - a) Various embedment/backfill materials
 - c. The price bid shall include:
 - 1) Furnishing backfill or embedment as specified by this Specification
 - 2) Hauling to the site
 - 3) Placement and compaction of backfill or embedment
3. Concrete Encasement for Utility Lines
- a. Measurement
 - 1) Measured by the cubic yard per plan quantity.
 - b. Payment
 - 1) The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid per cubic yard of "Concrete Encasement for Utility Lines" per plan quantity.
 - c. The price bid shall include:
 - 1) Furnishing, hauling, placing and finishing concrete in accordance with Section 033000
 - 2) Clean-up
4. Ground Water Control
- a. Measurement
 - 1) Measurement shall be lump sum when a ground water control plan is specifically required by the Contract Documents.
 - b. Payment
 - 1) Payment shall be per the lump sum price bid for "Ground Water Control" including:
 - a) Submittals
 - b) Additional Testing
 - c) Ground water control system installation
 - d) Ground water control system operations and maintenance
 - e) Disposal of water
 - f) Removal of ground water control system
5. Trench Safety
- a. Measurement
 - 1) Measured per linear foot of excavation for all trenches that require trench safety in accordance with OSHA excavation safety standards (29 CFR Part 1926 Subpart P Safety and Health regulations for Construction)
 - b. Payment
 - 1) The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid per linear foot of excavation to comply with OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P), including, but not limited to, all submittals, labor and equipment.

1.3 REFERENCES

A. Definitions

1. General – Definitions used in this section are in accordance with Terminologies ASTM F412 and ASTM D8 and Terminology ASTM D653, unless otherwise noted.
2. Definitions for trench width, backfill, embedment, initial backfill, pipe zone, haunching bedding, springline, pipe zone and foundation are defined as shown in the following schematic:



3. Deleterious materials – Harmful materials such as clay lumps, silts and organic material
4. Excavated Trench Depth – Distance from the surface to the bottom of the bedding or the trench foundation
5. Final Backfill Depth
 - a. Unpaved Areas – The depth of the final backfill measured from the top of the initial backfill to the surface
 - b. Paved Areas – The depth of the final backfill measured from the top of the initial backfill to bottom of permanent or temporary pavement repair

B. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.

2. ASTM Standards:
 - a. ASTM C33-08 Standard Specifications for Concrete Aggregates
 - b. ASTM C88-05 Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - c. ASTM C136-01 Test Method for Sieve Analysis of Fine and Coarse Aggregate
 - d. ASTM D448-08 Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
 - e. ASTM C535-09 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - f. ASTM D588 – Standard Test method for Moisture-Density Relations of Soil-Cement Mixture
 - g. ASTM D698-07 Test Method for Laboratory Compaction Characteristics of Soil Using Stand Efforts (12,400 ft-lb/ft³ 600 Kn-m/M³).
 - h. ASTM 1556 Standard Test Methods for Density and Unit Weight of Soils in Place by Sand Cone Method.
 - i. ASTM 2487 – 10 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - j. ASTM 2321-09 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - k. ASTM D2922 – Standard Test Methods for Density of Soils and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
 - l. ASTM 3017 - Standard Test Method for Water Content of Soil and Rock in place by Nuclear Methods (Shallow Depth)
 - m. ASTM D4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density
3. OSHA
 - a. Occupational Safety and Health Administration CFR 29, Part 1926-Safety Regulations for Construction, Subpart P - Excavations

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 1. Utility Company Notification
 - a. Notify area utility companies at least 48 hours in advance, excluding weekends and holidays, before starting excavation.
 - b. Request the location of buried lines and cables in the vicinity of the proposed work.
- B. Sequencing
 1. Sequence work for each section of the pipe installed to complete the embedment and backfill placement on the day the pipe foundation is complete.
 2. Sequence work such that proctors are complete in accordance with ASTM D698 prior to commencement of construction activities.

1.5 SUBMITTALS

- A. All submittals shall be approved by the Owner prior to construction.

1.6 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

- A. Shop Drawings
 1. Provide detailed drawings and explanation for ground water and surface water control, if required.

2. Trench Safety Plan in accordance with Occupational Safety and Health Administration CFR 29, Part 1926-Safety Regulations for Construction, Subpart P - Excavations
3. Stockpiled excavation and/or backfill material
 - a. Provide a description of the storage of the excavated material only if the Contract Documents do not allow storage of materials in the right-of-way of the easement.

1.7 CLOSEOUT SUBMITTALS [NOT USED]

1.8 MAINTENANCE MATERIAL SUBMITTALS [NOT USED]

1.9 QUALITY ASSURANCE [NOT USED]

1.10 DELIVERY, STORAGE, AND HANDLING

A. Storage

1. Within Existing Rights-of-Way (ROW)
 - a. Spoil, imported embedment and backfill materials may be stored within existing ROW, easements or temporary construction easements, unless specifically disallowed in the Contract Documents.
 - b. Do not block drainage ways, inlets or driveways.
 - c. Provide erosion control in accordance with Section 312500.
 - d. Store materials only in areas barricaded as provided in the traffic control plans.
 - e. In non-paved areas, do not store material on the root zone of any trees or in landscaped areas.
2. Designated Storage Areas
 - a. If the Contract Documents do not allow the storage of spoils, embedment or backfill materials within the ROW, easement or temporary construction easement, then secure and maintain an adequate storage location.
 - b. Provide an affidavit that rights have been secured to store the materials on private property.
 - c. Provide erosion control in accordance with Section 312500.
 - d. Do not block drainage ways.
 - e. Only materials used for 1 working day will be allowed to be stored in the work zone.

B. Deliveries and haul-off - Coordinate all deliveries and haul-off.

1.11 FIELD [SITE] CONDITIONS

A. Existing Conditions

1. Any data which has been or may be provided on subsurface conditions is not intended as a representation or warranty of accuracy or continuity between soils. It is expressly understood that neither the Owner nor the Engineer will be responsible for interpretations or conclusions drawn there from by the Contractor.
2. Data is made available for the convenience of the Contractor.

1.12 WARRANTY [NOT USED]

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED [or] OWNER-SUPPLIED PRODUCTS

2.2 MATERIALS

A. Materials

1. Utility Sand
 - a. Granular and free flowing
 - b. Generally meets or exceeds the limits on deleterious substances per Table 1 for fine aggregate according to ASTM C 33
 - c. Reasonably free of organic material
 - d. Gradation: sand material consisting of durable particles, free of thin or elongated pieces, lumps of clay, loam or vegetable matter and meets the following gradation may be used for utility sand embedment/backfill, and graded with following limits when tested in accordance with ASTM C136.

Sieve Size	Percent Retained
1/2"	0
1/4"	0-5
#4	0-10
#16	0-20
#50	20-70
#100	60-90
#200	90-100

2. Crushed Rock
 - a. Durable crushed rock or recycled concrete
 - b. Meets the gradation of ASTM D448 size numbers 56, 57 or 67
 - c. May be unwashed
 - d. Free from significant silt clay or unsuitable materials
 - e. Percentage of wear not more than 40 percent per ASTM C131 or C535
 - f. Not more than a 12 percent maximum loss when subjective to 5 cycles of sodium sulfate soundness per ASTM C88
3. Fine Crushed Rock
 - a. Durable crushed rock
 - b. Meets the gradation of ASTM D448 size numbers 8 or 89
 - c. May be unwashed
 - d. Free from significant silt clay or unsuitable materials.
 - e. Have a percentage of wear not more than 40 percent per ASTM C131 or C535
 - f. Not more than a 12 percent maximum loss when subjective to 5 cycles of sodium sulfate soundness per ASTM C88
4. Ballast Stone
 - a. Stone ranging from 3 inches to 6 inches in greatest dimension.
 - b. May be unwashed
 - c. Free from significant silt clay or unsuitable materials
 - d. Percentage of wear not more than 40 percent per ASTM C131 or C535

- e. Not more than a 12 percent maximum loss when subjected to 5 cycles of sodium sulfate soundness per ASTM C88
- 5. Acceptable Backfill Material
 - a. In-situ or imported soils classified as CL, CH, SC or GC in accordance with ASTM D2487
 - b. Free from deleterious materials, boulders over 6 inches in size and organics
 - c. Can be placed free from voids
 - d. Must have 20 percent passing the number 200 sieve
- 6. Blended Backfill Material
 - a. In-situ soils classified as SP, SM, GP or GM in accordance with ASTM D2487
 - b. Blended with in-situ or imported acceptable backfill material to meet the requirements of an Acceptable Backfill Material
 - c. Free from deleterious materials, boulders over 6 inches in size and organics
 - d. Must have 20 percent passing the number 200 sieve
- 7. Unacceptable Backfill Material
 - a. In-situ soils classified as ML, MH, PT, OL or OH in accordance with ASTM D2487
- 8. Select Fill
 - a. Classified as SC or CL in accordance with ASTM D2487
 - b. Liquid limit less than 35
 - c. Plasticity index between 8 and 20
- 9. Cement Stabilized Sand (CSS)
 - a. Sand
 - 1) Shall be clean, durable sand meeting grading requirements for fine aggregates of ASTM C33 and the following requirements:
 - a) Classified as SW, SP, or SM by the United Soil Classification System of ASTM D2487
 - b) Deleterious materials
 - (1) Clay lumps, ASTM C142, less than 0.5 percent
 - (2) Lightweight pieces, ASTM C123, less than 5.0 percent
 - (3) Organic impurities, ASTM C40, color no darker than standard color
 - (4) Plasticity index of 4 or less when tested in accordance with ASTM D4318.
 - b. Minimum of 4 percent cement content of Type I/II portland cement
 - c. Water
 - 1) Potable water, free of soils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C94
 - d. Mix in a stationary pug mill, weigh-batch or continuous mixing plant.
 - e. Strength
 - 1) 50 to 150 psi compressive strength at 2 days in accordance with ASTM D1633, Method A
 - 2) 200 to 250 psi compressive strength at 28 days in accordance with ASTM D1633, Method A
 - 3) The maximum compressive strength in 7 days shall be 400 psi. Backfill that exceeds the maximum compressive strength shall be removed by the Contractor for no additional compensation.
 - f. Random samples of delivered product will be taken in the field at point of delivery for each day of placement in the work area. Specimens will be prepared in accordance with ASTM D1632.

10. Trench Geotextile Fabric
 - a. Soils other than ML or OH in accordance with ASTM D2487
 - 1) Needle punch, nonwoven geotextile composed of polypropylene fibers
 - 2) Fibers shall retain their relative position
 - 3) Inert to biological degradation
 - 4) Resist naturally occurring chemicals
 - 5) UV Resistant
 - 6) Mirafi 140N by Tencate, or approved equal
 - b. Soils Classified as ML or OH in accordance with ASTM D2487
 - 1) High-tenacity monofilament polypropylene woven yarn
 - 2) Percent open area of 8 percent to 10 percent
 - 3) Fibers shall retain their relative position
 - 4) Inert to biological degradation
 - 5) Resist naturally occurring chemicals
 - 6) UV Resistant
 - 7) Mirafi FW402 by Tencate, or approved equal
11. Concrete Encasement
 - a. Conform to Section 033000.

2.3 ACCESSORIES [NOT USED]

2.4 SOURCE QUALITY CONTROL [NOT USED]

PART 3 - EXECUTION

3.1 INSTALLERS [NOT USED]

3.2 EXAMINATION

- A. Verification of Conditions
 1. Review all known, identified or marked utilities, whether public or private, prior to excavation.
 2. Locate and protect all known, identified and marked utilities or underground facilities as excavation progresses.
 3. Notify all utility owners within the project limits 48 hours prior to beginning excavation.
 4. The information and data shown in the Drawings with respect to utilities is approximate and based on record information or on physical appurtenances observed within the project limits.
 5. Coordinate with the Owner(s) of underground facilities.
 6. Immediately notify any utility owner of damages to underground facilities resulting from construction activities.
 7. Repair any damages resulting from the construction activities.
- B. Notify the Owner immediately of any changed condition that impacts excavation and installation of the proposed utility.

3.3 PREPARATION

- A. Protection of In-Place Conditions
 1. Pavement

- a. Conduct activities in such a way that does not damage existing pavement that is designated to remain.
 - 1) Where desired to move equipment not licensed for operation on public roads or across pavement, provide means to protect the pavement from all damage.
 - b. Repair or replace any pavement damaged due to the negligence of the contractor outside the limits designated for pavement removal at no additional cost to the Owner.
2. Drainage
- a. Maintain positive drainage during construction and re-establish drainage for all swales and culverts affected by construction.
3. Trees
- a. When operating outside of existing ROW, stake permanent and temporary construction easements.
 - b. Restrict all construction activities to the designated easements and ROW.
 - c. Flag and protect all trees designated to remain in accordance with Section 31 10 00.
 - d. Conduct excavation, embedment and backfill in a manner such that there is no damage to the tree canopy.
 - e. Prune or trim tree limbs as specifically allowed by the Drawings or as specifically allowed by the Owner.
 - 1) Pruning or trimming may only be accomplished with equipments specifically designed for tree pruning or trimming.
4. Above ground Structures
- a. Protect all above ground structures adjacent to the construction.
5. Traffic
- a. Maintain existing traffic, except as modified by the traffic control plan.
 - b. Do not block access to driveways or alleys for extended periods of time unless:
 - 1) Alternative access has been provided
 - 2) Proper notification has been provided to the property owner or resident
 - 3) It is specifically allowed in the traffic control plan
 - c. Use traffic rated plates to maintain access until access is restored.
6. Traffic Signal – Poles, Mast Arms, Pull boxes, Detector loops
- a. Notify the Owner a minimum of 48 hours prior to any excavation that could impact the operations of an existing traffic signal.
 - b. Protect all traffic signal poles, mast arms, pull boxes, traffic cabinets, conduit and detector loops.
 - c. Immediately notify the Owner if any damage occurs to any component of the traffic signal due to the contractors activities.
 - d. Repair any damage to the traffic signal poles, mast arms, pull boxes, traffic cabinets, conduit and detector loops as a result of the construction activities.
7. Fences
- a. Protect all fences designated to remain.
 - b. Leave fence in the equal or better condition as prior to construction.

3.4 INSTALLATION

A. Excavation

- 1. Excavate to a depth indicated on the Drawings.

2. Trench excavations are defined as unclassified. No additional payment shall be granted for rock or other in-situ materials encountered in the trench.
 3. Excavate to a width sufficient for laying the pipe in accordance with the Drawings and bracing in accordance with the Excavation Safety Plan.
 4. The bottom of the excavation shall be firm and free from standing water.
 - a. Notify the Owner immediately if the water and/or the in-situ soils do not provide for a firm trench bottom.
 - b. The Owner will determine if any changes are required in the pipe foundation or bedding.
 5. Unless otherwise permitted by the Drawings or by the Owner, the limits of the excavation shall not advance beyond the pipe placement so that the trench may be backfilled in the same day.
 6. Over Excavation
 - a. Fill over excavated areas with the specified bedding material as specified for the specific pipe to be installed.
 - b. No additional payment will be made for over excavation or additional bedding material.
 7. Unacceptable Backfill Materials
 - a. In-situ soils classified as unacceptable backfill material shall be separated from acceptable backfill materials.
 - b. If the unacceptable backfill material is to be blended in accordance with this Specification, then store material in a suitable location until the material is blended.
 - c. Remove all unacceptable material from the project site that is not intended to be blended or modified.
 8. Rock – No additional compensation will be paid for rock excavation or other changed field conditions.
- B. Shoring, Sheet piling and Bracing
1. Engage a Licensed Professional Engineer in the State of Texas to design a site specific excavation safety system in accordance with Federal and State requirements.
 2. Excavation protection systems shall be designed according to the space limitations as indicated in the Drawings.
 3. Furnish, put in place and maintain a trench safety system in accordance with the Excavation Safety Plan and required by Federal, State or local safety requirements.
 4. If soil or water conditions are encountered that are not addressed by the current Excavation Safety Plan, engage a Licensed Professional Engineer in the State of Texas to modify the Excavation Safety Plan and provide a revised submittal to the Owner.
 5. Do not allow soil, or water containing soil, to migrate through the Excavation Safety System in sufficient quantities to adversely affect the suitability of the Excavation Protection System. Movable bracing, shoring plates or trench boxes used to support the sides of the trench excavation shall not:
 - a. Disturb the embedment located in the pipe zone or lower
 - b. Alter the pipe's line and grade after the Excavation Protection System is removed
 - c. Compromise the compaction of the embedment located below the spring line of the pipe and in the haunching

C. Water Control

1. Surface Water

- a. Furnish all materials and equipment and perform all incidental work required to direct surface water away from the excavation.

2. Ground Water

- a. Furnish all materials and equipment to dewater ground water by a method which preserves the undisturbed state of the subgrade soils.
- b. Do not allow the pipe to be submerged within 24 hours after placement.
- c. Do not allow water to flow over concrete until it has sufficiently cured.
- d. Engage a Licensed Engineer in the State of Texas to prepare a Ground Water Control Plan if any of the following conditions are encountered:
 - 1) A Ground Water Control Plan is specifically required by the Contract Documents
 - 2) If in the sole judgment of the Owner, ground water is so severe that an Engineered Ground Water Control Plan is required to protect the trench or the installation of the pipe which may include:
 - a) Ground water levels in the trench are unable to be maintained below the top of the bedding
 - b) A firm trench bottom cannot be maintained due to ground water
 - c) Ground water entering the excavation undermines the stability of the excavation.
 - d) Ground water entering the excavation is transporting unacceptable quantities of soils through the Excavation Safety System.
- e. In the event that there is no bid item for a Ground Water Control and the Owner requires an Engineered Ground Water Control Plan due to conditions discovered at the site, the contractor will be eligible to submit a change order.
- f. Control of ground water shall be considered subsidiary to the excavation when:
 - 1) No Ground Water Control Plan is specifically identified and required in the Contract Documents
- g. Ground Water Control Plan installation, operation and maintenance
 - 1) Furnish all materials and equipment necessary to implement, operate and maintain the Ground Water Control Plan.
 - 2) Once the excavation is complete, remove all ground water control equipment not called to be incorporated into the work.
- h. Water Disposal
 - 1) Dispose of ground water in accordance with Owner policy or Ordinance.
 - 2) Do not discharge ground water onto or across private property without written permission.
 - 3) Permission from the Owner is required prior to disposal into the Sanitary Sewer.
 - 4) Disposal shall not violate any Federal, State or local regulations.

D. Embedment and Pipe Placement

1. Water Lines less than, or equal to, 12 inches in diameter:

- a. The entire embedment zone shall be of uniform material.
- b. Utility sand shall be generally used for embedment.
- c. If ground water is in sufficient quantity to cause sand to pump, then use crushed rock as embedment.
 - 1) If crushed rock is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
- d. Place evenly spread bedding material on a firm trench bottom.

- e. Provide firm, uniform bedding.
 - f. Place pipe on the bedding in accordance with the alignment of the Drawings.
 - g. In no case shall the top of the pipe be less than 42 inches from the surface of the proposed grade, unless specifically called for in the Drawings.
 - h. Place embedment, including initial backfill, to a minimum of 6 inches, but not more than 12 inches, above the pipe.
 - i. Where gate valves are present, the initial backfill shall extend to 6 inches above the elevation of the valve nut.
 - j. Form all blocking against undisturbed trench wall to the dimensions in the Drawings.
 - k. Compact embedment and initial backfill.
 - l. Place marker tape on top of the initial trench backfill in accordance with Section 330526.
2. Water Lines 16-inches through 24-inches in diameter:
- a. The entire embedment zone shall be of uniform material.
 - b. Utility sand may be used for embedment when the excavated trench depth is less than 15 feet deep.
 - c. Crushed rock or fine crushed rock shall be used for embedment for excavated trench depths 15 feet, or greater.
 - d. Crushed rock shall be used for embedment for steel pipe.
 - e. Provide trench geotextile fabric at any location where crushed rock or fine crushed rock come into contact with utility sand
 - f. Place evenly spread bedding material on a firm trench bottom.
 - g. Provide firm, uniform bedding.
 - 1) Additional bedding may be required if ground water is present in the trench.
 - 2) If additional crushed rock is required not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
 - h. Place pipe on the bedding according to the alignment shown on the Drawings.
 - i. The pipe line shall be within:
 - 1) ± 3 inches of the elevation on the Drawings for 16-inch and 24-inch water lines
 - j. Place and compact embedment material to adequately support haunches in accordance with the pipe manufacturer's recommendations.
 - k. Place remaining embedment including initial backfill to a minimum of 6 inches, but not more than 12 inches, above the pipe.
 - l. Where gate valves are present, the initial backfill shall extend to up to the valve nut.
 - m. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.
 - n. Density test may be performed by Owner to verify that the compaction of embedment meets requirements.
 - o. Place trench geotextile fabric on top of the initial backfill.
 - p. Place marker tape on top of the trench geotextile fabric in accordance with Section 330526.
3. Water Lines 30-inches and greater in diameter
- a. The entire embedment zone shall be of uniform material.
 - b. Crushed rock shall be used for embedment.

- c. Provide trench geotextile fabric at any location where crushed rock or fine crushed rock come into contact with utility sand.
 - d. Place evenly spread bedding material on a firm trench bottom.
 - e. Provide firm, uniform bedding.
 - 1) Additional bedding may be required if ground water is present in the trench.
 - 2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
 - f. Place pipe on the bedding according to the alignment shown on the Drawings.
 - g. The pipe line shall be within:
 - 1) ± 1 inch of the elevation on the Drawings for 30-inch and larger water lines
 - h. Place and compact embedment material to adequately support haunches in accordance with the pipe manufacturer's recommendations.
 - i. For steel pipe greater than 30 inches in diameter, the initial embedment lift shall not exceed the spring line prior to compaction.
 - j. Place remaining embedment, including initial backfill, to a minimum of 6 inches, but not more than 12 inches, above the pipe.
 - k. Where gate valves are present, the initial backfill shall extend to up to the valve nut.
 - l. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.
 - m. Density test may be performed by Owner to verify that the compaction of embedment meets requirements.
 - n. Place trench geotextile fabric on top of the initial backfill.
 - o. Place marker tape on top of the trench geotextile fabric in accordance with Section 330526.
4. Sanitary Sewer Lines and Storm Sewer Lines (HDPE)
- a. The entire embedment zone shall be of uniform material.
 - b. Crushed rock shall be used for embedment.
 - c. Place evenly spread bedding material on a firm trench bottom.
 - d. Spread bedding so that lines and grades are maintained and that there are no sags in the sanitary sewer pipe line.
 - e. Provide firm, uniform bedding.
 - 1) Additional bedding may be required if ground water is present in the trench.
 - 2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
 - f. Place pipe on the bedding according to the alignment shown in the Drawings.
 - g. The pipe line shall be within ± 0.1 inches of the elevation, and be consistent with the grade shown on the Drawings.
 - h. Place and compact embedment material to adequately support haunches in accordance with the pipe manufacturer's recommendations.
 - i. For sewer lines greater than 30 inches in diameter, the embedment lift shall not exceed the spring line prior to compaction.
 - j. Place remaining embedment including initial backfill to a minimum of 6 inches, but not more than 12 inches, above the pipe.
 - k. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.

- l. Density test may be performed by Owner to verify that the compaction of embedment meets requirements.
 - m. Place trench geotextile fabric on top of the initial backfill.
 - n. Place marker tape on top of the trench geotextile fabric in accordance with Section 330526.
5. Storm Sewer (RCP)
- a. The bedding and the pipe zone up to the spring line shall be of uniform material.
 - b. Crushed rock shall be used for embedment up to the spring line.
 - c. The specified backfill material may be used above the spring line.
 - d. Place evenly spread bedding material on a firm trench bottom.
 - e. Spread bedding so that lines and grades are maintained and that there are no sags in the storm sewer pipe line.
 - f. Provide firm, uniform bedding.
 - 1) Additional bedding may be required if ground water is present in the trench.
 - 2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
 - g. Place pipe on the bedding according to the alignment of the Drawings.
 - h. The pipe line shall be within ± 0.1 inches of the elevation, and be consistent with the grade, shown on the Drawings.
 - i. Place embedment material up to the spring line.
 - 1) Place embedment to ensure that adequate support is obtained in the haunch.
 - j. Compact the embedment and initial backfill to 95 percent Standard Proctor ASTM D 698.
 - k. Density test may be performed by Owner to verify that the compaction of embedment meets requirements.
 - l. Place trench geotextile fabric on top of pipe and crushed rock.
6. Storm Sewer Reinforced Concrete Box
- a. Crushed rock shall be used for bedding.
 - b. The pipe zone and the initial backfill shall be:
 - 1) Crushed rock, or
 - 2) Acceptable backfill material compacted to 95 percent Standard Proctor density
 - c. Place evenly spread compacted bedding material on a firm trench bottom.
 - d. Spread bedding so that lines and grades are maintained and that there are no sags in the storm sewer pipe line.
 - e. Provide firm, uniform bedding.
 - 1) Additional bedding may be required if ground water is present in the trench.
 - 2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
 - f. Fill the annular space between multiple boxes with crushed rock.
 - g. Place pipe on the bedding according to the alignment of the Drawings.
 - h. The pipe shall be within ± 0.1 inches of the elevation, and be consistent with the grade, shown on the Drawings.
 - i. Compact the embedment initial backfill to 95 percent Standard Proctor ASTM D698.

7. Water Services (Less than 2 Inches in Diameter)
 - a. The entire embedment zone shall be of uniform material.
 - b. Utility sand shall be generally used for embedment.
 - c. Place evenly spread bedding material on a firm trench bottom.
 - d. Provide firm, uniform bedding.
 - e. Place pipe on the bedding according to the alignment of the Plans.
 - f. Compact the initial backfill to 95 percent Standard Proctor ASTM D698.
 8. Sanitary Sewer Services
 - a. The entire embedment zone shall be of uniform material.
 - b. Crushed rock shall be used for embedment.
 - c. Place evenly spread bedding material on a firm trench bottom.
 - d. Spread bedding so that lines and grades are maintained and that there are no sags in the sanitary sewer pipe line.
 - e. Provide firm, uniform bedding.
 - 1) Additional bedding may be required if ground water is present in the trench.
 - 2) If additional crushed rock is required which is not specifically identified in the Contract Documents, then crushed rock shall be paid by the pre-bid unit price.
 - f. Place pipe on the bedding according to the alignment of the Drawings.
 - g. Place remaining embedment, including initial backfill, to a minimum of 6 inches, but not more than 12 inches, above the pipe.
 - h. Compact the initial backfill to 95 percent Standard Proctor ASTM D698.
 - i. Density test may be required to verify that the compaction meets the density requirements.
- E. Trench Backfill
1. At a minimum, place backfill in such a manner that the required in-place density and moisture content is obtained, and so that there will be no damage to the surface, pavement or structures due to any trench settlement or trench movement.
 - a. Meeting the requirement herein does not relieve the responsibility to damages associated with the Work.
 2. Backfill Material
 - a. Final backfill depth less than 15 feet
 - 1) Backfill with:
 - a) Acceptable backfill material
 - b) Blended backfill material, or
 - c) Select backfill material, CSS, or CLSM when specifically required
 - b. Final backfill depth 15 feet or greater: (under pavement or future pavement)
 - 1) Backfill depth from 0 to 15 feet deep
 - a) Backfill with:
 - (1) Acceptable backfill material
 - (2) Blended backfill material, or
 - (3) Select backfill material, CSS, or CLSM when specifically required
 - 2) Backfill depth from 15 feet and greater
 - a) Backfill with:
 - (1) Select Fill
 - (2) CSS, or
 - (3) CLSM when specifically required
 - c. Final backfill depth 15 feet or greater: (not under pavement or future pavement)
 - 1) Backfill with:

- a) Acceptable backfill material, or
 - b) Blended backfill material
 - d. Backfill for service lines:
 - 1) Backfill for water or sewer service lines shall be the same as the requirement of the main that the service is connected to.
- 3. Required Compaction and Density
 - a. Final backfill (depths less than 15 feet)
 - 1) Compact acceptable backfill material, blended backfill material or select backfill to a minimum of 95 percent Standard Proctor per ASTM D698 at moisture content within -2 to +5 percent of the optimum moisture.
 - 2) CSS or CLSM requires no compaction.
 - b. Final backfill (depths 15 feet and greater/under existing or future pavement)
 - 1) Compact select backfill to a minimum of 98 percent Standard Proctor per ASTM D 698 at moisture content within -2 to +5 percent of the optimum moisture.
 - 2) CSS or CLSM requires no compaction.
 - c. Final backfill (depths 15 feet and greater/not under existing or future pavement)
 - 1) Compact acceptable backfill material blended backfill material, or select backfill to a minimum of 95 percent Standard Proctor per ASTM D 698 at moisture content within -2 to +5 percent of the optimum moisture.
- 4. Saturated Soils
 - a. If in-situ soils consistently demonstrate that they are greater than 5 percent over optimum moisture content, the soils are considered saturated.
 - b. Flooding the trench or water jetting is strictly prohibited.
 - c. If saturated soils are identified in the Drawings or Geotechnical Report in the Appendix, Contractor shall proceed with Work following all backfill procedures outlined in the Drawings for areas of soil saturation greater than 5 percent.
 - d. If saturated soils are encountered during Work but not identified in Drawings or Geotechnical Report in the Appendix:
 - 1) The Contractor shall:
 - a) Immediately notify the Owner.
 - b) Submit a Contract Claim for Extra Work associated with direction from Owner.
 - 2) The Owner shall:
 - a) Investigate soils and determine if Work can proceed in the identified location.
 - b) Direct the Contractor of changed backfill procedures associated with the saturated soils that may include:
 - (1) Imported backfill
 - (2) A site specific backfill design
- 5. Placement of Backfill
 - a. Use only compaction equipment specifically designed for compaction of a particular soil type and within the space and depth limitation experienced in the trench.
 - b. Flooding the trench or water setting is strictly prohibited.
 - c. Place in loose lifts not to exceed 12 inches.
 - d. Compact to specified densities.
 - e. Compact only on top of initial backfill, undisturbed trench or previously compacted backfill.

- f. Remove any loose materials due to the movement of any trench box or shoring or due to sloughing of the trench wall.
- 6. Backfill Means and Methods Demonstration
 - a. Notify the Owner in writing with sufficient time for the Owner to obtain samples and perform standard proctor test in accordance with ASTM D698.
 - b. The results of the standard proctor test must be received prior to beginning excavation.
 - c. Upon commencing of backfill placement for the project the Contractor shall demonstrate means and methods to obtain the required densities.
 - d. Demonstrate Means and Methods for compaction including:
 - 1) Depth of lifts for backfill which shall not exceed 12 inches
 - 2) Method of moisture control for excessively dry or wet backfill
 - 3) Placement and moving trench box, if used
 - 4) Compaction techniques in an open trench
 - 5) Compaction techniques around structure
 - e. Provide a testing trench box to provide access to the recently backfilled material.
- 7. Varying Ground Conditions
 - a. Notify the Owner of varying ground conditions and the need for additional proctors.
 - b. Request additional proctors when soil conditions change.
 - c. The Owner may acquire additional proctors at its discretion.
 - d. Significant changes in soil conditions will require an additional Means and Methods demonstration.

3.5 REPAIR [NOT USED]

3.6 RE-INSTALLATION [NOT USED]

3.7 FIELD QUALITY CONTROL

A. Non-Conforming Work

- 1. All non-conforming work shall be removed and replaced.

3.8 SYSTEM STARTUP [NOT USED]

3.9 ADJUSTING [NOT USED]

3.10 CLEANING [NOT USED]

3.11 CLOSEOUT ACTIVITIES [NOT USED]

3.12 PROTECTION [NOT USED]

3.13 MAINTENANCE [NOT USED]

3.14 ATTACHMENTS [NOT USED]

END OF SECTION

SECTION 331300

DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes disinfection of potable water distribution [and transmission] system; and testing and reporting results.
- B. Related Sections:
 - 1. Section 33 11 16 - Site Water Utility Distribution Piping Product and Execution requirements for installation, testing, of site domestic water distribution piping.

1.2 REFERENCES

- A. American Water Works Association:
 - 1. AWWA B300 - Hypochlorites.
 - 2. AWWA B301 - Liquid Chlorine.
 - 3. AWWA B302 - Ammonium Sulfate.
 - 4. AWWA B303 - Sodium Chlorite.
 - 5. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
 - 6. AWWA C651 - Disinfecting Water Mains.

1.3 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Certificate: Certify cleanliness of water distribution system meets or exceeds specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Disinfection Report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Name of person collecting samples.
 - 5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
 - 6. Date and time of flushing start and completion.
 - 7. Disinfectant residual after flushing in ppm for each outlet tested.
- C. Bacteriological Report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.

3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certify water conforms, or fails to conform, to bacterial standards of Manville WSC

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.

1.6 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing or examining potable water systems, certified by State of Texas.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping system has been cleaned, inspected, and pressure tested.
- B. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

- A. Provide and attach required equipment to perform the Work of this section.
- B. Perform disinfection of water distribution system and installation of system and pressure testing. Refer to Section 33 11 16.
- C. Introduce treatment into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Disinfection, Flushing, and Sampling:
 - 1. Disinfect pipeline installation in accordance with AWWA C651. Use of liquid chlorine is not permitted
 - 2. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
 - 3. Legally dispose of chlorinated water. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
 - 4. After final flushing and before pipeline is connected to existing system, or placed in service, employ an approved independent testing laboratory to sample, test and certify water quality suitable for human consumption.

END OF SECTION

SECTION 331116

SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings for site water line including domestic water line, fire water line, and sprinkler system.
 - 2. Valves.
 - 3. Hydrants.
 - 4. Backflow preventers.
 - 5. Underground pipe markers.
 - 6. Precast concrete vault.
 - 7. Bedding and cover materials.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete for thrust restraints.
 - 2. Section 31 20 00 - Earthwork
 - 3. Section 33 05 10 - Excavation: Utility trench excavation, embedment and backfill.
 - 4. Section 33 13 00 - Disinfecting of Water Utility Distribution: Disinfection of site service utility water piping.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- B. American Society of Mechanical Engineers:
 - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

- C. American Society of Sanitary Engineering:
 - 1. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent.
 - 2. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.

- D. American Water Works Association:
 - 1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

5. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C502 - Dry-Barrel Fire Hydrants.
7. AWWA C509 - Resilient-Seated Gate Valves for Water-Supply Service.
8. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
9. AWWA C606 - Grooved and Shouldered Joints.
10. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.
11. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
12. UL 246 - Hydrants for Fire - Protection Service.

1.3 SUBMITTALS

- A. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with City standards.
- B. Valves: Manufacturer's name and pressure rating marked of valve body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 WATER PIPING

- A. Pipe shall be AWWA C100, Class 350 Ductile Iron Pipe:
 1. Fittings: Ductile iron standard thickness.
 2. Joints: ANSI/AWWA C111, rubber gasket with rods.
- B. Pipe shall be AWWA C900, DR-14 PVC Pipe
 1. Fittings: Ductile iron standard thickness.

2. Joints: ANSI/AWWA C111, rubber gasket with rods.

2.2 GATE VALVES

- A. 2-1/2 inches and Smaller: Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, with control rod, extension box and valve key.
- B. 3 inches and Larger: AWWA C509, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, control rod, extension box and valve key.

2.3 HYDRANT

- A. Hydrants for the project shall meet City requirements.
- B. Contractor shall contact City Fire Marshall to verify hose and steamer connection diameters and threads. Match sizes with City Fire Department, two hose nozzles, one pumper nozzle.
- C. Hydrant extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- D. Finish: Primer and two coats of enamel to color required by City Fire Department.

2.4 BACKFLOW PREVENTERS

- A. Furnish materials in accordance with City of standards

2.5 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.6 BEDDING AND COVER MATERIALS

- A. Bedding: Crushed stone with not less than 95% passing the 3/4" sieve and not less than 95% retained by the No. 4 sieve.

2.7 ACCESSORIES

- A. Concrete for Thrust Blocks: Concrete shall be minimum 3000 psi specified in Section 32 1313.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify building service connection and municipal utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 4133 for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.
- D. Maintain optimum moisture content of fill material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Maintain separation of water main from sewer piping in accordance with code.
- B. Install pipe to indicated elevation to within tolerance of 5/8 inches.
- C. Route pipe in straight line.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Install access fittings to permit disinfection of water system performed under Section 33 1300.
- F. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- G. Establish elevations of buried piping with not less than 3.5 ft of cover.
- H. Install plastic ribbon tape continuous over top of pipe. Buried 6 inches below finish grade,] above pipe line
- I. Backfill trench in lifts not exceeding 8" compacted thickness

3.5 INSTALLATION - VALVES AND HYDRANTS

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- D. Set hydrants to grade, with nozzles at least 20 inches above ground.

- E. Locate control valve 4 feet away from hydrant.
- F. Provide drainage pit as shown on the drawings. Encase elbow of hydrant in gravel to 1 inch above drain opening. Do not connect drain opening to sewer.

3.6 INSTALLATION - METERS

- A. Install meters in accordance with City standards

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 33 1300.

3.8 FIELD QUALITY CONTROL

- A. Field inspection and pressure testing will be performed by Contractor.
- B. Compaction Testing for Bedding: In accordance with ASTM D1557.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.9 REGULATORY REQUIREMENTS

- A. Provide certificate of compliance from the corresponding City Authority indicating approval of fire service main system.

END OF SECTION

SECTION 34 41 13

TRAFFIC SIGNS AND SIGNALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Traffic control signs.
- B. Related Requirements:

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by the basic designation only.
- B. ASTM International (ASTM):
 - 1. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - 2. ASTM C94 - Ready Mix Concrete
 - 3. ASTM D4956 - Retroreflective Sheeting for Traffic Control.
- C. US Department of Transportation, Federal Highway Administration:
 - 1. Manual on Uniform Traffic Control Devices (MUTCD).

PART 2 - PRODUCTS

2.1 SIGNS

- A. Conform to US Department of Transportation [MUTCD](#). Sign classification, type, size, and color shall be as shown on the drawings
- B. Retroreflectivity: Microprismatic type sheeting conforming to ASTM D 4956, Type VIII, IX, or XI.

2.2 POSTS

- A. Square Post: Square tubular steel sign post, galvanized, 12 ga, perforated full-length with 7/16 inch holes on four sides. Post size shall be as shown on the Drawings.
- B. Steel Pipe: ASTM A 53, Type E (electric-resistance welded) or Type S (seamless), Grade B, Schedule 40, size as shown on the Drawings.

2.3 CONCRETE

- A. Mix concrete and deliver in accordance with ASTM C 94.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:
 - 1. Compressive Strength: 3,500 psi, minimum at 28 days, unless otherwise indicated on the Drawings.
 - 2. Slump Range: 1 to 3-inches at time of placement
 - 3. Air Entrainment: 5 to 8 percent

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field verify underground utilities prior to sign installation. Primary utilities of concern of shallow depths are lawn sprinkler systems, electric, telephone, fiber optic, cable and gas.

3.2 INSTALLATION

- A. Install signs as shown on the Drawings and in accordance with MUTCD and manufacturer's instructions.
- B. Install signs of the type and at locations shown on the Drawings.
- C. Install posts of the type as shown on the drawing.

END OF SECTION



GEOTECHNICAL DATA REPORT

FOR

**WILLIAMSON COUNTY KARST MITIGATION
CAMBRIA DRIVE
WILLIAMSON COUNTY, TEXAS**

Project No. AAA18-018-00
March 7, 2018

Mr. Ross Eubanks, P.E., S.E.
Dunaway Associates, Inc.
5707 Southwest Parkway
Building 2, Suite 250
Austin, Texas 78735

P 512.339.1745 F 512.339.6174
TBPE Firm F-3257

**RE: Geotechnical Data Report
Williamson County Karst Mitigation
Cambria Drive
Williamson County, Texas**

Dear Mr. Eubanks:

RABA KISTNER Consultants Inc. (RKCI) is pleased to submit this geotechnical engineering data report for the above-referenced project. This study was performed in accordance with RKCI Proposal No. PAA18-031-00, Revision No. 1, dated February 21, 2018. The purpose of this study was to drill 5 borings, to perform laboratory testing to classify and characterize subsurface conditions, and to prepare an engineering data report.

We appreciate the opportunity to be of service to you on this project. Should you have any questions about the information presented in this report, or if we may be of additional assistance with value engineering or on the materials testing-quality control program during construction, please call.

Very truly yours,

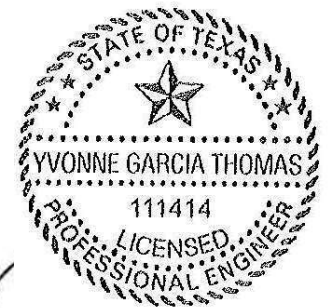
RABA KISTNER CONSULTANTS, INC.



Richard T. Shimono, E.I.T.
Graduate Engineer



Yvonne Garcia Thomas, P.E.
Associate



03/07/2018

RTS/YGT: ss

Attachments

Copies Submitted: Above (1-electronic)

GEOTECHNICAL DATA REPORT

For

**WILLIAMSON COUNTY KARST MITIGATION
CAMBRIA DRIVE
WILLIAMSON COUNTY, TEXAS**

Prepared for

DUNAWAY ASSOCIATES, INC.
Austin, Texas

Prepared by

RABA KISTNER CONSULTANTS, INC.
Austin, Texas

PROJECT NO. AAA18-018-00

March 7, 2018

TABLE OF CONTENTS

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ATTACHMENTS

The following figures are attached and complete this report:

Boring Location Map..... Figure 1
Logs of Borings..... Figures 2 to 6
Key to Terms and Symbols..... Figure 7
Results of Soil Analyses..... Figure 8
Photographs
Important Information About Your Geotechnical Engineering Report

INTRODUCTION

RABA KISTNER Consultants Inc. (RKCI) has completed the authorized subsurface exploration and laboratory testing for the Williamson County karst mitigation project in Williamson County, Texas. This report briefly describes the procedures utilized during this study and presents our findings.

PROPOSED SCOPE OF SERVICES

The scope of services being considered in this study consists of performing a subsurface exploration west of a known, cave/karst feature beneath Cambria Drive in Williamson County, Texas, and providing an engineering data report, which includes a summary of our subsurface findings, boring logs, a boring location map, and laboratory test results.

LIMITATIONS

This engineering data report has been prepared in accordance with accepted Geotechnical Engineering practices in the region of central Texas and for the use of Dunaway Associates, Inc. (CLIENT) and its representatives. This data report may not contain sufficient information for purposes of other parties or other uses. This report is not intended for use in determining construction means and methods. The attachments and report text should not be used separately.

This report may not reflect the actual variations of the subsurface conditions across the site. This is particularly true of this site where the presence of solution cavities and/or voids that may not have been encountered in our test borings potentially exists. The nature and extent of variations across the site may not become evident until construction commences. The construction process itself may also alter subsurface conditions.

The scope of our geotechnical engineering data study does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the site. No environmental opinions are presented in this report.

BORINGS AND LABORATORY TESTS

Subsurface conditions at the site were evaluated by 5 borings drilled at the locations shown on the Boring Location Map, Figure 1. Boring locations were documented in the field utilizing a hand-held GPS device. The borings were drilled to approximate depths of 30 ft below the existing ground surface using a truck-mounted drilling rig.

During drilling operations, the following samples were collected:

Type of Sample	Number Collected
Auger (Grab)	2
Split-Spoon (with Standard Penetration Test)	5
Undisturbed Shelby Tube	3
NX Rock Core	136 ft

Each sample was visually classified in the laboratory by a member of our geotechnical engineering staff. The geotechnical engineering properties of the strata were evaluated by 9 moisture content and 11 unconfined rock compression tests.

The results of all laboratory tests are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 6. A key to classification terms and symbols used on the logs is presented on Figure 7. The results of the laboratory and field testing are also tabulated on Figure 8 for ease of reference.

Standard Penetration Test results (N-values) are noted as “blows per ft” on the boring logs and Figure 8. The N-value is the number of blows required to drive a split-spoon sampler 1 ft into soil/weak rock with a falling, 140-lb hammer. Where hard or dense materials were encountered, the tests were terminated at 50 blows even if one foot of penetration had not been achieved. When all 50 blows fall within the first 6 in. (seating blows), refusal “ref” for 6 in. or less will be noted on the boring logs and on Figure 8.

The core recovery presented on the logs as “REC” is the total length of the recovered material divided by the attempted run length during coring activities, presented as a percentage. The Rock Quality Designation (RQD) is the sum of the length of all the pieces recovered measuring 4 inches or more divided by the attempted run length during coring activities, presented as a percentage.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the request of the Client.

GENERAL SITE CONDITIONS

SITE DESCRIPTION

The project site is a segment of Cambria Drive, approximately 50 ft south of its intersection with Ephraim Road in Williamson County, Texas. The site is paved with asphalt, and has recently experienced a partial collapse of a cave/karst feature below the roadway.

GEOLOGY

A review of the *Geologic Atlas of Texas, Austin Sheet*, indicates that this site is naturally underlain with the soils/rock (limestone) of the Edwards Group. Edwards limestone is generally considered hard in induration and typically contains harder zones/seams of chert and dolomite. Edwards limestone also typically contains karstic features in the form of open and/or clay-filled vugs, voids, and/or solution cavities that form as a result of solution movement through fractures in the rock mass.

Key geotechnical engineering considerations for development supported on this formation will be the depth to rock, the expansive nature of the overlying clays, the condition of the rock, and the presence/absence of karstic features.

STRATIGRAPHY

The subsurface conditions encountered at the boring locations are shown on the boring logs, Figures 2 through 6. These boring logs represent our interpretation of the subsurface conditions based on the field logs, visual examination of field samples by our geotechnical personnel, and test results of selected field samples. Each stratum has been designated by grouping soils that possess similar physical and engineering characteristics. The lines designating the interfaces between strata on the boring logs represent approximate boundaries. Transitions between strata may be gradual.

Each boring was drilled through the existing asphalt pavement. Pavement sections were generally comprised of 1-1/2 to 2 in. of asphalt overlying 8 to 13 in. of flexible base.

The subsurface conditions in our borings generally consisted of 1 to 2 ft of clay with gravel, overlying hard, tan to gray, competent limestone near the surface transitioning into soft, highly weathered limestone with depth. Typical inclusions in the Edwards formation, such as chert seams, clay-filled vugs, and voids, were encountered in our borings. Refer to attached boring logs for noted inclusions. During drilling operations, a 7 ft void and/or very soft decomposed layer was observed from 13 to 20 ft.

The limestone unconfined compressive strength ranged from 157 to 954 tsf for the upper, hard, competent limestone. A single test performed on a highly weathered limestone specimen resulted in an unconfined compressive strength of 32 tsf.

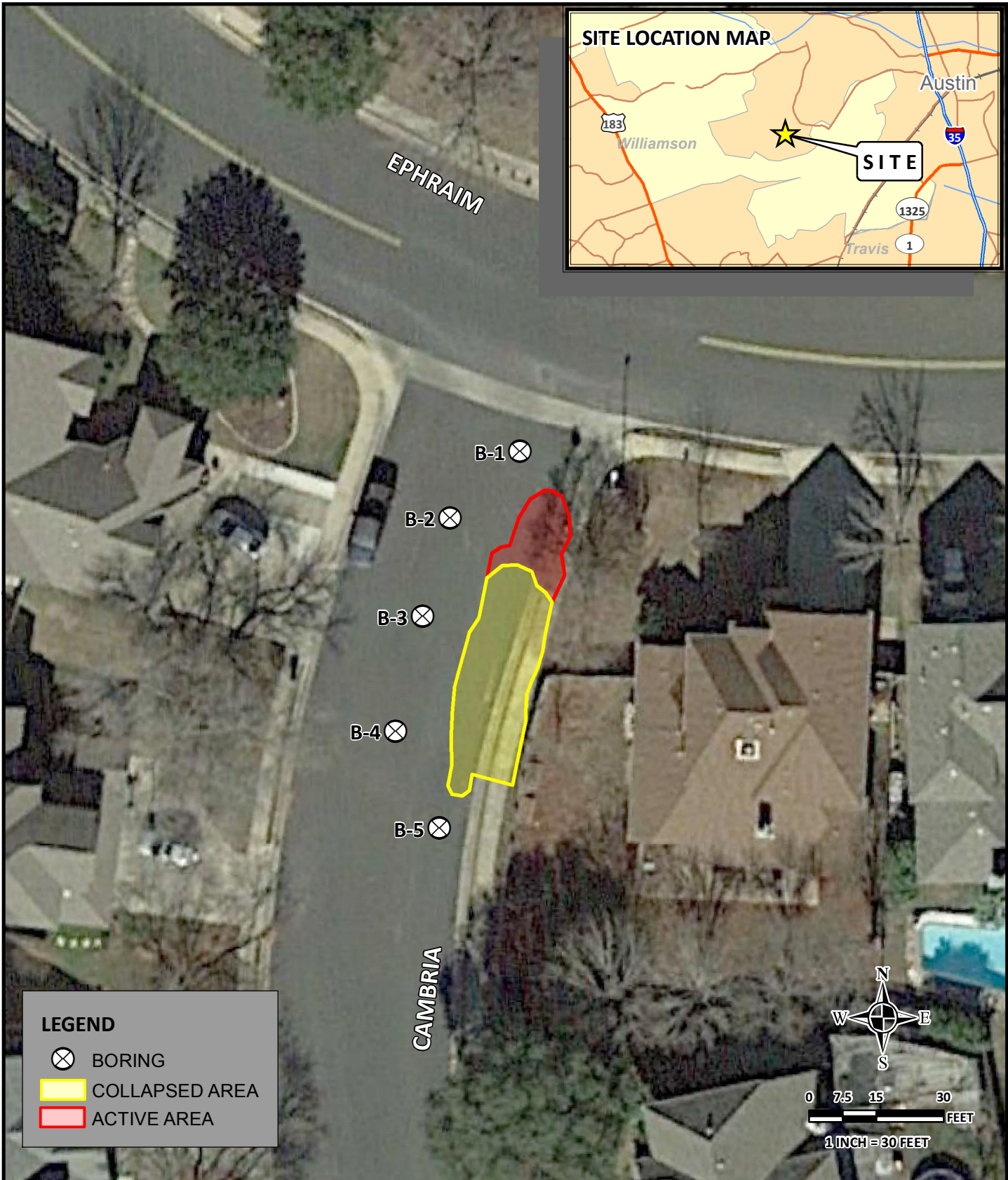
GROUNDWATER

NX rock core samples were collected using both wet sampling and dry, air sampling techniques. Air rock core sampling was utilized in Borings B-1 and B-2. Wet coring, which involves the introduction of water to facilitate drilling operations, was utilized in Borings B-3, B-4, and B-5. Groundwater was not observed in the borings either during or immediately before the introduction of water for NX rock coring.

It is possible for groundwater to exist beneath this site at shallow depths on a transient basis, particularly at the clay/limestone interface, within weathered limestone seams, and following periods of precipitation. Fluctuations in groundwater levels occur due to variation in rainfall and surface water run-off. The construction process itself may also cause variations in the groundwater level.

* * * * *

ATTACHMENTS



LEGEND

- BORING
- COLLAPSED AREA
- ACTIVE AREA

**RABA
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TBPE Firm Number 3257

SOURCE: Aerial Photograph Obtained from Google Earth Pro - 2018

BORING LOCATION MAP
WILLIAMSON COUNTY KARST MITIGATION
CAMBRIA DRIVE
WILLIAMSON COUNTY, TEXAS



PROJECT No.:	AAA18-018-00
ISSUE DATE:	03/06/2018
DRAWN BY:	CCL
CHECKED BY:	RTS
REVIEWED BY:	YGT

FIGURE

1

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

LOG OF BORING NO. B-1
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48944; W 97.74410

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²								PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0		
			ASPHALT (2 inches)												
			BASE (10 inches)												
			CLAY, Very Stiff, Brown, with sand, gravel, and limestone fragments												
			LIMESTONE, Hard, Highly Weathered, Tan UC = 214 tsf - decomposed above 2 ft	ref/0.5"											
5			VOID, 2.5 to 3 ft REC: 60% RQD: 29% DRILLER'S NOTE: 100% water loss at 2.5 ft - ferrous stains, 3 to 4 ft		148										
			UC = 157 tsf - vuggy, with ferrous stains, 6 to 10 ft REC: 73% RQD: 40%		133										
10			VOID, 10 to 12 ft REC: 13% RQD: 7%												
			VOID, 13 to 20 ft (possible very soft, decomposed zone) REC: 0% RQD: 0%												
15															
DEPTH DRILLED:		30.0 ft		DEPTH TO WATER:		Dry		PROJ. No.:		AAA18-018-00					
DATE DRILLED:		3/1/2018		DATE MEASURED:		3/1/2018		FIGURE:		2a					

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-1
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48944; W 97.74410

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²							PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5		
25			LIMESTONE, Hard, Highly Weathered, Tan <i>(continued)</i> REC: 19% RQD: 0% VOID, 23 to 23.5 ft VOID, 26 to 26.4 ft REC: 9% RQD: 0% VOID, 28 to 30 ft, with decomposed limestone											
30			Boring Terminated NOTES: 1. Groundwater not encountered during drilling operations. 2. Borehole was backfilled with bentonite chips and capped with asphalt.											
35														

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 3/1/2018	DATE MEASURED: 3/1/2018	FIGURE: 2b

LOG OF BORING NO. B-2
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48940; W 97.74415

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²						PLASTICITY INDEX	% -200	
						0.5	1.0	1.5	2.0	2.5	3.0			3.5
			ASPHALT (2 inches) BASE (12 inches)											
			CLAY, Very Stiff, Brown, with sand, gravel, and limestone fragments	50/1"										
			LIMESTONE, Hard, Highly Weathered, Tan REC: 60% RQD: 22% VOID, 3 to 3.4 ft DRILLER'S NOTE: 100% water loss at 3 ft											
5			VOID, 4.7 to 5 ft DRILLER'S NOTE: 100% water loss at 4.7 ft											
			REC: 79% RQD: 43% - vuggy, 7 to 11 ft		145									
			UC = 212 tsf											
10			UC = 192 tsf REC: 55% RQD: 24%		148									
			- chert seam at 13 ft											
15			LIMESTONE, Soft to Moderately Hard, Highly Vuggy, Highly Weathered, Tan to Gray UC = 32 tsf		85									
			- chert seam, 16 ft REC: 43% RQD: 15%											

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 3/1/2018	DATE MEASURED: 3/1/2018	FIGURE: 3a

LOG OF BORING NO. B-2
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48940; W 97.74415

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²							PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5		
			LIMESTONE , Soft to Moderately Hard, Highly Vuggy, Highly Weathered, Tan to Gray (<i>continued</i>) REC: 12% RQD: 0%											
25			REC: 18% RQD: 0%											
30			Boring Terminated NOTES: 1. Groundwater not encountered during drilling operations. 2. Borehole was backfilled with bentonite chips and capped with asphalt.											
35														

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 3/1/2018	DATE MEASURED: 3/1/2018	FIGURE: 3b

LOG OF BORING NO. B-3
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48934; W 97.74417

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²				PLASTICITY INDEX	% -200		
						0.5	1.0	1.5	2.0			2.5	3.0
						PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT			
						10	20	30	40	50	60	70	80
			ASPHALT (1-1/2 inches)										
			BASE (13 inches)										
			CLAY, Hard, Brown, with gravel										
			REC: 79% RQD: 19%	50/3"									
			LIMESTONE, Hard, Highly Weathered, Tan - highly vuggy, with ferrous stains, 3.5 to 5 ft										
5			UC = 364 tsf										
			REC: 68% RQD: 35%		156								
			VOID, 7 to 8.5 ft (possible very soft, decomposed zone)										
			- highly vuggy, with ferrous stains, 8.5 to 10 ft										
10			VOID, 10 to 11 ft, with decomposed limestone										
			REC: 32% RQD: 15%		156								
			UC = 313 tsf										
			VOID, 13 to 14 ft (possible very soft, decomposed zone)										
15			VOID, 16 to 18 ft (possible very soft, decomposed zone)										
			REC: 27% RQD: 0%										
			- with intermittent chert seams, 18 to 20 ft										

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 2/28/2018	DATE MEASURED: 2/28/2018	FIGURE: 4a

LOG OF BORING NO. B-3
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48934; W 97.74417

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²							PLASTICITY INDEX	% -200	
						0.5	1.0	1.5	2.0	2.5	3.0	3.5			4.0
			LIMESTONE, Hard, Highly Weathered, Tan <i>(continued)</i>												
			LIMESTONE, Soft to Moderately Hard, Vuggy, Highly Weathered, Tan REC: 20% RQD: 0% VOID, 22 to 22.5 ft (possible very soft, decomposed zone)												
25			REC: 52% RQD: 8%												
30			Boring Terminated												
			NOTES: 1. Groundwater not encountered during drilling operations. 2. Borehole was backfilled with bentonite chips and capped with asphalt.												
35															
DEPTH DRILLED:		30.0 ft		DEPTH TO WATER:		Dry		PROJ. No.:		AAA18-018-00					
DATE DRILLED:		2/28/2018		DATE MEASURED:		2/28/2018		FIGURE:		4b					

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-4
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48927; W 97.74419

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²						PLASTICITY INDEX	% -200		
						0.5	1.0	1.5	2.0	2.5	3.0			3.5	4.0
						PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT					
						10	20	30	40	50	60	70	80		
			ASPHALT (1-1/2 inches) BASE (13 inches)												
			CLAY, Hard, Brown, with gravel	50/5"											
5			LIMESTONE, Hard, Highly Weathered, Tan REC: 88% RQD: 27% - ferrous stains, 3 to 3.5 ft VOID, 3.5 to 3.7 ft DRILLER'S NOTE: 100% water loss at 3.5 ft UC = 373 tsf												
			VOID, 6 to 7 ft REC: 65% RQD: 18% - vuggy, 7 to 11 ft - ferrous stains, 7 to 8.5 ft		147										
10			VOID, 10.5 to 11 ft REC: 40% RQD: 15% UC = 313 tsf		151										
15			- 6 inch chert seam at 15 ft UC = 954 tsf VOID, 16 to 17 ft (possible very soft, decomposed zone) REC: 40% RQD: 11%		160										
			VOID, 19 to 20 ft (possible very soft, decomposed zone)												
DEPTH DRILLED:		30.0 ft		DEPTH TO WATER:		Dry		PROJ. No.:		AAA18-018-00		DATE DRILLED:		2/27/2018	
DATE DRILLED:		2/27/2018		DATE MEASURED:		2/27/2018		FIGURE:		5a					

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

LOG OF BORING NO. B-4
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48927; W 97.74419

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²							PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5		
			<p>LIMESTONE, Soft to Moderately Hard, Highly Vuggy, Highly Weathered, Tan to Gray</p> <p>VOID, 21 to 22 ft</p> <p>REC: 43% RQD: 0%</p>											
25			<p>VOID, 26 to 28 ft (possible very soft, decomposed zone)</p> <p>REC: 40% RQD: 0%</p>											
30			<p>Boring Terminated</p> <p>NOTES: 1. Groundwater not encountered during drilling operations. 2. Borehole was backfilled with bentonite chips and capped with asphalt.</p>											
35														

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 2/27/2018	DATE MEASURED: 2/27/2018	FIGURE: 5b

LOG OF BORING NO. B-5
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48921; W 97.74416

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²				PLASTICITY INDEX	% -200	
						0.5	1.0	1.5	2.0			2.5
			ASPHALT (1-1/2 inches) BASE (8 inches) CLAY, Gravelly, Hard, Brown									
			LIMESTONE, Hard, Highly Weathered, Tan REC: 60% RQD: 40% - highly vuggy, 3 to 3.5 ft UC = 273 tsf	ref/3"	162							
5			- vuggy, 6 to 7-1/2 ft REC: 68% RQD: 13%									
10			VOID, 7.5 to 7.7 ft DRILLER'S NOTE: 100% water loss at 7.5 ft VOID, 7.8 to 8.0 ft - vuggy, 8 to 12 ft REC: 62% RQD: 7%									
15			- 4 inch chert seam at 15 ft									
			LIMESTONE, Soft to Moderately Hard, Highly Vuggy, Highly Weathered, Tan REC: 14% RQD: 0% VOID, 17 to 19 ft (possible very soft, decomposed zone)									

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 2/27/2018	DATE MEASURED: 2/27/2018	FIGURE: 6a

LOG OF BORING NO. B-5
 Williamson County Karst Mitigation
 Cambria Drive
 Williamson County, Texas



DRILLING METHOD: Straight Flight Auger & NX Core

LOCATION: N 30.48921; W 97.74416

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	SHEAR STRENGTH, TONS/FT ²								PLASTICITY INDEX	% -200
						0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0		
			LIMESTONE, Soft to Moderately Hard, Highly Vuggy, Highly Weathered, Tan <i>(continued)</i> REC: 43% RQD: 0% VOID, 22 to 22.7 ft												
			LIMESTONE, Hard, Highly Weathered, Tan												
25			LIMESTONE, Soft to Moderately Hard, Highly Vuggy, Highly Weathered, Tan REC: 25% RQD: 0%												
30			Boring Terminated												
			NOTES: 1. Groundwater not encountered during drilling operations. 2. Borehole was backfilled with bentonite chips and capped with asphalt.												
35															

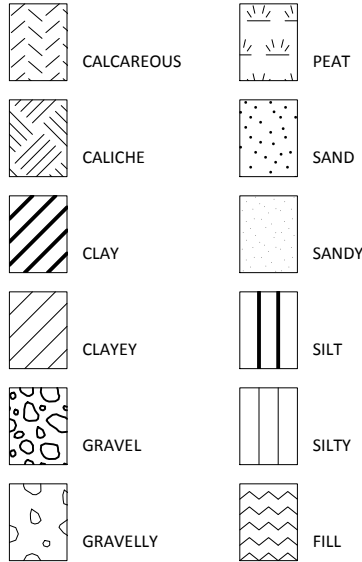
NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 30.0 ft	DEPTH TO WATER: Dry	PROJ. No.: AAA18-018-00
DATE DRILLED: 2/27/2018	DATE MEASURED: 2/27/2018	FIGURE: 6b

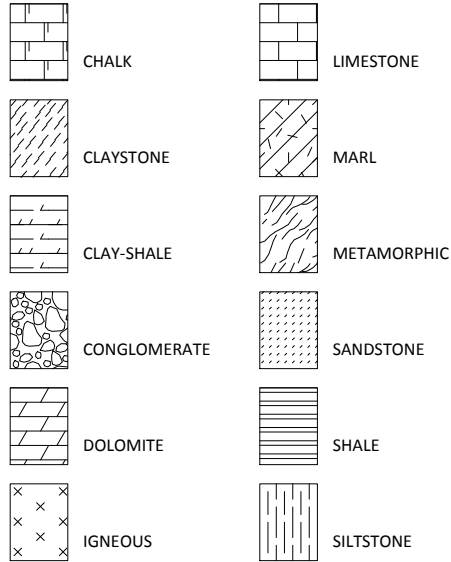
KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

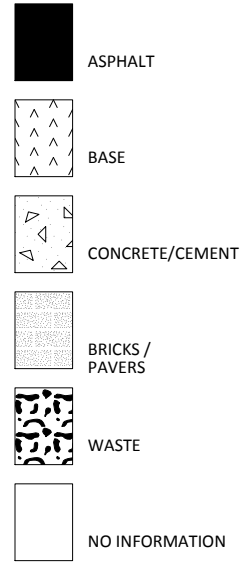
SOIL TERMS



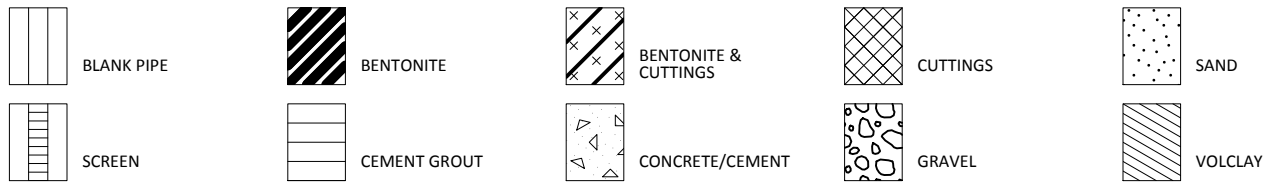
ROCK TERMS



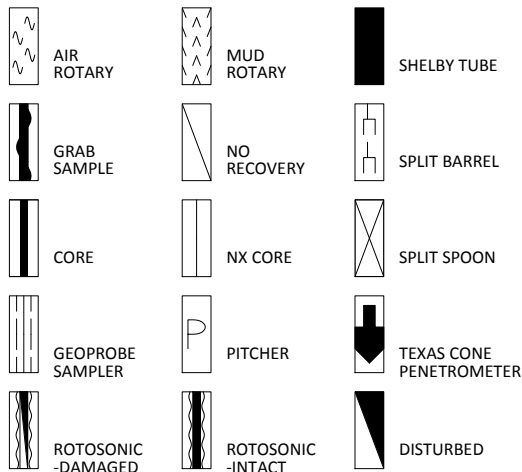
OTHER



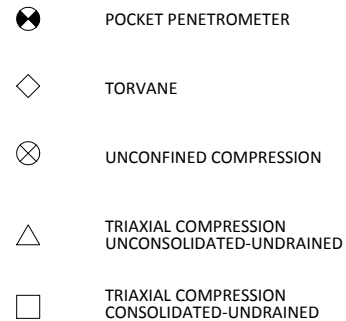
WELL CONSTRUCTION AND PLUGGING MATERIALS



SAMPLE TYPES



STRENGTH TEST TYPES



NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. AAA18-018-00

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOILS MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc., 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

COHESIVE STRENGTH

PLASTICITY

<u>Penetration Resistance Blows per ft</u>	<u>Relative Density</u>	<u>Resistance Blows per ft</u>	<u>Consistency</u>	<u>Cohesion TSF</u>	<u>Plasticity Index</u>	<u>Degree of Plasticity</u>
0 - 4	Very Loose	0 - 2	Very Soft	0 - 0.125	0 - 5	None
4 - 10	Loose	2 - 4	Soft	0.125 - 0.25	5 - 10	Low
10 - 30	Medium Dense	4 - 8	Firm	0.25 - 0.5	10 - 20	Moderate
30 - 50	Dense	8 - 15	Stiff	0.5 - 1.0	20 - 40	Plastic
> 50	Very Dense	15 - 30	Very Stiff	1.0 - 2.0	> 40	Highly Plastic
		> 30	Hard	> 2.0		

ABBREVIATIONS

B = Benzene	Qam, Qas, Qal = Quaternary Alluvium	Kef = Eagle Ford Shale
T = Toluene	Qat = Low Terrace Deposits	Kbu = Buda Limestone
E = Ethylbenzene	Qbc = Beaumont Formation	Kdr = Del Rio Clay
X = Total Xylenes	Qt = Fluvial Terrace Deposits	Kft = Fort Terrett Member
BTEX = Total BTEX	Qao = Seymour Formation	Kgt = Georgetown Formation
TPH = Total Petroleum Hydrocarbons	Qle = Leona Formation	Kep = Person Formation
ND = Not Detected	Q-Tu = Uvalde Gravel	Kek = Kainer Formation
NA = Not Analyzed	Ewi = Wilcox Formation	Kes = Escondido Formation
NR = Not Recorded/No Recovery	Emi = Midway Group	Kew = Walnut Formation
OVA = Organic Vapor Analyzer	Mc = Catahoula Formation	Kgr = Glen Rose Formation
ppm = Parts Per Million	EI = Laredo Formation	Kgru = Upper Glen Rose Formation
	Kknm = Navarro Group and Marlbrook Marl	Kgrl = Lower Glen Rose Formation
	Kpg = Pecan Gap Chalk	Kh = Hensell Sand
	Kau = Austin Chalk	

PROJECT NO. AAA18-018-00

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

<u>Blows Per Foot</u>	<u>Description</u>
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Williamson County Karst Mitigation
Cambria Drive
Williamson County, Texas

FILE NAME: AAA18-018-00.GPJ

3/7/2018

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	1.0 to 2.0	ref/0.5"	16					148		1.25	PP
	2.0 to 2.1										
	2.1 to 5.0										
	5.0 to 10.0										
	10.0 to 15.0										
	15.0 to 20.0										
	20.0 to 25.0										
B-2	1.0 to 2.0	50/1"	26				145		1.50	PP	
	2.0 to 2.6		13								
	2.7 to 5.0										
	5.0 to 10.0		148								
	10.0 to 15.0		85								
	14.5										
	15.0 to 20.0										
B-3	1.0 to 2.0	50/3"	21				156		2.00	PP	
	2.5 to 3.2		18								
	3.2 to 5.0										
	5.0 to 10.0		156								
	10.0 to 15.0										
	15.0 to 20.0										
	20.0 to 25.0										
B-4	0.0 to 2.0	50/5"	21				147				
	2.0 to 2.9		14								
	3.0 to 5.0										
	5.0 to 10.0		151								
	10.0 to 15.0		160								
	15.0 to 20.0										
	20.0 to 25.0										
B-5	0.0 to 2.0	ref/3"	13				162				
	2.5 to 2.8		11								
	3.0 to 5.0										
	5.0 to 10.0										
	10.0 to 15.0										
15.0 to 20.0											

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial
CU = Consolidated Undrained Triaxial

PROJECT NO. AAA18-018-00

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: Williamson County Karst Mitigation
Cambria Drive
Williamson County, Texas

FILE NAME: AAA18-018-00.GPJ

3/7/2018

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-5	15.0 to 20.0 20.0 to 25.0 25.0 to 30.0										

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial
CU = Consolidated Undrained Triaxial

PROJECT NO. AAA18-018-00

PHOTOGRAPHS



Photograph 1 – Boring B-1



Photograph 2 – Boring B-1



Photograph 3 – Boring B-2



Photograph 4 – Boring B-2



Photograph 5 – Boring B-3



Photograph 6 – Boring B-3



Photograph 7 – Boring B-4



Photograph 8 – Boring B-4



Photograph 9 – Boring B-5



Photograph 10 – Boring B-5

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



8811 Colesville Road/Suite G106, Silver Spring, MD 20910

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ENGINEERING • ENVIRONMENTAL • INFRASTRUCTURE • PROJECT CONTROL

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Salt Lake City, UT

Freeport, TX

New Braunfels, TX

Mexico



**Proposed Sensitive Feature Mitigation Plan for Cambria Cavern Located
Near the Intersection of Cambria Drive and Ephraim Road, Austin,
Williamson County, Texas**

Prepared for:

Williamson County

Prepared by:

Kemble White, Ph.D, P.G.
&
Craig Crawford, P.G.

Cambrian Environmental
4422 Pack Saddle Pass
Suite 204
Austin, Texas 78745

TX Geoscience Firm Registration #50484



April 20th, 2018

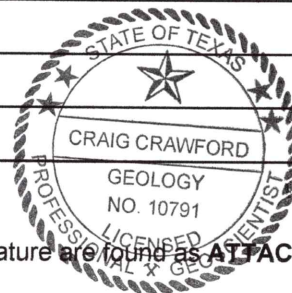
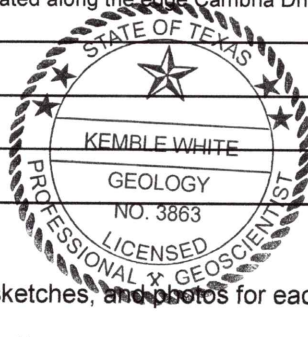
Solution Feature Discovery Notification Form
 Edwards Aquifer Protection Program
 For Regulated Activities on the Edwards Aquifer Recharge Zone and Transition Zone
 And Relating to 30 TAC 213.5(f)(2) Effective June 1, 1999

When reporting a solution feature encountered during construction activities please provide the following information:

Regulated Entity Name:	Williamson County	EAPP ID #:	N/A (no WPAP)
Project Type:	WPAP SCS UST AST	Approval Date:	N/A
Regulated Entity Location:	Cambria Drive, Round Rock, Williamson County, Texas	Approval Dates/ID#'s of any Modifications:	N/A
Date Feature(s) Discovered:	February 8, 2018	Date TCEQ Notified:	February 8, 2018
Holder of Approved Plan:	N/A	Solution Feature Plan Submitted By:	Kemble White, Ph.D., P.G. Craig Crawford, P.G.
Contact:	J. Terron Evertson (Williamson County) Mike Petter (Brushy Creek MUD)	Title:	Senior Geoscientists
Title:	County Engineer, BCMUD Manager	Company:	Cambrian Environmental
Mailing Address:	901 South Austin Ave. Georgetown, TX 78626	Mailing Address:	4422 Pack Saddle Pass, Ste. 204 Austin, Texas 78745
Phone:	(512) 943-3330	Phone:	512.663.0156, 512.705.5541
Fax:		Fax:	

Feature No.	Feature Dimensions	Location of Feature (Reference features related to a SCS by Line and Station)	Case*/ Sensitivity**
Cambria Cavern	190 x 40 x 23	Located along the edge Cambria Drive, near the intersection with Ephraim Road	Sensitive

* per TCEQ Guidance Document 96.004
 ** per Geologic Assessment Table



- Plan, profile, cross section sketches, and photos for each feature are found as **ATTACHMENT 1**.
- Geologic Assessment Table (if applicable) is found as **ATTACHMENT 2**.
- Drawings and narrative descriptions of the proposed protection measures are found as **ATTACHMENT 3**.
- If the discovery is related to a sewage collection system, a Texas Registered Professional Engineer is required to submit the protection plan.

Submitted by: Kemble White Craig Crawford Date: 20 Apr. 2018
 Printed name: Kemble White, Ph.D., P.G.; Craig Crawford, P.G.

If you have questions on how to fill out this form or about the Edwards Aquifer protection program, please contact us at 210/490-3096 for projects located in the San Antonio Region or 512/339-2929 for projects located in the Austin Region.

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512/239-3282.

Description of Cambria Cavern Located Near the Intersection of Cambria Drive and Ephraim Road, Austin, Williamson County, Texas

This report details the proposed mitigation plan for Cambria Cavern, which was discovered on February 8th, 2018 when the ceiling of the cave collapsed overnight. As you are aware there was no active project at the site at the time of the collapse, hence there was no pre-existing EAPP number. We understand that development of the neighborhood occurred between 1986 and 1990. Although several other caves are known from the neighborhood, including several encountered during construction, we know of no previous knowledge of a cave at this specific location. No evidence of previous human entry was observed. The collapse ruptured an 8-inch water main located along the west side of the collapse rim and exposed a low-pressure natural gas line on the east side of the collapse rim. The utility trenches run parallel to and under Cambria Drive approximately 12 feet apart. The collapse area consists mainly of the bedrock block in between the utility trenches. Accordingly we believe that the limestone bed which forms the ceiling of the cave had been scored like a sheet of glass by the installation of the utility trenches. We believe the collapse event was precipitated by frost heaving associated with a series of hard freezes leading up to the discovery date.

With prior approval from your program, mechanized equipment was used to stabilize the collapse area by removing unstable material around the rim. A wooden frame structure was constructed over the collapsed area in order to cover the exposed cave, to protect the public, and to prevent unauthorized entry into the feature. Additionally, perimeter fencing and stormwater controls were placed around the wooden structure.

Cambrian Environmental geoscientists mapped the cave during the second week of February. Cambria Cavern measures approximately 190 feet long by 40 feet wide, with a maximum floor-to-ceiling height of about 23 feet (See ATTACHMENT 1 for cave maps and photos). Only about 10 percent of the cave was affected by the collapse. The structure of the cave follows a master fracture set which trends east-to-west and which is visible in the cave ceiling. The interior of the cave is lined with numerous speleothem formations, and many of the formations were observed to be actively dripping at the time of the site visits. The largest of the formations are aligned with the master fracture set and reflect long-term vertical infiltration of groundwater. The largest of these formations is a robust floor-to-ceiling column which appears to provide support to the cave ceiling adjacent to the collapse area. No additional extent of the cave was able to be observed beyond what was mapped during the field investigation; however, other extensions of the void may be present. Cambria Cavern has been further described in the attached Geologic Assessment Table (See ATTACHMENT 2).

Cambria Cavern had no surface expression prior to the collapse, however now that it has been breached the void may function as a potential contaminant pathway. The proposed closure methodology is intended to leave the majority of the void open, but to seal the collapse area (See

ATTACHMENT 3 for detailed closure drawings). The major goals of the plan are to eliminate the possibility of direct infiltration of stormwater into the aquifer, to maintain any hydrologic function the void may have outside of the collapse area, and to provide sufficient structural integrity required to support the reconstruction of the two utilities and the adjacent roadway. In conjunction with engineers from Dunaway Associates, the following proposed mitigation strategy has been prepared. The methodology consists of a series of steps, and they are detailed below and in the attached design sheets prepared by Dunaway (sheet C6.0).

The construction sequence is as follows:

- 1.** Demo the existing wood frames covering the cave.
- 2.** Excavate all spoils and rock debris to expose the cave floor.
- 3.** The excavated void shall be re-inspected by a Licensed Texas Professional Geoscientist to determine if any additional cave passage is present.
 - a.** If additional cave passages are discovered, the existing void map and mitigation will require revision to reflect the new configuration of the void. The revised plans will be submitted to TCEQ for secondary approval.
- 4.** Install granular drainage layer base.
 - a.** Backfill is to be emplaced in any lower pockets or undercuts of the feature with clean-washed 3 to 5-inch diameter gravel to establish a level floor elevation. The backfill is to be installed in 18-inch lifts, and a remote-controlled roller will be utilized to compact each lift (make 20 passes in each direction).
 - b.** Place a 12-inch thick layer of clean-washed free-drain gravel with a gradation of ½-inch to 1-inch diameter. A remote-controlled roller will be utilized to compact each lift (make 20 passes in each direction).
 - c.** Place filter fabric over granular fill with complete return on all sides to the cave floor.
- 5.** Infill void with concrete in 18-inch thick lifts up to the karst ceiling.
 - a.** Lay geogrid and wireframe retaining form.
 - b.** Place pea gravel bags against wireframe retaining form.
 - c.** Install welded wire fabric reinforcing steel.
 - d.** Place an even lift of concrete across void.
 - e.** Let concrete cure until it reaches a minimum compressive strength of 2500 psi prior to installing the next lift.

6. Reestablish utilities and asphalt road.

- a.** Install road sub-base.
- b.** Trench cavities for water and gas utility lines.
- c.** Install piping run in utility with proper bedding and reconnect to existing lines.
- d.** Install road base material per specifications.
- e.** Place asphalt per specifications.

In accordance with the provisions of the Texas Geoscience Practice Act, I attest that the contents of this report are true and accurate as of the date of submittal, and was produced by me and/or under my direct supervision.



Craig Crawford, P.G.

Texas Geoscience License #10791



Kemble White, Ph.D., P.G.

Texas Geoscience License #3863

ATTACHMENT 1

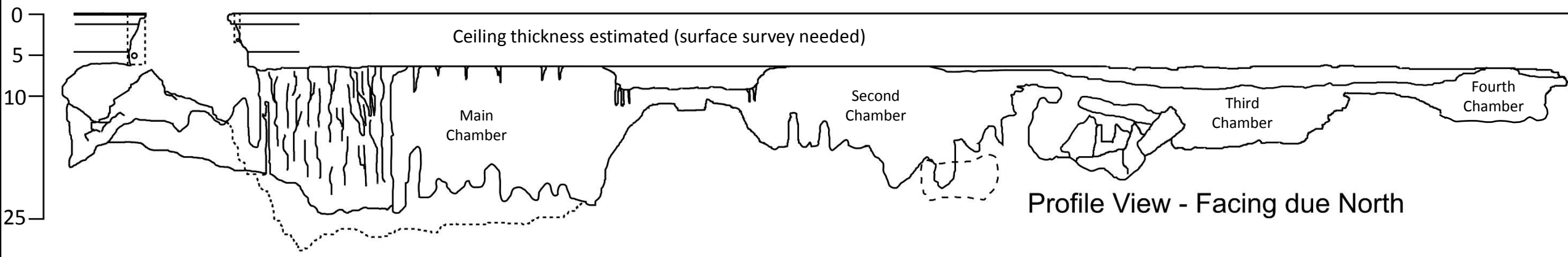
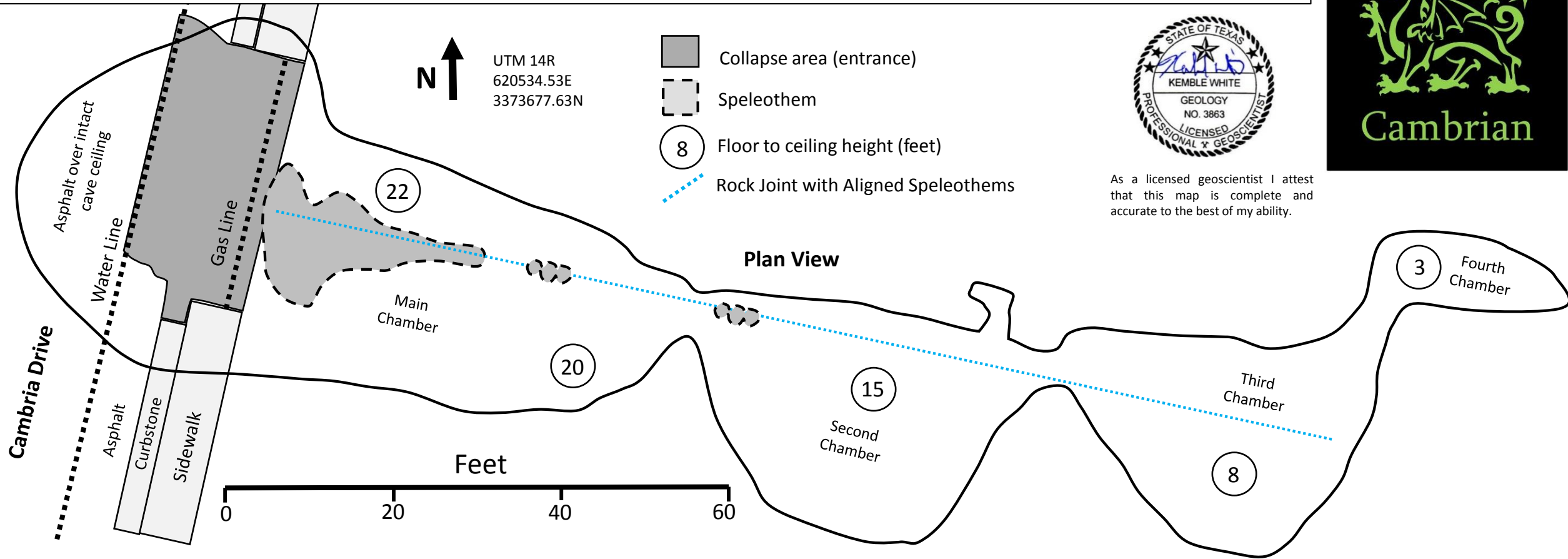
Plan, Profile, Cross-section Sketches, and Photos

Cambria Cavern Draft Plan and Profile, Round Rock, Williamson County, Texas.

Mapped by Kemble White, Ashley Wall, and Christopher Francke on 2/8/2018 with compass and laser range finder. Drafted by Kemble White and Christopher Francke.

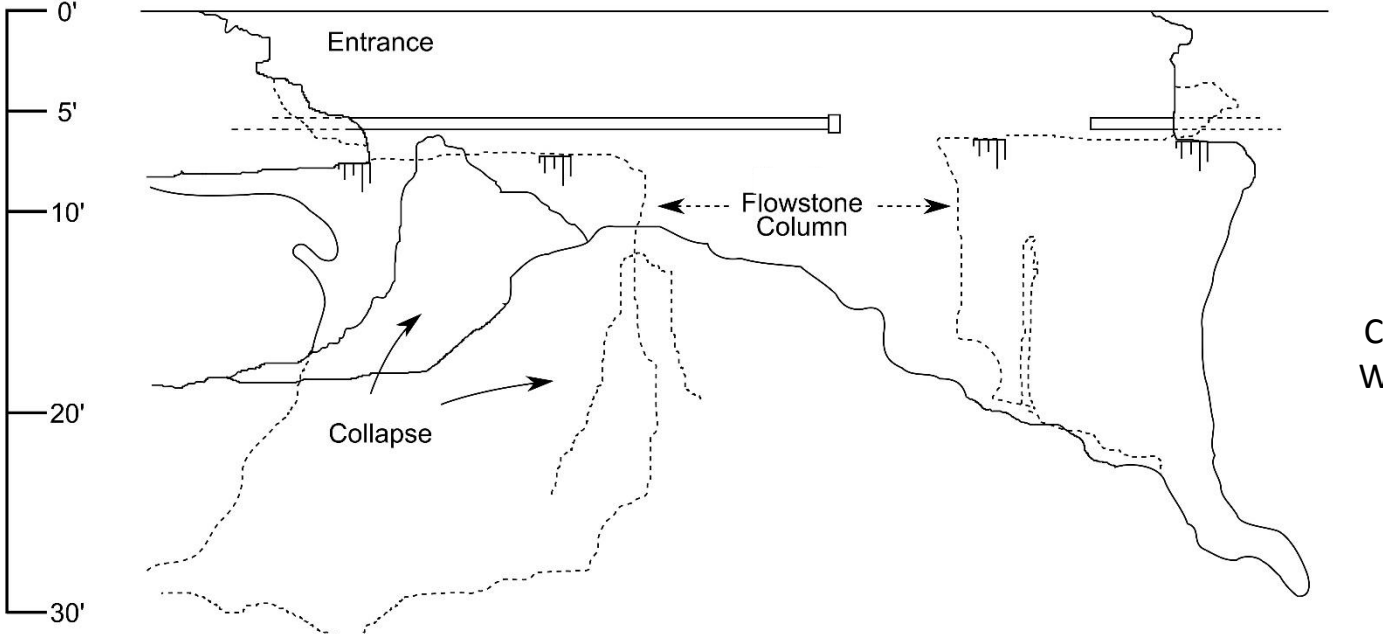


As a licensed geoscientist I attest that this map is complete and accurate to the best of my ability.



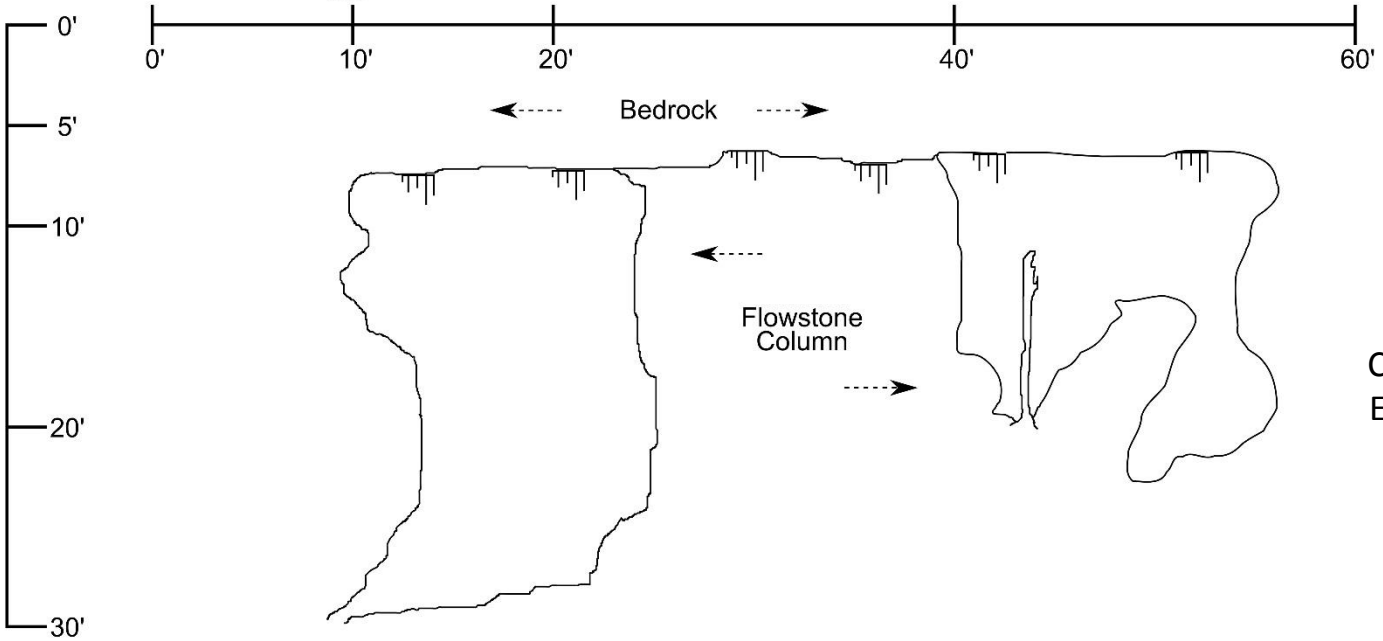
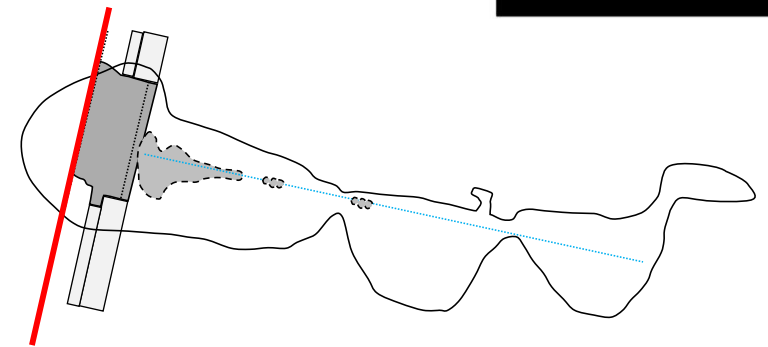
Cambria Cavern Draft Plan and Profile, Round Rock, Williamson County, Texas.

Mapped by Kemble White, Ashley Wall, and Christopher Francke on 2/8/2018 with compass and laser range finder. Drafted by Kemble White and Christopher Francke.

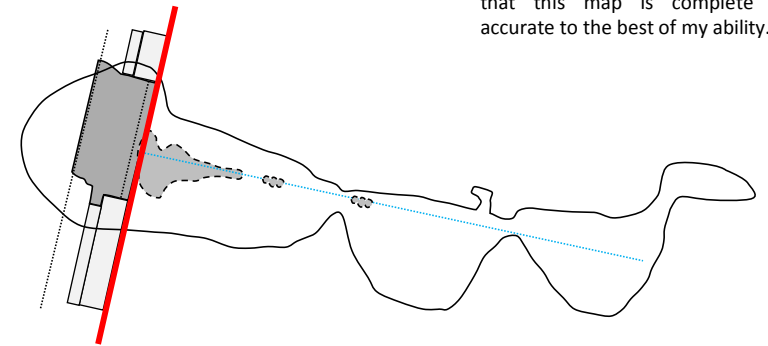


PROFILE VIEW
Looking due East
1 of 2

Main Chamber West Side



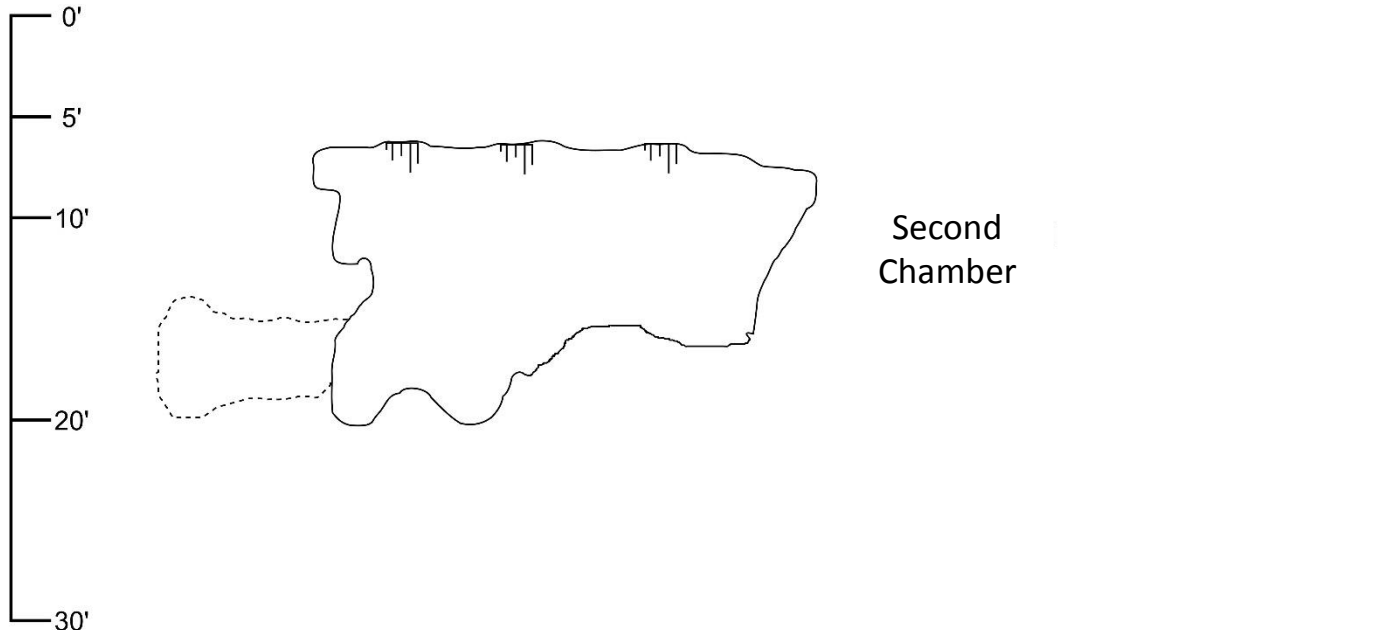
Main Chamber East Side



As a licensed geoscientist I attest that this map is complete and accurate to the best of my ability.

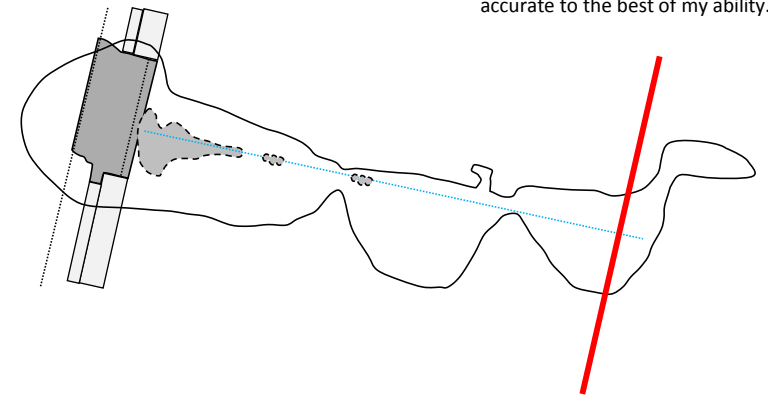
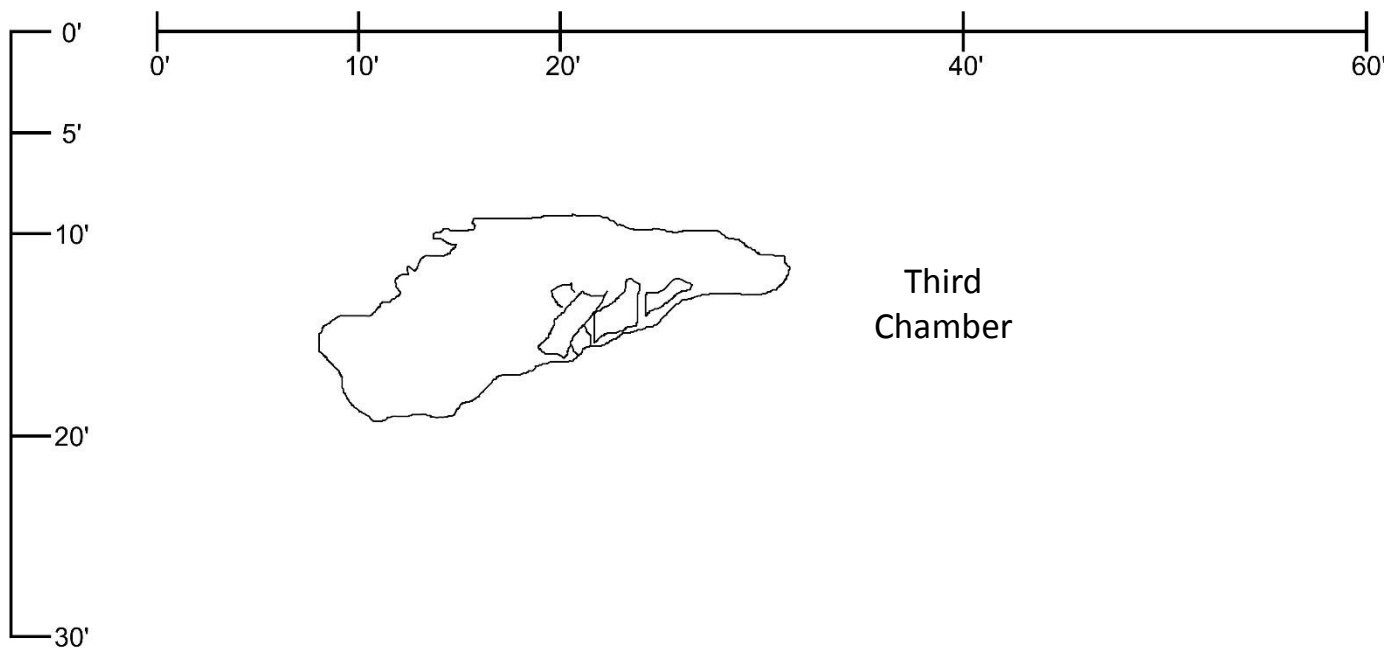
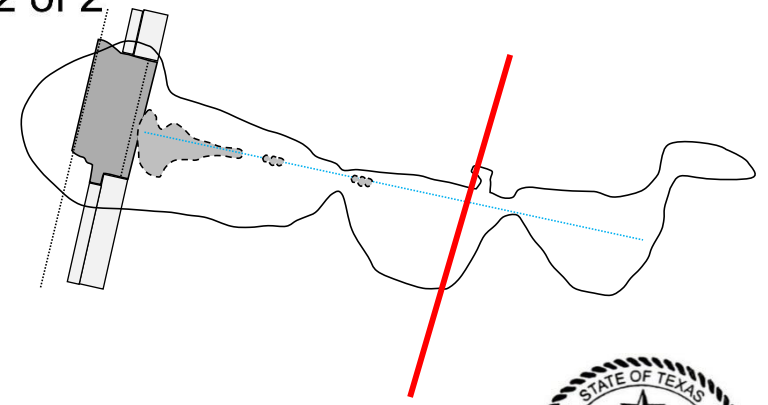
Cambria Cavern Draft Plan and Profile, Round Rock, Williamson County, Texas.

Mapped by Kemble White, Ashley Wall, and Christopher Francke on 2/8/2018 with compass and laser range finder. Drafted by Kemble White and Christopher Francke.



PROFILE VIEW

Looking due East
2 of 2



As a licensed geoscientist I attest that this map is complete and accurate to the best of my ability.

Photo log of Cambria Cavern, Round Rock, Texas as of 2/14/2018



Photo 1. View of collapse area facing north.



Photo 2. South wall of collapse area with drain.



Photo 3. View of the main chamber from the south side of the collapse area facing east.

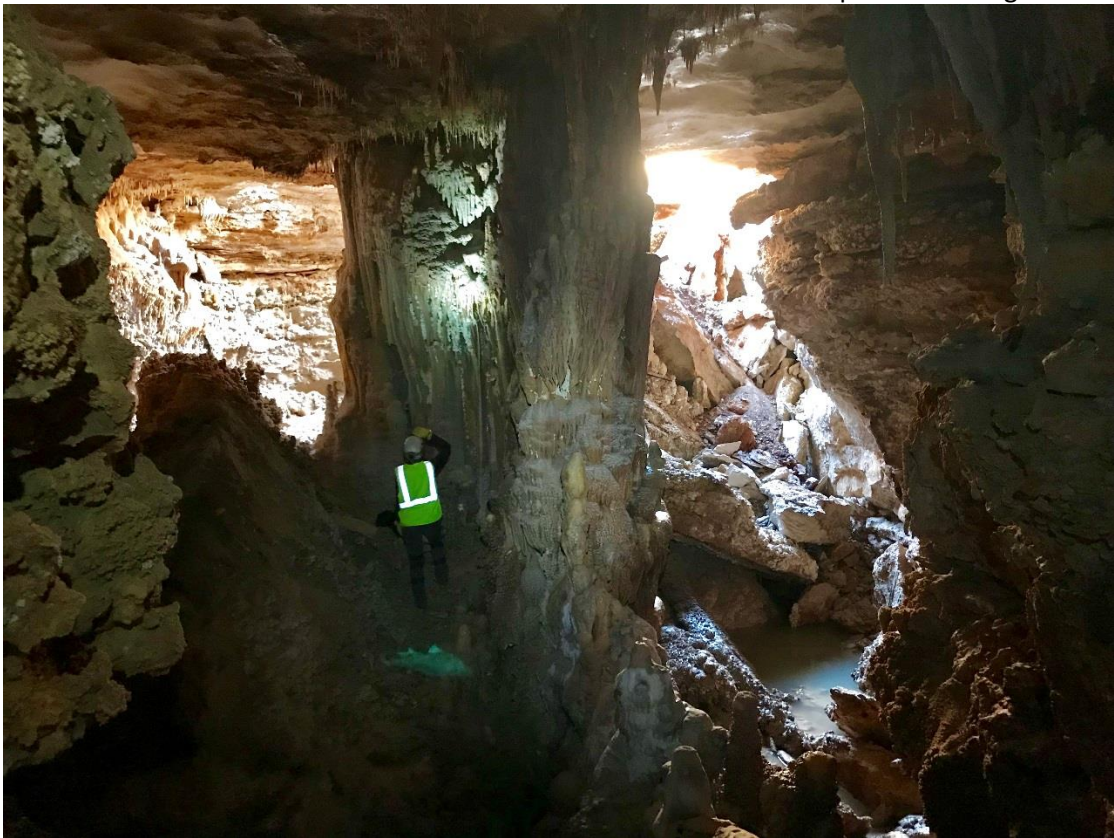


Photo 4. View from the east end of the main chamber facing west.



Photo 5. View of the north side of the main chamber facing east toward the second chamber.



Photo 6. Constricted passage between the main chamber and the second chamber facing west.



Photo 7. Tree roots penetrating cave ceiling in passage depicted in photo 6.



Photo 7. View of second chamber facing west. Light from the collapse area can be seen at upper right.



Photo 8. View of constricted passage between second and third chambers facing west.



Photo 9. Surveyors in third chamber facing east.

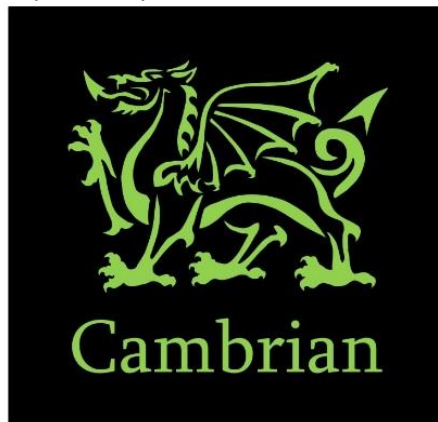


Photo 10. View of constricted passage leading northeast to the fourth chamber.



Photo 11. Interior of fourth chamber which is primarily belly-crawl passage.

All photos by Cambrian Environmental



ATTACHMENT 2

Geologic Assessment Table

