

CONTRACT DOCUMENTS
AND
TECHNICAL SPECIFICATIONS

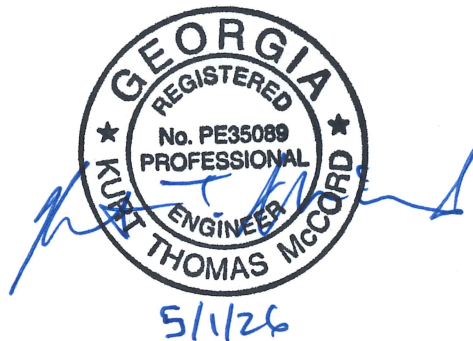
NEW 2MG GROUND STORAGE TANK
AT FIRE TOWER ROAD (BROGDON)

FOR THE

CITY OF CALHOUN
GORDON COUNTY, GEORGIA

MAY 2026

PROJECT NO.: 358



PREPARED BY



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INVITATION TO BID

PART 1. GENERAL

1.1 SEALED BIDS

Sealed bids for construction of the **New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)** will be received until **Thursday, June 18, 2026 at 2:00 pm**, inside the Utilities Training Room at the **Calhoun Utilities Building, 700 West Line St., Calhoun, GA 30701**, at which time and place they will be publicly opened and read. Any proposal received after said time and date will not be considered by the Owner. No bid may be withdrawn after the closing time for the receipt of bids for a period of sixty (60) days.

1.2 SCOPE OF WORK

Under this project, the Contractor shall furnish all labor, equipment, and materials necessary to construct a two million-gallon concrete pre-stressed ground storage tank with deep foundational supports (i.e. aggregate columns), mixing system, yard piping, fencing, grading, soil stabilization, driveway reconstruction, erosion control measures, and all other miscellaneous appurtenances necessary for a complete installation. Time allotted for completion of work is **240** consecutive calendar days.

All Work shall be completed in accordance with the plans and specifications. The Work will be awarded in **one (1) Contract**.

1.3 PLANS, SPECIFICATIONS AND CONTRACT DOCUMENTS

Plans, Specifications and Contract Documents are on file for public viewing at the Calhoun Utilities Engineering Department office located at the 700 West Line St., Calhoun, GA 30701. Copies **MUST** be obtained through the City of Calhoun Purchasing Department, Andrea L. Everett, Phone: (706) 602-5682 or aeverett@calnet-ga.net, upon payment of \$125 (non-refundable) for each set of printed bid documents or the digital copy. **Sealed bids will not be considered by the Owner unless the Bidder is on record with City of Calhoun as having purchased and received complete Bidding Documents.**

1.4 CONTRACTOR LICENSE

The Scope of Work as described herein is defined as “utility contracting” in accordance with O.C.G.A. 43-14-2(17) so the Contractor performing the work must provide proof of a valid license by the State of Georgia as a “Utility Contractor” and must employ a “Utility Manager” certification holder who will have oversight on all the work. **License numbers may be written on the face of the bid envelope, but not required if proof of valid licensing is given inside the sealed package or upon subsequent request.** See Instruction to Bidders for additional bidding requirements.

1.5 PREQUALIFICATION OF BIDDERS

Prequalification may be required of Bidders prior to the award of contract. At the Owner’s request, detailed written evidence such as financial data, bonding capacity, previous experience, present commitments, and other such data as may be necessary to assist Owner in determining Contractor’s qualifications shall be provided per the Instructions to Bidders contained in the contract documents.

1.6 BONDS

Bids shall be accompanied by a bid bond or certified cashier's check in an amount not less than 10% of the base bid. All bonds shall be by a surety company licensed in Georgia with an "A" minimum rating of performance and a financial strength of at least five (5) times the contract price as listed in the most current publication of "Best's Key Rating Guide Property Liability". Performance and Payment Bonds, each in an amount equal to 100% of the contract price shall be required of the successful bidder if contract is awarded. Each Bond shall be accompanied by a "Power of Attorney" authorizing the attorney-in-fact to bind the surety and certified to include the date of the bond.

1.7 PERMITS

All anticipated federal, state, or local permits required for the project have been obtained or will be obtained prior to the start of construction.

1.8 GEORGIA SECURITY AND IMMIGRATION COMPLIANCE ACT AFFIDAVIT

All qualifying Contractors and Subcontractors performing work with the City of Calhoun must register and participate in the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, to verify the work eligibility information of new employees.

1.9 RIGHT-OF-WAY AND EASEMENTS

All anticipated rights of way and easements required for the project have been obtained or will be obtained by Owner prior to issuing the Notice to Proceed.

1.10 RESERVATION OF RIGHTS

Owner reserves the right to reject any or all Bids, including without limitation, the rights to reject any or all nonconforming, nonresponsive, unbalanced or conditional Bids and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Owner. Owner reserves the right to waive informalities, and/or to re-advertise.

CITY OF CALHOUN

Represented By: Erik Henson, Water & Sewer Director
City of Calhoun

END OF SECTION

INSTRUCTIONS TO BIDDERS

INTENTION: It is intended that the Instructions to Bidders, General Conditions, Supplementary Conditions, Technical Specifications and Construction Drawings shall cover the complete work to which they relate.

PART 1. DEFINED TERMS

In addition to the terms defined in the General Conditions, (EJCDC 1910-8), additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof.

1.1 BIDDER

One who submits a Bid directly to Owner as distinct from a sub-bidder, who submits a bid to a Bidder.

1.2 SUCCESSFUL BIDDER

The lowest, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

1.3 BID

A complete and properly signed offer to execute work for the prices stipulated in Bid Form and submitted in accordance with the Bidding Documents.

1.4 ADDENDA

Graphic or written documents issued by Engineer prior to the opening of Bids issued to clarify, revise, add to, or delete information in the original bidding documents or in previous addenda.

PART 2. BID FORM

2.1 All bids must be made upon the Bid Forms here to annexed, and shall state the amount bid for each item shown, and all bids must be for materials and work called for in the specifications. ***Deposits for plans and specifications are not refundable.***

A. The Bid Form is included with the Bidding Documents; additional copies may be obtained from Engineer.

B. All blanks on the Bid Form must be completed by printing in black ink or by typewriter.

C. Bids by corporations must be executed in the corporate name by the president or a

vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.

- D. All names must be typed or printed in black ink below the signature.
- E. The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).
- F. The address and telephone number for communications regarding the Bid must be shown.

PART 3. QUALIFICATIONS OF BIDDERS

- 3.1 To demonstrate qualifications to perform the Work, each Bidder must submit their qualifications, experience on similar projects, a list of references, and the Section 00470 questionnaire preferably within five (5) days prior to the Bid opening. Upon Owner's request detailed written evidence such as financial data, previous experience, present commitments, and other such data shall also be submitted as may be necessary to assist Owner in determining Bidder's qualifications.
- 3.2 Each Bid must contain evidence of Contractor's authority to conduct business in the state where the Work is to be performed. Furthermore, we request that the state contractor license number be listed on the Bid Form.
- 3.3 Bidder must be on record with the City of Calhoun as having purchased and received complete Bidding Documents. Proposals from Contractors that are not listed on City's plan holders list will not be considered by the Owner.

PART 4. COPIES OF BIDDING DOCUMENTS

- 4.1 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement or Invitation to Bid may be obtained from Engineer. The deposit is nonrefundable.
- 4.2 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 4.3 Owner and Engineer in making copies of Bidding Documents available for a non-refundable deposit do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

PART 5. EXAMINATION OF BIDDING DOCUMENTS, OTHER DATA, AND SITE

- 5.1 It is the responsibility of each Bidder before submitting a bid:
- A. To examine and study thoroughly the Bidding Documents and other related data identified in the Bidding Documents;
 - B. To visit the work site to ascertain by inspection pertinent location conditions such as location, character and accessibility of the site including existing surface and subsurface conditions in the work area; availability of facilities, location and character of existing work within or adjacent thereto, labor conditions, etc.
 - C. To become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, or performance of the Work;
 - D. To obtain and carefully study (or assume responsibility for doing so) all additional or supplementary examination investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and underground facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate any aspect of the means, methods, techniques, sequences, and procedures of construction expressly required of the bidding documents, and safety precautions and programs incident thereto;
 - E. To study and carefully correlate Bidder's knowledge and observations with the Bidding Documents and such other related data; and
 - F. To promptly notify Engineer of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between the Bidding Documents and such other related documents;
 - G. To agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies or data are necessary for the determination of its Bid for performance of the work at the price bid and within the times and in accordance with the other terms and conditions of the Bidding Documents;
 - H. To become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
 - I. To determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- 5.2 The Owner shall make available to all prospective bidders, prior to receipt of bids, information that it may have as to sub-soil conditions and surface topography at the work site. Such information shall be given as the best factual information available without being considered as a representation of the Owner.
- 5.3 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Part 5, that without exception, the Bid is

premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

PART 6. PRE-BID CONFERENCE

6.1 A pre-bid conference will not be held for this project.

PART 7. INTERPRETATIONS AND ADDENDA

7.1 All questions about the meaning or intent of the Bidding Documents are to be directed to Engineer. The person submitting the request shall do so in writing and be responsible for its prompt delivery. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the bidding Documents. Questions received less than ten (10) days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.2 Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer.

PART 8. BID SECURITY

8.1 Each Bid must be accompanied by Bid security made payable to Owner in an amount of ten (10%) percent of Bidder's maximum Bid price and in the form of a certified or bank check or a Bid Bond (on form attached, if a form is prescribed) issued by a surety company licensed in Georgia with an "A" minimum rating of performance and a financial strength of at least five (5) times the contract price as listed in the most current publication of "Best's Key Rating Guide Property Liability".

8.2 The Bid security of Successful Bidder will be retained until such Bidder has executed the Agreement, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen (15) days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh (7th) day after the Effective Date of the Agreement or the sixty-first (61) day after the Bid opening, whereupon Bid security furnished by such bidders will be returned. Bid security with Bids, which are not competitive, will be returned

within seven (7) days after the Bid opening.

PART 9. CONTRACT COMPLETION TIME

9.1 The number of days within which, or by which the Work is to be (a) Substantially Completed and (b) also completed and ready for final payment are set forth in the Agreement. Provisions for liquidated damages, if any, are set forth in the Agreement.

PART 10. SUBSTITUTE AND “OR EQUAL” TERMS

10.1 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or “or-equal” items. Wherever it is specified or described in the Bidding Documents that a substitute or “or-equal” item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in the General Conditions and may be supplemented in the General Requirements.

PART 11. SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.1 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five (5) days after Bid opening, submit to owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute without an increase in the BID.

11.2 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions would not constitute grounds for forfeiture of the bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in paragraph 6.8 of the General Conditions.

11.3 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

PART 12. SUBMITTAL OF BIDS

- 12.1 Bids shall be submitted at the time and place indicated in the Invitation to Bid and shall be enclosed in a sealed opaque envelope, marked with the project title, and name and address and Contractor's utility license number, of Bidder, and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED", on the face thereof. Bids submitted by facsimile (fax) will not be considered.
- 12.2 Each Bidder is responsible for seeing that his Bid is received by the Owner not later than the advertised time set for the opening of Bids.

PART 13. MODIFICATION AND WITHDRAWAL OF BIDS

- 13.1 Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of bids.
- 13.2 If, within twenty-four (24) hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided.

PART 14. OPENING OF BIDS

- 14.1 Bids will be opened and (unless obviously non-responsive) read aloud publicly at the place where Bids are to be submitted. An abstract of the amount of the base Bids and major alternates (if any) will be made available to Bidders after the opening of Bids.

PART 15. ACCEPTANCE OF BIDS

- 15.1 Bids may not be withdrawn (except as noted in Paragraph 13) after the time set for the opening of Bids. Bids will remain subject to acceptance for **sixty (60) days** after the day of the Bid opening, but the Owner may, in its sole discretion, release any Bid and return the Bid security prior to expiration of the acceptance period.

PART 16. AWARD OF CONTRACT

- 16.1 Owner reserves the right to reject any or all Bids, including without limitation, the rights to reject any or all nonconforming, nonresponsive, unbalanced or conditional Bids and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive, or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Owner.

16.2 Owner also reserves the right to waive all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

16.3 In evaluating Bids, Owner will consider the qualification of Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

The Owner will also consider whether the Bidder involved:

- A. Maintains a permanent place of business;
- B. Has adequate plant and equipment to do the work properly and expeditiously;
- C. Has suitable financial status to meet obligations incidental to the work;
- D. Has appropriate technical experience.

16.4 Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

16.5 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

16.6 If the contract is to be awarded, it will be awarded to the Bidder whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project.

16.7 If the contract is to be awarded, Owner will give Successful Bidder a Notice of Award within sixty (60) days after the day of the Bid opening.

PART 17. MODIFICATIONS OF QUANTITIES

17.1 If the lowest bona fide Bid exceeds the money available for the Work, the Owner reserves the right to delete enough of the Work to bring the cost within the available funds. The

Owner also reserves the right to delete whichever items or portions of items he considers to be in the best interest of the Owner.

PART 18. CONTRACT SECURITY

18.1 The General Conditions and Supplementary Conditions set forth Owner's requirements as to performance and payment bonds. When the Successful Bidder delivers the executed Agreement to the Owner, it must be accompanied by the required performance and payment bonds.

PART 19. SIGNING THE AGREEMENT

19.1 When the Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within fifteen (15) days thereafter, Contractor shall sign and deliver the required counterparts of the Agreement and attached documents to Owner with the required Bonds. Within ten (10) days thereafter, Owner shall deliver one (1) fully signed counterpart to the Contractor.

PART 20. LAWS AND REGULATIONS

20.1 The Contractor shall comply with local, District, County, State and Federal laws applicable to the work.

The Contractor shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work and Safety Standards Act (PL 91-54). The regulations are administered by the Department of Labor and the Contractor shall allow access to the project to personnel from that Department.

PART 21. CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE

21.1 Contractor shall not commence work under this contract until he has obtained all the insurance required by the Supplementary Conditions.

PART 22. TERMINATION OF CONTRACT

22.1 If the Owner is made to stop construction of the work because of an order from a Court or State Department, the contract shall be terminated. Payment will be made for work completed and a prorating of the work underway, materials stored, and for the overhead and profit of the completed work and work underway. Payment will not be made for anticipated profit and overhead on work not completed or underway.

END OF SECTION

BID FORM

PART I. GENERAL

1.1 PROJECT IDENTIFICATION:
New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)

1.2 CONTRACT IDENTIFICATION AND NUMBER:
Project No.: 358

1.3 THIS BID IS SUBMITTED TO:
City of Calhoun
Attn: Kurt T. McCord
700 West Line St.
Calhoun, GA 30701

1.4 THIS BID IS SUBMITTED FROM

Bidder: _____

Address: _____

Phone: _____

Contractor's Utility License No.: _____

1.5 BASIS OF BIDS

A. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

B. Bidder accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for **60 days** after the day of Bid opening. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within fifteen (15) days after the date of Owner's Notice of Award.

C. In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:

- 1. Bidder has examined copies of all the Bidding Documents and of the following Addenda (receipt of all which is hereby acknowledged):

Date	Addendum Number

2. Bidder has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

3. Bidder has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 4.2 of the General Conditions, and accepts the determination set forth in Paragraph 6 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which Bidder is entitled to rely.

4. Bidder has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests and studies (in addition to or to supplement those referred to in (3.) above) which pertain to the subsurface or physical conditions at the site or otherwise may affect the cost, progress, performance or furnishing of the Work as Bidder considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports or similar information or data are or will be required by Bidder for such purposes.

5. Bidder has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports or similar information or data in respect of said Underground Facilities are or will be required by Bidder in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.3 of the General Conditions.

6. Bidder has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

7. Bidder has given Engineer written notice of all conflicts, errors or

discrepancies that it has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Bidder.

8. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with an agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.
9. Bidder agrees to commence work under this Agreement on or before a date to be specified in a written "Notice to Proceed" of the Owner and to fully complete the work within **240 consecutive calendar days** from the "Notice to Proceed" date.

D. Bidder will complete the Work in accordance with the Contract Documents for the following price(s) listed in the BID SCHEDULE.

1.6 BID SCHEDULE

A. The Contractor is directed to Section 01025 "Measurement and Payment" for the methods and limits for payments to the Contractor for the pay items listed below:

Base Bid Items:

Item	Qty	Unit	Description	Unit Price	Total Price
1	1	LS	2.0 Million Gallon Pre-Stressed Concrete Ground Storage Tank 90'IDx42'1" (Includes tank foundation, aggregate piers, reinforced concrete tank structure, ladders, rails, safety equipment, hatches, level indicator, vents, overflows, post-construction cleaning, sterilization, materials testing, and any other work or equipment necessary that hasn't been specifically broken-out in the other line items below).		
2	1	LS	Grading Complete and Storm Drainage Improvements (Includes all earthwork, clearing & grubbing, dirt stockpiling, hauling of excess soil and debris, soil compaction, soil stabilization, soil nail wall design/construction, finished grading, gravel access driveway, storm drainage structures, drainage piping, and all other work that involves the conditioning or movement of dirt and rainwater with exception to waterline trenching).		
3	1	LS	Water Main Improvements (Includes exterior yard piping, tank drain line, overflow line, interior piping, duckbill mixing valves, hydrants, valves, valve vault, tie-in accommodations, old main abandonment, incidental point repairs, trenching, backfilling, shoring, flushing, disinfecting, testing and all other work and materials that facilitate the transmission to and from the new water tank).		
4	1	LS	Erosion Control Work (Includes the installation and maintenance of erosion control BMPs, mulching, rip rap, temporary grassing, permanent grassing, fertilizing, and any other means or methods required to control erosion and establish a suitable stand of perennial grass).		

5	1	LS	Security Fencing w/ Gate (Includes demolition of the old fence and construction of the proposed temporary and permanent chain link fences with 3-strands of barb wire used to secure the premises during and after tank construction).		
6	1	LS	GeoTechnical Engineering Allowance (Used under Engineer's Discretion at the request of the Prime Contractor, excludes soil nail wall design and material testing).	\$5,000.00	\$5,000.00
7	1	LS	Landscaping Allowance (Covers aesthetic enhancements such as ornamental shrubs, groundcovers, stone walkways, etc. that are installed at the Engineer's discretion as a supplement to grassing and mandatory erosion control work). No depiction on construction plans.	\$2,500.00	\$2,500.00
8	20	CY	Rock Removal Base Cost	\$45.00	\$900.00
9	20	CY	Rock Removal Premium Cost		
Total Base Bid:					

The total base bid for all work as proposed in the base bid is _____

 _____ Dollars (\$ _____).

Alternate Bid Items:

Item	Qty	Unit	Description	Unit Price	Total Price
A1	1	LS	2.25 Million Gallon Pre-Stressed Concrete Ground Storage Tank 90'IDx47'4" in lieu of base bid item #1 (Includes tank foundation, aggregate piers, reinforced concrete tank structure, ladders, rails, safety equipment, hatches, level indicator, vents, overflows, post-construction cleaning, sterilization, materials testing, and any other work or equipment necessary that hasn't been specifically broken-out in the other line items below).		
A2	1	LS	2.5 Million Gallon Pre-Stressed Concrete Ground Storage Tank 90'IDx52'7" in lieu of base bid item #1 (Includes tank foundation, aggregate piers, reinforced concrete tank structure, ladders, rails, safety equipment, hatches, level indicator, vents, overflows, post-construction cleaning, sterilization, materials testing, and any other work or equipment necessary that hasn't been specifically broken-out in the other line items below).		

Optional Deductions:

Item	Qty	Unit	Description	Unit Price	Total Price
D1	1	LS	Tideflex Alternative Mixing System (Contract Doc. Section 800) - As a substitution for the yard piping and inlet/outlet design depicted on Plan Sheets 5&7, Contractor would offer the following deduct under Base Bid Item #3 in order to install the Tideflex Mixing System with a reduction in buried valves, hydrants, yard piping, floor penetrations, a vault, and other ancillary tasks as depicted on Plan Sheet 10. Indicate deduction with negative number.		
D2	4	EA	16" Butterfly Valve w/ Spur Gearing and Box Swap - As a substitute to the yard piping depicted on Plan Sheet 5, Contractor would offer the following deduct under Base Bid Item #3 to install a 16" butterfly valve instead of a 16" gate valve. Indicate deduction with negative number.		

- B. Bidder agrees to furnish materials and equipment and to perform all labor necessary for the construction of the **New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)**. A contract shall be awarded to the lowest responsible, responsive bidder based on the Total Base Bid with any, all, or none of the selected additional work items. The above lump sum and unit prices shown shall include all labor, materials, bailing, shoring removal, overhead, profit, insurance, etc. to cover the work shown on the plans.
- C. Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.
- D. Bidder acknowledges that estimated quantities are not guaranteed and are solely for the purpose of comparison of Bids, and final payment for all Unit Price bid items will be based on actual quantities installed as provided in the Contract Documents. Owner reserves the right to eliminate base bid items and/ or include additional work items.

1.7 BID DATA (BASE BID)

- A. Bidder agrees that the Work will be substantially complete after the date when the Contract Times commence to run as provided in Paragraph 2.3 of the General Conditions and ready for final payment in accordance with Paragraph 14.8. of the General Conditions within the following number of consecutive calendar days after the date when the Contract Times commence to run:

240 Consecutive Calendar days

- B. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the times specified in the Agreement.
- C. The following documents are attached to and made a condition of this Bid:
 - 1. Required Bid Security in the form of **10%** of the Total Base Bid Amount.
 - 2. List of Proposed Subcontractors (if applicable).
 - 3. Qualification of Bidder (if not pre-approved already).
- D. The undersigned further agrees that in case of failure on his part to execute the said contract and the Bond within fifteen (15) consecutive calendar days after written notice being given of the award of the contract, the check or bid bond accompanying this bid, and the monies payable thereon shall be paid into the funds of the Owner as liquidated damages for such failure, otherwise, the check or bid bond accompanying this proposal shall be returned to the undersigned.
- E. Communications concerning this Bid shall be addressed to:
 - City of Calhoun
 - 700 West Line St.
 - Calhoun, GA 30701

Phone; (706) 602-6082
Attn: Kurt T. McCord, PE

F. Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions or Instructions.

SUBMITTED on _____, 20__.

BIDDER: _____

BY: _____

TITLE: _____

CONTRACTOR PERFORMING WORK
UTILITY LICENSE NO. _____

ADDRESS: _____

PHONE: _____

Seal: (if bid by a Corporation)

END OF SECTION

BID BOND

STATE OF GEORGIA

COUNTY OF GORDON

KNOW ALL MEN BY THESE PRESENTS, that we, _____ as Principal, and _____, as Surety, are held and firmly bound unto the **City of Calhoun** for the sum of _____ Dollars (\$ _____) lawful money of the United States, for the payment of which sum will and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted to the Owner a Proposal for construction of:

New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)

NOW THEREFORE, the conditions of this obligation are such that if the Bid be accepted, the Principal shall within ten (10) days after receipt of confirmed contract documents execute a contract in accordance with the Bid upon the terms, conditions and prices set forth therein, and in the form and manner required by the Owner and execute a sufficient and satisfactory Performance Bond and Payment Bond payable to the Owner, each in an amount of one hundred percent (100%) of the total contract price, in form and with security satisfactory to the Owner, or in the event of the failure of the Contractor to execute and deliver the Contract Agreement and give said Performance and Payment Bonds, the Contractor shall pay the Owner the difference not to exceed the penalty hereof between the amount specified in said Proposal and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said Proposal, and execute the Special Assurances form, then this obligation shall be void; otherwise, it shall be and remain in full force and virtue in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

This bond is given pursuant to and in accordance with the provisions of O.C.G.A. Section 36-10-1 et seq and all the provisions of the law referring to this character of bond as set forth in said sections or as may be hereinafter enacted and these are hereby made a part hereof to the same extent as if set out herein in full.

IN WITNESS WHEREOF, the said Principal has hereunder affixed its signature and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this ____ day of _____, 20____.

City of Calhoun
New 2MG Ground Storage Tank
at Fire Tower Road (Brogdon)

Project No 358
May 2026

PRINCIPAL: _____

Signed and sealed in
the presence of

By: _____

1. _____

Title: _____

2. _____

SURETY: _____

Signed and sealed in
the presence of:

By: _____

1. _____

Title: _____

2. _____

END OF SECTION

QUALIFICATIONS OF BIDDER

(To be submitted by Bidder at the request of Owner)

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information he desires.

1. Legal Name of Bidder.
2. Permanent main office address and telephone number.
3. When organized.
4. If a corporation, where incorporated.
5. Provide a statement that the applicant has operated under the current corporate name for the last five years. If the corporate name has changed, provide information on the previous corporate name.
6. Contract on hand: (Schedule these, showing amount of each contract and the appropriate anticipated dates of completion.)
7. General character of work performed by your company.
8. Have you ever vacated, been terminated, or failed to complete any work awarded to you? If so, where and why?
9. Have you ever defaulted on a contract? If so, where and why?
10. List the more important projects recently completed by your company, stating the approximate cost for each, and the month and year completed.
11. Provide a statement that the applicant has not been involved in liquidated damages in the past five years or served the Owner with a claim for additional compensation prepared by an attorney or a claims consultant excluding routine change order requests. If this is not the case, please provide an explanation.
12. The applicant shall provide a statement that they have not been involved in litigation as a plaintiff against the Owner or Engineering Firm in the past five years. If this is not the case, provide an explanation.
13. List your major equipment available for this contract.
14. Experience in construction work similar in importance to this project.

15. Background and experience of the principal members of your organization, including the officers.
16. Provide experience of proposed on-site project manager and/or field superintendent who would supervise and be in charge of the project. Experience can be from previous employment but must be pertinent to this project. If your firm is the successful bidder, at least one of these key personnel must be actively involved in the day-to-day operations of this project.
17. List all other projects currently under contract, the current contract amounts and scheduled completion dates.
18. Credit available: \$ _____.
19. Give Bank Reference _____.
20. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the _____.
21. The undersigned authorizes and requests any person, firm, or corporation to furnish any information requested by the City of Calhoun in verification of the recitals comprising the Statement of Bidder's Qualifications. Dated at _____ this _____ day of _____, 20____.

(Name of Bidder)

By _____

Title _____

State of _____

County of _____

_____, being duly sworn deposes and says
that he is _____ of _____

(Name of Organization)

and that the answers to the foregoing questions and all statements therein contained are true and correct.

Subscribed and sworn to before me this _____ day of _____, 20__.

(Notary Public)

My Commission expires:

_____, 20__

END OF SECTION

Contractor Affidavit under O.C.G.A. § 13-10-91(b)(1)

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services on behalf of the City of Calhoun has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned contractor will continue to use the federal work authorization program throughout the contract period and the undersigned contractor will contract for the physical performance of services in satisfaction of such contract only with subcontractors who present an affidavit to the contractor with the information required by O.C.G.A. § 13-10-91(b). Contractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

Federal Work Authorization User Identification Number

Date of Authorization

Name of Contractor

Name of Project

Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, ____, 20__ in _____(city), _____(state).

Signature of Authorized Officer or Agent

Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 20__.

NOTARY PUBLIC

My Commission Expires: _____

Subcontractor Affidavit under O.C.G.A. § 13-10-91(b)(3)

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with _____ on behalf of the City of Calhoun has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned subcontractor will contract for the physical performance of services in satisfaction of such contract only with sub-subcontractors who present an affidavit to the subcontractor with the information required by O.C.G.A. § 13-10-91(b). Additionally, the undersigned subcontractor will forward notice of the receipt of an affidavit from a sub-subcontractor to the contractor within five business days of receipt. If the undersigned subcontractor receives notice of receipt of an affidavit from any sub-subcontractor that has contracted with a sub-subcontractor to forward, within five business days of receipt, a copy of such notice to the contractor. Subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

Federal Work Authorization User Identification Number

Date of Authorization

Name of Subcontractor

Name of Project

Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, ____, 20__ in _____(city), _____(state).

Signature of Authorized Officer or Agent

Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 20__.

NOTARY PUBLIC

My Commission Expires: _____

City of Calhoun
New 2MG Ground Storage Tank
at Fire Tower Road (Brogdon)

Project No. 358
May 2026

AGREEMENT

This AGREEMENT is dated as of the ____ day of _____ in the year 20__, by and between the **City of Calhoun** (hereafter called OWNER) and (hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

PART 1. WORK

1.1 CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)

1.2 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)

PART 2. ENGINEER

2.1 The Project has been designed by the Calhoun Utilities Engineering Department, who is hereinafter called ENGINEER and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

PART 3. CONTRACT TIME

3.1. CONTRACTOR agrees to commence Work under this Agreement on or before a date to be specified on a written "Notice to Proceed" of the OWNER and to fully complete the Work within **240 consecutive calendar days** from the "Notice to Proceed" date.

3.2. Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the times specified in Paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding, the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER **Five Hundred and no/100 (\$ 500.00)** for each day that expires after the time specified in Paragraph 3.1.

PART 4. CONTRACT PRICE

4.1. Unit Price Work

OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents an amount in current funds of the amounts determined for all Unit Price Work, an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of that item as indicated in the CONTRACTOR'S UNIT PRICE BID (attached hereto as an exhibit), said amount being:

_____ Dollars (\$_____).

As provided in Paragraph 11.9.1 of the General Conditions estimated quantities are not guaranteed, and determinations of actual quantities and classification are to be made by ENGINEER as provided in Paragraph 9.10 of the General Conditions. Unit prices have been computed as provided in Paragraph 11.9.2 of the General Conditions.

PART 5. PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1 Progress Payments; Retainage. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR'S Applications for Payment as recommended by ENGINEER, on or about the 25th day of each month during performance of the Work as provided in Paragraphs 5.1.1.1, 5.1.1.2, and 5.2 below. All such payments will be measured by the schedule of values established in Paragraph 2.6 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) as provided in the General Requirements.

5.1.1 For Cost of Work: Progress payments on account of the Cost of the Work will be made:

5.1.1.1 Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with Article 14 of the General Conditions.

90% of the Work completed (with the balance being retainage). If Work has been 50% completed as determined by ENGINEER, and if the character and progress of the Work have been satisfactory to OWNER and ENGINEER, OWNER, on recommendation of ENGINEER, may determine that as long as the character and progress of the Work remain satisfactory to them, there

will be no additional retainage on account of Work completed, in which case the remaining progress payments prior to Substantial Completion will be in an amount equal to 100% of the Work completed.

90% of the Cost of the Work (with the balance being retainage) applicable to materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in Paragraph 14.2 of the General Conditions).

5.1.1.2 Upon Substantial Completion, in an amount sufficient to increase the total payments to CONTRACTOR to 95% of the Cost of the Work, (with the balance being retainage), less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with Paragraph 14.7 of the General Conditions.

5.2 Final Payment. Upon final completion and acceptance of the Work in accordance with Paragraph 14.13 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said Paragraph 14.13.

PART 6. INTEREST

6.1 All monies not paid when due as provided in Article 14 of the General Conditions shall bear interest at the maximum rate allowed by law at the place of the Project.

PART 7. CONTRACTOR'S REPRESENTATIONS.

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

7.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

7.2 CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 4.2 of the General Conditions, and accepts the determination set forth in Paragraph 6 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.

7.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in Paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price,

within the Contract Time and in accordance of Paragraph 4.2 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.

- 7.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities. No additional examinations, investigations, explorations, tests, reports, studies or similar information or data in respect of said Underground Facilities are or will be required by CONTRACTOR in order to perform and furnish the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 4.3 of the General Conditions.
- 7.5 CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.
- 7.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

PART 8. CONTRACT DOCUMENTS

- 8.1 This Agreement
- 8.2 Exhibits to this Agreement
- 8.3 Performance and other Bonds
- 8.4 Notice of Award
- 8.5 General Conditions
- 8.6 Supplementary Conditions
- 8.7 Specifications bearing the title **New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)** and consisting of 1 division and all sections listed in table of contents thereof.
- 8.8 Drawings, consisting of a cover sheet and sheets numbered 1 through 10 inclusive with each sheet bearing the following general title: **New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)**
- 8.9 Addenda numbers - to -, inclusive.

- 8.10 CONTRACTOR's Bid
- 8.11 Documentation submitted by CONTRACTOR prior to Notice of Award.
- 8.12 The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Paragraphs 3.4 and 3.5 of the General Conditions.
- 8.13 The documents listed in Paragraphs 8.2 et seq. above are attached to this Agreement (except as expressly noted otherwise above).

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in Paragraphs 3.4 and 3.5 of the General Conditions.

PART 9. ALTERNATIVE DISPUTE RESOLUTION

Notwithstanding the provisions contained in Article 16 of the General Conditions (Section 00700), the Contractor and the Owner specifically agree to the following processes and procedures for resolution of disputes arising pursuant to this Agreement:

- 9.1 Negotiation. The parties will attempt in good faith to resolve any controversy or claim arising out of or relating to this Agreement by prompt negotiations between representatives of the parties who have authority to settle the controversy, subject to ratification by the governing authority of the Owner.
 - 9.1.1 Notice & Response. The disputing party shall give the other party written notice of the dispute. Within ten (10) days after receipt of said notice, the receiving party shall submit to the other a written response.
 - 9.1.2 Content of Position Papers. The notice and response shall include (a) a statement of each party's position, a summary of the evidence and arguments supporting its position and (b) the name and title of the individual(s) ("Representative(s)") who will represent that party.
 - 9.1.3 Meeting. The Representatives of the parties shall meet at a mutually-acceptable time and place within twenty (20) days of the date of the disputing party's notice and, after that, as often as they reasonably deem necessary to exchange relevant information and to attempt to resolve the dispute.
 - 9.1.4 Impasse. If the matter is not resolved within forty-five (45) days of the disputing party's notice, or if the party receiving said notice will not meet within twenty (20) days, either party may initiate mediation of the controversy or claim according to the terms provided below.

9.2 Mediation. In the event any controversy arising under this agreement is not resolved by informal negotiations as provided above, the case may be referred by either party to the nearest office of Henning Mediation for mediation, that is, an informal, non-binding conference or conferences between the parties in which a mediator will seek to guide the parties to a resolution of the case.

9.2.1. Choice of Mediator. The parties are free to select promptly any mutually-acceptable mediator experienced in governmental construction law from the list at Henning Mediation. If the parties cannot agree or have no particular choice of mediator and simply request that Henning Mediation assign one to the case, then a list of the resumes of available mediators, numbering one more than there are parties, will be sent to the parties, each of whom may strike one name leaving the remaining name as the mediator. If more than one name remains, the designated mediator shall be selected by Henning Mediation from the remaining names.

9.2.2. Sessions. After the mediator has been selected, the parties shall promptly agree upon a date and time for the initial conference with the mediator, but no later than thirty (30) days after the date the mediator was selected. The parties understand and agree that, besides counsel, a representative from each side with full settlement authority (subject to ratification by the governing authority of the County) will be present at all mediation conferences unless excused by the mediator. In addition, each party may bring additional persons as needed to respond to questions, contribute information and participate in the negotiation. The number of additional persons may be agreed upon in advance with the assistance and advice of the mediator.

9.2.3. Discovery. In the event any party has substantial need for information in the possession of another party to prepare for the mediation conference(s), the parties shall attempt in good faith to agree upon procedures for the expeditious exchange of information, with the help of the mediator, if required.

9.2.4. Briefs. No later than seven (7) days before the first scheduled mediation session, each party shall deliver a concise written summary of its position together with any appropriate documents, views, and a proposed solution to the matters in controversy to the mediator and shall also serve a copy on all other parties.

9.2.5. Fees & Costs. The fees and costs shall conform to the then current fee schedule of Henning Mediation and, in the absence of an agreement to the contrary, will be borne equally by all parties.

9.2.6. Confidentiality of Proceedings. The mediation process is to be considered settlement or compromise negotiation for the purpose of all state and federal rules protecting disclosures made during such conferences from later discovery or use in evidence. The entire procedure is confidential, and no stenographic or other record shall be made except to memorialize a settlement record. All conduct,

statements, promises, offers, views, and opinions, oral or written, made during the mediation by any party or a party's agent, employee, or attorney are confidential and, where appropriate, are to be considered work product and privileged. Such conduct, statements, promises, offers, views, and opinions shall not be subject to discovery or admissible for any purpose, including impeachment, in any litigation or other proceeding involving the parties. Provided, however, that evidence otherwise subject to discovery or admissible is not excluded from discovery or admission in evidence simply as a result of its having been used in connection with this settlement process.

- 9.2.7. Termination. The mediation process shall continue until the case is resolved or the mediator makes a finding that there is no possibility of settlement through mediation or until either party by written notice to the other announces its decision not to continue further. In any event, the mediation is non-binding on the parties.

PART 10. MISCELLANEOUS

- 10.1. Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.
- 10.2. No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.
- 10.3 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.
- 10.4 Complete Agreement. This Agreement, including the Contract Documents, contains all of the understandings and agreements of whatsoever kind and nature existing between the parties hereto with respect to the subject matter contained herein.
- 10.5 Governing Law. This Agreement shall be governed by and construed under the laws of the State of Georgia.
- 10.6 Counterparts. This Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original, but all of which together shall constitute one and the same instrument.

- 10.7 Any provision or part of the Contract documents held to be invalid or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon OWNER and CONTRACTOR, who agree that the Contract documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- 10.8 Notice. All notices requests, demands and other communications hereunder shall be in writing and shall be deemed received, and shall be effective when personally delivered or on the third day after the postmark date when mailed by certified mail, postage prepaid, return receipt requested or upon actual delivery when sent *via* national overnight commercial carrier to the parties at the addresses given below, unless a substitute address shall first be furnished to the other parties by written notice in accordance herewith:

NOTICE TO OWNER shall be sent to:

Calhoun Utilities
Attn: Kurt T. McCord
700 West Line St.
Calhoun, GA 30701

NOTICE TO CONTRACTOR shall be sent to:

- 10.9 Sovereign Immunity. Nothing contained in this Agreement shall be construed to be a waiver of the Owner's sovereign immunity or any individual's qualified good faith or official immunities.
- 10.10 Force Majeure. Neither the Owner nor the Contractor shall be liable for their respective non-negligent or non-willful failure to perform or shall be deemed in default with respect to the failure to perform (or cure a failure to perform) any of their respective duties or obligations under this Agreement or for any delay in such performance due to: (i) any cause beyond their respective reasonable control; (ii) any act of God; (iii) any change in applicable governmental rules or regulations rendering the performance of any portion of this Agreement legally impossible; (iv) earthquake, fire, explosion or flood; (v) strike or labor dispute, excluding strikes or labor disputes by employees and/or agents of Engineer; (vi) delay or failure to act by any governmental or military authority; or (vii) any war, hostility, embargo, sabotage, civil disturbance, riot, insurrection or invasion. In such event, the time for performance shall be extended by an amount of time equal to the period of delay caused by such acts and all other obligations shall remain intact.
- 10.11 Headings. All headings herein are inserted only for convenience and ease of reference and are not to be considered in the construction or interpretation of any provision of this Agreement.

PART 11. OTHER PROVISIONS

IN WITNESS WHEREOF. OWNER and CONTRACTOR have signed this Agreement in **four (4)** counterparts. One counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on _____, 20____.

OWNER: City of Calhoun

By _____
CORPORATE SEAL

Attest _____

(If OWNER is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Agreement)

CONTRACTOR:

BY _____
CORPORATE SEAL

Attest _____

License No. _____

Agent for service of process: _____

(If CONTRACTOR is a corporation, attach evidence of authority to sign)

END OF SECTION

PERFORMANCE BOND

STATE OF GEORGIA

COUNTY OF GORDON

KNOW ALL MEN BY THESE PRESENTS, that we, as Principal (hereinafter known as "CONTRACTOR") and we, _____

_____,

(Name and Address of Surety)

as Surety, do hereby acknowledge ourselves indebted and firmly bound and held unto the **City of Calhoun** for the use and benefit of those entitled thereto, in the sum of Dollars () for the payment of which will and truly to be made, in lawful money of the United States, we do hereby bind ourselves, successors, assigns, heirs, and personal representatives.

BUT THE CONDITION OF THE FOREGOING OBLIGATION OR BOND IS THIS:

WHEREAS, the OWNER has engaged the said CONTRACTOR for the sum of Dollars (\$ _____).

for the construction of: **New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)** as more fully appears in a written Agreement bearing the date of _____, 20____, a copy of which Agreement is by reference hereby made a part hereof.

NOW, THEREFORE, if said Contractor shall fully and faithfully perform all the undertakings and obligations under the said agreement or contract hereinbefore referred to and shall fully indemnify and save harmless the said OWNER from all costs and damage whatsoever which it may suffer by reason of any failure on the part of said CONTRACTOR to do so, and shall fully reimburse and repay the said default, and shall guarantee all products and workmanship against defects for a period of one year, then this obligation or bond shall be null and void, otherwise, it shall remain in full force and effect.

And for value received it is hereby stipulated and agreed that no change, extension of time, alteration or addition to the terms of the said Agreement or Contract or in the work to be performed there under, or the Specifications accompanying the same shall in any way affect the obligations under the obligation or bond, and notice is hereby waived of any such damage, extension of time, alteration or addition to the terms of the Agreement or Contract or to the work or to the Specifications.

This bond is given pursuant to and in accordance with the provisions of O.C.G.A. Section 36-91-40 et seq and 36-91-70 et seq and all the provisions of the law referring to this character of bond as set forth in said sections or as may be hereinafter enacted and these are hereby made a part hereof to the

City of Calhoun
New 2MG Ground Storage Tank
at Fire Tower Road (Brogdon)

Project No. 358
May 2026

same extent as if set out herein in full.

IN WITNESS WHEREOF, the said CONTRACTOR has hereunder affixed its signature and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this ___ day of _____, 20____. Executed in 3 counterparts.

CONTRACTOR:

Signed and sealed in the presence of: By: _____

1. _____ Title: _____

2. _____ (SEAL)

SURETY: _____

Signed and sealed in the presence of: By: _____

1. _____ Title: _____

2. _____ (SEAL)

APPROVED AS TO FORM

By: _____
Attorney for the Owner

- NOTE:
1. Date of bond must not be prior to date of contract. If CONTRACTOR is a PARTNERSHIP, all partners should execute bond.
 2. Surety companies executing bonds must appear on the Treasure Department's most current list (circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

END OF SECTION

PAYMENT BOND

STATE OF GEORGIA

COUNTY OF GORDON

KNOW ALL MEN BY THESE PRESENTS, that we, as Principal (hereinafter known as "CONTRACTOR") and we, _____

_____,

(Name and Address of Surety)

as Surety, do hereby acknowledge ourselves indebted and firmly bound and held unto the **City of Calhoun** for the use and benefit of those entitled thereto, in the sum of Dollars (\$ _____) for the payment of which well and truly to be made, in lawful money of the United States, we do hereby bind ourselves, successors, assigns, heirs, and personal representatives.

BUT THE CONDITION OF THE FOREGOING OBLIGATION OR BOND IS THIS:

WHEREAS, the OWNER has engaged the said CONTRACTOR for the sum of Dollars () for the construction of: **New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)** as more fully appears in a written Agreement bearing the date of _____, 20__, a copy of which Agreement is by reference hereby made a part hereof.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if said CONTRACTOR and all subcontractors to whom any portion of the work provided for in said Contract is sublet and all assignees of said Contractor and of such subcontractors shall promptly make payments to all persons supplying him or them with labor, products, services, or supplies for or in the prosecution of the work provided for in such Contract, or in any amendment or extension of or addition to said Contract, and for the payment of reasonable attorney's fees, incurred by the claimants in suits on this bond, then the above obligation shall be void; otherwise, it shall remain in full force and effect.

HOWEVER, this bond is subject to the following conditions and limitations:

- a) Any person, firm or corporation that has furnished labor, products, or supplies for or in the prosecution of the work provided for in said Contract shall have a direct right of action against the CONTRACTOR and Surety on this bond, which right of action shall be asserted in a proceeding, instituted in the County in which the work provided for in said Contract is to be performed or in any county in which Contractor or Surety does business. Such right of action shall be asserted in proceedings instituted in the name of the claimant or claimants for his or their use and benefit against said CONTRACTOR or Surety or either of them (but not later than one year after the final settlement or said Contract) in which action such claim or claims shall be adjudicated and judgment rendered thereon.

- b) The Principal and Surety hereby designate and appoint the _____

_____, as the agent of each them to receive and accept service of process or other pleading issued or filed in any proceeding instituted on this bond and hereby consent that such service shall be the same as personal service on the CONTRACTOR and/or Surety.

- c) In no event shall the Surety be liable for a greater sum than the penalty of this bond, or subject to any suit, action or proceeding thereon that is instituted later than one year after the final settlement of said Contract.
- d) This bond is given pursuant to and in accordance with provisions of O.C.G.A. Section 36-91-40 et seq and 36-91-90 et seq. and all the provisions of law referring to this character of bond as set forth in said sections or as may be hereinafter enacted, and these are hereby made a part hereof to the same extent as if set out herein in full.

IN WITNESS WHEREOF, the said CONTRACTOR has hereunder affixed its signature and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this ____ day of _____, 20 _____. Executed in **3** counterparts.

CONTRACTOR: _____

Signed and sealed in the presence of: _____ By: _____

1. _____ Title: _____

2. _____ (SEAL)

SURETY: _____

Signed and sealed in the presence of: _____ By: _____

1. _____ Title: _____

2. _____ (SEAL)

APPROVED AS TO FORM

By: _____
Attorney for the Owner

- NOTE:
1. Date of bond must not be prior to date of contract. If CONTRACTOR is a PARTNERSHIP, all partners should execute bond.
 2. Surety companies executing bonds must appear on the Treasure Department's most current list (circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

END OF SECTION

NOTICE OF AWARD

PROJECT DESCRIPTION:

New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids dated Thursday, June 18, 2026 at 2:00 pm and Instructions to Bidders.

You are hereby notified that your BID has been accepted for items in the amount of _____ Dollars (\$_____).

You are required by the Instructions to Bidders to execute the Agreement and furnish the required CONTRACTOR's Performance BOND, Payment BOND and Certificates of Insurance with fifteen (15) calendar days from the date of the Notice to you.

If you fail to execute said Agreement and to furnish said BONDS within fifteen (15) days from the date of this notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE of AWARD to the OWNER.

Dated this ____ day of _____, 20__.

City of Calhoun

By: _____

Title: _____ Mayor _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged by this ____ day of _____, 20__.

By: _____

Title: _____

NOTICE TO PROCEED

To: _____

Date: _____

Project Description:

New 2MG Ground Storage Tank at Fire Tower Road (Brogdon)

You are hereby notified to commence WORK in accordance with the Agreement dated _____, 20____, on or before _____, 20____, and you are to complete the WORK within **240 consecutive calendar days** thereafter. The date of completion of all WORK is therefore _____, 20____.

City of Calhoun

By _____

Title: _____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged on the _____ day of _____, 20____

By _____

Title _____

**SECTION 00700
GENERAL CONDITIONS
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PART 1. DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

Addenda - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the bidding documents or the Contract Documents.

Agreement - The written agreement between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Application for Payment - The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress for final payments and which is to include such supporting documentation as is required by the Contract Documents.

Bid - The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bonds - Bid, performance and payment bonds and other instruments of security.

Change Order - A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents - The Agreement,

Addenda (which pertain to the Contract Documents), CONTRACTOR'S Bid (including documentation accompanying the Bid and any post-Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all amendments, modifications and supplements issued pursuant to paragraphs 3.4 and 3.5 on or after the Effective Date of the Agreement.

Contract Price - The monies payable by OWNER to CONTRACTOR under the Contract Documents as stated in the Agreement (subject to the provisions of paragraph 11.9.1 in the case of Unit Price Work).

Contract Time - The number of days (computed as provided in paragraph 17.2.1 through 17.2.2.) or the date stated in the Agreement for the completion of the Work.

CONTRACTOR - The person, firm or corporation with whom OWNER has entered into the Agreement.

Defective - An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER'S recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion in accordance with paragraph 14.8 or 14.10).

Drawings - The drawings which show the character and scope of the Work to be

performed and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents.

Effective Date of the Agreement - The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

ENGINEER - The person, firm or corporation named as such in the Agreement.

Field Order - A written order issued by ENGINEER which orders minor changes in the Work in accordance with paragraph 9.5 but which does not involve a change in the Contract Price or the Contract Time.

General Requirements - Sections of Division 1 of the Specifications.

Laws and Regulations; Laws or Regulations - Laws, rules, regulations, ordinances, codes and/or orders.

Notice of Award - The written notice by OWNER to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

Notice to Proceed - A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR'S obligations under the Contract Documents.

OWNER - The public body or authority, corporation, association, firm or person

with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided.

Partial Utilization - Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work.

Project - The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

Resident Project Representative - The authorized representative of ENGINEER who is assigned to the site or any part thereof.

Shop Drawings - All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for CONTRACTOR to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

Specifications - Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

Subcontractor - An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.

Substantial Completion - The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER'S definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if there be no such certificate issued, when final payment is due in accordance with paragraph 14.13. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof.

Supplementary Conditions - The part of the Contract Documents which amends or supplements these General Conditions.

Supplier - A manufacturer, fabricator, supplier, distributor, material man or vendor.

Underground Facilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials; electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

Unit Price Work - Work to be paid for on the basis of unit prices.

Work - The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor and furnishing and incorporating materials and equipment into the construction, all as

required by the Contract Documents.

Work Directive Change - A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommended by ENGINEER, ordering and addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.2.1 through 4.2.6. or 4.3.1 through 4.3.2. or to emergencies under paragraph 6.22. A Work Directive Change may not change the Contract Price or the Contract Time, but is evidence that the parties expect that the change directed or documented by a Work Directive Change will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in paragraph 10.2.

Written Amendment - A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the non-engineering or non-technical rather than strictly Work-related aspects of the Contract Documents.

PART 2. PRELIMINARY MATTERS

Delivery of Bonds:

2.1. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds as CONTRACTOR may be required to furnish in accordance with paragraph 5.1.

Copies of Documents:

2.2. OWNER shall furnish to CONTRACTOR up to ten copies (unless

otherwise specified in the Supplementary Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional Copies will be furnished, upon request, at the cost of reproduction.

Commencement of Contract Time; Notice to Proceed:

2.3. The Contract Time will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. In no event will the Contract Time commence to run later than the seventy-fifth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

Starting the Project:

2.4. CONTRACTOR shall start to perform the Work on the date when the Contract Time commences to run, but no Work shall be done at the site prior to the date on which the Contract Time commences to run.

Before Starting Construction:

2.5. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures shown thereon and all applicable field measurements. CONTRACTOR shall promptly report in writing to ENGINEER any conflict, error or discrepancy which CONTRACTOR may discover and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby; however,

CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents, unless CONTRACTOR had actual knowledge thereof or should reasonably have known thereof.

2.6. Within ten days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), CONTRACTOR shall submit to ENGINEER for review:

2.6.1. an estimated progress schedule indicating the starting and completion dates of the various stages of the Work;

2.6.2. a preliminary schedule of Shop Drawing submissions; and

2.6.3. a preliminary schedule of values for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work which will be confirmed in writing by CONTRACTOR at the time of submission.

2.7. Before any Work at the site is started, CONTRACTOR shall deliver to OWNER, with a copy to ENGINEER, certificates (and other evidence of insurance requested by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with paragraphs 5.3 and 5.4., and OWNER shall deliver to CONTRACTOR certificates (and other evidence of insurance requested by CONTRACTOR) which OWNER is required to purchase and maintain in accordance with paragraphs 5.6 and 5.7.

Preconstruction Conference:

2.8. Within twenty days after the Effective Date of the Agreement, but before CONTRACTOR starts the Work at the site, a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to discuss the schedules referred to in paragraph 2.6., to discuss procedures for handling Shop Drawings and other submittals and for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

Finalizing Schedules:

2.9. At least ten days before submission of the first Application for Payment a conference attended by CONTRACTOR, ENGINEER and others as appropriate will be held to finalize the schedules submitted in accordance with paragraph 2.6. The finalized progress schedule will be acceptable to ENGINEER as providing an orderly progression of the Work to completion within the Contract Time, but such acceptance will neither impose on ENGINEER responsibility for the progress or scheduling of the Work nor relieve CONTRACTOR from full responsibility therefore. The finalized schedule of Shop Drawing submissions will be acceptable to ENGINEER as providing a workable arrangement for processing the submissions. The finalized schedule of values will be acceptable to ENGINEER as to form and substance.

PART 3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

Intent:

3.1. The Contract Documents comprise the

entire agreement between OWNER and CONTRACTOR concerning the Work. The Contract Documents are complementary; what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

3.2. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result will be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe Work, materials or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or Laws or Regulations in effect at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to ENGINEER, or any of ENGINEER'S consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or

authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16. Clarifications and interpretations of the Contract Documents shall be issued by ENGINEER as provided in paragraph 9.4.

3.3. If, during the performance of the Work, CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, CONTRACTOR shall so report to ENGINEER in writing at once and before proceeding with the Work affected thereby shall obtain a written interpretation or clarification from ENGINEER; however, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any conflict, error or discrepancy in the Contract Documents unless CONTRACTOR had actual knowledge thereof or should reasonable have known thereof.

Amending and Supplementing Contract Documents:

3.4. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

3.4.1. a formal Written Amendment,

3.4.2. a Change Order (pursuant to paragraph 10.4), or

3.4.3. a Work Directive Change (pursuant to paragraph 10.1).

As indicated in paragraphs 11.2 and 12.1, Contract Price and Contract Time may only be changed by a Change Order or a Written Amendment.

3.5. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the followings ways:

3.5.1. a Field Order (pursuant to paragraph 9.5),

3.5.2. ENGINEER'S approval of a Shop Drawing or sample (pursuant to paragraphs 6.26 and 6.27), or

3.5.3. ENGINEER'S written interpretation or clarification (pursuant to paragraph 9.4).

Reuse of Documents:

3.6. Neither CONTRACTOR nor any Subcontractor or Supplier or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Specifications or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER; and they shall not reuse any of them on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaptation by ENGINEER.

PART 4. AVAILABILITY OF LANDS; PHYSICAL CONDITIONS; REFERENCE POINTS

Availability of Lands:

4.1. OWNER shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the

use of CONTRACTOR. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. If CONTRACTOR believes that any delay in OWNER'S furnishing these lands, rights-of-way or easements entitles CONTRACTOR to an extension of the Contract Time, CONTRACTOR may make a claim therefore as provided in Article 12. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

Physical Conditions:

4.2.1. *Explorations and Reports:* Reference is made to the Supplementary Conditions for identification of those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparation of the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such reports, but not upon non-technical data, interpretations or opinions contained therein or for the completeness thereof for CONTRACTOR'S purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to subsurface conditions at the site.

4.2.2. *Existing Structures:* Reference is made to the Supplementary Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities referred to in paragraph 4.3.1 through 4.3.2.) which are at or contiguous to the site that have been utilized by ENGINEER in preparation of

the Contract Documents. CONTRACTOR may rely upon the accuracy of the technical data contained in such drawings, but not for the completeness thereof for CONTRACTOR'S purposes. Except as indicated in the immediately preceding sentence and in paragraph 4.2.6, CONTRACTOR shall have full responsibility with respect to physical conditions in or relating to such structures.

4.2.3. *Report of Differing Conditions:* If CONTRACTOR believes that:

4.2.3.1. any technical data on which CONTRACTOR is entitled to rely as provided in paragraphs 4.2.1 and 4.2.2 is inaccurate, or

4.2.3.2. any physical condition uncovered or revealed at the site differs materially from that indicated, reflected or referred to in the Contract Documents,

CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work in connection therewith (except in an emergency as permitted by paragraph 6.22), notify OWNER and ENGINEER in writing about the inaccuracy or difference.

4.2.4. *ENGINEER'S Review:* ENGINEER will promptly review the pertinent conditions, determine the necessity of obtaining additional explorations or tests with respect thereto and advise OWNER in Writing (with a copy to CONTRACTOR) of ENGINEER'S findings and conclusions.

4.2.5. *Possible Document Change:* IF ENGINEER concludes that there is a material error in the Contract Documents or that because of newly discovered conditions a change in the Contract Documents is

required, a Work Directive Change or a change Order will be issued as provided in Article 10 to reflect and document the consequences of the inaccuracy or difference.

4.2.6. *Possible Price and Time Adjustments:* In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to any such inaccuracy of difference. If OWNER and CONTRACTOR are unable to agree as to the amount or length thereof, a claim may be made therefore as provided in Articles 11 and 12.

Physical Conditions - Underground Facilities:

4.3.1. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based on information and data furnished to OWNER or ENGINEER by the owners of such Underground Facilities or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

4.3.1.1. OWNER and ENGINEER shall not be responsible for the accuracy or completeness or any such information or data; and,

4.3.1.2. CONTRACTOR shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Facilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Facilities during construction, for the safety and protection

thereof as provided in paragraph 6.20 and repairing any damage thereto resulting from the Work, the cost of all of which will be considered as having been included in the Contract Price.

4.3.2. *Not Shown or Indicated.* If an Underground Facility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of, CONTRACTOR shall, promptly after becoming aware thereof and before performing any Work affected thereby (except in an emergency as permitted by paragraph 6.22), identify the owner of such Underground Facility and give written notice thereof to that owner and to OWNER and ENGINEER. ENGINEER will promptly review the Underground Facility to determine the extent to which the Contract Documents should be modified to reflect and document the consequences of the existence of the Underground Facility, and the Contract Documents will be amended or supplemented to the extent necessary. During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility as provided in paragraph 6.20. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, to the extent that they are attributable to the extent to the existence of any Underground Facility that was not shown or indicated in the Contract Documents and which CONTRACTOR could not reasonably have been expected to be aware of. If the parties are unable to agree as to the amount or length thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12.

Reference Points:

4.4. OWNER shall provide engineering

surveys to establish reference points for construction which in ENGINEER'S judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for laying out the Work (unless otherwise specified in the General Requirements), shall protect and preserve the established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever a reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points by professionally qualified personnel.

PART 5. BONDS AND INSURANCE

Performance and Other Bonds:

5.1 CONTRACTOR shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all CONTRACTOR'S obligations under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Law or Regulation or by the Contract Documents. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions. All Bonds shall be in the forms prescribed by Law or Regulation or by the Contract Documents and be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the

Audit Staff Bureau of Accounts, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of the authority to act.

5.2. If the surety on any Bond furnished by CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.1, CONTRACTOR shall within five days thereafter substitute another Bond and Surety, both of which must be acceptable to OWNER.

Contractor's Liability Insurance:

5.3. CONTRACTOR shall purchase and maintain such comprehensive general liability and other insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims set forth below which may arise out of or result from CONTRACTOR'S performance and furnishing of the Work and CONTRACTOR'S other obligations under the Contract Documents, whether it is to be performed or furnished by CONTRACTOR, by any Subcontractor, by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable.

5.3.1. Claims under workers' or workmen's compensation, disability benefits and other similar employee benefit acts;

5.3.2. Claims for damages because of bodily injury occupational sickness or disease, or death on CONTRACTOR'S employees;

5.3.3. Claims for damages because of bodily injury, sickness or disease, or death

of any person other than CONTRACTOR'S employees;

5.3.4. Claims for damages insured by personal injury liability coverage which are sustained (a) by any person as a result of an offense directly or indirectly related to the employment of such person by CONTRACTOR, or (b) by any other person for any other reason;

5.3.5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting there from;

5.3.6. Claims arising out of operation of Laws or Regulations for damages because of bodily injury or death of any person or for damage to property; and

5.3.7. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

The insurance required by this paragraph 5.3 shall include the specific coverage and be written for not less than the limits of liability and coverage provided in the Supplementary Conditions, or required by law, whichever is greater. The comprehensive general liability insurance shall include completed operations insurance. All of the policies of insurance so required to be purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days' prior written notice has been given to

OWNER and ENGINEER by certified mail. All such insurance shall remain in effect until final payment and at all times thereafter when CONTRACTOR may be correcting, removing or replacing *defective* Work in accordance with paragraph 13.12. In addition, CONTRACTOR shall maintain such completed operations insurance for at least two years after final payment and furnish OWNER and with evidence of continuation of such insurance at final payment and one year thereafter.

Contractual Liability Insurance:

5.4. The comprehensive general liability insurance required by paragraph 5.3 will include contractual liability insurance applicable to CONTRACTOR'S obligations under paragraphs 6.30 and 6.31.

Owner's Liability Insurance:

5.5. OWNER shall be responsible for purchasing and maintaining OWNER'S own liability insurance and, at OWNER'S option, may purchase and maintain such insurance as will protect OWNER against claims which may arise from operations under the Contract Documents.

Property Insurance:

5.6. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain property insurance upon the Work at the site to the full insurable value thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and ENGINEER'S consultants in the Work, all of whom shall be listed as insured or additional insured parties, shall insure against the perils of fire and extended

coverage and shall include "all risk" insurance for physical loss and damage including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in the Supplementary Conditions, and shall include damages, losses and expenses arising out of or resulting from any insured loss or incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers, architects, attorneys and other professionals). If not covered under the "all risk" insurance or otherwise provided in the Supplementary Conditions, CONTRACTOR shall purchase and maintain similar property insurance on portions of the Work stored on and off the site or in transit when such portions of the Work are to be included in an Application for Payment.

5.7. OWNER shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of OWNER, CONTRACTOR, Subcontractors, ENGINEER and ENGINEER'S consultants in the Work, all of whom shall be listed as insured or additional insured parties.

5.8 All the policies of insurance (or the certificates or other evidence thereof) required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.6 and 5.7 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER by certified mail and will contain waiver provisions in accordance with paragraph 5.11.2.

5.9 OWNER shall not be responsible for purchasing and maintaining any property insurance to protect the interests of CONTRACTOR, Subcontractors or others in the Work to the extent of any deductible amounts that are provided in the Supplementary Conditions. The risk of loss within the deductible amount will be borne by CONTRACTOR, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

5.10. If OWNER requests in writing that other special insurance be included in the property insurance policy, CONTRACTOR shall, if possible, include such insurance, and the cost thereof will be charged to CONTRACTOR by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the site, CONTRACTOR shall in writing advise OWNER whether or not such other insurance has been procured by CONTRACTOR.

Waiver of Rights:

5.11.1. OWNER and CONTRACTOR waive all rights against each other for all losses and damages caused by any of the perils covered by the policies of insurance provided in response to paragraphs 5.6 and 5.7 and any other property insurance applicable to the Work, and also waive all such rights against the Subcontractors, ENGINEER, ENGINEER'S consultants and all other parties names as insured in such policies for losses and damages so caused. As required by paragraph 6.11, each subcontract between CONTRACTOR and a Subcontractor will contain similar waiver provisions by the Subcontractor in favor of OWNER, CONTRACTOR, ENGINEER,

ENGINEER'S consultants and all other parties named as insured. None of the above waivers shall extend to the rights that any of the insured parties may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11.2 OWNER and CONTRACTOR intend that any policies provided in response to paragraphs 5.6 and 5.7 shall protect all of the parties insured and provide primary coverage for all losses and damages caused by the perils covered thereby. Accordingly, all such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any of the parties named as insureds or additional insureds, and if the insurers require separate waiver forms to be signed by ENGINEER or ENGINEER'S consultant OWNER will obtain the same, and if such waiver forms are required of any Subcontractor, CONTRACTOR will obtain the same.

Receipt and Application of Proceeds:

5.12. Any insured loss under the policies of insurance required by paragraphs 5.6 and 5.7 will be adjusted with OWNER and made payable to OWNER as trustee for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.13. OWNER shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order or Written

Amendment.

5.13. OWNER as trustee shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER'S exercise of this power. If such objection be made, OWNER as trustee shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If required in writing by any party in interest, OWNER as trustee shall, upon the occurrence of an insured loss, give bond for the proper performance of such duties.

Acceptance of Insurance:

5.14. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with paragraphs 5.3 and 5.4 on the basis of its not complying with the Contract Documents, OWNER shall notify CONTRACTOR in writing thereof within ten days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.7. If CONTRACTOR has any objection to the coverage afforded by or other provisions of the policies of insurance required to be purchased and maintained by OWNER in accordance with paragraphs 5.6 and 5.7 on the basis of their not complying with the Contract Documents, CONTRACTOR shall notify OWNER in writing thereof within ten days of the date of delivery of such certificates to CONTRACTOR in accordance with paragraph 2.7. OWNER and CONTRACTOR shall each provide to the other such additional information in respect of insurance provided by each as the other may reasonably request. Failure by OWNER or CONTRACTOR to give any such notice of objection within the time provided shall constitute acceptance of such insurance

purchased by the other as complying with the Contract Documents.

Partial Utilization - Property Insurance:

5.15. If OWNER finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, such use or occupancy may be accomplished in accordance with paragraph 14.10; provided that no such use or occupancy shall commence before the insurers providing the property insurance have acknowledge notice thereof and in writing effected the changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or lapse on account of any such partial use or occupancy.

PART 6. CONTRACTOR'S RESPONSIBILITIES

Supervision and Superintendence:

6.1. CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction, but CONTRACTOR shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract Documents. CONTRACTOR shall be responsible to see that the finished Work complies accurately with the Contract Documents.

6.2. CONTRACTOR shall keep on the Work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. The superintendent will be CONTRACTOR'S representative at the site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

Labor, Materials and Equipment:

6.3 CONTRACTOR shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents.

CONTRACTOR shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the site shall be performed during regular working hours, and CONTRACTOR will not permit overtime work or the performance of Work on Saturday, Sunday or any legal holiday without OWNER'S written consent given after prior written notice to ENGINEER.

6.4. Unless otherwise specified in the General Requirements, CONTRACTOR shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start-up and completion of the Work.

6.5. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instruction of the applicable Supplier except as otherwise provided in the Contract Documents; but no provision of any such instructions will be effective to assign to ENGINEER, or any of ENGINEER'S consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16.

Adjusting Progress Schedule:

6.6 CONTRACTOR shall submit to ENGINEER for acceptance (to the extent indicated in paragraph 2.9) adjustments in the progress schedule to reflect the impact thereon of new developments; these will conform generally to the progress schedule then in effect and additionally will comply with any provisions of the General Requirements applicable thereto.

Substitutes or "Or-Equal" Items:

6.7.1. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is

permitted, materials or equipment of other Suppliers may be accepted by ENGINEER if sufficient information is submitted by CONTRACTOR to allow ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named. The procedure for review by ENGINEER will include the following as supplemented in the General Requirements. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR. If CONTRACTOR wishes to furnish or use a substitute item of material or equipment, CONTRACTOR shall make written application to ENGINEER for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. The application will state that the evaluation and acceptance of the proposed substitute will not prejudice CONTRACTOR'S achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs or redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed sub-

stitute. ENGINEER may require CONTRACTOR to furnish at CONTRACTOR'S expense additional data about the proposed substitute.

6.7.2. If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to ENGINEER, if CONTRACTOR submits sufficient information to allow ENGINEER to determine that the substitute proposed is equivalent to that indicated or required by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in paragraph 6.7.1 as applied by ENGINEER and as may be supplemented in the General Requirements.

6.7.3. ENGINEER will be allowed a reasonable time within which to evaluate each proposed substitute. ENGINEER will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without ENGINEER'S prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. OWNER may require CONTRACTOR to furnish at CONTRACTOR'S expense a special performance guarantee or other surety with respect to any substitute. ENGINEER will record time required by ENGINEER and ENGINEER'S consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Contract Documents occasioned thereby. Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER'S consultants for evaluating each proposed substitute.

Concerning Subcontractors, Suppliers and Others:

6.8.1. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organization (including those acceptable to OWNER and ENGINEER as indicated in paragraph 6.8.2), whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall not be required to employ any Subcontractor, Supplier or other person or organization to furnish or perform any of the Work against whom CONTRACTOR has reasonable objection.

6.8.2. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers or other persons or organizations (including those who are to furnish the principal items of materials and equipment) to be submitted to OWNER in advance of the specified date prior to the Effective Date of the Agreement for acceptance by OWNER and ENGINEER and if CONTRACTOR has submitted a list thereof in accordance with the Supplementary Conditions, OWNER'S or ENGINEER'S acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the bidding documents or the Contract Documents) of any such Subcontractor, Supplier or other person or organization so identified may be revoked on the basis of reasonable objection after due investigation, in which case CONTRACTOR shall submit an acceptable substitute, the Contract Price will be increased (or decreased) by the difference in the cost occasioned by such substitution and an appropriate Change Order will be issued or Written Amendment signed. No acceptance by OWNER or ENGINEER of any such Subcontractor, Supplier or other person or organization shall constitute a waiver of any right of OWNER or ENGINEER to reject

defective Work.

6.9 CONTRACTOR shall be fully responsible to OWNER and ENGINEER for all acts and omissions of the Subcontractors, Suppliers and other persons and organization performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR'S own acts and omissions. Nothing in the Contract Documents shall create any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization except as may other wise be required by Laws and Regulations.

6.10. The divisions and sections of the Specifications and the identifications of any Drawings shall not control CONTRACTOR in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

6.11. All Work performed for CONTRACTOR by a Subcontractor will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor which specifically binds the Subcontractor to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER and contains waiver provisions as required by paragraph 5.11.1. through 5.11.2. CONTRACTOR shall pay each Subcontractor a just share of any insurance moneys received by CONTRACTOR on account of losses under policies issued pursuant to paragraphs 5.6 and 5.7.

Patent Fees and Royalties:

6.12. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in the Contract Documents. CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees and court and arbitration costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

Permits:

6.13. Unless otherwise provided in the Supplementary Conditions, CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening the Bids, or if there are no Bids on the Effective Date of

the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work, and OWNER shall pay all charges of such utility owners for capital costs related thereto such as plant investment fees.

Laws and Regulations:

6.14.1. CONTRACTOR shall give all notices and comply with all Laws and Regulations applicable to furnishing and performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR'S compliance with any Laws or Regulations.

6.14.2. If CONTRACTOR observes that the Specifications or Drawings are at variance with any Laws or Regulations, CONTRACTOR shall give ENGINEER prompt written notice thereof, and any necessary changes will be authorized by one of the methods indicated in paragraph 3.4. If CONTRACTOR performs any Work knowing or having reason to know that it is contrary to such Laws or Regulations, and without such notice to ENGINEER, CONTRACTOR shall bear all costs arising there from; however, it shall not be CONTRACTOR'S primary responsibility to make certain that the Specifications and Drawings are in accordance with such Laws and Regulations.

Taxes:

6.15. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the

Work.

Use of Premises:

6.16. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements, and shall not unreasonably encumber the premises which construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against OWNER or ENGINEER by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold OWNER and ENGINEER harmless from and against all claims damages, losses and expenses (including, but not limited to fees or engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any such other party against OWNER or ENGINEER to the extent based on a claim arising out of CONTRACTOR'S performance of the Work.

6.17. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste

materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the site clean and ready for occupancy by OWNER. CONTRACTOR shall restore to original condition all property not designated for alteration by the Contract Documents.

6.18. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

Record Documents:

6.19. CONTRACTOR shall maintain in a safe place at the site one record copy of all Drawings, Specifications, Addenda, Written Amendments, Change Orders, Work Directive Changes, Field Orders and written interpretations and clarifications (issued pursuant to paragraph 9.4) in good order and annotated to show all changes made during construction. These record documents together with all approved samples and a counterpart of all approved Shop Drawings will be available to ENGINEER for reference. Upon completion of the Work, these record documents, samples and Shop Drawings will be delivered to ENGINEER for OWNER.

Safety and Protection:

6.20. CONTRACTOR shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent

damage, injury or loss to:

6.20.1 all employees on the Work and other persons and organizations who may be affected thereby:

6.20.2 all the Work and materials and equipment to be incorporated therein, whether in storage on or off the site; and

6.20.3. other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.

CONTRACTOR shall comply with all applicable Laws and Regulations of any public body (Including OSHA) having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of Underground Facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation and replacement of their property. All damage, injury or loss to any property referred to in paragraph 6.20.2 or 6.20.3 caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier or any other person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or

negligence of CONTRACTOR). CONTRACTOR'S duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.13 that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.21. CONTRACTOR shall designate a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be CONTRACTOR'S superintendent unless otherwise designated in writing by CONTRACTOR to OWNER. Emergencies:

6.22. In emergencies affecting the safety or protection of persons or the Work or property at the site or adjacent thereto, CONTRACTOR, without special instruction or authorization from ENGINEER or OWNER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken in response to an emergency, a Work Directive Change or Change Order will be issued to document the consequences of the changes or variations.

Shop Drawings and Samples:

6.23. After checking and verifying all field measurements and after complying with applicable procedures specified in the General Requirements, CONTRACTOR

shall submit to ENGINEER for review and approval in accordance with the accepted schedule of Shop Drawing submissions (see paragraph 2.9), or for other appropriate action if so indicated in the Supplementary Conditions, five copies (unless otherwise specified in the General Requirements) of all Shop Drawings, which will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR'S responsibilities under the Contract Documents with respect to the review submission. All submissions will be identified as ENGINEER may require. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to enable ENGINEER to review the information as required.

6.24. CONTRACTOR shall also submit to ENGINEER for review and approval with such promptness as to cause no delay in Work, all samples required by the Contract Documents. All samples will have been checked by and accompanied by a specific written indication that CONTRACTOR has satisfied CONTRACTOR'S responsibilities under the Contract Documents with respect to the review of the submission and will be identified clearly as to material, Supplier, pertinent data such as catalog numbers and the use for which intended.

6.25.1 Before submission of each Shop Drawing or sample CONTRACTOR shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each Shop Drawing or sample with other Shop Drawings and samples and with the requirements of the Work and the Contract Documents.

6.25.2. At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the Shop Drawings or samples may have from the requirements of the Contract Documents, and, in addition, shall cause a specific notation to be made on each Shop Drawing submitted to ENGINEER for review and approval of each such variation.

6.26. ENGINEER will review and approve with reasonable promptness Shop Drawings and samples, but ENGINEER'S review and approval will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences or procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. CONTRACTOR shall make corrections required by ENGINEER, and shall return the required number of corrected copies of Shop Drawings and submit as required new samples for review and approval. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous submittals.

6.27. ENGINEER'S review and approval of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER'S attention to each such variation at the time of submission as

required by paragraph 6.25.2 and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated in or accompanying the Shop Drawing or sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings or from responsibility for having complied with the provisions of paragraph 6.25.1.

6.28. Where a Shop Drawing or sample is required by the Specifications, any related Work performed prior to ENGINEER'S review and approval of the pertinent submission will be the sole expense and responsibility of CONTRACTOR.

Continuing the Work:

6.29. CONTRACTOR shall carry on the Work and adhere to the progress schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by paragraph 15.5 or as CONTRACTOR and OWNER may otherwise agree in writing.

Indemnification:

6.30. To the fullest extent permitted by Laws and Regulations CONTRACTOR shall indemnify and hold harmless OWNER and ENGINEER and their consultants, agents and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) arising out of or resulting from the performance of the Work, provided that any such claim, damage, loss or expense (a) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use

resulting there from and (b) is caused in whole or in part by a negligent act or omission of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder or arises by or is imposed by Law and Regulations regardless of the negligence of any such party.

6.31. In any and all claims against OWNER or ENGINEER or any of their consultants, agents or employees by any employee of CONTRACTOR, any Subcontractor, any person or organization directly or indirectly employed by any of them to perform or furnish any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.30 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR or any such Subcontractor or other person or organization under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

6.32. The obligations of CONTRACTOR under paragraph 6.30 shall not extend to the liability of ENGINEER, ENGINEER'S consultants, agents or employees arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications.

PART 7. OTHER WORK

Related Work at Site:

7.1. OWNER may perform other work related to the Project at the site by

OWNER'S own forces, have other work performed by utility owners or let other direct contracts therefore which shall contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to CONTRACTOR prior to starting any such other work; and, if CONTRACTOR believes that such performance will involve additional expense to CONTRACTOR or requires additional time and the parties are unable to agree as to the extent thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12.

7.2. CONTRACTOR shall afford each utility owner and other contractor who is a party to such a direct contract (or OWNER, if OWNER is performing the additional work with OWNER'S employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work, and shall properly connect and coordinate the Work with theirs. CONTRACTOR shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected. The duties and responsibilities of CONTRACTOR under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of CONTRACTOR in said direct contracts between OWNER and such utility owners and other contractors.

7.3. If any part of CONTRACTOR'S Work depends for proper execution or results upon

the work of any such other contractor or utility owner (or OWNER), CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. CONTRACTOR'S failure so to report will constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR'S Work except for latent or non-apparent defects and deficiencies in the other work.

Coordination:

7.4. If OWNER contracts with others for the performance of other work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in the Supplementary Conditions, and the specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided in the Supplementary Conditions. Unless otherwise provided in the Supplementary Conditions, neither OWNER nor ENGINEER shall have any authority or responsibility in respect of such coordination.

PART 8. OWNER'S RESPONSIBILITIES

8.1. OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.2. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable

objection, whose status under the Contract Documents shall be that of the former ENGINEER. Any dispute in connection with such appointment shall be subject to arbitration.

8.3. OWNER shall furnish the data required of OWNER under the Contract Documents promptly and shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.4 and 14.13.

8.4. OWNER'S duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.1 and 4.4. Paragraph 4.2.1 through 4.2.6. refers to OWNER'S identifying and making available to CONTRACTOR copies of reports of explorations and tests of subsurface conditions at the site and in existing structures which have been utilized by ENGINEER in preparing the Drawings and Specifications.

8.5. OWNER'S responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in paragraphs 5.5 through 5.8.

8.6. OWNER is obligated to execute Change Orders as indicated in paragraph 10.4.

8.7. OWNER'S responsibility in respect of certain inspections, tests and approvals is set forth in paragraph 13.4.

8.8. In connection with OWNER'S right to stop Work or suspend Work, see paragraphs 13.10 and 15.1 Paragraph 15.2 deals with OWNER'S right to terminate services of CONTRACTOR under certain circumstances.

PART 9. ENGINEER'S STATUS

DURING CONSTRUCTION

Owner's Representative:

9.1. ENGINEER will be OWNER'S representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER'S representative during construction are set forth in the Contract Documents and shall not be extended without written consent of OWNER and ENGINEER.

Visits to Site:

9.2. ENGINEER will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. ENGINEER will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. ENGINEER'S efforts will be directed toward providing for OWNER a greater degree of confidence that the completed Work will conform to the Contract Documents. On the basis of such visits and on-site observations as an experienced and qualified design professional, ENGINEER will keep OWNER informed of the progress of the Work and will endeavor to guard OWNER against defects and deficiencies in the Work.

Project Representation:

9.3. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in observing the performance of the Work. The duties, responsibilities and limitations of authority of any such Resident Project Representative and assistants will be as

provided in the Supplementary Conditions. If OWNER designates another agent to represent OWNER at the site who is not ENGINEER'S agent or employee, the duties, responsibilities and limitations of authority of such other person will be as provided in the Supplementary Conditions.

Clarifications and Interpretation:

9.4. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents. If CONTRACTOR believes that a written clarification or interpretation justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Article 11 or Article 12.

Authorized Variations in Work:

9.5. ENGINEER may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve as adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and will be binding on OWNER, and also on CONTRACTOR who shall perform the Work involved promptly. If CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Article 11 or 12.

Rejecting Defective Work:

9.6. ENGINEER will have authority to disapprove or reject Work which ENGINEER believes to be *defective*, and will also have authority to require special inspection or testing of the Work as provided in paragraph 13.9, whether or not the Work is fabricated, installed or completed.

Shop Drawings, Change Orders and Payments:

9.7. In connection with ENGINEER'S responsibility for Shop Drawings and samples, see paragraphs 6.23 through 6.29 inclusive.

9.8. In connection with ENGINEER'S responsibilities as to Change Orders, see Articles 10, 11, and 12.

9.9. In connection with ENGINEER'S responsibilities in respect of Applications for Payment, etc., see Article 14.

Determinations for Unit Prices:

9.10. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER'S preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER'S written decisions thereon will be final and binding upon OWNER and CONTRACTOR, unless, within ten days after the date of any such decision, either OWNER or CONTRACTOR delivers to the other party to the Agreement and to ENGINEER written notice of intention to appeal from such a decision.

Decisions on Disputes:

9.11. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work there under. Claims, disputes and other matters relating to the acceptability of the Work or the interpretation of the requirements of the Contract Documents pertaining to the performance and furnishing of the Work and claims under Articles 11 and 12 in respect of changes in the Contract Price or Contract Time will be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph, which ENGINEER will render in writing within a reasonable time. Written notice of each such claim, dispute and other matter will be delivered by the claimant to ENGINEER and the other party to the Agreement promptly (but in no event later than thirty days) after the occurrence of the event giving rise thereto, and written supporting data will be submitted to ENGINEER and the other party within sixty days after such occurrence unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.

9.12. When functioning as interpreter and judge under paragraphs 9.10 and 9.11, ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by ENGINEER pursuant to paragraphs 9.10 and 9.11 with respect to any such claim, dispute or other matter (except any which have been waived by the making or acceptance of final payment as provided in paragraph 14.16) will be a condition precedent to any exercise by

OWNER or CONTRACTOR of such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute or other matter.

Limitations on ENGINEER'S Responsibilities:

9.13. Neither ENGINEER'S authority to act under this Article 9 or elsewhere in the Contract Documents nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of ENGINEER to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization performing any of the Work, or to any surety for any of them.

9.14. Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved" or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the Work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.15 or 9.16.

9.15. ENGINEER will not be responsible for CONTRACTOR'S means, methods, techniques, sequences or procedures of

construction, or the safety precautions and programs incident thereto, and ENGINEER will not be responsible for CONTRACTOR'S failure to perform or furnish the Work in accordance with the Contract Documents.

9.16. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, any Supplier, or of any other person or organization performing or furnishing any of the Work.

PART 10. CHANGES IN THE WORK

10.1. Without invalidating the Agreement and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions or revisions in the Work; these will be authorized by a Written Amendment, a Change Order, or a Work Directive Change. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

10.2. If OWNER and CONTRACTOR are unable to agree as to the extent, if any, of an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of a Work Directive Change, a claim may be made therefore as provided in Article 11 or Article 12.

10.3. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraphs 3.4 and 3.5, except in the case of an emergency as provided in paragraph 6.22 and except in the case of uncovering Work as

provided in paragraph 13.9.

10.4. OWNER and CONTRACTOR shall execute appropriate Change Orders (or Written Amendments)

10.4.1. changes in the Work which are ordered by OWNER pursuant to paragraph 10.1, are required because of acceptance of defective Work under paragraph 13.13 or correcting defective Work under paragraph 13.14, or are agreed to by the parties;

10.4.2. changes in the Contract Price or Contract Time which are agreed to by the parties; and

10.4.3. changes in the Contract Price or Contract Time which embody the substance of any written decision rendered by ENGINEER pursuant to paragraph 9.11; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, CONTRACTOR shall carry on the Work and adhere to the progress schedule as provided in paragraph 6.29.

10.5. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Time) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be CONTRACTOR'S responsibility, and the amount of each applicable Bond will be adjusted accordingly.

PART 11. CHANGE OF CONTRACT PRICE

11.1. The Contract Price constitutes the total compensation (subject to authorized adjustments) payable to CONTRACTOR for performing the Work. All duties, responsibilities and obligations assigned to or undertaken by CONTRACTOR shall be at his expense without change in the Contract Price.

11.2. The Contract Price may only be changed by a Change Order or by a Written Amendment. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph 11.2.

11.3. The value of any Work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

11.3.1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved (subject to the provisions of paragraphs 11.9.1. through 11.9.3, inclusive).

11.3.2. By mutual acceptance of a lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.6.2.1.).

11.3.3. On the basis of the Cost of the Work (determined as provided in paragraphs 11.4 and 11.5) plus a CONTRACTOR'S Fee for overhead and profit (determined as provided in paragraphs 11.6 and 11.7).

Cost of the Work:

11.4. The term Cost of the Work means the sum of all costs necessarily incurred and paid by CONTRACTOR in the proper performance of the Work. Except as otherwise may be agreed to in writing by OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items and shall not include any of the costs itemized in paragraph 11.5:

11.4.1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contri-

butions unemployment, excise and payroll taxes, workers' or workmen's compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. Such employees shall include superintendents and foremen at the site. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays shall be included in the above to the extent authorized by OWNER.

11.4.2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates and refunds and all returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

11.4.3. Payments made by CONTRACTOR to the Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to CONTRACTOR and shall deliver such bids to OWNER who will then determine, with the advice of ENGINEER, which bids will be accepted. If a subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work Plus a Fee, the Subcontractor's Cost of the Work shall be determined in the same manner as CONTRACTOR'S Cost of the Work. All subcontracts shall be subject to the other provisions of the Contract Documents insofar as applicable.

11.4.4. Costs of special consultants

(including but not limited to engineers, architects, testing laboratories, surveyors, attorneys and accountants) employed for services specifically related to the Work.

11.4.5. Supplemental costs including the following:

11.4.5.1. The proportion of necessary transportation, travel and subsistence expenses of CONTRACTOR'S employees incurred in discharge of duties connected with the Work.

11.4.5.2. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost less market value of such items used by not consumed which remain the property of CONTRACTOR.

11.4.5.3. Rentals of all construction equipment and machinery and the parts thereof whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof - all in accordance with terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is not longer necessary for the Work.

11.4.5.4. Sales, consumer, use or similar taxes related to the Work, and for which CONTRACTOR is liable, imposed by Laws and Regulations.

11.4.5.5. Deposits lost for causes other than negligence of CONTRACTOR,

any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

11.4.5.6. Losses and damages (and related expenses), not compensated by insurance or otherwise, to the Work or otherwise sustained by CONTRACTOR in connection with the performance and furnishing of the Work (except losses and damages within the deductible amounts of property insurance established by OWNER in accordance with paragraph 5.9), provided they have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages and expenses will be included in the Cost of Work for the purpose of determining CONTRACTOR'S Fee. If, however, any such loss or damage requires reconstruction and CONTRACTOR is placed in charge thereof, CONTRACTOR shall be paid for services a fee proportionate to that stated in paragraph 11.6.2.

11.4.5.7. The cost of utilities, fuel and sanitary facilities at the site.

11.4.5.8. Minor expenses such as telegrams, long distance telephone calls, telephone service at the site, expressage and similar petty cash items in connection with the Work.

11.4.5.9. Cost of premiums for additional Bonds and insurance required because of changes in the Work and premiums for property insurance coverage within the limits of the deductible amounts established by OWNER in accordance with

paragraph 5.9.

11.5. The term Cost of the Work shall not include any of the following:

11.5.1. Payroll costs and other compensation of CONTRACTOR'S officers, executives, principals (of partnership and sole proprietorships), general managers, project managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks and other personnel employed by CONTRACTOR whether at the site or in CONTRACTOR'S principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 11.4.1 or specifically covered by paragraph 11.4.4 - all of which are to be considered administrative costs covered by the CONTRACTOR'S Fee.

11.5.2. Expenses of CONTRACTOR'S principal and branch offices other than CONTRACTOR'S office at the site.

11.5.3. Any part of CONTRACTOR'S capital expenses, including interest on CONTRACTOR'S capital employed for the Work and charges against CONTRACTOR for delinquent payments.

11.5.4. Cost of premiums for all Bonds and for all insurance whether or not CONTRACTOR is required by the Contract Documents to purchase and maintain the same (except for the cost of premiums covered by subparagraph 11.4.5.9. above).

11.5.5. Cost due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied and making good any damage to property.

11.5.6. Other overhead or general expenses costs of any kind and the costs of any item not specifically and expressly included in paragraph 11.4.

CONTRACTOR'S Fee:

11.6. The CONTRACTOR'S Fee allowed to CONTRACTOR for overhead and profit shall be determined as follows:

11.6.1. a mutually acceptable fixed fee; or if none can be agreed upon,

11.6.2. a fee based on the following percentages of the various portions of the Cost of the Work:

11.6.2.1. for costs incurred under paragraphs 11.4.1 and 11.4.2., the CONTRACTOR'S Fee shall be fifteen percent;

11.6.2.2. for costs incurred under paragraph 11.4.3, the CONTRACTOR'S Fee shall be five percent; and if a subcontract is on the basis of Cost of the Work Plus a Fee, the maximum allowable to CONTRACTOR on account of overhead and profit of all Subcontractors shall be fifteen percent;

11.6.2.3. no fee shall be payable on the basis of costs itemized under paragraphs 11.4.4, 11.4.5 and 11.5;

11.6.2.4 the amount of credit

to be allowed by CONTRACTOR to OWNER for any such change which results in a net decrease in cost will be the amount of the actual net decreases plus a deduction in CONTRACTOR'S Fee by an amount equal to ten percent of the net decrease; and

11.6.2.5 when both additions and credits are involved in any one change, the adjustment in CONTRACTOR'S Fee shall be computed on the basis of the net change in accordance with paragraphs 11.6.2.1. through 11.6.2.4, inclusive.

11.7. Whenever the cost of any Work is to be determined pursuant to paragraph 11.4 or 11.5, CONTRACTOR will submit in form acceptable to ENGINEER an itemized cost breakdown together with supporting data.

Cash Allowances:

11.8. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be done by such Subcontractors or Suppliers and for such sums within the limit of the allowances as may be acceptable to ENGINEER. CONTRACTOR agrees that:

11.8.1. The allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the site, and all applicable taxes; and

11.8.2. CONTRACTOR'S costs for unloading and handling on the site, labor, installation costs, overhead, profit and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances. No demand for

additional payment on account of any thereof will be valid.

Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

Unit Price Work:

11.9.1. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by CONTRACTOR will be made by ENGINEER in accordance with Paragraph 9.10.

11.9.2. Each unit price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR'S overhead and profit for each separately identified item.

11.9.3. Where the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimated quantity of such item indicated in the Agreement and there is no corresponding adjustment with respect to any other item of Work and if CONTRACTOR believes that CONTRACTOR has incurred additional expenses as a result thereof, CONTRACTOR may make a

claim for an increase in the Contract Price in accordance with Article 11 if the parties are unable to agree as to the amount of any such increase.

PART 12. CHANGE OF CONTRACT TIME

12.1 The Contract Time may only be changed by a Change Order or a Written Amendment. Any claim for an extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party and to ENGINEER promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence (unless ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by ENGINEER in accordance with paragraph 9.11 if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this paragraph 12.1.

12.2. The Contract Time will be extended in an amount equal to time lost due to delays beyond the control of CONTRACTOR if a claim is made therefore as provided in paragraph 12.1. Such delays shall include, but not be limited to, acts or neglect by OWNER or

others performing additional work as contemplated by Article 7, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God.

12.3. All time limits stated in the Contract Documents are of the essence of the Agreement. The provisions of this Article 12 shall not exclude recovery for damages (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) for delay by either party.

PART 13. WARRANTY AND GUARANTEE; TESTS AND INSPECTIONS: CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

Warranty and Guarantee:

13.1 CONTRACTOR warrants and guarantees to OWNER and ENGINEER that all Work will be in accordance with the Contract Documents and will not be *defective*. Prompt notice of all defects shall be given to CONTRACTOR. All *defective* Work, whether or not in place, may be rejected, corrected or accepted as provided in this Article 13.

Access to Work:

13.2 ENGINEER and ENGINEER'S representatives, other representative of OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspecting and testing. CONTRACTOR shall provide proper and safe conditions for such access.

Tests and Inspection:

13.3. CONTRACTOR shall give ENGINEER timely notice of readiness of the Work for all required inspection, tests or approvals.

13.4. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefore, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval. CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with OWNER'S or ENGINEER'S acceptance of a Supplier of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR'S purchase thereof for incorporation in the Work. The cost of all inspections, tests and approvals in addition to the above which are required by the Contract Documents shall be paid by OWNER (unless otherwise specified).

13.5. All inspections, tests or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by organizations acceptable to OWNER and CONTRACTOR (or by ENGINEER if so specified).

13.6. If any Work (including the work of others) that is to be inspected, tested or approved is covered without written concurrence of ENGINEER, it must, if requested by ENGINEER, be uncovered for observation. Such uncovering shall be at CONTRACTOR'S expense unless CONTRACTOR has given ENGINEER

timely notice of CONTRACTOR'S intention to cover the same and ENGINEER has not acted with reasonable promptness in response to such notice.

13.7. Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR with CONTRACTOR'S obligations to perform the Work in accordance with the Contract Documents.

Uncovering Work:

13.8 If any Work is covered contrary to the written request of ENGINEER, it must, if requested by ENGINEER, be uncovered for ENGINEER'S observations and replaced at CONTRACTOR'S expense.

13.9. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER'S request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material and equipment. If it is found that such Work is *defective*, CONTRACTOR shall bear all direct, indirect and consequential costs of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, (including but not limited to fees and charges of engineers, architects, attorneys and other professionals), and OWNER shall be entitled to an appropriate decrease in the CONTRACT Price, and, if the parties are unable to agree as to the amount thereof, may make a claim therefore as provided in Article 11. If, however, such Work is not found to be *defective*, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering,

exposure, observation, inspection, testing and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, CONTRACTOR may make a claim therefore as provided in Articles 11 and 12.

Owner May Stop the Work:

13.10. If the Work is *defective*, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR or any other party.

Correction or Removal of Defective Work:

13.11. If required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all *defective* Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with *non-defective* Work. CONTRACTOR shall bear all direct, indirect and consequential costs of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) made necessary thereby.

One Year Correction Period:

13.12. If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by

Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be *defective*, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER'S written instruction, either correct such *defective* Work, or, if it has been rejected by OWNER, remove it from the site and replace it with *non-defective* Work. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the *defective* Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement (including but not limited to fees and charges of engineers, architects, attorneys and other professionals) will be paid by CONTRACTOR. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications or by Written Amendment.

Acceptance of Defective Work:

13.13. If, instead of requiring correction or removal and replacement of *defective* Work, OWNER (and, prior to ENGINEER'S recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall bear all direct, indirect and consequential costs attributable to OWNER'S evaluation of and determination to accept such *defective* Work (such costs to be approved by ENGINEER as to reasonableness and to include but not be limited to fees and charges of engineers, architects, attorneys and other professionals). If any such acceptance occurs prior to

ENGINEER'S recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefore as provided in Article 11. If the acceptance occurs after such recommendation, an appropriate amount will be paid by CONTRACTOR to OWNER.

OWNER May Correct Defective Work:

13.14. If CONTRACTOR fails within a reasonable time after written notice of ENGINEER to proceed to correct and to correct *defective* Work or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.11, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents, or if CONTRACTOR fails to comply with any other provision of the Contract Documents, OWNER may, after seven days' written notice to CONTRACTOR, correct and remedy any such deficiency. In exercising the rights and remedies under this paragraph OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the site, take possession of all or part of the Work, and suspend CONTRACTOR'S services related thereto, take possession of CONTRACTOR'S tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER'S representatives,

agents and employees such access to the site as many be necessary to enable OWNER to exercise the rights and remedies under this paragraph. All direct, indirect and consequential costs of OWNER in exercising such rights and remedies will be charged against CONTRACTOR in an amount approved as to reasonableness by ENGINEER, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, OWNER may make a claim therefore as provided in Article 11. Such direct, indirect and consequential costs will include but not be limited to fees and charges of engineers, architects, attorneys and other professionals, all court and arbitration costs and all costs of repair and replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR'S *defective* Work. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER'S rights and remedies hereunder.

PART 14. PAYMENTS TO CONTRACTOR AND COMPLETION

Schedule of Values:

14.1 The schedule of values established as provided in paragraph 2.9 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to ENGINEER. Progress payments on account of Unit Price Work will be based on the number of units completed.

Application for Progress Payment:

14.2. At least twenty days before each progress payment is scheduled (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment filled out and signed by CONTRACTOR covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that OWNER has received the materials and equipment free and clear of all liens, charges, security interests and encumbrances (which are hereinafter in these General Conditions referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect OWNER'S interest therein, all of which will be satisfactory to OWNER. The amount of retainage with respect to progress payments will be as stipulated in the Supplementary Conditions.

CONTRACTOR'S Warranty of Title:

14.3. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER no later than the time of payment free and clear of all Liens.

Review of Applications for Progress Payment:

14.4. ENGINEER will, within ten days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to OWNER, or return the Application to CONTRACTOR indicating in writing ENGINEER'S reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty days after presentation of the Application for Payment with ENGINEER'S recommendation, the amount recommended will (subject to the provisions of the last sentence of paragraph 14.7) become due and when due will be paid by OWNER to CONTRACTOR.

14.5. ENGINEER'S recommendation of any payment requested in an Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER'S on-site observations of the Work in progress as an experienced and qualified design professional and on ENGINEER'S review of the Application for Payment and the accompanying data and schedules that the Work has progressed to the point indicated; that, to the best of ENGINEER'S knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under paragraph 9.10, and to any other qualifications stated in the recommendation); and that CONTRACTOR is entitled to payment of the amount recommended. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that exhaustive or continuous on-site inspections have been

made to check the quality or the quantity of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract Documents or that there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or OWNER to withhold payment to CONTRACTOR.

14.6. ENGINEER'S recommendation of final payment will constitute an additional representation by ENGINEER to OWNER that the conditions precedent to CONTRACTOR'S being entitled to final payment as set forth in paragraph 14.13 have been fulfilled.

14.7. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER'S opinion, it would be incorrect to make such representations to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended, to such extents as may be necessary in ENGINEER'S opinion to protect OWNER from loss because:

14.7.1. the Work is defective, or completed Work has been damaged requiring correction or replacement.

14.7.2. the Contract Price has been reduced by Written Amendment or Change Order,

14.7.3. OWNER has been required to correct defective Work or complete Work in accordance with paragraph 13.14, or

14.7.4. of ENGINEER'S actual

knowledge of the occurrence of any of the events enumerated in paragraphs 15.2.1 through 15.2.9 inclusive.

OWNER may refuse to make payment of the full amount recommended by ENGINEER because claims have been made against OWNER on account of CONTRACTOR'S performance or furnishing of the Work or Liens have been filed in connection with the Work or there are other items entitling OWNER to a set-off against the amount recommended, but OWNER must give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action.

Substantial Completion:

14.8. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that ENGINEER issue a certificate of Substantial Completion. Within a reasonable time thereafter, OWNER, CONTRACTOR and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefore. If ENGINEER considers the Work substantially complete ENGINEER will prepare and deliver to OWNER a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. OWNER shall have seven days after receipt of the tentative certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached

list. If, after considering such objections, ENGINEER concludes that the Work is not substantially complete, ENGINEER will within fourteen days after submission of the tentative certificate to OWNER notify CONTRACTOR in writing, stating the reasons therefore. If, after consideration of OWNER'S objections, ENGINEER considers the Work substantially complete, ENGINEER will within said fourteen days execute and deliver to OWNER and CONTRACTOR a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as ENGINEER believes justified after consideration of any objections from OWNER. At the time of delivery of the tentative certificate of Substantial Completion ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties. Unless OWNER and CONTRACTOR agree otherwise in writing and so inform ENGINEER prior to ENGINEER'S issuing the definitive certificate of Substantial Completion, ENGINEER'S aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

14.9 OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

Partial Utilization:

14.10. Use by OWNER of any finished part of the Work, which has specifically

been identified in the Contract Documents, or which OWNER, ENGINEER and CONTRACTOR agree constitutes a separately functioning and useable part of the Work that can be used by OWNER without significant interference with CONTRACTOR'S performance of the remainder of the Work, may be accomplished prior to Substantial Completion of all the Work subject to the following:

14.10.1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any such part of the Work which OWNER believes to be ready for its intended use and substantially complete. If CONTRACTOR agrees, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. CONTRACTOR at any time may notify OWNER and ENGINEER in writing that CONTRACTOR considers any such part of the Work ready for its intended use and substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving the reasons therefore. If ENGINEER considers that part of the Work to be substantially complete, the provisions of paragraphs 14.8 and 14.9 will apply with respect to certification of Substantial Completion of that part of the Work and the division or responsibility in respect thereof and access thereto.

14.10.2. OWNER may at any time

request CONTRACTOR in writing to permit OWNER to take over operation of any such part of the Work although it is not substantially complete. A copy of such request will be sent to ENGINEER and within a reasonable time thereafter OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If CONTRACTOR does not object in writing to OWNER and ENGINEER that such part of the Work is not ready for separate operation by OWNER, ENGINEER will finalize the list of items to be completed or corrected and will deliver such list to OWNER and CONTRACTOR together with a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities, insurance warranties and guarantees for that part of the Work which will become binding upon OWNER and CONTRACTOR at the time when OWNER takes over such operation (unless they shall have otherwise agreed in writing and so informed ENGINEER). During such operation and prior to Substantial Completion of such part of the Work, OWNER shall allow CONTRACTOR reasonable access to complete or correct items on said list and to complete other related Work.

14.10.3. No occupancy or separate operation of part of the Work will be accomplished prior to compliance with the requirements of paragraph 5.15 in respect of property insurance.

Final Inspection:

14.11. Upon written notice from CONTRACTOR that the entire Work or an agreed portion thereof is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or *defective*. CONTRACTOR shall immediately take such measures as are necessary to remedy such deficiencies.

Final Application for Payment:

14.12. After CONTRACTOR has completed all such corrections to the satisfaction of ENGINEER and delivered all maintenance and operating instruction, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in paragraph 6.19) and other documents - all as required by the Contract Documents, and after ENGINEER has indicated that the Work is acceptable (subject to the provisions of paragraph 14.16), CONTRACTOR may make application for final payment following the procedure for progress payments. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents, together which complete and legally effective releases of waivers (satisfactory to OWNER) of all Liens arising out of or filed in connection with the Work. In lieu thereof and as approved by OWNER, CONTRACTOR may furnish receipts or leases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or OWNER'S property might in any way be responsible, have been paid or otherwise satisfied; and consent of the surety, if any, to final payment. If any

Subcontractor of Supplier fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Lien.

Final Payment and Acceptance:

14.13. If, on the basis of ENGINEER'S observation of the Work during construction and final inspection, and ENGINEER'S review of the final Application for Payment and accompanying documentation - all as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR'S other obligations under the Contract Documents have been fulfilled, ENGINEER will, within ten days after receipt of the final Application for Payment, indicate in writing ENGINEER'S recommendation of payment and present the Application to OWNER for payment. Thereupon ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.16. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. Thirty days after presentation to OWNER of the Application and accompanying documentation, in appropriate form and substance, and with ENGINEER'S recommendation and notice of acceptability, the amount recommended by ENGINEER will become due and will be paid by OWNER to CONTRACTOR.

14.14. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR'S final

Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.1, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

Contractor's Continuing Obligation:

14.15. CONTRACTOR'S obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by ENGINEER, nor the issuance of a certificate of Substantial Completion, nor any payment by OWNER to CONTRACTOR under the Contract Documents, nor any use or occupancy of the Work or any part thereof by OWNER, nor any act of acceptance by OWNER nor any failure to do so, nor any review and approval of a Shop Drawing or sample submission, nor the issuance of a notice of acceptability by ENGINEER pursuant to paragraph 14.13, nor any correction of *defective* Work by OWNER will constitute an acceptance of Work not in accordance with the Contract Documents or a release of CONTRACTOR'S obligation to perform the Work in accordance with the Contract Documents (except as provided in paragraph 14.16).

Waiver of Claims:

14.16. The making and acceptance of final payment will constitute:

14.16.1. a waiver of all claims by OWNER against CONTRACTOR, except claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.11 or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; however, it will not constitute a waiver by OWNER of any rights in respect of CONTRACTOR'S continuing obligations under the Contract Documents; and

14.16.2. a waiver of all claims by CONTRACTOR against OWNER other than those previously made in writing and still unsettled.

PART 15. SUSPENSION OF WORK AND TERMINATION

Owner May Suspend Work:

15.1. OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than ninety days by notice in writing to CONTRACTOR and ENGINEER which will fix the date on which Work will be resumed. CONTRACTOR shall resume the Work on the date so fixed. CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if CONTRACTOR makes an approved claim therefore as provided in Articles 11 and 12.

Owner May Terminate:

15.2. Upon the occurrence of any one or more of the following events:

15.2.1. if CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time relating to the bankruptcy or insolvency;

15.2.2. if a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency;

15.2.3. if CONTRACTOR makes a general assignment for the benefit of creditors;

15.2.4. if a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge or property of CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR'S creditors;

15.2.5. if CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

15.2.6. if CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.9 as revised from time to time);

15.2.7. if CONTRACTOR disregards Laws or Regulations of any public body having jurisdiction;

15.2.8. if CONTRACTOR disregards the authority of ENGINEER; or

15.2.9. if CONTRACTOR otherwise violates in any substantial way any provisions of the Contract Documents;

OWNER may, after giving CONTRACTOR (and the surety, if there be one) seven days' written notice and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the site and take possession of the Work and of all CONTRACTOR'S tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, and finish the Work as OWNER may deem expedient. In such case CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the direct, indirect and consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs) such excess will be paid to CONTRACTOR. If such costs exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such costs incurred by OWNER will be approved as to reasonableness by ENGINEER and incorporated in a Change Order, but when exercising any rights or remedies under this

paragraph OWNER shall not be required to obtain the lowest price for the Work performed.

15.3. Where CONTRACTOR'S services have been so terminated by OWNER, the termination will not affect any rights or remedies of OWNER against CONTRACTOR when existing or which may thereafter accrue. Any retention or payment of moneys due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.4. Upon seven days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the Work and terminate the Agreement. In such case, CONTRACTOR shall be paid for all Work executed and any expense sustained plus reasonable termination expenses, which will include, but not be limited to, direct, indirect and consequential costs (including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs).

Contractor May Stop Work or Terminate:

15.5. If, through no act or fault of CONTRACTOR, the Work is suspended for a period of more than ninety days by OWNER or under an order of court or other public authority, or ENGINEER fails to act on any Application for Payment within thirty days after it is submitted, or OWNER fails for thirty days to pay CONTRACTOR any sum finally determined to be due, then CONTRACTOR may, upon seven days' written notice to OWNER and ENGINEER, terminate the Agreement and recover from OWNER payment for all Work executed and any expense sustained plus reasonable termination expenses. In addition and in lieu of terminating the Agreement, if ENGINEER

has failed to act on an Application for Payment or OWNER has failed to make any payment as aforesaid, CONTRACTOR may upon seven days' written notice to OWNER and ENGINEER stop the Work until payment of all amounts then due. The provisions of this under paragraph 6.29 to carry on the Work in accordance with the progress schedule and without delay during disputes and disagreements with OWNER.

PART 16. DISPUTE RESOLUTION

16.1 METHODS AND PROCEDURES

In an effort to resolve any conflicts that arise during the construction of the project or following the completion of the project, the OWNER and the CONTRACTOR agree that all disputes between them arising out of or relating to this Agreement shall be submitted to nonbinding mediation, unless the parties mutually agree otherwise.

The OWNER and the CONTRACTOR further agree to include a similar mediation provision in all agreements with independent contractors and consultants retained for the project and to require all independent contractors and consultants also to include a similar mediation provision in all agreements with subcontractors, subconsultants, suppliers or fabricators so retained, thereby providing for mediation as the primary method for dispute resolution between the parties to those agreements.

PART 17. MISCELLANEOUS

Giving Notice:

17.1. Whenever any provision of the

Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

Computation of Time:

17.2.1. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.2.2. A calendar day of twenty-four hours measured from midnight to the next midnight shall constitute a day.

General:

17.3. Should OWNER or CONTRACTOR suffer injury or damage to person or property because of any error, omission or act of the other party or of any of the other party's employees or agents or others for whose acts the other party is legally liable, claim will be made in writing to the other party within a reasonable time of the first observance of such injury or damage. The provisions of this paragraph 17.3 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose.

17.4 The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and

obligations imposed upon CONTRACTOR by paragraphs 6.30, 13.1, 13.12, 13.14, 14.3 and 15.2 and all of the rights and remedies available to OWNER and ENGINEER there under, are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee or by other provisions of the Contract Documents, and the provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply. All representations, warranties and guarantees made in the Contract Documents will survive final payment and termination or completion of the Agreement.

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**SECTION 00800
SUPPLEMENTARY CONDITIONS**

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

PART 1. TERMS

1.1 The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract have the meanings assigned to them in the General Conditions.

PART 2. SCOPE OF THE WORK

2.1 The Work includes the furnishing of all necessary machinery, equipment, tools, labor and other construction means, and all materials and equipment required to perform the Work including the placing of the Work into satisfactory operation.

PART 3. CONSTRUCTION DRAWINGS

3.1 The Work shall conform to the following construction drawings:

Sheet No.	Sheet Title
-	Title
1	General Construction Notes
2	Soil Erosion & Sediment Control Plan
3	Soil Erosion & Sediment Control Details
4	Grading & Storm Drainage Plan
5	Yard Piping Plan
6-7	Ground Storage & Section Plan
8	Ground Storage Tank Details
9-10	Miscellaneous Details

PART 4. COMMENCEMENT AND COMPLETION OF WORK

4.1 The Contractor shall commence work within 10 days after Notice to Proceed is issued. He shall complete his work within the contract time designated in the Agreement.

4.2 If the Contractor fails to prosecute the work with such diligence as will insure the completion of each portion of the work within the time shown on the above schedule, plus any extensions made in accordance with Article 12 of the General Conditions; and, if the Owner does not exercise his reservations as set forth in Article 13, the Contractor shall continue the work in which event liquidated damages for the delay will be impossible to determine. In lieu thereof, liquidated damages in the amount of **\$500.00** per each day of

delay of the work until the work is completed.

PART 5. SUBSTITUTIONS OR "OR EQUAL"

- 5.1 Substitutes may be offered in lieu of the major equipment manufacturers listed in the Technical Specifications. Submittals on "Or Equal" substitutes must be received by the Engineer within 48 hours after the Bid Opening.
- A. Submittals for each type of equipment proposed shall include illustrative drawings; specifications, descriptive brochures, installation lists, weights, metal thickness of principal components; drive arrangements; torques; power requirements; performance curves; installation requirements; availability of spare parts; local service capability and other items necessary for the Engineers to determine that the intent of these Specifications is to be met.
 - B. The price bid for substitute equipment shall not be used in the base bid but shall be bid as a deductible or additive alternate and listed on the forms provided in the Proposal.
 - C. Unless otherwise waived by the Owner, a five (5) year warranty shall be required on all substitute equipment/materials/systems in the form of a bond or other equivalent surety. Such warranty/surety shall be in the amount of the Contractor's purchase order, including installation and service for the substitute. Should the substitute fail to perform satisfactorily, either in mechanical integrity or in performance, the Owner can require modification or replacement or if the supplier/manufacturer fails to remedy the defects/performance the Owner may use any or all of the bond/surety to modify or replace the system or portions thereof including modifications to another process.
 - D. The Contractor shall be responsible for the substitute supplier/manufacturer's action and performance until satisfactory performance is obtained and thereafter during the one (1) year warranty period as specified in the Contract Documents. After this to cover the remaining period of the two (2) years, the Owner can take action on the system supplier's bond/surety. The bond/surety must be tended prior to approval of the substitute.
 - E. The Owner reserves the right to accept or reject any and all substitutes that may be offered.
 - F. The contract will be awarded on the basis of the lowest qualified base bid including any substitute selected by the Owner.
 - G. The adjustment in price bid for the substitute equipment shall include the cost of all re-design, the cost of structural, mechanical and electrical changes when the considered item will not fit the design, as determined by the Engineer.

PART 6. REPORTS AND DRAWINGS USED BY THE ENGINEER

6.1 In the preparation of Drawings and Specifications, ENGINEER has relied upon:

A. The following reports of explorations and tests of sub-surface conditions at the site of the Work:

1. GeoSystems Subsurface Investigation Report (No. 24-2937) for the New 2.0-MG Ground Storage Tank on Fire Tower Road dated August 22, 2024.

B. The following drawings of physical conditions in or relating to existing surface and sub-surface structures (except Underground Facilities) which are contiguous to the site of the Work.

1. none (title, date, sheet no.)

PART 7. INSURANCE

7.1 The limits of liability for the insurance required by Paragraph 5.3 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

A. Workers' Compensation, etc. under Paragraphs 5.3.1 and 5.3.2 of the General Conditions:

1.	State:	Statutory
2.	Applicable Federal (e.g. Longshoreman's):	Statutory
3.	Employer's Liability:	\$500,000
4.	Contractor shall show Owner as additional insured.	

7.2 Comprehensive General Liability (under Paragraphs 5.3.3 through 5.3.6 of the General Conditions):

1. Combined single limit for Bodily Injury and Property Damage:

Each Occurrence	\$1,000,000
Or combined single limit	\$2,000,000
General Aggregate	\$2,000,000
Operations Aggregate	\$2,000,000

2. Property Damage liability insurance will provide Explosion, Collapse and Underground coverages where applicable.

3. Personal Injury, with employment exclusion deleted

	Each Occurrence	\$1,000,000
	Annual Aggregate	\$1,000,000
4.	Excess or Umbrella Liability	
	Each Occurrence	\$5,000,000
	General Aggregate	\$5,000,000
B.	Comprehensive Automobile Liability (under Paragraph 5.3.7 of the General Conditions):	
1.	Bodily Injury:	
	Each Person	\$1,000,000
	Each Occurrence	\$2,000,000
2.	Property Damage:	
	Each Occurrence	\$1,000,000
	Or combined single limit of	\$2,000,000

7.3 Builders Risk Insurance (Fire and Extended Coverage):

1. 100% completed value based on the insurable portion of the project.

7.4 Contractual Endorsement:

A. The Contractual Liability required by Paragraph 5.4 of the General Conditions shall provide coverage for not less than the following amounts:

1.	Bodily Injury:	
	Each Person	\$2,000,000
	Each Occurrence	\$2,000,000
2.	Property Damage:	
	Each Occurrence	\$2,000,000
	Annual Aggregate	\$2,000,000

PART 8. CERTIFICATES OF INSURANCE

8.1 Certificates acceptable to the Owner shall be attached to the signed Contract Documents when they are transmitted to the Owner for execution. These certificates shall contain the statement that "Coverages afforded under the policies will not be cancelled unless at least thirty (30) days prior to cancellation written notice has been given to the Owner, as evidenced by receipts of registered or certified mail". Furthermore, the owner, their active officers, directors, engineers, members, partners, employees, agents, representatives, consultants, and/or subcontractors shall be listed as additionally insured under the contractor's the general liability policy.

PART 9. BUILDER'S RISK

9.1 The Contractor shall procure and shall maintain during the life of the Contract Agreement, Builder's Risk Insurance to protect the interests of the Owner, Contractor, and Sub-Contractors against loss by fire, vandalism, malicious mischief, and all hazards included in a standard "All Risk" Coverage endorsement. The amount of the insurance shall be at all times equal or exceed the full amount of the Contract. The policies shall be in the name of the Owner and the Contractor.

PART 10. ACCIDENTS

10.1 The Contractor shall provide, at the site, such equipment and medical facilities as are necessary to supply first-aid service to anyone who may be injured in connection with the work. The Contractor must report in writing to the Engineer all accidents whatsoever arising out of, or in connection with, the performance of the work, whether on or adjacent to the site, which causes death, personal injury or property damages, giving full details and statement of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts to the Engineer, giving full details in writing of the claim. The Contractor shall advise his superintendent and foreman, who are on the site of the work, the name of the hospital and phone number and the name and phone number of the doctor he proposes to use in case of an accident.

PART 11. HOLD HARMLESS CLAUSE

11.1 The Contractor agrees to hold harmless, indemnify and defend the Owner and his agents, architects, engineers and employees from and against any and all claims, losses, damages, demands, causes of action and any and all related costs and expenses, of every kind and character, growing out of, incidental to, or resulting directly or indirectly from the Contractor's performance of the work described herein, whether such loss, damage, injury, or liability is contributed to by the negligence of the Owner, its agents, architects, engineers, or employees, except that the Contractor shall have no liability for damages or the costs incidental thereto caused by the sole negligence of the Owner, his agents, architects, engineers, or employees. The Contractor will require any and all subcontractors to conform with the provisions of this clause prior to commencing any work and agrees to ensure that this clause is in conformity with the insurance provisions of the contract.

PART 12. CONTRACTOR'S STATUS

12.1 It is agreed that the Contractor shall occupy the status of an Independent Contractor and the Contractor's employees are not employees of the Owner.

PART 13. CONTRACTOR'S AFFIDAVIT

13.1 Upon completion of the work and prior to final payment and settlement of all sums due hereunder, Contractor will furnish to Owner, a Contractor's Affidavit in the usual form submitted by Contractor under the laws of the State of Georgia to the effect that all bills for labor, materials and services in connection with said contract have been paid in full, acknowledging receipt of the contract price and averring that there are not outstanding claims under said contract which could become a lien on the real estate arising out of said contract.

PART 14. RESIDENT PROJECT ENGINEER

14.1 The Owner reserves the right to furnish a Resident Project Engineer as deemed necessary to insure the Project quality control and conformance to Plans and Specifications, who will act as the Owner's Representative on the Project and will have the authority of the Engineer as set forth in the Contract Documents.

PART 15. ACCESS FOR INSPECTION

15.1 Access for inspection shall be provided for representatives of the Georgia Department of Natural Resources, Environmental Protection Division and the Georgia Department of Highways and Public Transportation.

PART 16. UTILITIES

16.1 Utilities such as sewer, water and electric lines encountered in the work shall be protected from injury and maintained in service until moved or replaced as required under this Contract or by others as the case may be, or abandoned as may be necessary for the proper construction and use of the new work.

PART 17. ADJUSTMENT OF DISCREPANCIES

17.1 In all cases of discrepancies between the various dimensions and details shown on drawings, or between the drawings and these specifications, the more expensive construction shall be estimated before construction is started, the matter shall be submitted to the ENGINEER for clarification. Without such a decision, discrepancies shall be adjusted by the CONTRACTOR at his own risk and in settlement of any complications arising from such adjustment, the CONTRACTOR shall bear all of the extra expense involved.

PART 18. MEASUREMENT AND PAYMENT

18.1 Measurement and payment shall be made for the units and at the lump sum contract prices shown on the Bid Schedule. Direct payment shall only be made for those items or work specifically listed in the proposal and the cost of any other work must be included in the contract price for the applicable items to which it relates.

PART 19. MODIFICATION OF QUANTITIES

- 19.1 The itemized quantities shall be considered by the Contractor as the quantities required to complete the work for the purpose of bidding. Should actual quantities required in the construction of the work be greater or less than the quantities shown on the items, an amount equal to the difference in quantities at the unit prices for the item will be added to or deducted from the contract price.
- 19.2 When itemized quantities are not given in the Proposal, the work shown on the plans or specified shall be considered by the Contractor to be included in his contract for the lump sum price bid.

PART 20. SAFETY AND HEALTH REGULATIONS

- 20.1 The Contractor shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the contract Work and Safety Standards Act (PL 91-54). The regulations are administered by the Department of Labor and the Contractor shall allow access to the project to personnel from that Department.

PART 21. SANITARY CONVENIENCES

- 21.1 The CONTRACTOR shall provide adequate sanitary conveniences for use of those employed on the work and their use shall be strictly enforced. Such conveniences shall be made available when the first employees arrive on the site and shall be removed after the departure of the last employees from the job.

PART 22. UTILITY SERVICES

- 22.1 The CONTRACTOR will arrange for water service and temporary electrical service through the local agencies at his own expense.

PART 23. ENVIRONMENTAL IMPACT

- 23.1 The CONTRACTOR shall conduct all operations so as to minimize, to the greatest extent possible, adverse environmental impact.
- A. Noise: All equipment and machinery shall be provided with exhaust mufflers maintained in good working order so as to reduce operating noise to minimum levels.
- B. Dust/Smoke: All equipment movements shall be accompanied by a minimum of dust. Traveled surfaces and earthwork shall be maintained in a moist condition to avoid the generation of dust or the airborne movement of particulate matter under all prevailing atmospheric conditions.

Burning operations will be conducted only with written permission of the OWNER and/or appropriate regulatory agency. The CONTRACTOR shall be responsible for obtaining all permits and comply with all codes, ordinances and regulations pertaining to the burning.

- C. Traffic: Trucks shall be routed over roads which will result in the least effect on traffic and nuisance to the public. All material shall be loaded in a manner which will preclude the loss of any portion of the load in transit, including covering, if necessary.
- D. Sedimentation: All points of concentrated runoff from rainfall shall be visually monitored to determine that no eroded material from the construction site is being deposited offsite. Measures shall be taken to promptly eliminate such a deposition if occurring, including the installation of detention basins. Soil Erosion and sediment control measures shall include all temporary and permanent means of protection and trapping soils of the construction site during land disturbing activity. Activity covered in this contract is regulated by the Georgia Erosion and Sediment Control Act, and NPDES General Permit for Construction Activity.

PART 24. CONSTRUCTION STAKEOUT

- 24.1 The CONTRACTOR shall be responsible for construction stakeout.
- 24.2 From the dimensions and benchmarks shown on the plans the CONTRACTOR shall complete the layout of the work and shall be responsible for all measurements that may be required for the execution of the work prescribed in the specifications or on the Drawings, subject to such modifications as may be required to meet changed conditions or as a result of necessary modifications to the Work.
- 24.3 The CONTRACTOR shall furnish, at his own expense, all such stakes, spikes, steel pins, templates, platforms, equipment, instruments, tools and material and all labor as may be required in laying out any part of the Work from the baselines and benchmarks.
- 24.4 It shall be the responsibility of the CONTRACTOR to maintain and preserve all benchmarks shown on the plans.
- 24.5 All survey data shall be recorded in accordance with standard and approved methods. All field notes, sketches, records and computations made by the CONTRACTOR in laying out the work shall be available at all times during the progress of the work for the ready examination by the ENGINEER or his duly authorized representative.
- 24.6 The CONTRACTOR shall make such surveys and computations as are necessary to determine the quantities of work performed or placed during each period for which a progress payment is to be made.
- 24.7 The ENGINEER may make checks as the work progresses to verify lines and grades

established by the CONTRACTOR and to determine the conformance of the completed work as it progresses with the requirements of Contract Documents and Drawings. Such checking by the ENGINEER or his representative shall not relieve the CONTRACTOR of his responsibility to perform all work in accordance with the Contract Documents and Drawings and the lines and grades given therein. In the event that location marks as established by the CONTRACTOR are found to be inaccurate or inadequate, work shall be suspended until corrections have been made.

- 24.8 No separate payment will be made for the costs involved in the survey work, layout work or staking performed by the CONTRACTOR. All such costs will be considered as incidental to the Work.

PART 25. EQUIPMENT ADJUSTMENT AND CALIBRATION

25.1 All mechanical and electrical equipment, including related control systems, shall be subjected to preliminary operation and testing by the CONTRACTOR before the individual facilities and systems are put into operation. Tests shall be made to determine whether the equipment has been properly assembled, aligned, adjusted, wired and connected. Any changes, adjustments, or replacement or equipment which are due to errors or omissions on the part of the CONTRACTOR or which may be otherwise necessary to comply with the requirements of this Contract, shall be done without additional cost to the OWNER. Upon completion of the checking and adjustment, the CONTRACTOR shall demonstrate that each separate piece of equipment in each system of related items of mechanical equipment and the related instrumentation and control equipment operate in accordance with the requirements of the Contract Documents. Where no specific performance requirements are stated, the test shall show that the equipment operates in accordance with normal application practice of the equipment. The demonstration test shall show that the equipment operates smoothly and without excessive noise or vibration, that the equipment is responsive to manual and automatic controls, that control and protective devices are properly set, that the equipment will run continuously when continuous operation is intended, and that the equipment will run on a controlled or intermittent basis when this operation is intended. The demonstration test for each piece or equipment shall include check out from each remote control point. All alarm systems and safety lockout systems shall also be demonstrated for proper function along with all process instrumentation and controls.

25.2 The demonstration test shall be arranged by the CONTRACTOR who shall notify the ENGINEER not less than 3 days in advance of the date of the test. The CONTRACTOR shall provide personnel from the various trades involved to operate and demonstrate the equipment.

PART 26. SYSTEM START-UP

26.1 The CONTRACTOR shall place the various items of equipment into operation, along with the related piping and metering systems, and shall notify the ENGINEER at least 3 days in advance of the date of start-up.

- 26.2 Schedule for such start-up of the majority of the equipment and pumping systems will occur during the duration of the Contract Time and prior to final completion and acceptance of the overall project. After satisfactory start-up of these individual systems, including all of the related equipment, they will remain in continuous or intermittent operation as required.
- 26.3 All equipment and accessories shall be adjusted and calibrated prior to any start-up as specified under these Supplementary General Conditions. Any equipment placed into temporary operation prior to final completion of the total project shall be re-adjusted and/or calibrated.
- 26.4 The CONTRACTOR shall supervise, control, and be responsible for the operation and maintenance of the new equipment and/or system during a period of at least 10 days after each individual item is placed into operation. The CONTRACTOR shall furnish an adequate number of competent start-up personnel to provide supervision during these phases. The CONTRACTOR shall remain responsible for making any required changes, repairs or replacements to the new installation during this period.

PART 27. INSTRUCTION OF OWNER'S EMPLOYEES

- 27.1 The CONTRACTOR shall provide competent personnel who fully understand the operation of the equipment to instruct the OWNER's employees in the operation and maintenance of each item and system. Such instruction shall take place prior to acceptance of the installation by the OWNER at such a time or times that are acceptable to the OWNER. The CONTRACTOR shall include the cost of this training in the bid price for this Contract. Training shall be of the on-the-job type, and shall cover all areas of operation and equipment maintenance.
- 27.2 Scheduling of instruction of the OWNER's employees will be mutually agreed upon between the OWNER, CONTRACTOR and the ENGINEER.

PART 28. OPERATION AND MAINTENANCE (O & M) INSTRUCTION MANUALS.

- 28.1 The CONTRACTOR shall prepare and submit 6 copies of a complete set of O & M instructions for the overall project and covering all equipment and systems furnished.
- 28.2 Operating instruction shall be prepared specifically for each system installed and shall consider the specific equipment and controls included. Operating instructions shall be complete for each separate system, and shall detail start and stop procedures and shall explain all safety devices and detail procedures and precautions for restarting after failure or safety lockout situations.
- 28.3 Maintenance Instruction Manuals shall include complete parts listed for all equipment and recommended spare parts. Manuals shall be prepared specifically for the particular equipment furnished and shall consider the specific operation of this equipment in the particular process system involved. Complete lubrication requirements shall be listed,

including recommended lubricant and lubricating intervals or schedule.

PART 29. RECORD DATA AND DRAWINGS (AS-BUILTS)

- 29.1 The Contractor shall keep accurate, legible records of the locations, types, and sizes of sanitary lines, service laterals, manholes, cleanouts, water lines, fittings, valves, hydrants, drainage pipes, drainage structures and other related work performed under this project. On a set of project prints provided by the Owner, the Contractor shall prepare a set of “record” drawings from the data stated above. The horizontal locations of all portions of items installed on this project shall be accurately tied down to features that are physical and visible, such as property corner markers and/or permanent type structures. Invert elevations of all manholes, storm sewers and structures, sanitary sewers and lift stations shall be clearly indicated. These “record” drawings shall be kept clean and dry and maintained in a current state with the progress of the work. If at any time, a copy of this plan or portion of it is requested by the Owner, such copy shall be made available within 24 hours after the request is made.
- 29.2 The Contractor shall provide the Owner with one set of red-lined prints indicating record drawing information.

PART 30. PROPERTY CORNERS

- 30.1 The Contractor shall be responsible for restoring any property corners or monuments disturbed during construction. They shall be restored by a professional surveyor registered in the State of Georgia.

PART 31. RESTORATION

- 31.1 The CONTRACTOR shall conduct his operations so that restoration of roadways, driveways, curb and gutter, ditches and easement progresses along with the pipe laying.
- 31.2 Reasonable care shall be taken during construction to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed to those branches to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

PART 32. MAINTENANCE DURING CONSTRUCTION

- 32.1 The CONTRACTOR shall maintain the Work from the beginning of construction operations until final acceptance. This maintenance shall constitute continuous and effective work prosecuted day by day with adequate equipment and forces to the end that the site and structures thereon are kept in satisfactory condition at all times, including satisfactory signing or marking as appropriate and control of traffic where required by use of traffic control devices as required by the State in which this project is located.

- 32.2 Upon completion of the Work, the CONTRACTOR shall remove all construction signs and barriers before final acceptance.
- 32.3 While undergoing improvements, the roads shall be kept open to all traffic by the CONTRACTOR. The CONTRACTOR shall keep the portion of the site being used by public traffic, whether it be through or local traffic, in such condition that traffic will be adequately accommodated. The CONTRACTOR shall bear all cost of signs and markings as required and other maintenance work during construction and before the Work is accepted and of constructing and maintaining such approaches, crossing, intersections, and other features as may be necessary without direct compensation.

PART 33. BARRICADES, DANGER, WARNING AND DETOUR SIGNS

- 33.1 The CONTRACTOR shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Highways and streets closed to traffic shall be protected by effective barricades, and obstructions shall be lighted during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.
- 33.2 The CONTRACTOR shall furnish, install, and maintain all necessary barricades, warning signs, and other protection devices in accordance with the State requirements in which the project is located. Temporary signs may be reused, provided they are in good condition and legible. All protective devices shall be kept in a good, legible condition while in use.
- 33.3 As soon as construction advances to the extent that temporary barricades, and signs are no longer needed to inform the traveling public, such signs shall be promptly removed.
- 33.4 The cost of furnishing, erecting, maintaining, and removing protective devices will not be paid for as a separate Bid Item. Where the CONTRACTOR is required to perform any of these functions, the cost thereof shall be included in the overall Bid submitted. Ownership of the temporary warning devices shall remain with the CONTRACTOR.

PART 34. HIGH VOLTAGE ACT

- 34.1 The CONTRACTOR acknowledges the requirement of the High Voltage Act of the General Assembly of Georgia by execution of this Contract.

PART 35. BUY AMERICAN

- 35.1 By submitting this bid, the Contractor agrees that preference will be given to domestic construction material by the Contractor, sub-contractors, material men and suppliers in the performance of this Contract.

END OF SECTION



GEOTECHNICAL EXPLORATION REPORT

**CITY OF CALHOUN
NEW 2.0-MG GROUND STORAGE TANK
FIRE TOWER ROAD
CALHOUN, GORDON COUNTY, GEORGIA**

Prepared for:

**CALHOUN UTILITIES
700 WEST LINE STREET
CALHOUN, GEORGIA 30701**

**GeoSystems Project No. 24-2937
August 22, 2024**

August 22, 2024

Kurt T. McCord, P.E.
Calhoun Utilities
700 West Line Street
Calhoun, Georgia 30701

Re: Geotechnical Exploration Report
City of Calhoun
New 2.0-Million Gallon Ground Storage Tank
Fire Tower Road
Calhoun, Gordon County, Georgia
GeoSystems Project No. 24-2937

Dear Mr. McCord:

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized geotechnical exploration for a new 2.0-million gallon raw water ground storage tank for the City of Calhoun. The purpose of the exploration was to characterize subsurface conditions at the site and provide recommendations for foundation design and construction. The following report describes the exploration procedures and presents our findings and recommendations.

PROJECT INFORMATION

Our understanding of this project is based on the information from our previous discussions, observations of the site, and the tank design master plan provided on June 28, 2024. We have also reviewed available geologic information, historic aerial photographs, historic USGS topographic maps and on-line site specific soil survey data from the NRCS website for the proposed tank site.

The tank site is located north of downtown Calhoun on the west side of Fire Tower Road, 0.3 to 0.4 mile north of Georgia Highway 225. An existing 1.0 million gallon steel plate ground storage tank is currently located at the site and the new tank will be situated on the north side of the existing tank. The new tank location is currently forested with mature hardwood trees and some pines. The tank design master plan shows the tank site topography varies from steeply to very steeply sloping up to the north-northeast. Relief within the tank footprint is indicated at 23 feet, varying between a high elevation of 793 feet on the northeast side to a low of 770 feet along the perimeter in the southwest quadrant of the tank.

Plans are to construct a 90-foot diameter, 2.0-million gallon, prestressed concrete ground storage tank with a proposed bottom elevation at 768 feet. A 15-foot wide level access area extending beyond the perimeter of the tank at the bottom elevation will be required for construction and long-term maintenance of the tank. A maximum cut of about 27 feet will be required along the northeast side of the tank access area to achieve the planned grade elevation.

Specific details concerning the tank construction and loads have not been provided; however, we are familiar with prestressed concrete tanks from our previous experience and information provided by *ASI 372R* and *AWWA D110*. The typical foundation system for prestressed concrete, ground storage tanks consists of a thin (6-inch minimum) reinforced monolithic, turndown concrete slab overlying a 6-inch thick crushed stone base. A turndown edge footing is usually included along the entire circumference of the slab to support the exterior perimeter tank wall. Based on an expected tank height of about 42 feet, total loads should result in a uniform contact pressure not exceeding 2,700 pounds per square foot underneath the foundation slab. Perimeter wall loads are expected to be on the order of 7,000 to 8,000 pounds per linear foot. The continuous turndown footing is typically designed using a contact pressure equivalent to the floor loading.

EXPLORATION PROCEDURES

The scope of this exploration was outlined in our proposal number 24-2937, dated April 25, 2024. Calhoun Utilities initially staked the planned center of the tank and GeoSystems field located the planned borings using compass directions and measuring distances with a tape from the center stake on May 23, 2024. The field exploration work at the site was performed on June 5 and 6, 2024. Subsurface conditions were characterized by drilling five soil test borings (B-1 through B-5), at the approximate locations shown on the attached boring location plan. Due to steep grades and wet ground conditions causing drill rig access issues, most of the borings were slightly relocated from the staked locations at the time of the field exploration. Since our measurements were not precise, the boring locations and elevations referenced in this report should be considered approximate. Please note also that the planned center of the tank was relocated slightly by Calhoun Utilities after the field exploration was completed.

Soil sampling and standard penetration tests (SPTs) in the borings were in general accordance with ASTM Standard D1586. The borings were advanced by mechanically rotating hollow-stem augers into the soil to termination or refusal depths varying from 48 to 82 feet below the existing ground surface. The soil samples collected from each boring were initially visually classified in the field by the driller and groundwater levels, if present, were recorded at the time of boring. On completion of the field exploration, groundwater levels in three borings were again measured and all borings were closed by backfilling the open boreholes with the drill soil cuttings.

Soil samples were obtained in the borings by conducting SPTs at regular intervals using a standard 1.4-inch I.D., 2-inch O.D. split-spoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final foot was recorded and is designated the "standard penetration resistance," or "N" value. Penetration resistance, when properly evaluated, is an indication of the soil's strength and support capability.

In addition to the split-spoon sampling, three undisturbed samples (UDSs) of indicated weaker soils were also collected in supplementary auger borings, offset 3 to 4 feet from soil test borings B-1, B-4 and B-5. The undisturbed samples were obtained in accordance with ASTM D1587 by hydraulically pushing thin-walled steel sampling tubes (Shelby tubes) into the soil at the selected depths.

Laboratory analyses of two UDSs from borings B-1 and B-4 were performed to determine soil grain size distribution (sieve only), Atterberg limits and one dimensional consolidation properties. The grain-size distribution of soils was determined in accordance with procedures described by ASTM D422. Atterberg limits tests in accordance with ASTM D4318 were performed to determine the soil plasticity characteristics and soil consolidation properties determined per ASTM D2435.

Following examination of all split-spoon soil samples in the laboratory and review of the laboratory soil classification test results, final detailed logs of the borings and subsurface profiles (Figures 1 & 2) were prepared, which represent our interpretation of the field conditions. Included on the boring logs are soil descriptions, unified classifications, graphical plots of the standard penetration resistances, and groundwater conditions encountered at the time of the field exploration. The lines on the boring logs designating the interfaces between various strata represent approximate boundaries only, as transitions between materials may be gradual. We note that subsurface conditions in uninvestigated locations may vary from those encountered at specific boring locations.

All drilling, sampling, and laboratory testing operations were conducted in general accordance with ASTM standards. Further descriptions of the field and laboratory testing procedures are enclosed in Appendix A of this report. The boring location plan (Figure 1), subsurface profiles (Figure 2) and soil test boring records are attached in Appendix B. The laboratory test data are included in Appendix C.

AREA AND SITE GEOLOGY

Geologically, the proposed tank site is in the Great Valley District of the Southern Valley and Ridge Section of the Ridge and Valley Physiographic Province of Georgia. The topography of the Great Valley District is typically broad and open with a few scattered ridges and hills. Ground elevations generally range from 700 to 800 feet above sea level with relief of 50 to 100 feet. The eastern edge of this area follows the escarpment of the Great Smokey-Cartersville Fault.

The Ridge and Valley Province lies generally north and west of the Piedmont and Blue Ridge provinces and is bounded in Georgia on the north by the Cumberland Plateau and Lookout Mountain and on the south and east by the Great Smokey-Cartersville Fault. Rocks in this province are generally ancient sedimentary materials 420 to 500 million years old, dating from Cambrian or Ordovician times. Although the rocks were placed as sediments, they have long ago been consolidated into very hard rocks by cementation and great pressure. The basic rocks include limestones, sandstones, and shales, that are typically interbedded and quite broken. All these rocks have weathered in place and are covered by a mantle of residual soils formed by their chemical alteration. The residuum consists of the insoluble impurities which once were present in the rock. Characteristically, these soils are red-brown or yellow clay containing varying amounts of sand, chert gravel, and boulders.

The 1976 Geologic Map of Georgia indicates the underlying rock units at the site consist of either the Knox Group Undifferentiated or Maynardville Limestone. The Knox includes Newala Limestone and Copper Ridge Dolomite rocks. Limestone contains calcium or calcium carbonate, whereas dolomite contains calcium and magnesium carbonate. Most dolomites are associated and often interbedded with limestone.

Stratigraphy of the rock units in the Knox is uncertain; however, the Newala formation overlies the Copper Ridge in Georgia. Both the Newala and Copper Ridge rocks are Early/Lower Ordovician to Late/Upper Cambrian in Geologic age. The Newala Limestone consists of thick-bedded, gray limestone with little or no chert. It contains some dolomite and is very soluble and fast weathering. Copper Ridge Dolomite is light gray to brownish gray in color and ranges from thin to thick beds with depth. Chert is relatively abundant in the upper part of this rock unit. The Maynardville Limestone of Cambrian geologic age underlies the Knox and is part of the Conasauga Formation. It is a thick-bedded limestone apparently associated with the same Maynardville Limestone formation in Tennessee.

All of the limestone and dolomite rocks are carbonates, which are prone to karstic solutioning activity by water. Weathering of these rocks by solutioning typically proceeds along the joint dips of the bedding planes and along secondary joints that were formed by strain energy release during periods of

uplift and rebound. Due to the solution weathering, the bedrock surface is not characteristically flat, but is typically extremely irregular with slots, pits and pinnacles or fingers of hard rock projecting upward through the soil mass. The interface between soil and rock is typically a sharp, uneven line with a zone of very soft soil occurring in many instances immediately above the rock surface.

SUBSURFACE CONDITIONS

Soil Test Borings

Subsurface conditions encountered by the borings during this study are generally typical of those described in the previous geology section of this report. All borings encountered predominantly residual soils from the ground surface to termination or auger refusal depths. A layer of partially weathered rock (PWR) overlying auger refusal material was also encountered at one boring location.

The following are explanations of various geotechnical and geologic terms used to describe the types of conditions identified in the borings. Residual soils refer to soils formed in-situ by chemical weathering of the underlying rocks. Normally, the weathering is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. Partially weathered rock is residual material that can normally be penetrated by a power auger, but must have a standard penetration resistance greater than 100 blows per foot (bpf) to qualify as PWR. Refusal is a designation applied to any material that cannot be further penetrated by the soil drilling process and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock.

Residual soils were found from the ground surface to a boring termination depth of 70 feet below the ground surface (bgs) in borings B-1, B-2 and B-3, and to top of PWR and auger refusal at depths of 43 to 82 feet, respectively, in borings B-4 and B-5. The residual soils are mostly stiff to very stiff clay and sandy clay (CL/CH) interbedded with medium dense silty sand (SM) and some firm to very stiff sandy silt (ML). Standard penetration resistances (N-values) in the residual soils varied from a minimum of 4 to a maximum of 63 bpf, but typically ranged between 9 and 30 bpf. Laboratory Atterberg Limits testing on two undisturbed samples collected from borings B-1 and B-4 show the clay is typically highly plastic, as indicated by plasticity index values of 33 and 40. The tests also show liquid limits of 63 and 70 and a plastic limit of 30.

Boring B-4 encountered residual soils to a depth of 43 feet bgs and then approximately 5 feet of partially weathered rock prior to auger refusal at a depth of 48 feet. The partially weathered rock layer was described as very dense silty fine to coarse sand (SM) with rock fragments.

Auger refusal material was encountered at depths of 48 and 82 feet in borings B-4 and B-5, respectively. Rock core drilling or other exploration methods are required to determine the nature and continuity of refusal material; however, refusal at these two boring locations appears to be the upper surface of bedrock.

Time of boring groundwater levels were indicated in all borings at depths varying approximately from 41 to 58 feet below the ground surface. Groundwater was measured after 24 hours in boring B-3 at a depth of 50 feet. No 24-hour groundwater levels were recorded in borings B-1 and B-2 above caved depths of 28 and 53 feet; however, the caved depths may also indicate a proximity to groundwater. Measurements of stabilized water levels and caved depths were not performed in borings B-4 and B-5, drilled the final day of the field exploration. Groundwater is subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than reported during this study.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on our observations at the site, interpretation of the boring and laboratory data obtained during the exploration, and our experience with similar site and subsurface conditions. Should the project plans change substantially from those outlined in this report, we request the opportunity to review our recommendations considering the changes.

Seismic Site Classification

Site classification for seismic design of the tank was determined in accordance with ASCE/SEI 7-22. Subsurface conditions were not characterized to a depth of 100 feet; however, the available boring data and our previous experience with similar subsurface conditions allow an estimation of the average shear wave velocity profile to a depth of 100 feet below the ground surface. The data indicates the shear wave velocity profile to a depth of 100 feet would be in the range of 700 to 1,000 ft/sec. Therefore, based on the ASTM definitions provided in Table 20.2-1, the site is categorized as Site Class D (Medium dense sand or stiff clay).

Site and Subgrade Preparation

Before earthwork can commence at the tank site, clearing and grubbing of the entire construction area should be completed. The construction area is wooded with a mix of young to mature, large hardwood and pine trees requiring removal along with their root systems prior to excavation. All vegetation, root systems, topsoil, refuse, and other deleterious non-soil materials should be stripped from the proposed construction area and wasted from the site. Clean topsoil may be stockpiled and reused at a later time in areas to be landscaped.

Immediately prior to the tank foundation installation, the entire foundation area should be carefully inspected by the project geotechnical engineer. At that time, the engineer should observe proofrolling of the subgrade utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of inspection and proofrolling is to locate any soft, weak, or excessively wet soils which may be present at the time of construction and to confirm that conditions are suitable for placement of the tank floor base material. Depending on the weather and construction conditions, some undercutting and replacement of weak or wet soils with compacted crushed stone may be required in order to provide adequate foundation subgrade support. The extent of any undercutting required should be determined at the time of construction by the project geotechnical engineer.

Excavation Conditions

Planned grade of the 15-foot wide level access area around the perimeter of the tank is at or near existing site grade along the southwest tank quadrant. Varying excavations up to about 27 feet below the existing ground are indicated for the remainder of the tank construction area. Based on the boring data, materials requiring difficult excavation measures are not indicated to be encountered during construction. Removal of the soils can be performed by conventional bulldozers and excavators of appropriate size. However, we note that due to the erratic weathering of the rocks within this geologic setting, difficult excavation materials may be encountered at locations between the borings or in other areas not investigated.

Slope Stability

Our investigation did not include analysis of slope stability for any temporary or permanent condition. However, based on conditions at this site and OSHA requirements, we recommend that simple temporary slopes for excavations above the water table not exceed 1.5(H):1.0(V). Exposed slope faces should be protected from precipitation with an impermeable cover until the work is completed. Also, slope conditions should be inspected daily for any signs of instability such as tension cracks, bulging, or deterioration of the embankment soils.

Permanent slopes no steeper than 2.0(H):1.0(V) are recommended for construction in undisturbed residual materials or structural fill placed in accordance with our recommendations. Minimum setback distances from the top of slope of 10 feet for structures and 5 feet for pavements is recommended. Appropriate groundcover provisions should be made for protection of permanent slopes from erosion.

Due to the deep excavation, a permanent retaining wall will be required around the uphill side of the tank to prevent encroachment onto the adjacent property. Currently, it appears a retaining wall with a maximum height of 10 to 15 feet will be sufficient to achieve a permanent 2.0H:1.0V slope above the top of the wall with a 10-foot undisturbed buffer along the adjacent property. Feasible types of retaining walls that may be used include conventional cantilevered or gravity walls; however, these walls will likely require sloping and temporary slope stabilization measures or excavation shoring to provide the required construction area and maintain safe working conditions during installation. Conventional retaining walls and excavation bracing should be designed to support earth pressure conditions as outlined in the following *Lateral Earth Pressures* section of this report.

A more economical approach than a conventional retaining wall may be a permanent soil nail wall. Soil nails have been used for many years to provide temporary shoring for excavations and to permanently stabilize slopes. Soil nails typically are steel bars that are grouted into predrilled boreholes to reinforce the in situ soil and increase slope stability safety factors. Installation of the soil nails is performed from the top down the slope generally at vertical and horizontal spacings of 3 to 5 feet. Temporary and final shotcrete facings are installed during installation, and the final reinforced facing in combination with the soil nails form a permanent wall supporting the soil in the slope. The specialty soil nail contractor selected for the project should provide the soil nail wall design based on the available site subsurface conditions.

The limited Atterberg limits testing results indicate the insitu soils at the site may be susceptible to long-term creep that could affect lateral deflection of the soil nail wall. Creep testing of individual soil nails during the initial wall construction should be performed to evaluate the potential for creep. If creep is an issue, modifications to the wall design can be made to accommodate excessive creep.

Lateral Earth Pressures

Earth pressures on retaining walls and walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing cantilevered walls, where some movement and rotation may occur to mobilize soil shear strength. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition. A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures.

Passive earth pressure resistance is generally ignored for retaining wall foundations embedded 2 or 3 feet but can be relied on for deeper foundations. To rely on passive resistance, erosion, or excavation of the soil from the passive wedge side of the foundation must be prohibited during the life of the structure. Since significant lateral deflections are required to fully develop the passive resistance, the total calculated passive pressure should be reduced by a safety factor of at least 2.0 for design purposes.

We recommend that select, clean granular backfill be used behind cantilevered or gravity retaining walls for this project. The granular backfill zone must extend beyond the lateral earth pressure wedge in order to develop the respective earth pressure on the wall. Our recommended earth pressure coefficients for the granular backfill are based on previous experience with similar conditions and the following assumed properties for compacted crushed stone (GP/GW or GDOT graded aggregate base (GAB)) and sand (SW/SM):

Crushed Stone: Cohesion (c) - 0
 Angle of Internal Friction (ϕ) - 40 degrees
 Soil Unit Weight (γ) - 140 pcf

Sand: Cohesion (c) - 0
 Angle of Internal Friction (ϕ) - 30 degrees
 Soil Unit Weight (γ) - 120 pcf

Using ϕ -angles of 40 and 30 degrees for clean crushed stone and sand results in the following earth pressure coefficients for design of any retaining walls, below grade structure walls and moment resisting foundations at this site:

Earth Pressure Conditions	Coefficient	
	Crushed Stone	Sand
Active (K_A)	0.22	0.33
At-Rest (K_O)	0.36	0.50
Passive (K_P)	4.60	3.00

Tractors and other heavy equipment should not operate within 10 feet of retaining or below grade walls to prevent excessive lateral pressures on the walls. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the footing or surcharge load does not intersect the wall, the effect of the load on the wall may be neglected. Whenever this line intersects the wall, the effect of the surcharge loads should be added to the calculated earth pressures to determine total lateral stresses.

Earthwork/Fill

Except for tank foundation support and retaining wall backfill, general structural fill required to achieve planned site grades and backfill excavations or utility trenches should be clean soil, free of organic matter and deleterious materials. Structural fill soils should have a maximum dry density of at least 100 pcf as determined by the standard Proctor compaction test (ASTM D-698) and should not contain rocks or stones greater than 3 inches in diameter.

General site structural fill should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor compaction test (ASTM D-698). In confined areas portable compaction equipment and thinner lifts of 3 to 4 inches may be required to achieve specified degrees of compaction. All fill should be placed in horizontal lifts and adequately keyed into stripped and scarified subgrade soils.

Moisture control of the fill soils is essential in achieving specified densities and soil moisture contents within ± 3 percent of the optimum moisture content (OMC) should be maintained during placement and compaction. We recommend that the grading contractor have equipment on site during the earthwork for both drying and wetting fill soils in order to control moisture contents within tolerances for compaction.

During fill placement, an adequate number of density tests should be performed by a soils technician working under the direction of the project geotechnical engineer to determine the degree of compaction and compliance with the project specifications. Tests should be performed for each 2-foot thick layer of compacted fill. Any areas that do not meet compaction requirements should be reworked to achieve compliance.

Foundation Design and Construction

The boring data shows the tank will be underlain mostly by stiff to very stiff clay, medium dense silty sand and some firm to very stiff sandy silt residual soils. These soils generally extend to the top of rock at indicated depths varying from 48 to 82 feet below the existing ground surface. At the planned foundation bearing elevation, the available design soil bearing capacity in the undisturbed residual soils is at least 5,000 psf with a minimum factor of safety of 3.0 against a foundation bearing capacity failure. Actual foundation contact pressure beneath the tank is expected to be about 2,700 psf. The concrete slab turn-down footing, underneath the perimeter wall of the tank, should bear at a depth of at least 12 inches below finish grade, which is the maximum frost penetration depth in the local area.

In order to evaluate long-term performance of the tank, multiple settlement computations for the various site and subsurface conditions were completed. Settlement calculations were based on standard Westergaard stress distributions and multi-layered soil profiles that were interpreted from the boring data. Settlement amounts at the center and the perimeter of the tank were computed using elastic soil properties derived from correlations with standard penetration resistances and soil consolidation data from the laboratory consolidation tests. Our analysis considered a maximum total foundation area loading of 2,700 psf and foundation bearing elevation of approximately 768 feet for the tank. Due to the deep excavation required along the northeast side of the tank to achieve the tank bottom subgrade elevation, very little to no settlement should occur in the area of boring B-2. Maximum estimated total settlements at or near the remaining boring locations are approximately 2.0 inches at the location of B-1, 1.4 inches at B-3, 3.1 inches at B-4, and 2.8 inches at B-5.

We understand that prestressed concrete storage tanks, such as planned for this project, can tolerate up to about 6 inches of uniform total settlement; however, angular distortion of the membrane floor, expressed in terms of the slope of the settlement profile, is the concern at this site. The ACI document, *Design and Construction of Prestressed Concrete Structures* (ACI 372R) recommends a maximum limit of 1/4-inch differential settlement in a 10-foot distance. Our calculations show, the maximum estimated differential settlement of the floor will likely exceed in an angular distortion value greater than the recommended 1/4-inch in a 10-foot distance.

In order to limit long-term differential settlement to acceptable values, we recommend installation of aggregate columns or aggregate piers, as a cost-effective solution for foundation support of the tank. We anticipate that aggregate columns installed to maximum estimated depths on the order of 20 to 25 feet below the existing ground surface will provide adequate bearing capacity and reduce post construction tank settlements to acceptable values. The conventional reinforced concrete membrane slab tank foundation overlying a layer of crushed stone can be constructed directly over the columns.

The term “aggregate columns” or “aggregate piers” refers to stone columns and rammed aggregate columns. Stone columns are installed using large vibratory probes that vibrate at high frequency to compact granular material (typically No. 57 crushed stone) into the ground, laterally displace weak soil and create the columns. Rammed aggregate columns are installed by predrilling typically 18- to 36-inch diameter holes into the ground and ramming lifts of crushed stone into the open holes to form aggregate columns. All specifications, bid documents, etc. should refer to “aggregate columns,” “aggregate piers,” “vibro stone columns” or “vibro stone piers” since many ground improvement measures are proprietary, and design and construction of aggregate columns should not be limited to a proprietary product that only a contractor licensed for that product can install.

Many factors are considered in designing ground improvement measures and are best carried out by specialized geotechnical contractors utilizing their previous experience and adapting their specialized products, equipment and construction methods to the site-specific conditions. A company with knowledge and experience in the design and construction of aggregate columns can also provide engineering support in the early stages of the project and help determine the most feasible and economical foundation solution. We recommend that specialty geotechnical contractors such as Keller, Geopier, Menard USA, Nicholson Construction or others be consulted during the planning and design phase of the project to help in determining the most feasible and cost-effective type of ground improvement measure for the site.

Once the tank design is complete, proposals or bids for design and installation of the recommended aggregate columns, other alternative ground improvement measures or deep foundation support of the tank can be requested. The request should include performance specifications assuring compliance with the tank minimum required foundation bearing capacity and settlement tolerance. Specifications should also require the aggregate columns design to be confirmed by modulus load and creep testing during construction.

Pipe Thrust Block Restraint

Pipe thrust block restraint depends mainly on the passive lateral earth pressure resistance. Earth pressures on below grade thrust blocks include both active and passive conditions. The passive condition represents the maximum possible pressure when the thrust block is pushed against the soil, which resists the pipe thrust and active earth pressures acting on the opposite side of the block. We recommend soil parameters listed in the previous *Lateral Earth Pressures* section of this report for lateral earth pressure design of pipe thrust blocks at this site.

QUALIFICATIONS

This report has been prepared for the exclusive use of Calhoun Utilities for design and construction of the proposed 2.0-million gallon prestressed concrete ground storage tank. Conclusions and recommendations in this report were based on our understanding of the project, the data gathered during this exploration, and our experience with similar site and subsurface conditions.

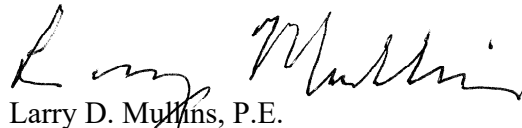
The anticipated subsurface conditions were interpolated from the boring and laboratory test data. We note that regardless of the thoroughness of a geotechnical exploration there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the unexpected conditions to address any issues.

Our professional services were performed, our findings derived, and our conclusions and recommendations were prepared consistent with the professional skill and care ordinarily provided by geotechnical engineers practicing in the Ridge and Valley Province geologic setting under the same or similar circumstances for projects of this type at the time of these services. We make no warranties or guarantees, either expressed or implied. GeoSystems is not responsible for the conclusions, opinions or recommendations of others based on our findings and evaluations.

We appreciate the opportunity to provide this geotechnical exploration for Calhoun Utilities and look forward to assisting with any necessary materials testing and inspections during the project construction phase. Should you have any questions concerning this report, please call me.

Sincerely,

GeoSystems Engineering, Inc.


Larry D. Mullins, P.E.
Principal Engineer



Appendix A: Standard Field and Laboratory Procedures

Appendix B: Boring Location Plan - Figure 1
Subsurface Profiles - Figure 2
Key to Symbols and Classifications
Test Boring Records

Appendix C: Laboratory Soil Test Reports

APPENDIX A

STANDARD

FIELD AND LABORATORY PROCEDURES

GEOSYSTEMS ENGINEERING

STANDARD FIELD AND LABORATORY TESTING PROCEDURES

Soil Test Boring

Soil sampling and penetration testing are performed in general accordance with ASTM Designation D1586. Borings are usually advanced either by mechanically twisting continuous steel auger flights into the ground or by wash boring using roller cone or Hawthorne bits. At regular intervals, soil samples are obtained with a standard 1.4-inch I.D., 2-inch O.D., split-spoon sampler. The sampler is first seated 6 inches into the bottom of the hole to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to achieve the final foot of penetration is recorded and is designated the "standard penetration resistance." Penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Groundwater levels are normally determined by the driller in conjunction with the field investigation and are noted on the drilling records. These levels indicate the approximate location of the hydrostatic water table at the time of observation. Generally, water levels are reported at the time of boring and at subsequent times. The time of boring water level is detected as the drilling tools are advanced by changes in the drilling rate, soil sample moisture conditions, water or mud on the drill rods, and moisture conditions of the borehole drill cuttings. Additional groundwater levels are typically obtained at various times after boring to minimize any disruption by the drilling operations and to allow the water table to stabilize. Normally, a time lag of at least 24 hours is required to permit stabilization of the water table. A longer time period may be required in low permeability (clayey) soils. Water table measurements are taken in open boreholes using a weighted measuring tape or electronic groundwater level indicator.

Representative portions of the soil samples, obtained from the split-spoon sampler, are sealed in containers and shipped or transported to the office. In the office, the samples are examined by an engineer to verify the driller's field classifications.

Auger/Wash/Air Hammer Borings

Auger borings, wash borings, and air hammer drilling without standard penetration testing are practical when the depth to rock is of primary concern. Auger and wash borings may also be used to obtain undisturbed samples at pre-selected depths. The borings may be advanced by hollow-stem augers, wash boring techniques using roller cone or Hawthorne bits, or pneumatic hammer drills to termination or refusal depths. The soils and rock materials encountered are roughly identified by the driller from cuttings brought to the surface during the drilling process. Crude estimates of the soil consistency or relative density and rock quality may also be made from the difficulty of the drilling process in advancing the borehole.

Undisturbed Sampling

Split tube samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory testing. Relatively undisturbed samples are obtained by pushing sections of 3 inch O.D., 16-gauge, steel "Shelby" tubing into the soil at the desired sampling levels. This procedure is described by ASTM Standard D-1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight, and transported to the laboratory. Locations and depths of undisturbed samples are shown on the Test Pit or Boring Records.

Soil Identification and Description

Soils are normally classified using the Unified Soil Classification System (ASTM D2487). In addition to standard classification, soils are identified in accordance with the important soil properties to provide a complete description and assist with predicting behavior. Soil properties significant to most earthwork/foundation problems include consistency (cohesive fine grained soils) or relative density (cohesionless granular soils), color, and texture or composition. Consistency and relative density are fundamental properties in evaluating soil strength and are typically estimated based on standard penetration test results. The engineer's examination of soil samples recovered during the field investigation is primarily a qualitative visual process. Detailed soil classification requires basic laboratory grain size analyses and Atterberg limits (plasticity) tests.

Grain Size/Gradation

Grain size tests are performed to determine the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D421 (dry preparation) or ASTM D2217 (wet preparation). The grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is determined by passing the samples through a standard set of nested sieves. A sample of known weight is passed through the sequence of sieves with decreasing size of openings and the portions retained on each sieve weighed. Materials passing the number 200 sieve are suspended in water and the grain size distributing calculated from the measured settlement rate (hydrometer analysis). Hydrometer analysis determines the density of a suspension of soil at various times after agitation. Using Stokes's law, the particle size remaining suspended at each particular time is calculated and the corresponding density is a measure of the quantity of soil smaller than the computed size. Procedures for the quantitative determination of the distribution of particle (grain) sizes in soils is described by ASTM D-422. Determination of the total amount of material finer than the No. 200 sieve is in accordance with ASTM D1140.

Soil Plasticity

Representative samples of the soils were selected for Atterberg limits testing to determine the soil plasticity characteristics. The soil's Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid, and the PL is the moisture content at which

the soil begins to lose its plasticity. The soil plasticity characteristics are determined in accordance with ASTM D4318.

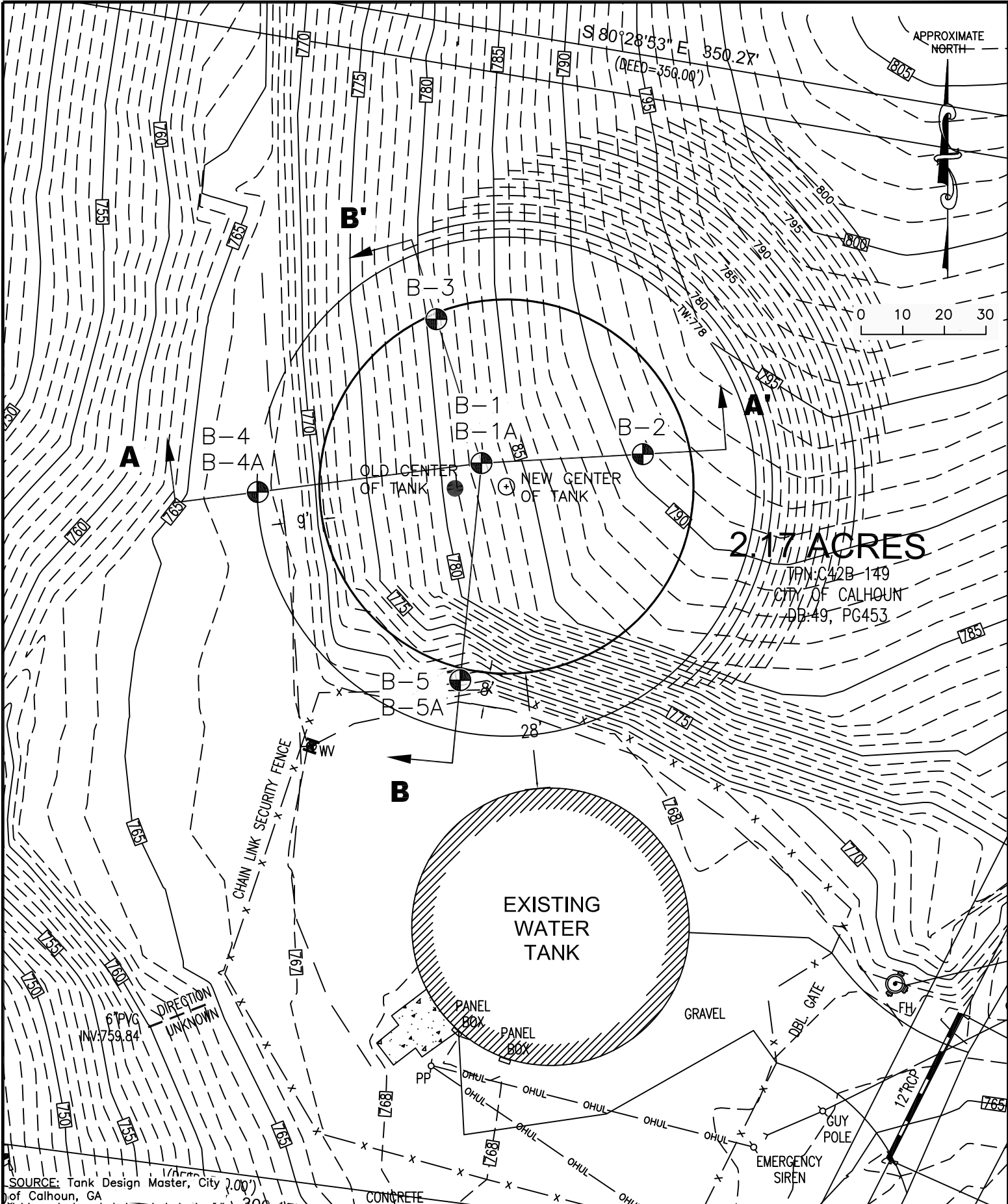
Certain soils swell and shrink with increases and decreases in soil moisture. The PL is related to this potential volume change ability. When such volume changes occur in soils confined beneath foundations, structural deformations can be produced. Past experience has shown that soils having a PI of less than 30 are only slightly susceptible to volume changes. Soils having a PI greater than 50 are generally very susceptible to these volume changes. Soils with a PI between these limits have moderate volume change potential.

Consolidation Testing

Consolidation tests are performed on sections of undisturbed soil samples in order to estimate post construction settlements and time rate of settlement. The test procedure is in accordance with ASTM Standard D2435. Each soil sample is extruded from the sampling tube and trimmed into a 2.5-inch diameter, 1-inch thick disc. The soil disc is then confined in a stainless steel ring, sandwiched between porous plates, and then subjected to incrementally increasing vertical loads. Deformation of the sample is measured over time under the applied loads and void ratios and equivalent strains for the sample are calculated from the deformation measurements. One-dimensional consolidation summary reports present the test results in the form of percent strain/void ratio verses vertical stress graphs and coefficient of consolidation (C_v) verses vertical stress graphs.

APPENDIX B

FIGURE 1 – BORING LOCATION PLAN
FIGURE 2 – SUBSURFACE PROFILES
KEY TO SYMBOLS AND CLASSIFICATIONS
TEST BORING LOGS



LEGEND

- - SOIL TEST BORING
- - - SUBSURFACE CROSS SECTION

SCALE: 1" = 1=30' (APPROXIMATELY)

PREPARED BY: GEI DATE: 7/1/2024

REVIEWED BY: LDM DATE: 7/1/2024

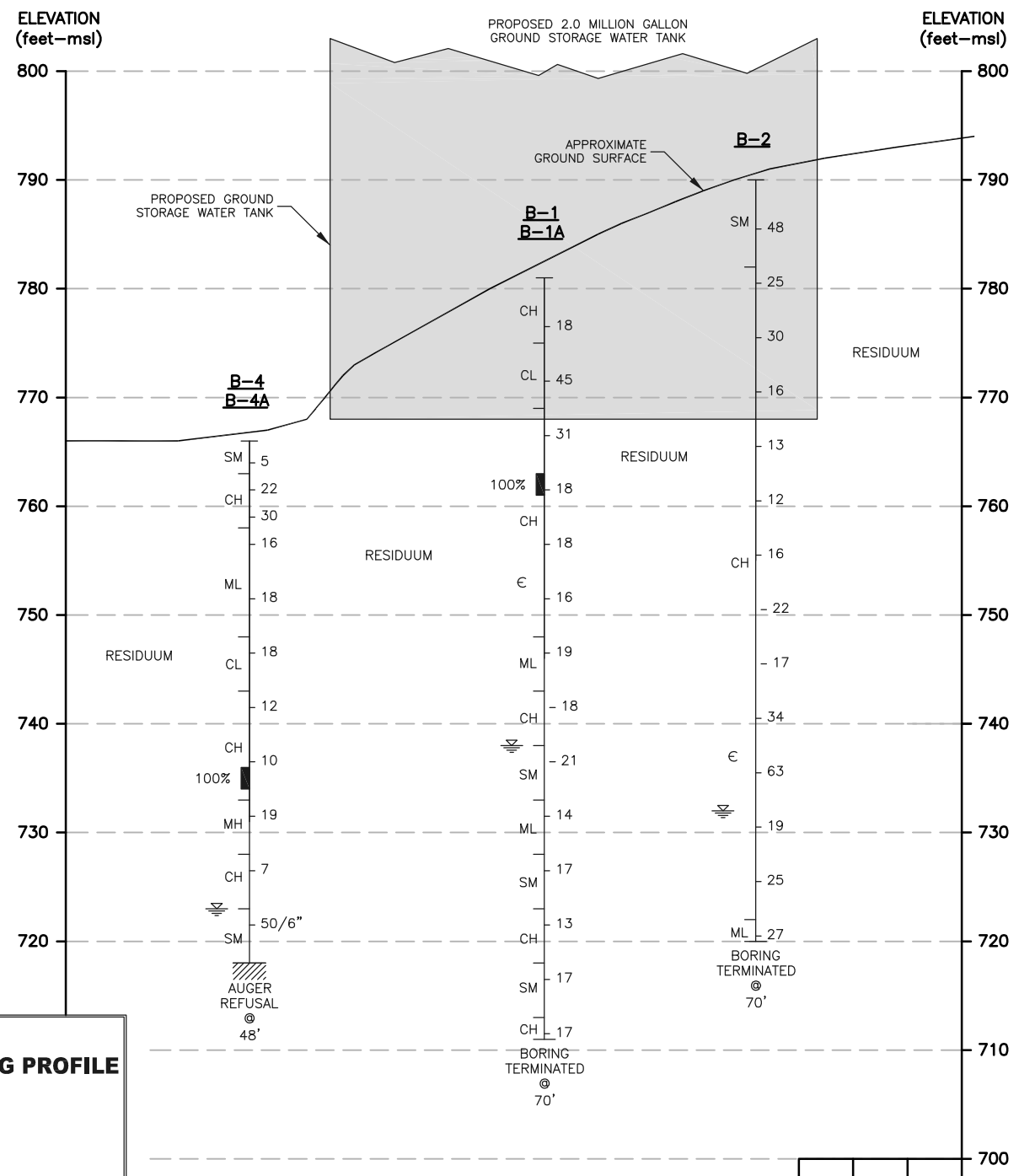


REFERENCE: F1.dwg

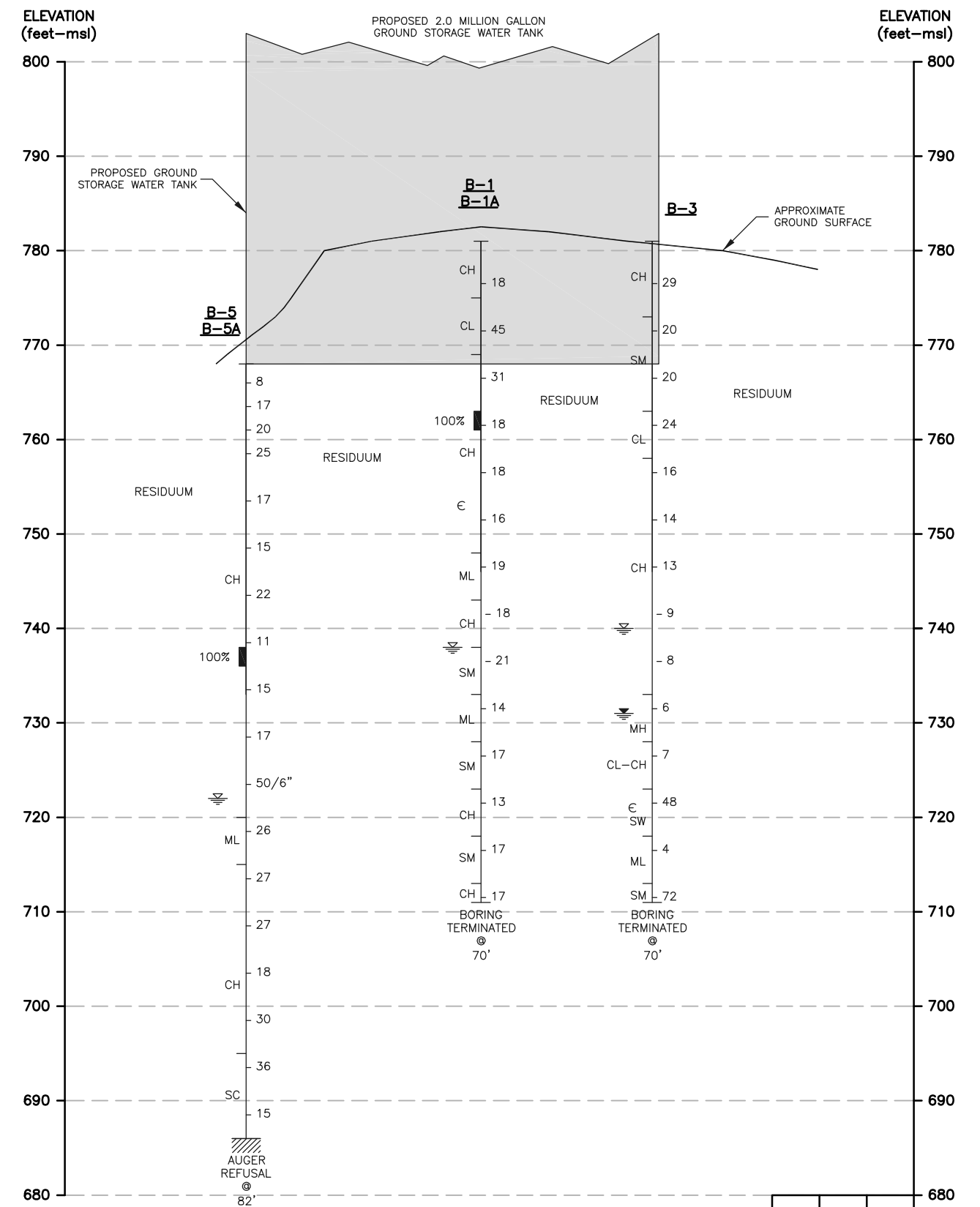
BORING LOCATION PLAN

PROJECT: CITY OF CALHOUN
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
Fire Tower Road, Calhoun, Gordon County, Georgia
GeoSystems Project Number: 24-2937

FIGURE: **1**



PROFILE A-A'
SCALE: 1" = 30'(HORIZONTAL), 1"=15'(VERTICAL)



PROFILE B-B'
SCALE: 1" = 30'(HORIZONTAL), 1"=15'(VERTICAL)

**LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE**






















BORING NUMBER
 TOPSOIL
 RESIDUUM
 CL
 WOH
 GROUNDWATER LEVEL AT 24 HOURS
 GROUNDWATER LEVEL AT TIME OF BORING
 SC
 EQUIVALENT N60 VALUE FROM LOGS
 15
 UNIFIED SOIL CLASSIFICATION
 SM
 73
 UNDISTURBED SAMPLE (SHELBY TUBE), PERCENT RECOVERY
 95%
 PARTIALLY WEATHERED ROCK
 SM
 50/1"
 AUGER REFUSAL
 55'

UNIFIED SOIL CLASSIFICATIONS
 OH - HIGH PLASTICITY ORGANICS
 ML - LOW PLASTICITY SILT
 SM - SILTY SAND
 SP - POORLY GRADED SAND
 SW - WELL GRADED SAND
 CL - LOW PLASTICITY CLAY
 CH - HIGH PLASTICITY CLAY

ADDITIONAL ABBREVIATIONS
 N60 - PENETRATION RESISTANCE AT BLOWS PER FOOT (BPF) AT STANDARD 60% HAMMER EFFICIENCY
 WOH - STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
 NSR - NO SAMPLE RECOVERY

SOURCE: Tank Design Master, City of Calhoun, GA

KEYS TO SYMBOLS AND CLASSIFICATIONS

SPECIAL STRATIGRAPHY IDENTIFIERS USED TO HIGHLIGHT SPECIFIC LAYERS	 FILL  TOPSOIL  PAVEMENT	 PARTIALLY WEATHERED ROCK  ROCK (GENERAL)  WATER	 ALLUVIUM
COARSE GRAINED SOIL - GRAVELS & SANDS (MORE THAN 50% OF MATERIAL IS RETAINED ON NO. 200 SIEVE)	CLEAN SANDS & GRAVELS (< 5% FINES CONTENT)	 SP: Poorly graded sands  SW: Well graded sands  GP: Poorly graded gravels  GW: Well graded gravels	
	SANDS & GRAVELS WITH HIGH FINES CONTENT (> 15% FINES CONTENT)	 SM: Silty sands  GM: Silty gravels  SC: Clayey sands  GC: Clayey gravels	
FINE GRAINED SOIL - SILTS & CLAYS (MORE THAN 50% OF MATERIAL PASSES NO. 200 SEIVE)	SILTS	 ML: Low plasticity inorganic silts  MH: High plasticity inorganic silts	
	CLAYS	 CL: Low placticity inorganic clays  CH: High plasticity inorganic clays	
	ORGANIC SILTS & CLAYS	 OL: Low plasticity organic silts and clays  OH: High plasticity organic silts and clays	

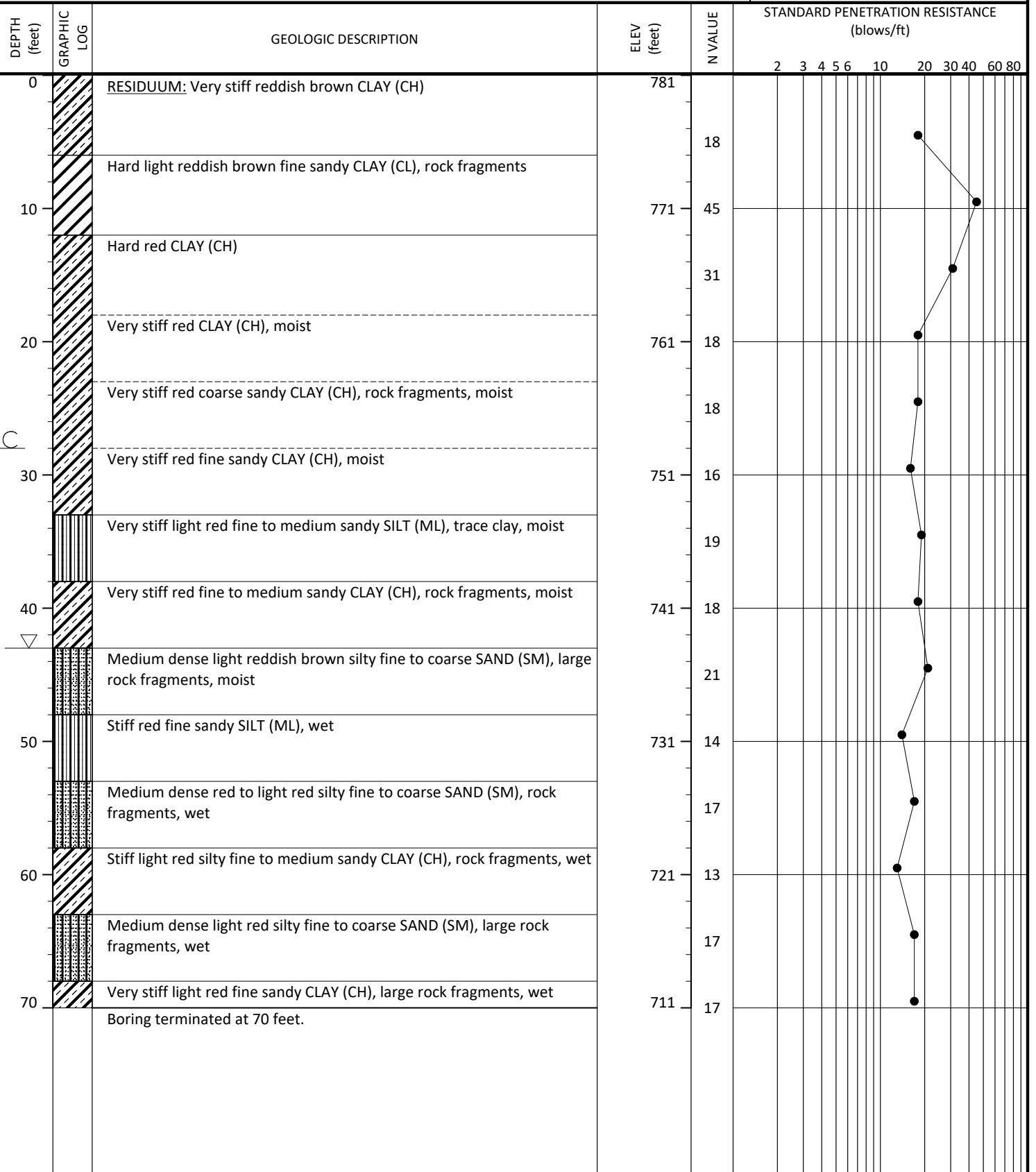
CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
	SILTS AND CLAYS	NUMBER OF BLOWS, N
0 - 1		Very Soft
2 - 4		Soft
5 - 8		Firm
9 - 15		Stiff
16 - 30		Very Stiff
31 - 50		Hard
OVER 50		Very Hard

**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-1

GEOLOGIST: <i>NA</i>		ELEVATION (feet): <i>781</i>		NOTES: 1. Groundwater detected at 43 feet at time of boring. 2. No ground water observed above caved depth at/after 24 hours (NGWO). 3. Borehole caved to a depth of 28 feet on removal of augers.
DATE DRILLED: <i>6/5/2024</i>		BORING DEPTH (feet): <i>70</i>		
DRILLER: <i>RANGER CONSULTING, INC.</i>		WATER LEVEL ∇ TOB (feet): <i>43</i> \blacktriangledown 24HR (feet): <i>NGWO</i>		
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>				



**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-1A

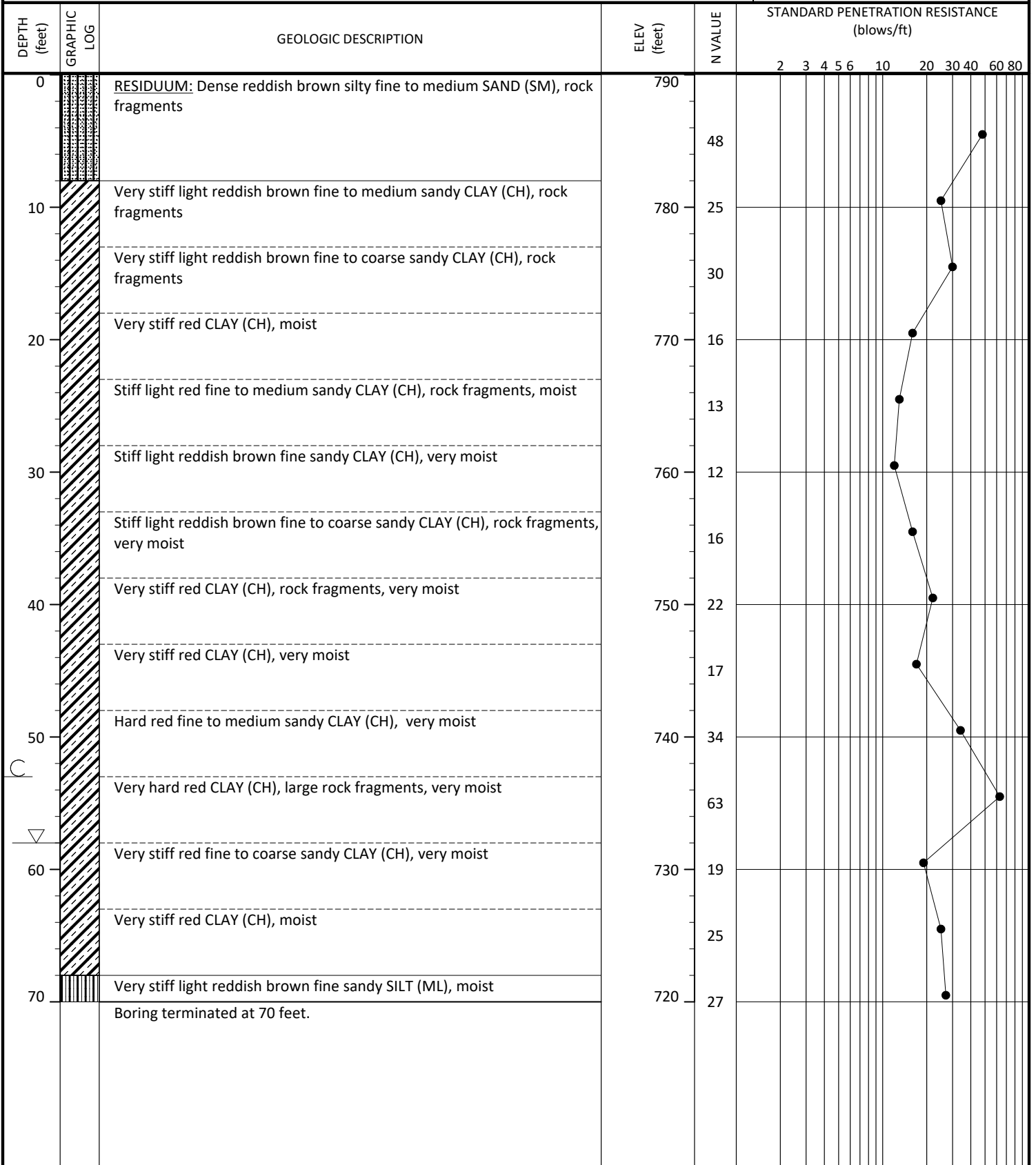
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>781</i>	NOTES: 1. No Groundwater detected at the time of boring (NGWE). 2. No groundwater observed at/after 24 hours (NGWO).
DATE DRILLED: <i>6/5/2024</i>	BORING DEPTH (feet): <i>20</i>	
DRILLER: <i>RANGER CONSULTING, INC.</i>	WATER LEVEL ∇ TOB (feet): <i>NGWE</i> \blacktriangledown 24HR (feet): <i>NGWO</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)															
					2	3	4	5	6	10	20	30	40	60	80					
0			781																	
10		Auger boring: No samples collected/recovered. (See log of boring B-1 for soil description)	771																	
20		Undisturbed Sample (Shelby Tube) 18' to 20', 100% Recovery	761																	
		Boring terminated at 20 feet.																		

**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-2

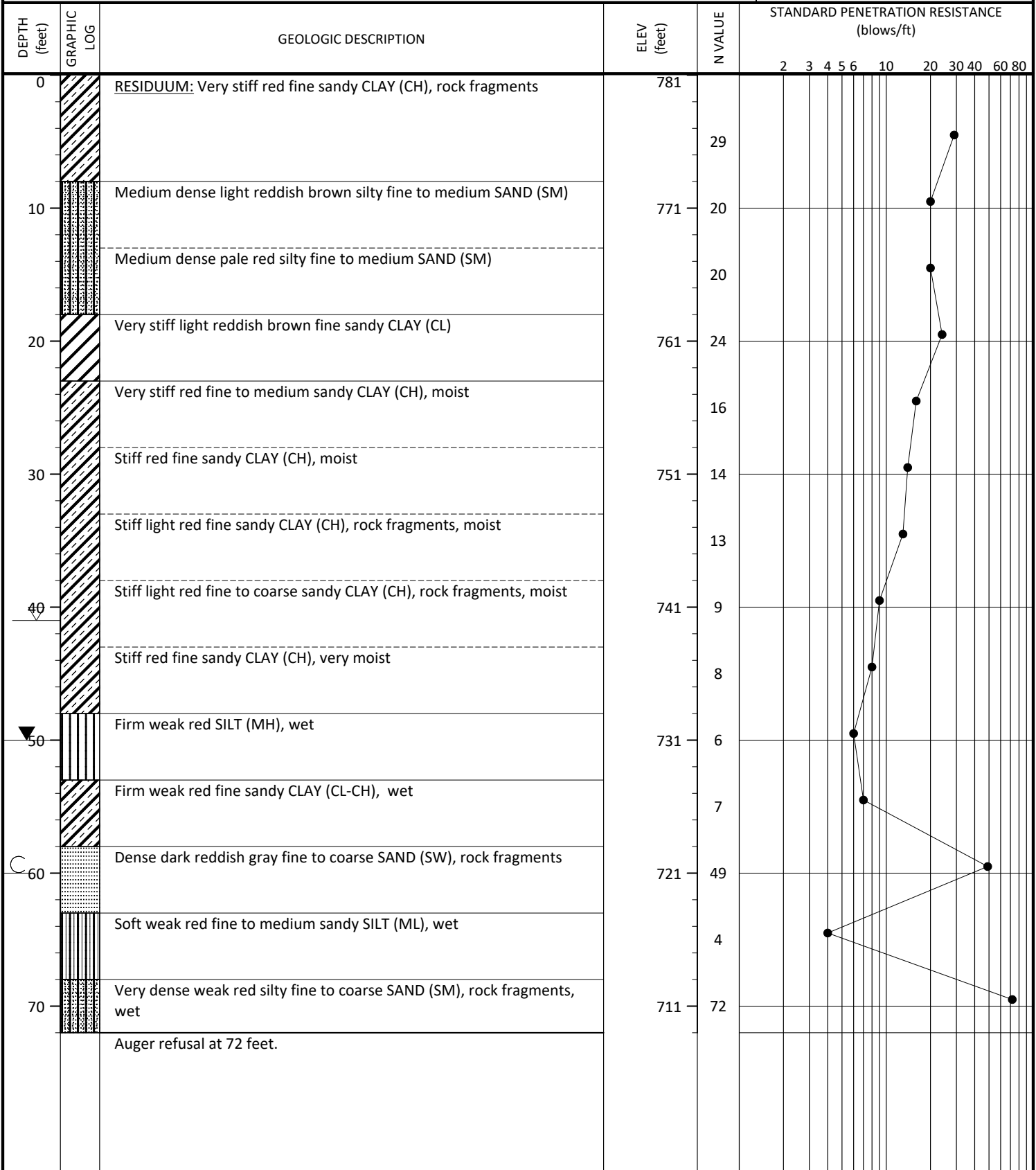
GEOLOGIST: NA		ELEVATION (feet): 790		NOTES: 1. Groundwater detected at 58 feet at time of boring. 2. No ground water observed above caved depth at/after 24 hours (NGWO). 3. Borehole caved to a depth of 53 feet on removal of augers.
DATE DRILLED: 6/5/2024		BORING DEPTH (feet): 70		
DRILLER: RANGER CONSULTING, INC.		WATER LEVEL ∇ TOB (feet): 58 \blacktriangledown 24HR (feet): NGWO		
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER				



**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-3

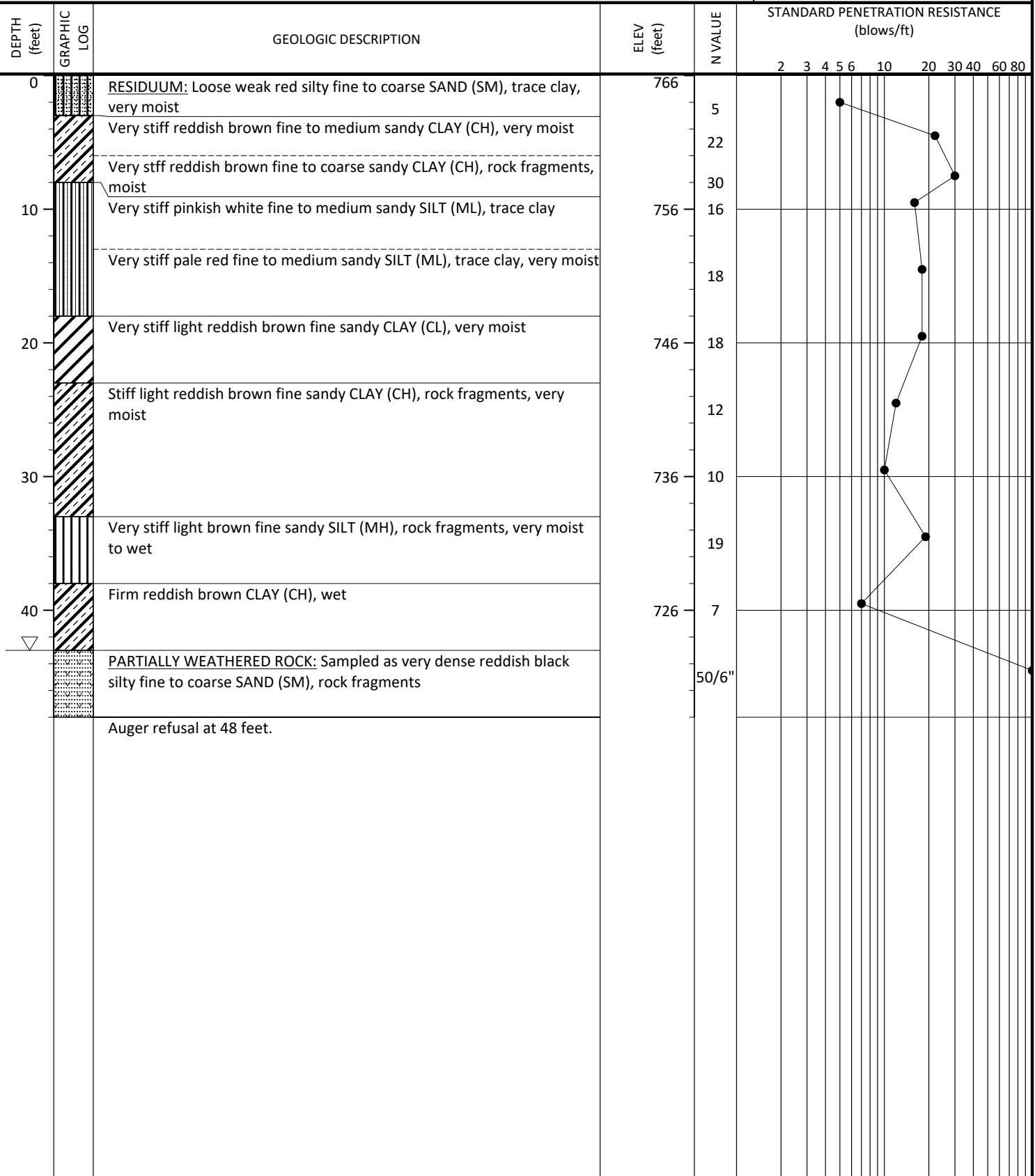
GEOLOGIST: NA	ELEVATION (feet): 781	NOTES: 1. Groundwater detected at 41 feet at time of boring. 2. Ground water level measured at 50 feet after 24 hours. 3. Borehole caved to a depth of 60 feet on removal of augers.
DATE DRILLED: 6/5 - 6/2024	BORING DEPTH (feet): 72	
DRILLER: RANGER CONSULTING, INC.	WATER LEVEL ∇ TOB (feet): 41 \blacktriangledown 24HR (feet): 50	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-4

GEOLOGIST: NA	ELEVATION (feet): 766	NOTES: 1. Groundwater detected at 43 feet at time of boring. 2. No ground water observed after 24 hours (NGWO).
DATE DRILLED: 6/6/2024	BORING DEPTH (feet): 48	
DRILLER: RANGER CONSULTING, INC.	WATER LEVEL ▽ TOB (feet): 43 ▼ 24HR (feet): NGWO	
DRILLING METHOD: HOLLOW STEM AUGER WITH AUTOMATIC HAMMER		



**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-4A

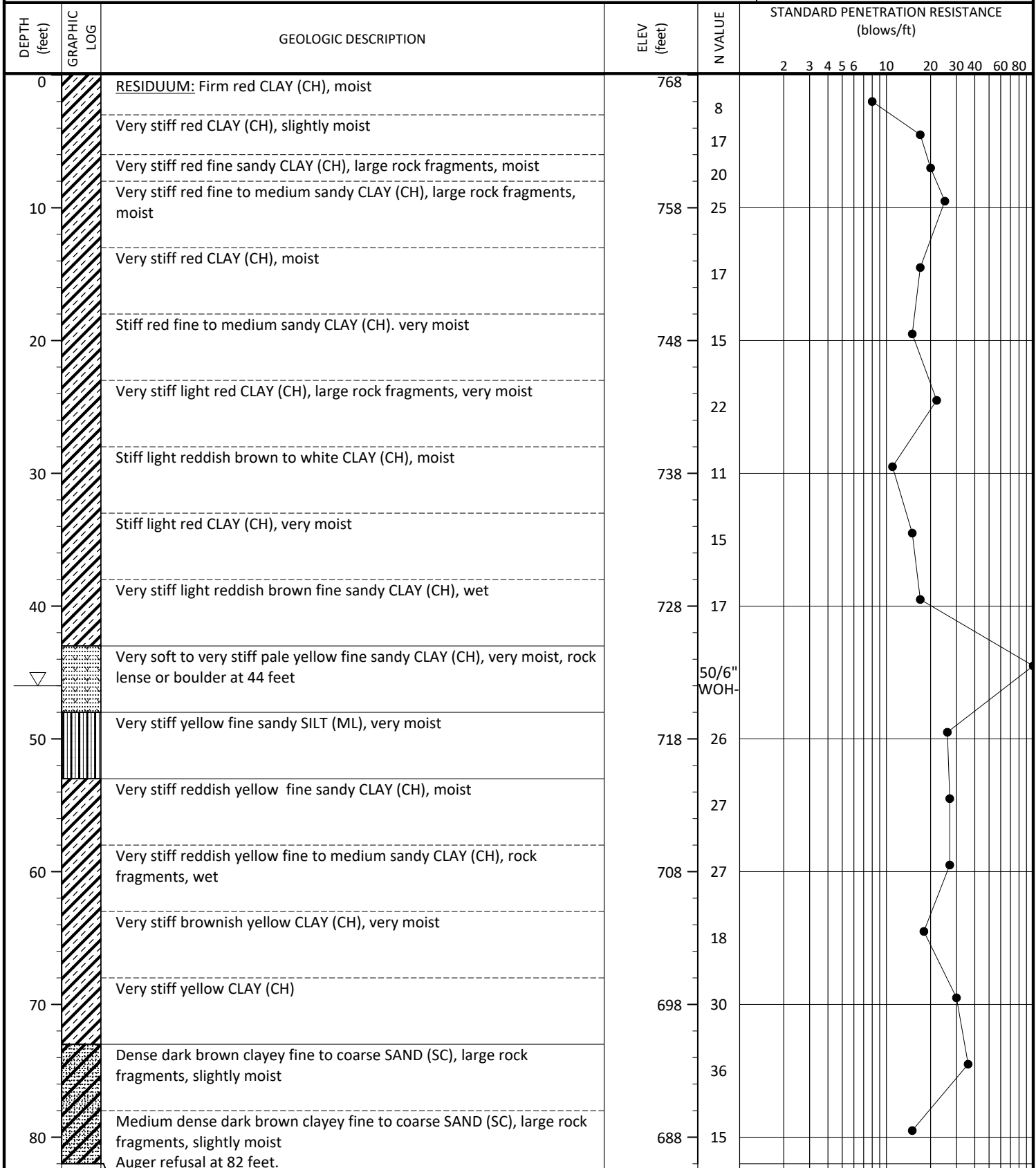
GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>766</i>	NOTES: 1. No Groundwater detected at the time of boring (NGWE). 2. No groundwater observed at/after 24 hours (NGWO).
DATE DRILLED: <i>6/6/2024</i>	BORING DEPTH (feet): <i>32</i>	
DRILLER: <i>RANGER CONSULTING, INC.</i>	WATER LEVEL ∇ TOB (feet): <i>NGWE</i> \blacktriangledown 24HR (feet): <i>NGWO</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
0			766																		
10		Auger boring: No samples collected/recovered. (See log of boring B-4 for soil description)	756																		
20			746																		
30		Undisturbed Sample (Shelby Tube) 30' to 32', 100% Recovery	736																		
		Boring terminated at 32 feet.																			

**CITY OF CALHOUN, GEORGIA
 NEW 2.0-MILLION GALLON GROUND STORAGE TANK
 GORDON COUNTY, GEORGIA**

LOG OF BORING B-5

GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>768</i>	NOTES: 1. Groundwater detected at 46 feet at time of boring. 2. No ground water observed after 24 hours (NGWO). 3. Weight of hammer (WOH).
DATE DRILLED: <i>6/6/2024</i>	BORING DEPTH (feet): <i>82</i>	
DRILLER: <i>RANGER CONSULTING, INC.</i>	WATER LEVEL ∇ TOB (feet): <i>46</i> \blacktriangledown 24HR (feet): <i>NGWO</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		



**CITY OF CALHOUN, GEORGIA
NEW 2.0-MILLION GALLON GROUND STORAGE TANK
GORDON COUNTY, GEORGIA**

LOG OF BORING B-5A

GEOLOGIST: <i>NA</i>	ELEVATION (feet): <i>768</i>	NOTES: 1. No Groundwater detected at the time of boring (NGWE). 2. No groundwater observed at/after 24 hours (NGWO).
DATE DRILLED: <i>6/6/2024</i>	BORING DEPTH (feet): <i>32</i>	
DRILLER: <i>RANGER CONSULTING, INC.</i>	WATER LEVEL ∇ TOB (feet): <i>NGWE</i> \blacktriangledown 24HR (feet): <i>NGWO</i>	
DRILLING METHOD: <i>HOLLOW STEM AUGER WITH AUTOMATIC HAMMER</i>		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)																
					2	3	4	5	6	10	20	30	40	60	80						
0			768																		
10		Auger boring: No samples collected/recovered. (See log of boring B-5 for soil description)	758																		
20			748																		
30		Undisturbed Sample (Shelby Tube) 30' to 32', 100% Recovery	738																		
		Boring terminated at 32 feet.																			

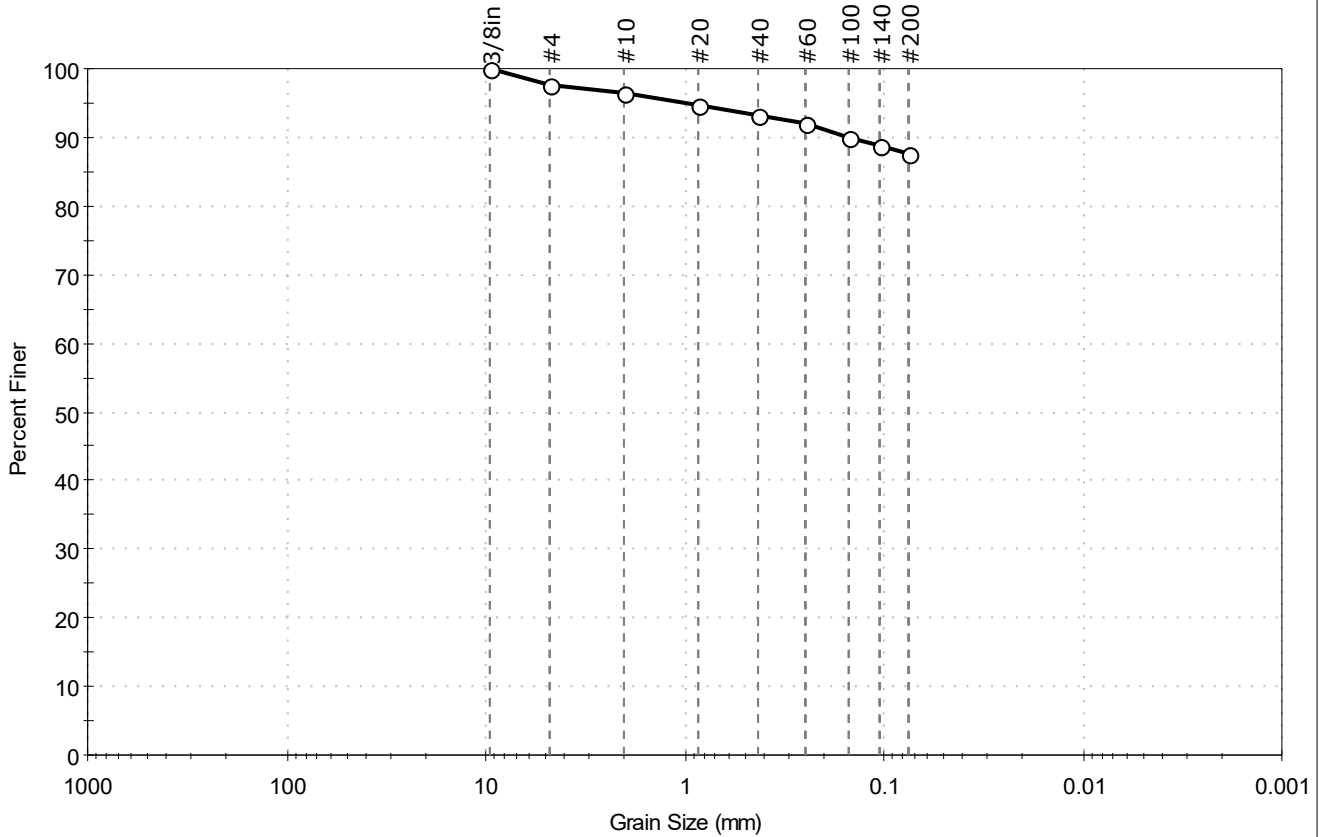
APPENDIX C

LABORATORY SOIL TEST REPORTS



Client:	GeoSystems Engineering, Inc.		
Project:	Calhoun Utilities - Firetower Road Water Tank		
Location:	Calhoun, Gordon County, GA	Project No:	GTX-319291
Boring ID:	B-1	Sample Type:	Tube
Sample ID:	UDS-1	Test Date:	06/25/24
Depth :	18-20 ft	Test Id:	360045
Test Comment:	---		
Visual Description:	Moist, yellowish brown clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	2.3	10.1	87.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8in	9.50	100		
#4	4.75	98		
#10	2.00	97		
#20	0.85	95		
#40	0.42	93		
#60	0.25	92		
#100	0.15	90		
#140	0.11	89		
#200	0.075	88		

<u>Coefficients</u>	
D ₈₅ = N/A	D ₃₀ = N/A
D ₆₀ = N/A	D ₁₅ = N/A
D ₅₀ = N/A	D ₁₀ = N/A
C _u = N/A	C _c = N/A

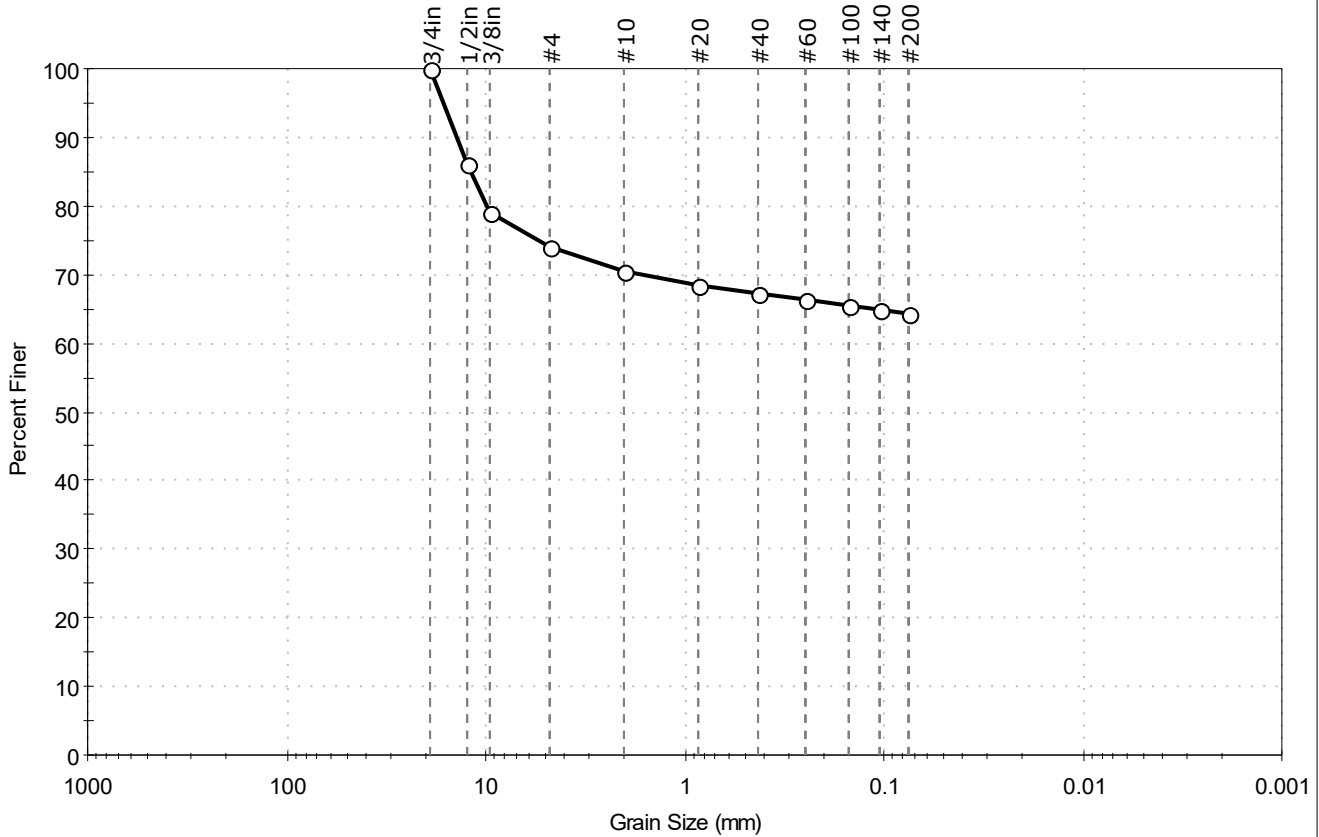
<u>Classification</u>	
<u>ASTM</u>	Fat CLAY (CH)
<u>AASHTO</u>	Clayey Soils (A-7-5 (33))

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---



Client:	GeoSystems Engineering, Inc.		
Project:	Calhoun Utilities - Firetower Road Water Tank		
Location:	Calhoun, Gordon County, GA	Project No:	GTX-319291
Boring ID:	B-4	Sample Type:	Tube
Sample ID:	UDS-2	Test Date:	06/25/24
Depth :	30-32 ft	Test Id:	360046
Test Comment:	---		
Visual Description:	Moist, yellowish red gravelly clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	25.9	9.9	64.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4in	19.00	100		
1/2in	12.50	86		
3/8in	9.50	79		
#4	4.75	74		
#10	2.00	70		
#20	0.85	68		
#40	0.42	67		
#60	0.25	66		
#100	0.15	65		
#140	0.11	65		
#200	0.075	64		

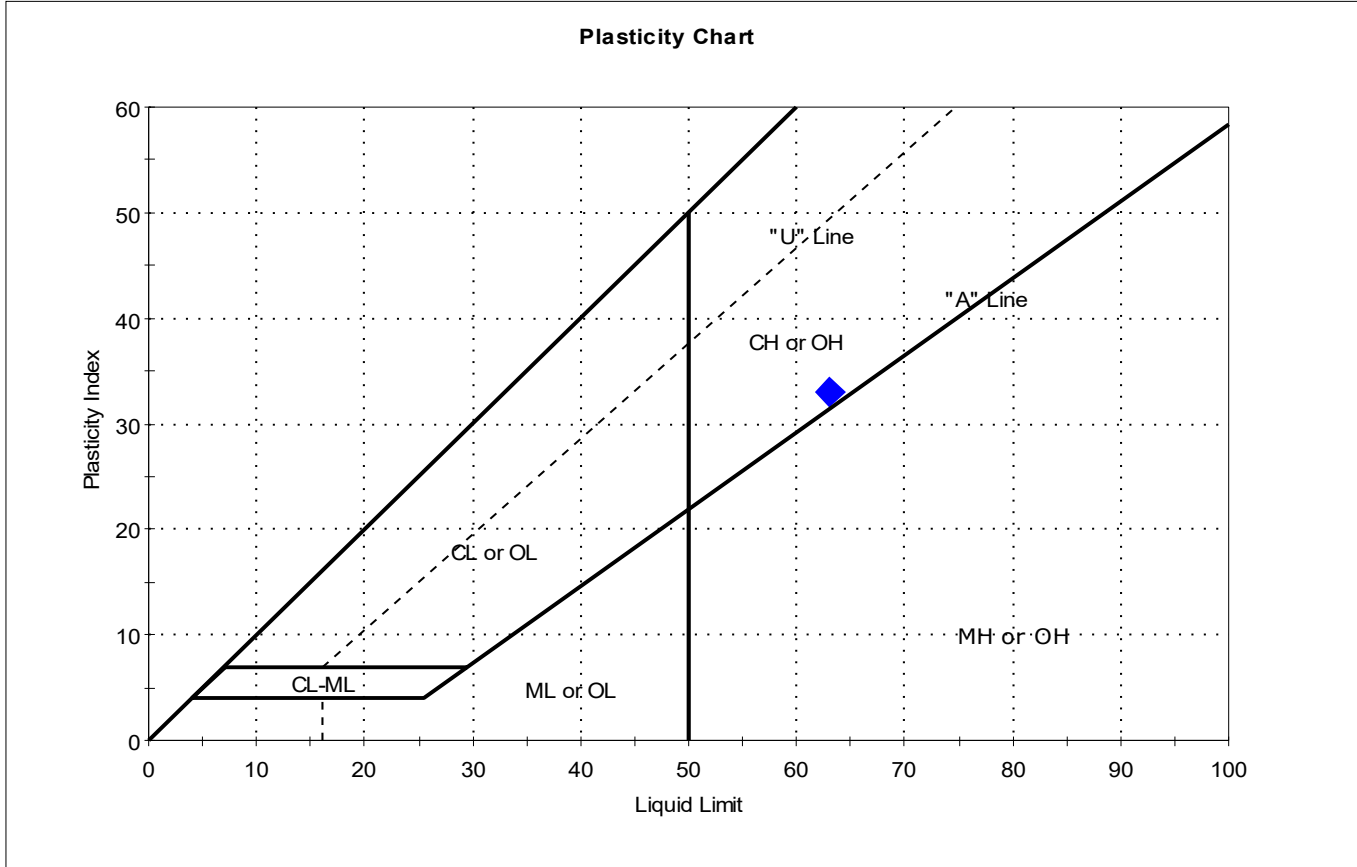
Coefficients	
D ₈₅ = 11.9750 mm	D ₃₀ = N/A
D ₆₀ = N/A	D ₁₅ = N/A
D ₅₀ = N/A	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification	
ASTM	Gravelly Fat CLAY (CH)
AASHTO	Clayey Soils (A-7-5 (25))

Sample/Test Description
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD

Client:	GeoSystems Engineering, Inc.		
Project:	Calhoun Utilities - Firetower Road Water Tank		
Location:	Calhoun, Gordon County, GA	Project No:	GTX-319291
Boring ID:	B-1	Sample Type:	Tube
Sample ID:	UDS-1	Test Date:	06/21/24
Depth:	18-20 ft	Test Id:	360043
Test Comment:	---		
Visual Description:	Moist, yellowish brown clay		
Sample Comment:	---		

Atterberg Limits - ASTM D4318

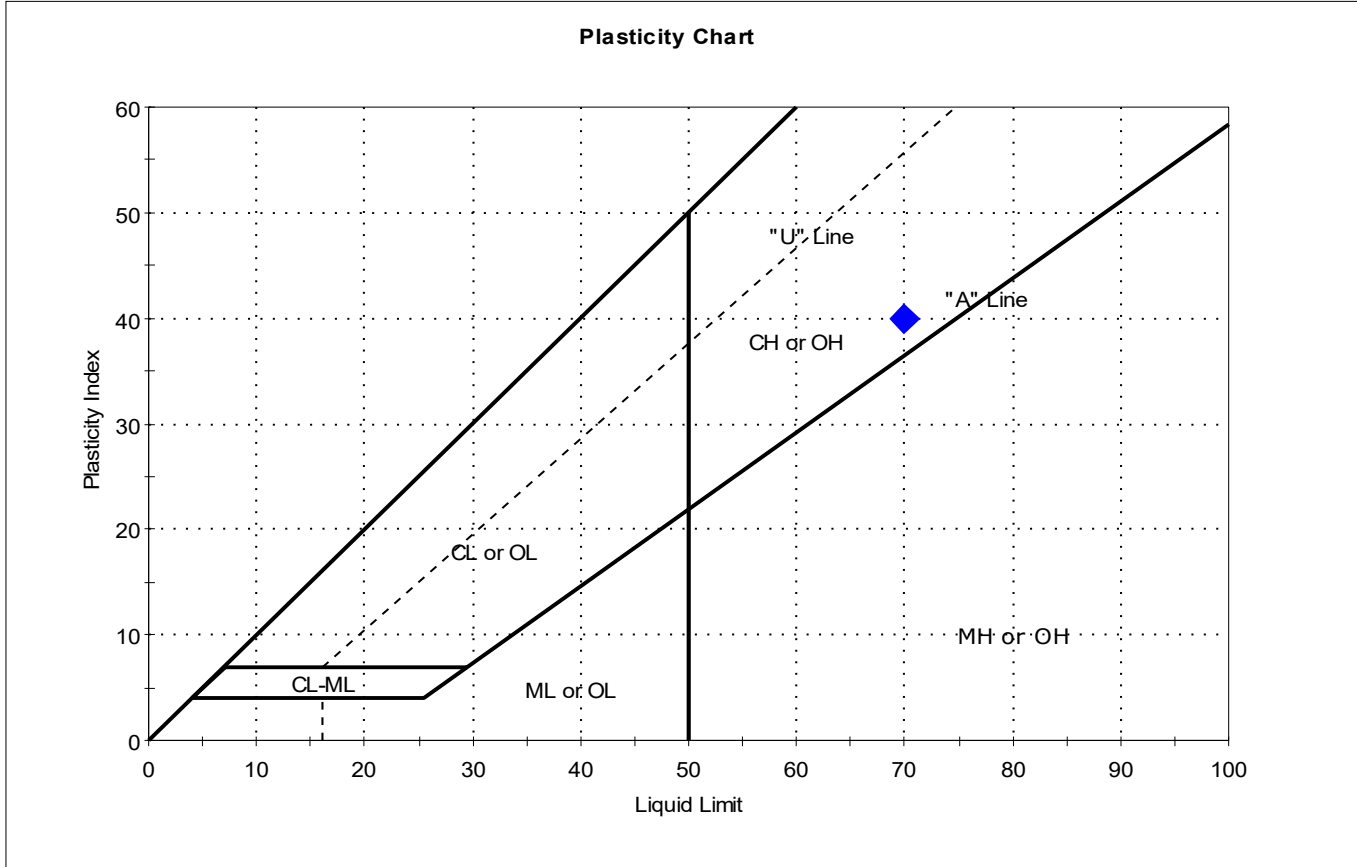


Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	UDS-1	B-1	18-20 ft	30	63	30	33	0	Fat CLAY (CH)

Sample Prepared using the WET method
 7% Retained on #40 Sieve
 Dry Strength: MEDIUM
 Dilatancy: NONE
 Toughness: MEDIUM

Client:	GeoSystems Engineering, Inc.		
Project:	Calhoun Utilities - Firetower Road Water Tank		
Location:	Calhoun, Gordon County, GA	Project No:	GTX-319291
Boring ID:	B-4	Sample Type:	Tube
Sample ID:	UDS-2	Test Date:	06/21/24
Depth :	30-32 ft	Test Id:	360044
Test Comment:	---		
Visual Description:	Moist, yellowish red gravelly clay		
Sample Comment:	---		

Atterberg Limits - ASTM D4318

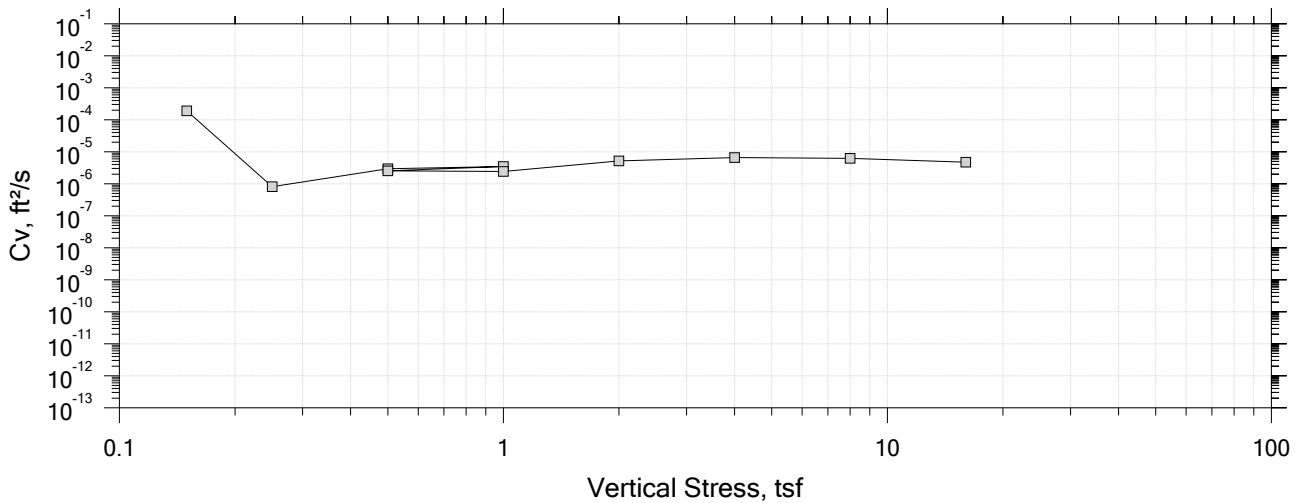
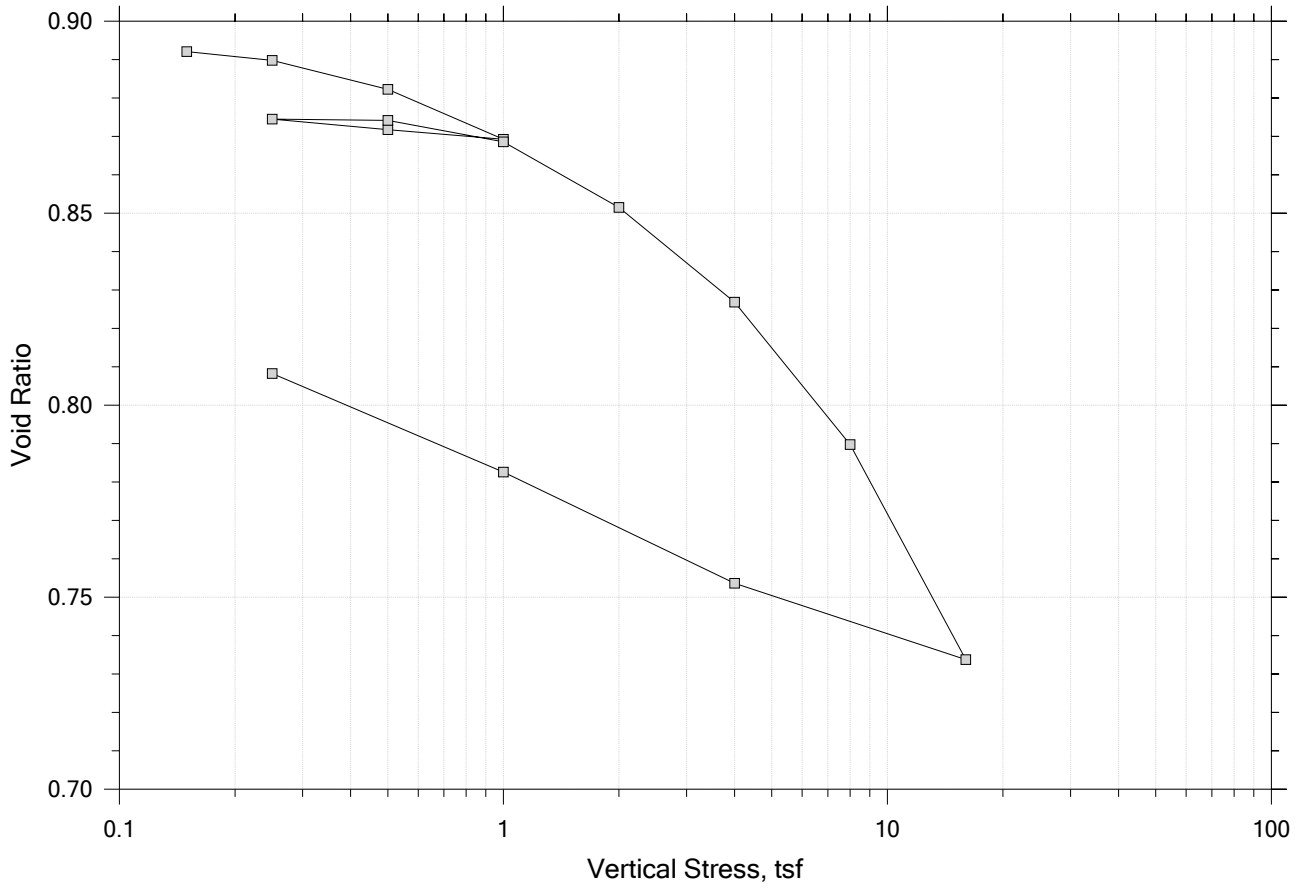



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	UDS-2	B-4	30-32 ft	26	70	30	40	-0.1	Gravelly Fat CLAY (CH)

Sample Prepared using the WET method
 33% Retained on #40 Sieve
 Dry Strength: MEDIUM
 Dilatancy: NONE
 Toughness: MEDIUM

One-Dimensional Consolidation by ASTM D2435 - Method B

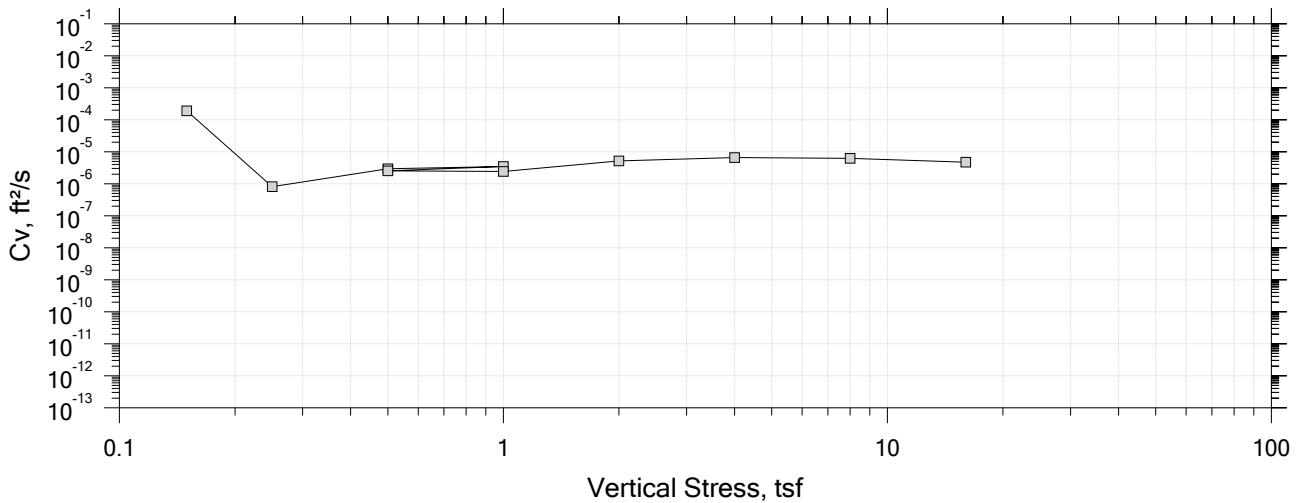
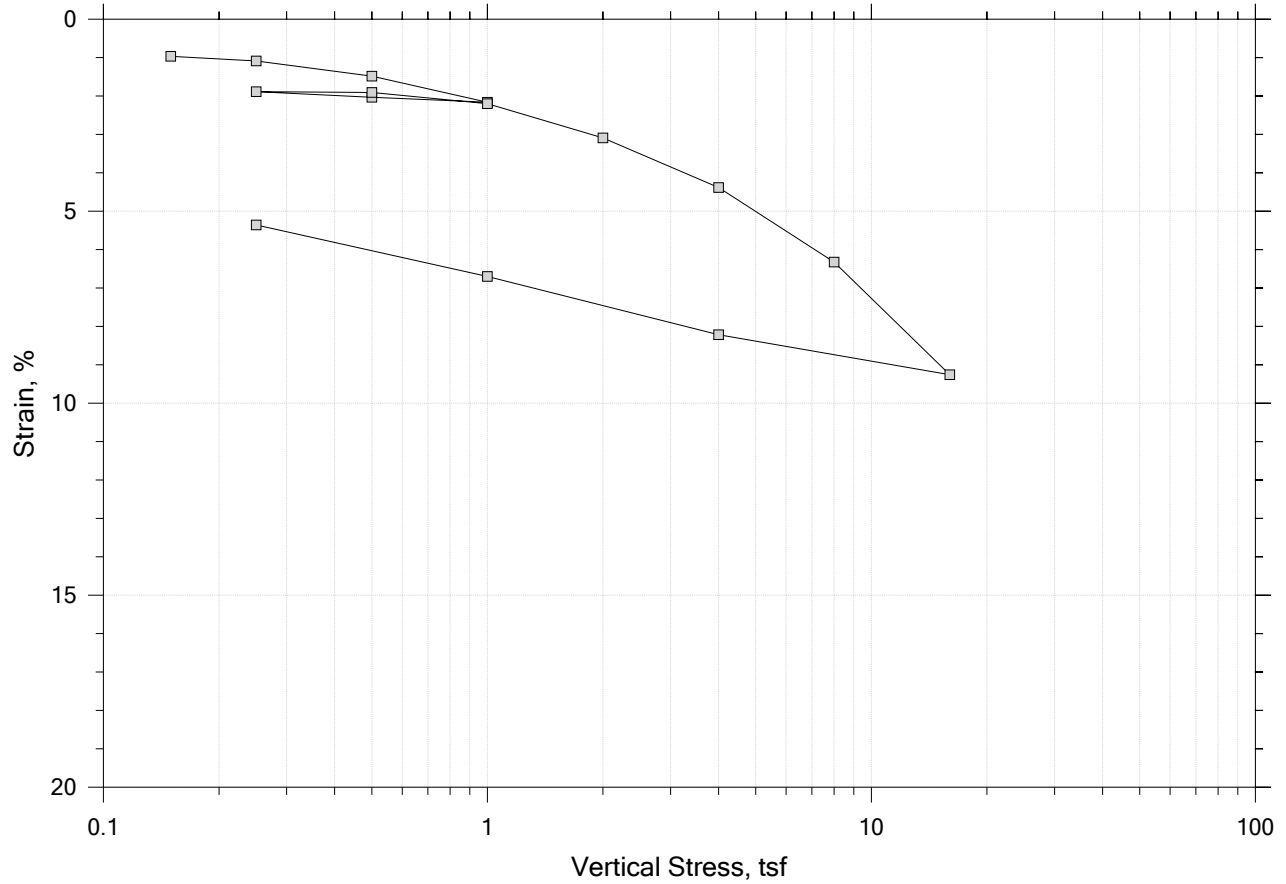
Summary Report




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

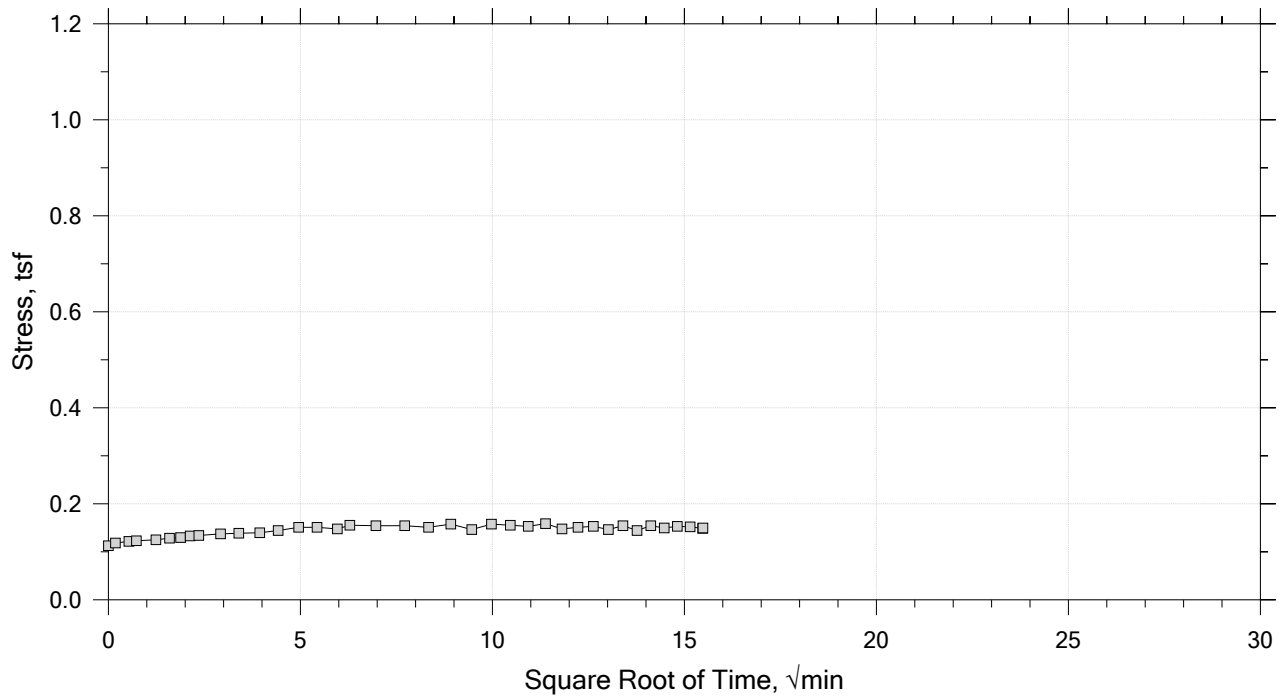
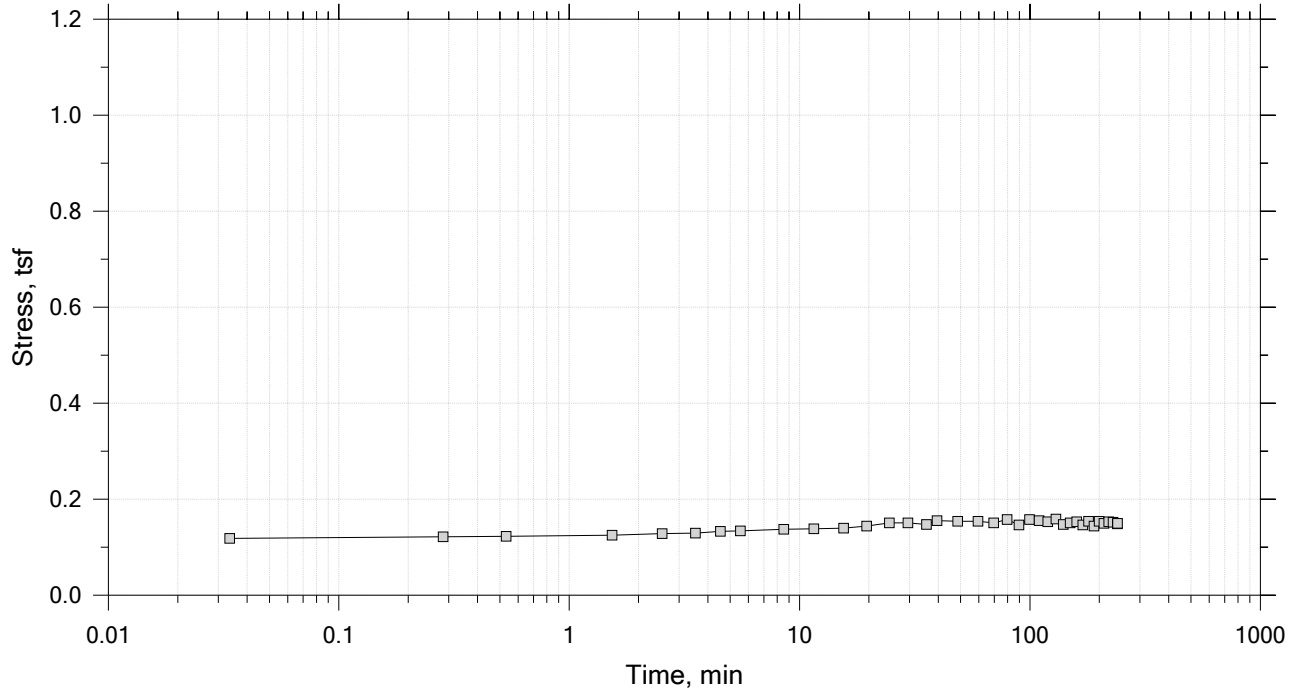
Summary Report




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

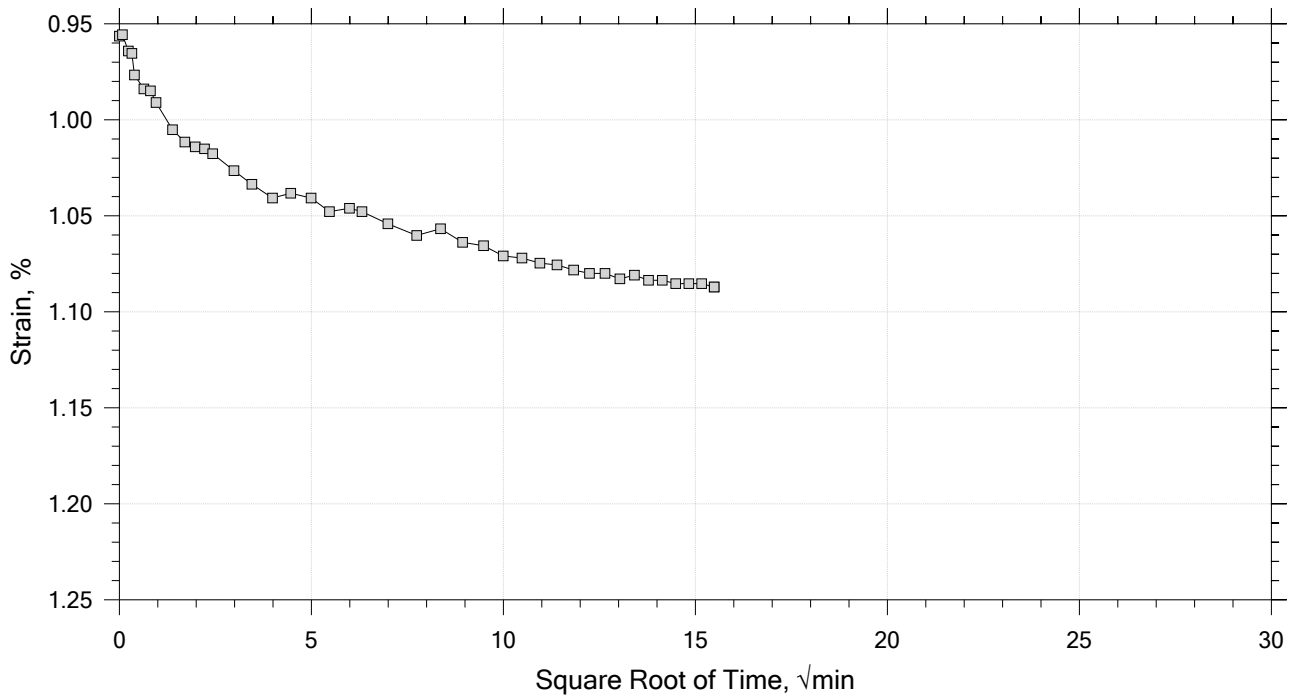
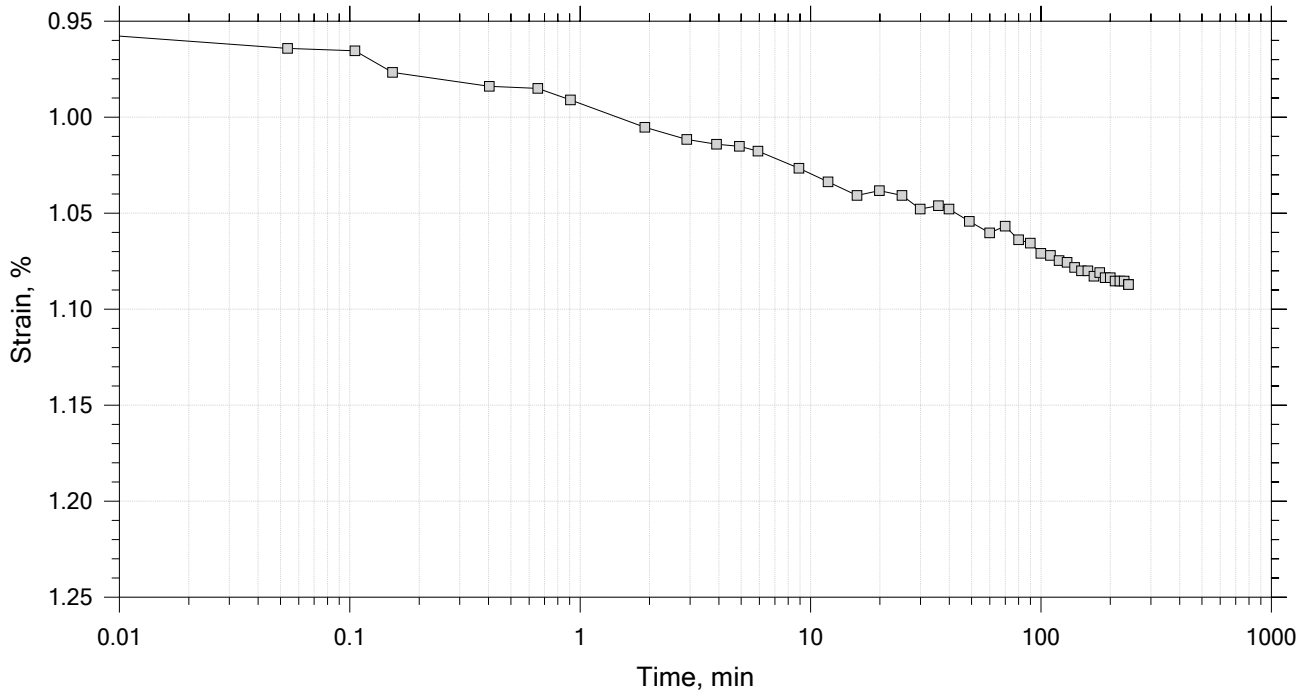
Time Curve 1 of 15
 Constant Volume Step
 Stress: 0.15 tsf




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

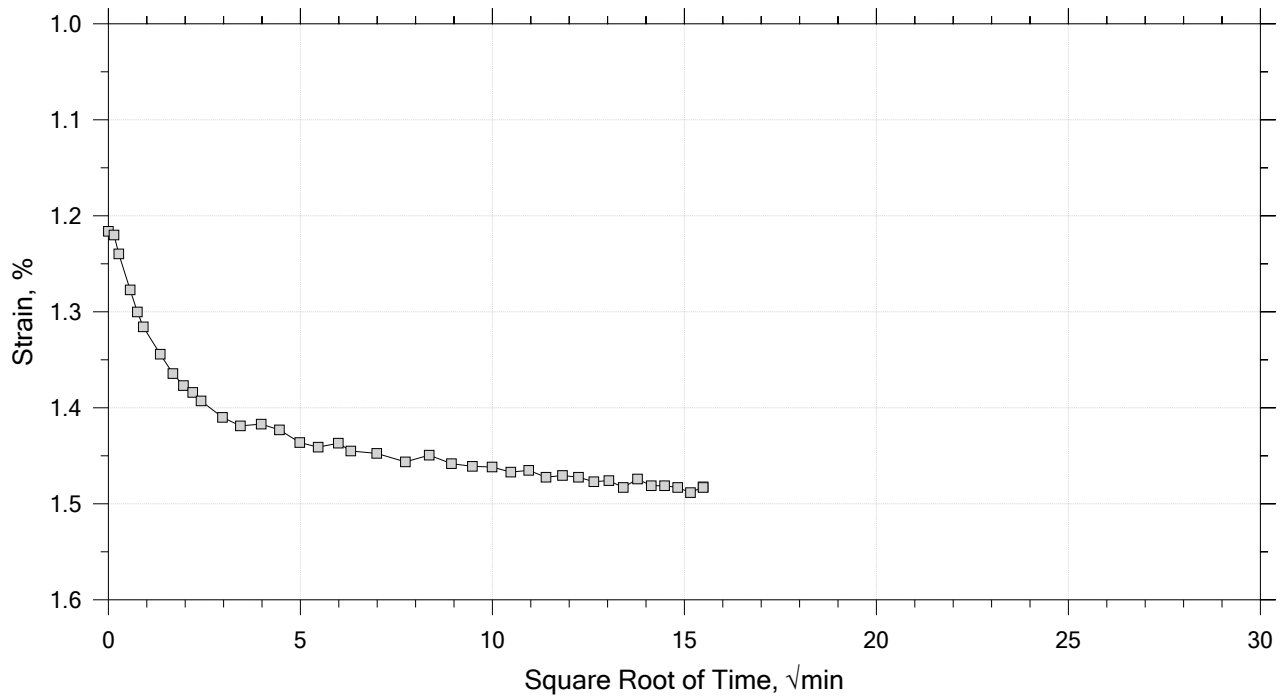
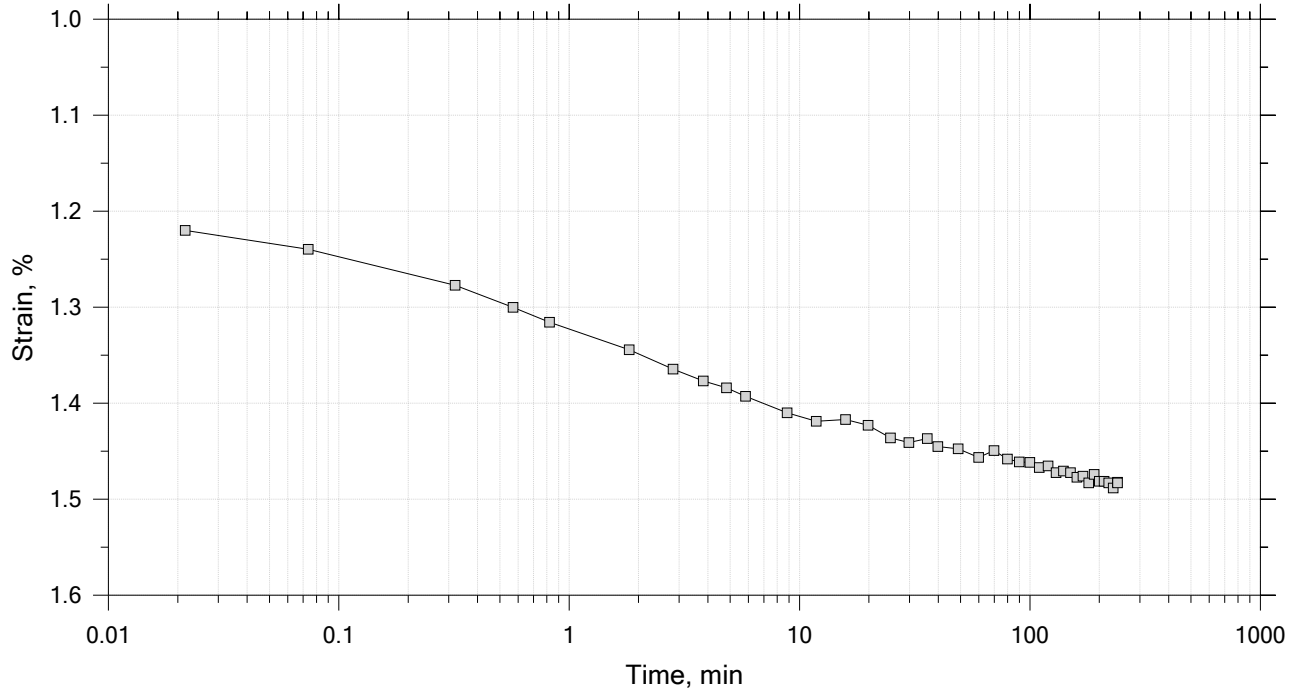
Time Curve 2 of 15
 Constant Load Step
 Stress: 0.25 tsf




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

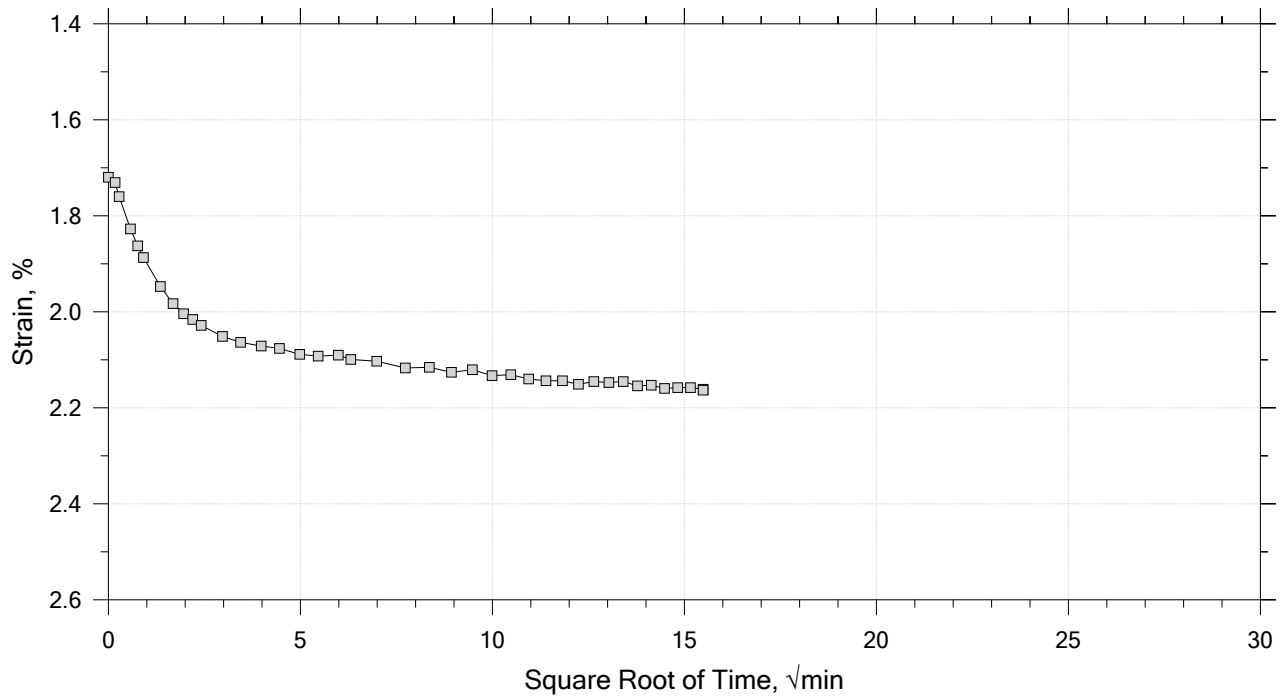
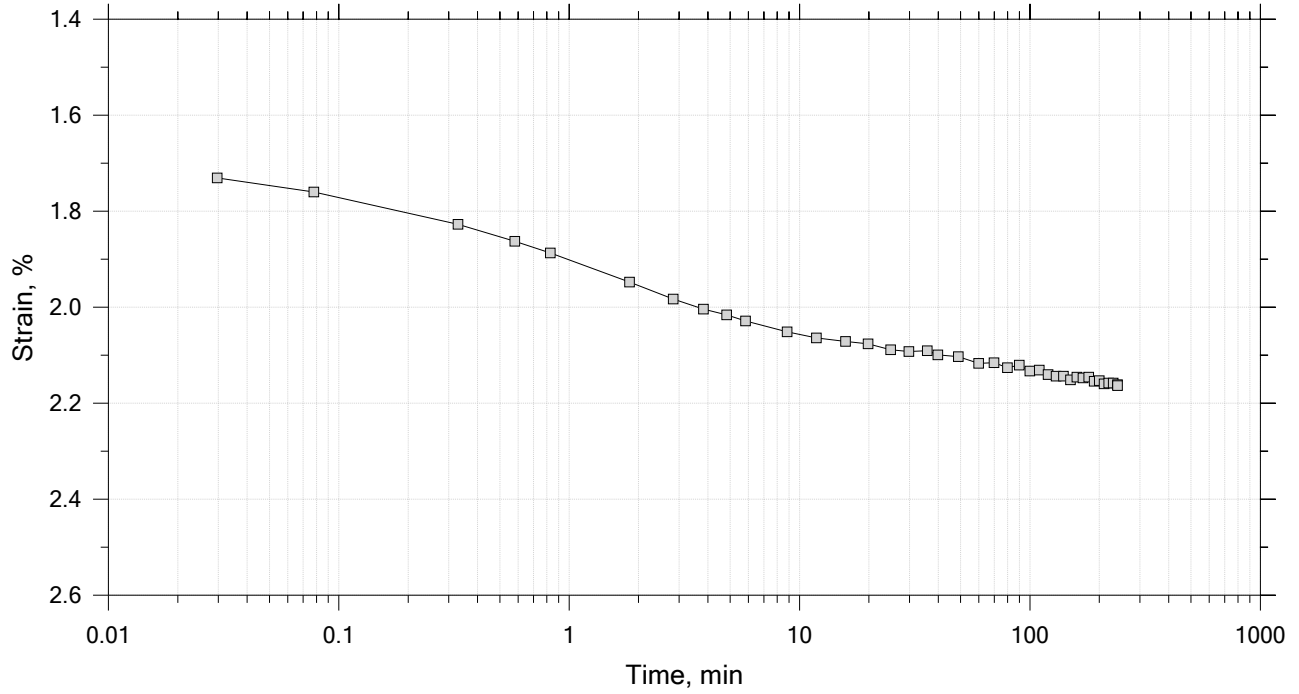
Time Curve 3 of 15
 Constant Load Step
 Stress: 0.5 tsf




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 4 of 15
 Constant Load Step
 Stress: 1 tsf



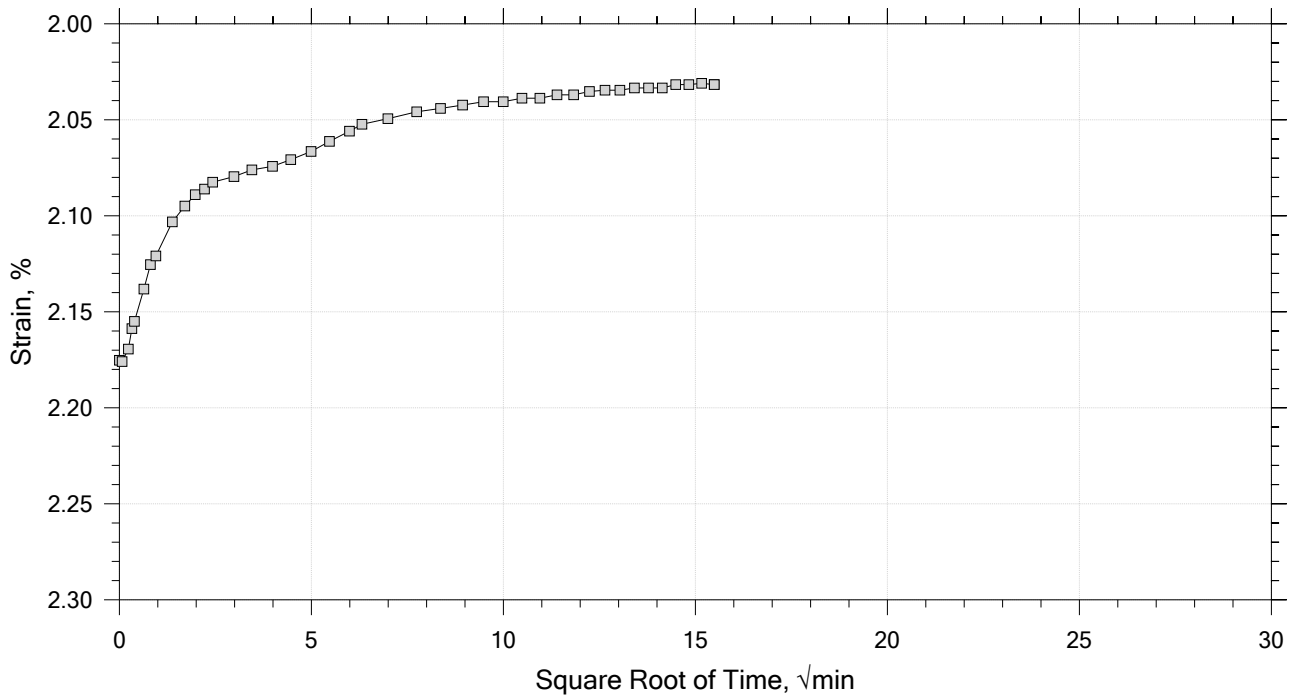
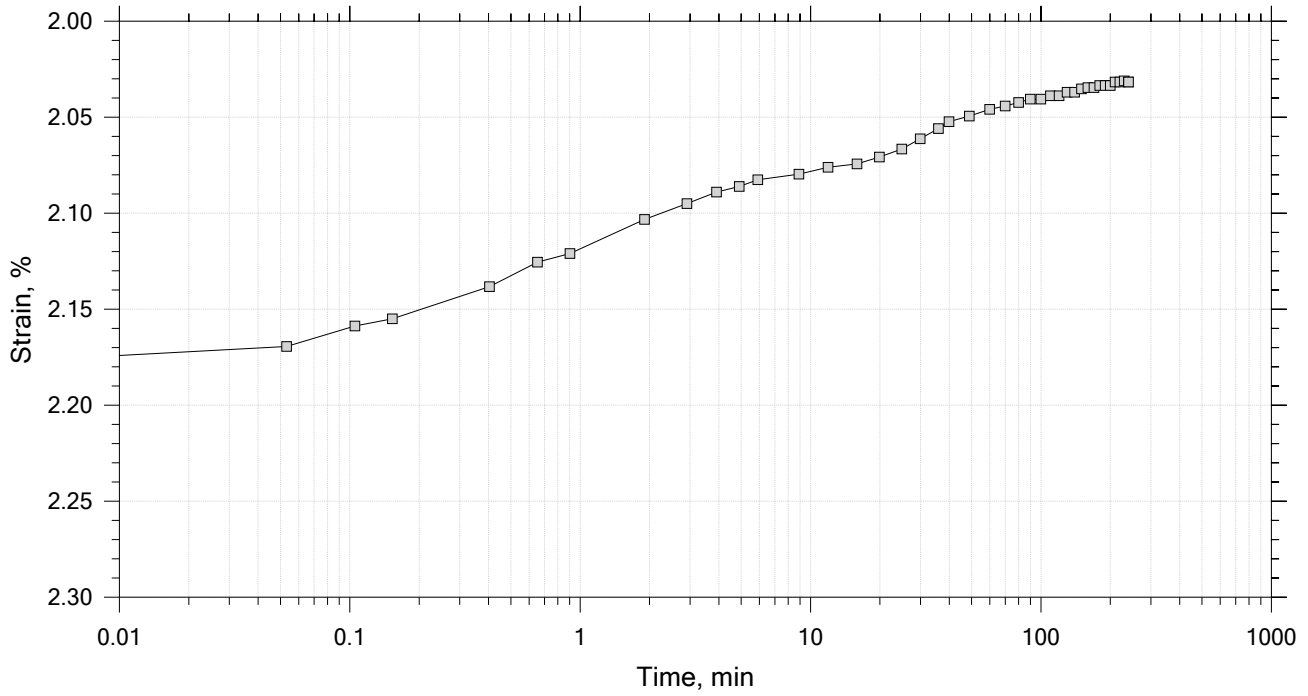
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 5 of 15

Constant Load Step

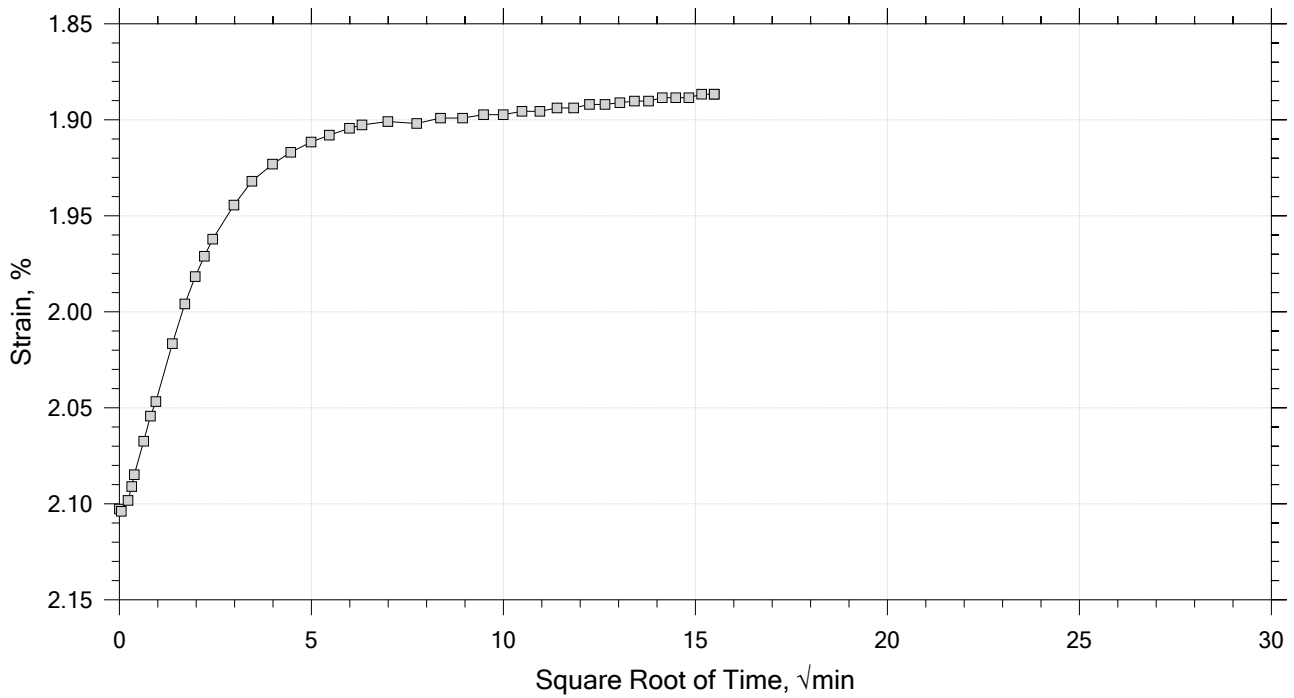
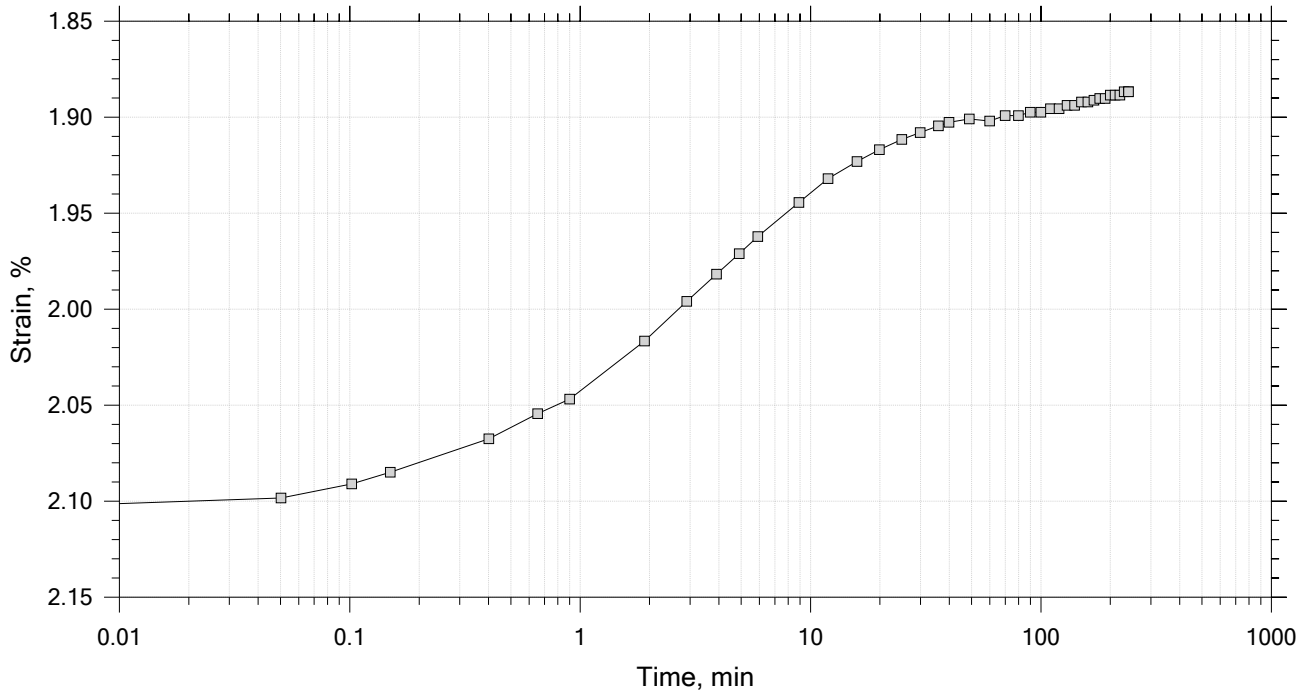
Stress: 0.5 tsf




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 6 of 15
 Constant Load Step
 Stress: 0.25 tsf



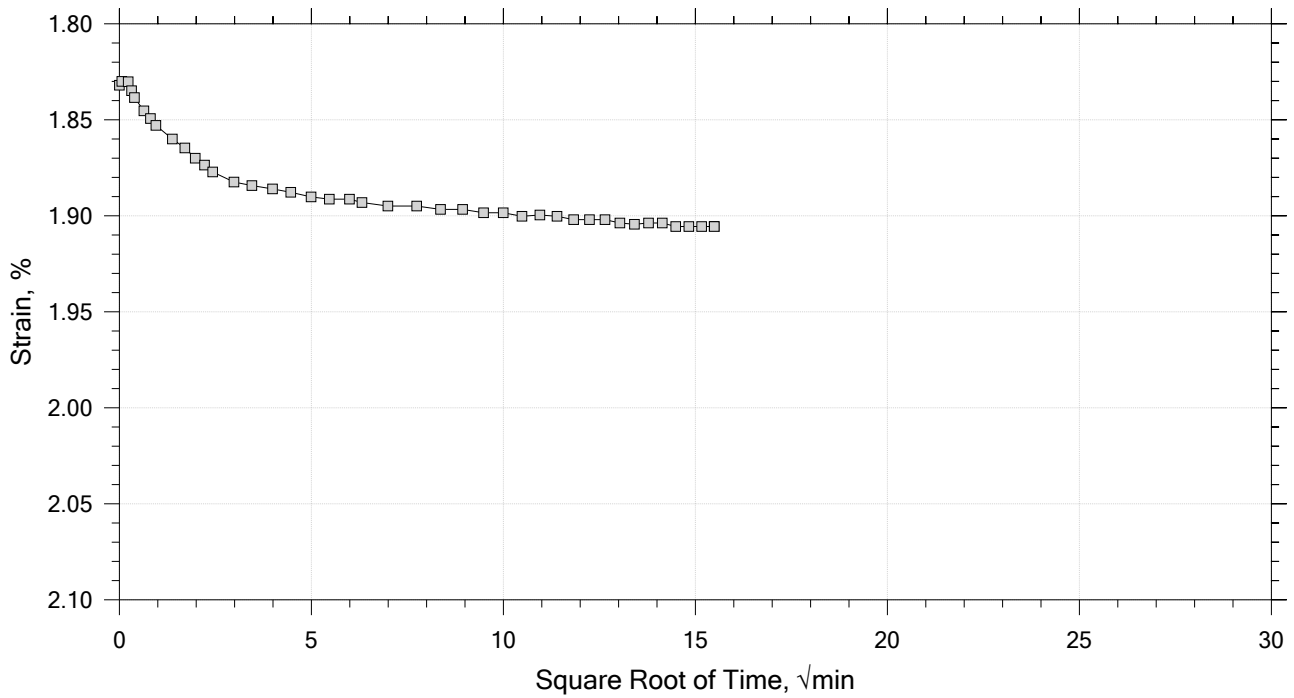
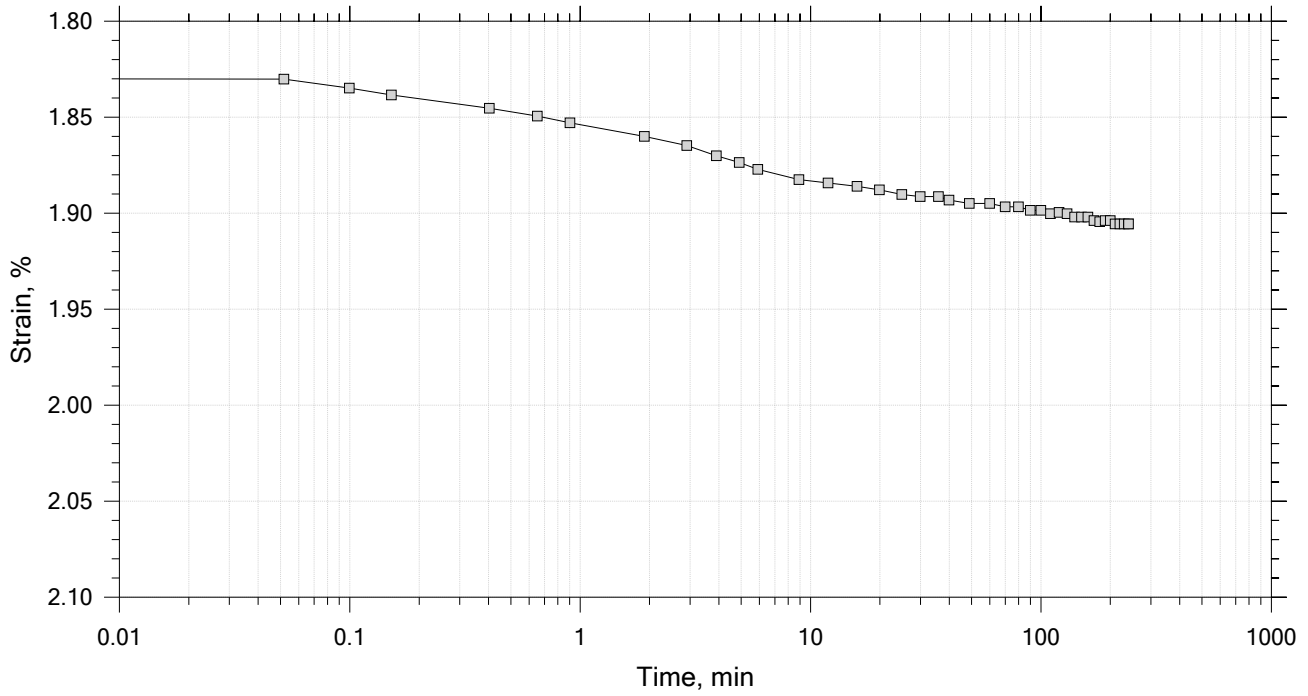
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 7 of 15

Constant Load Step

Stress: 0.5 tsf



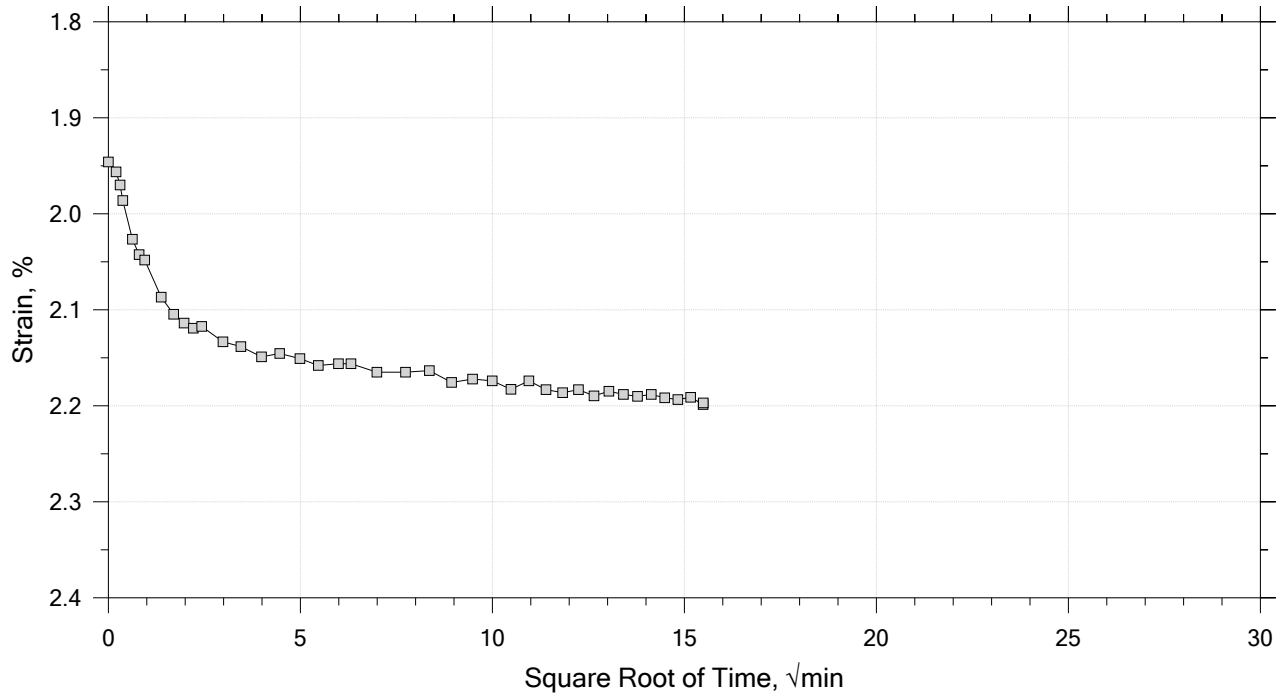
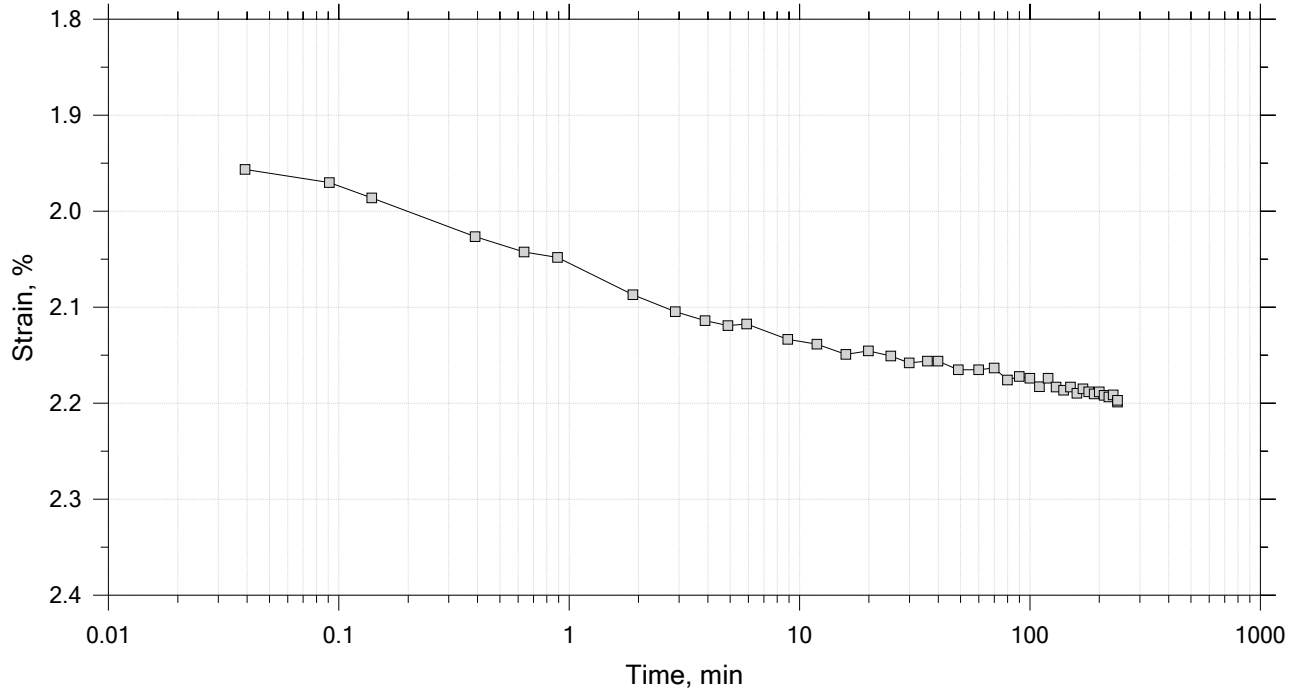
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 8 of 15

Constant Load Step

Stress: 1 tsf



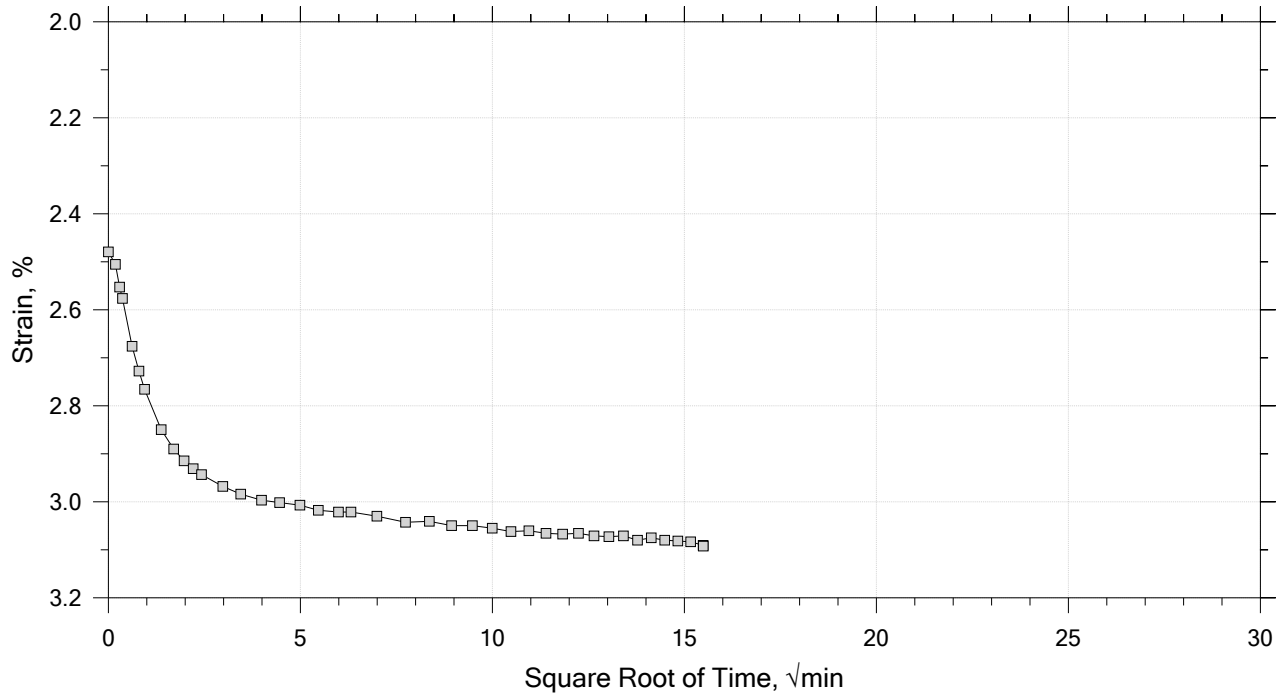
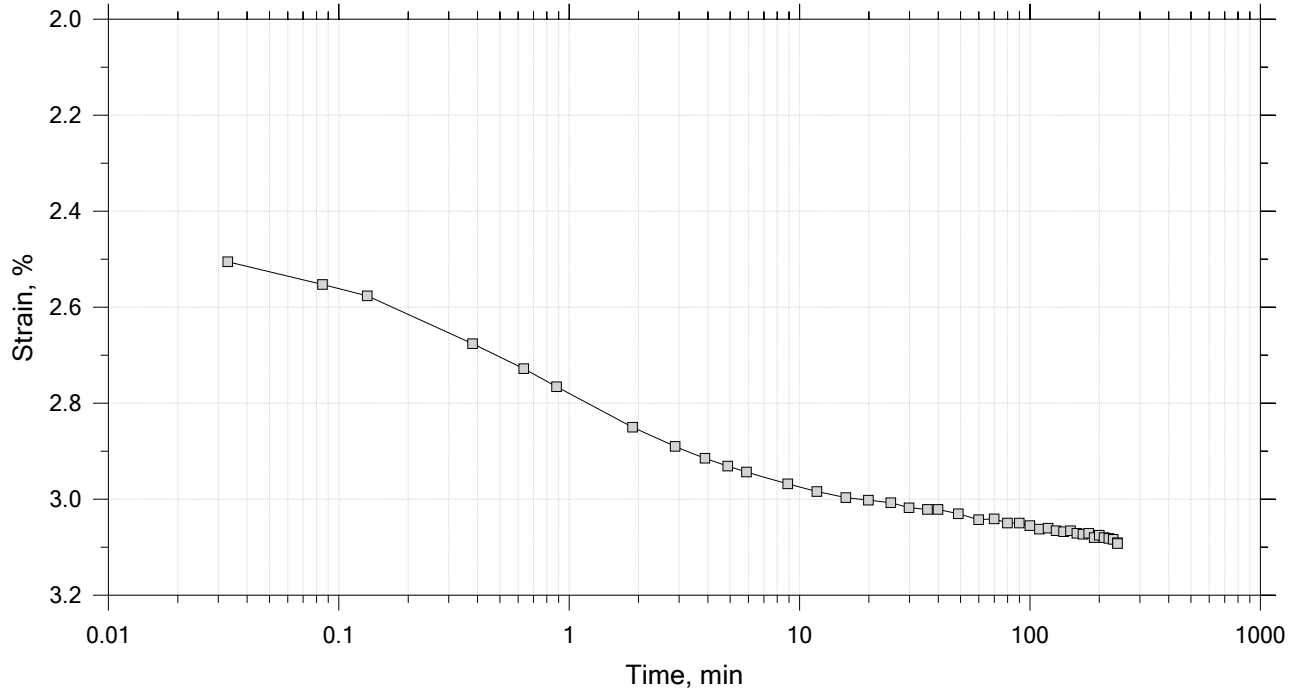
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 15

Constant Load Step

Stress: 2 tsf



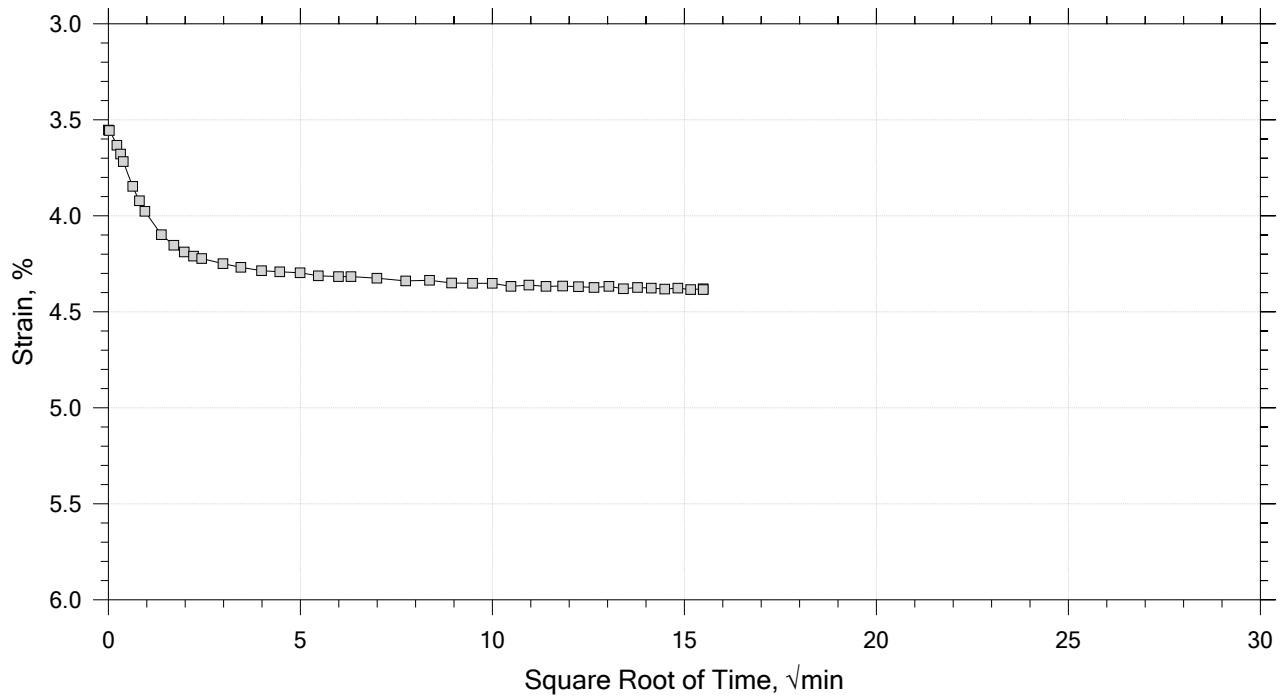
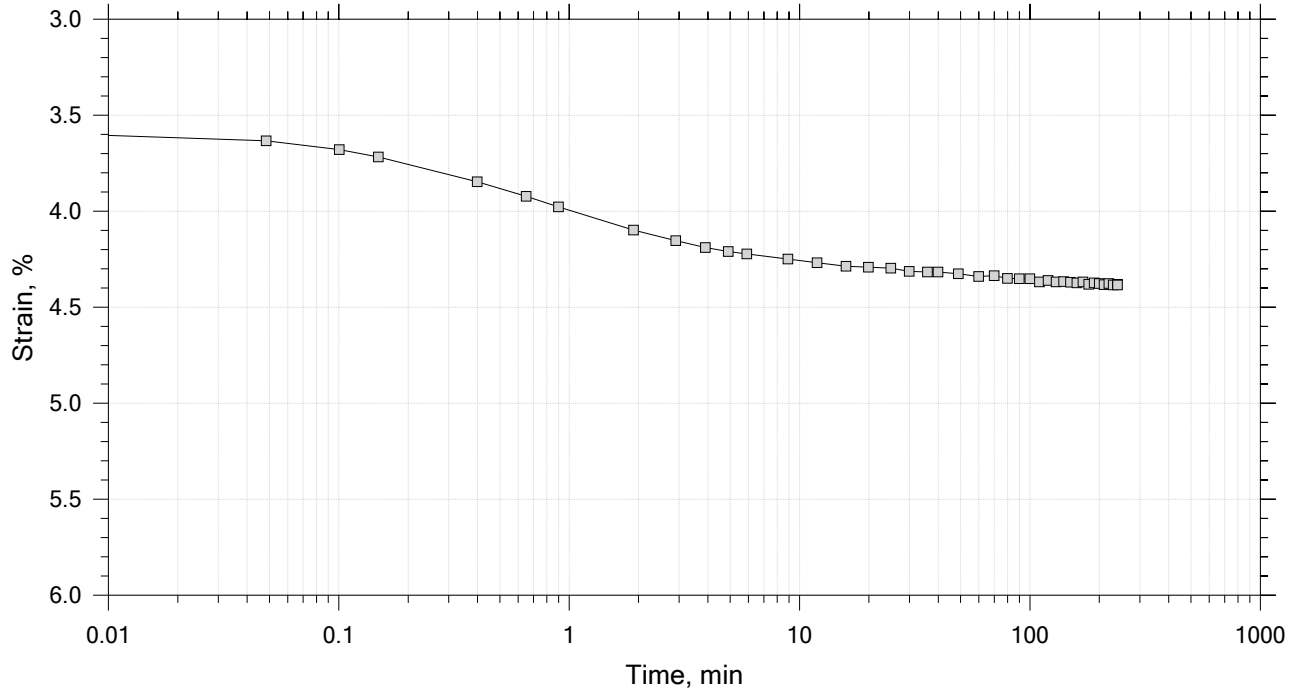
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 15

Constant Load Step

Stress: 4 tsf



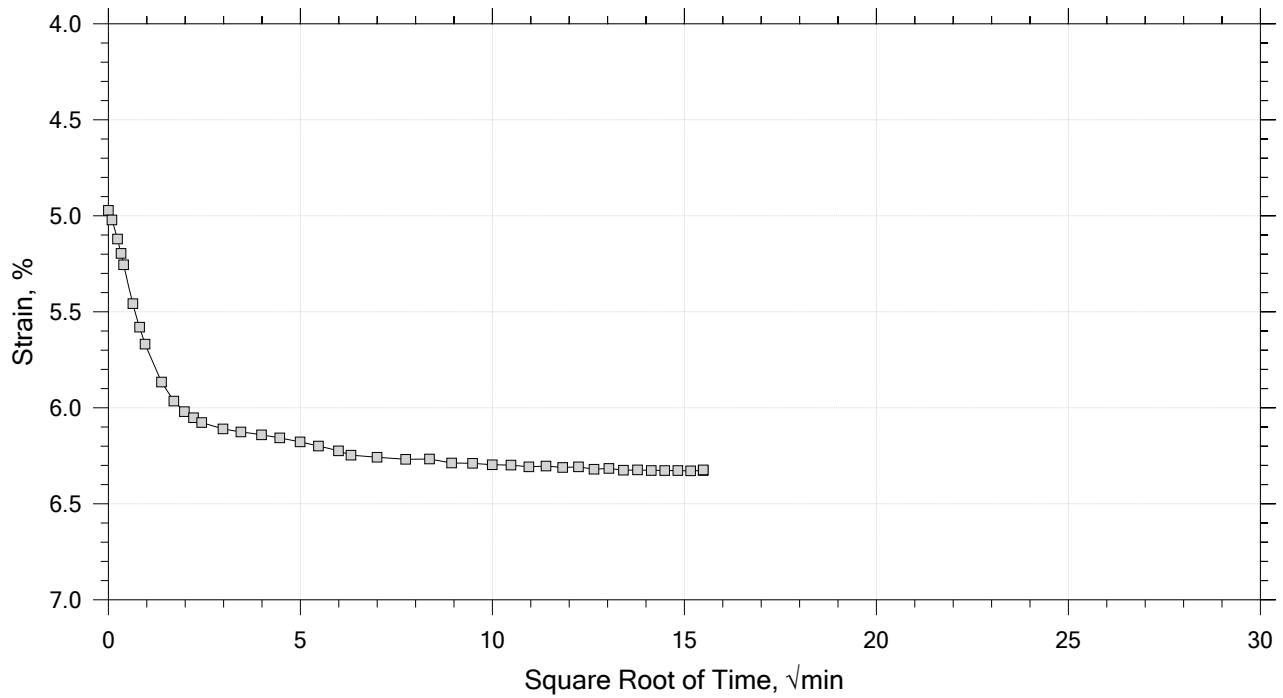
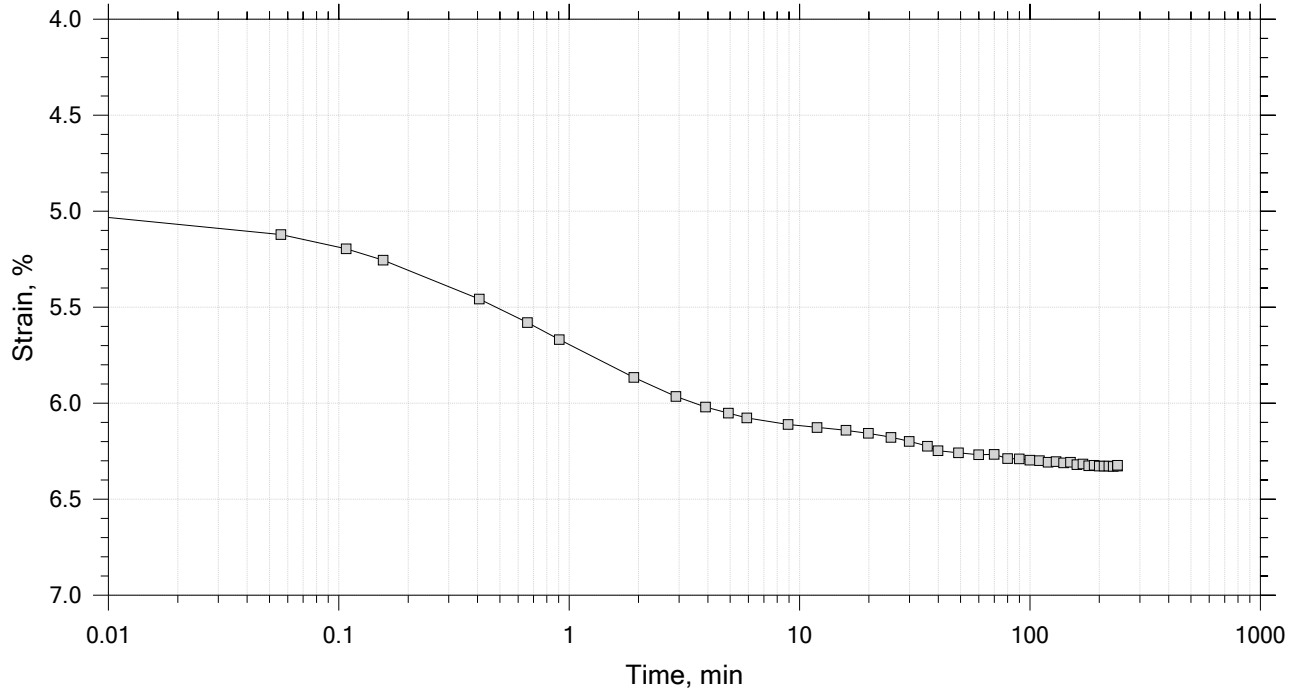
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 15

Constant Load Step

Stress: 8 tsf



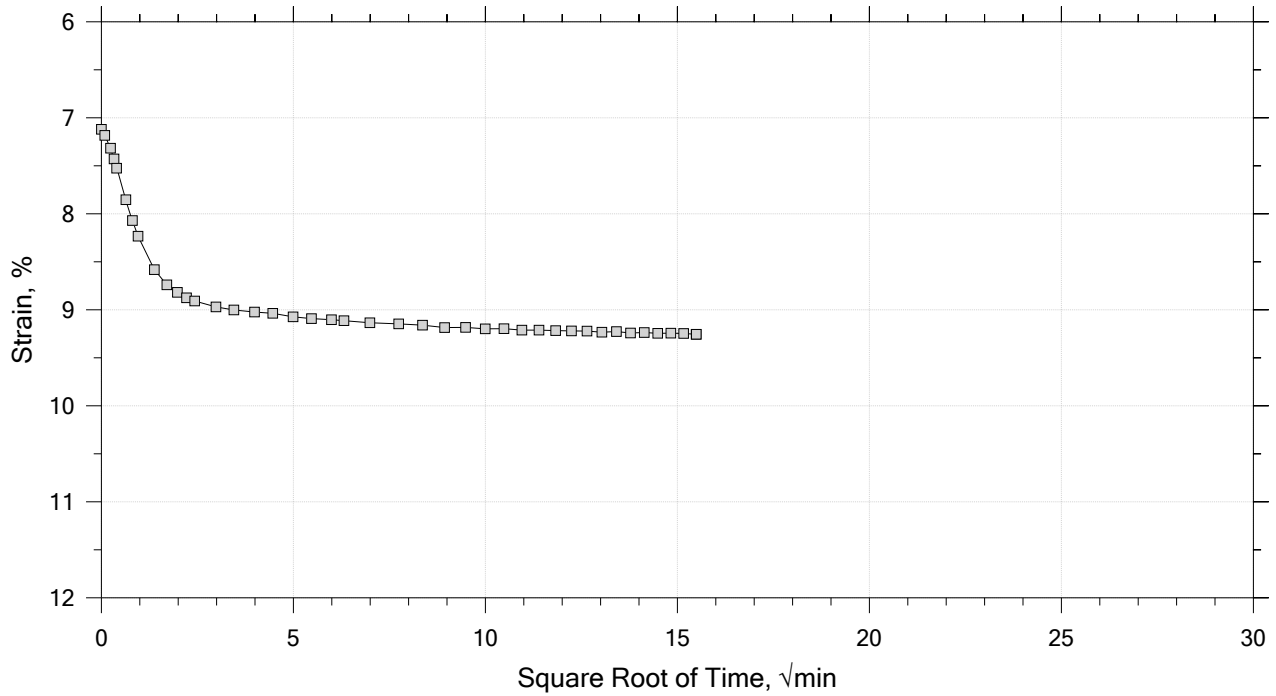
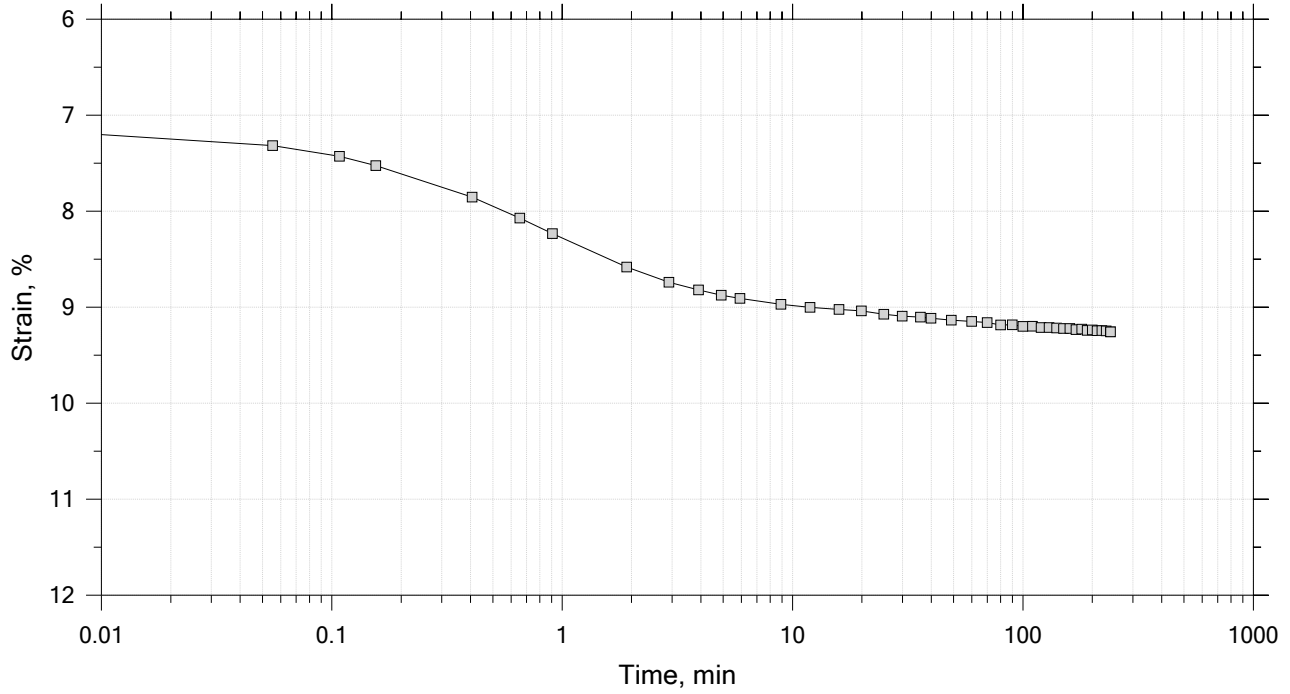
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 12 of 15

Constant Load Step

Stress: 16 tsf



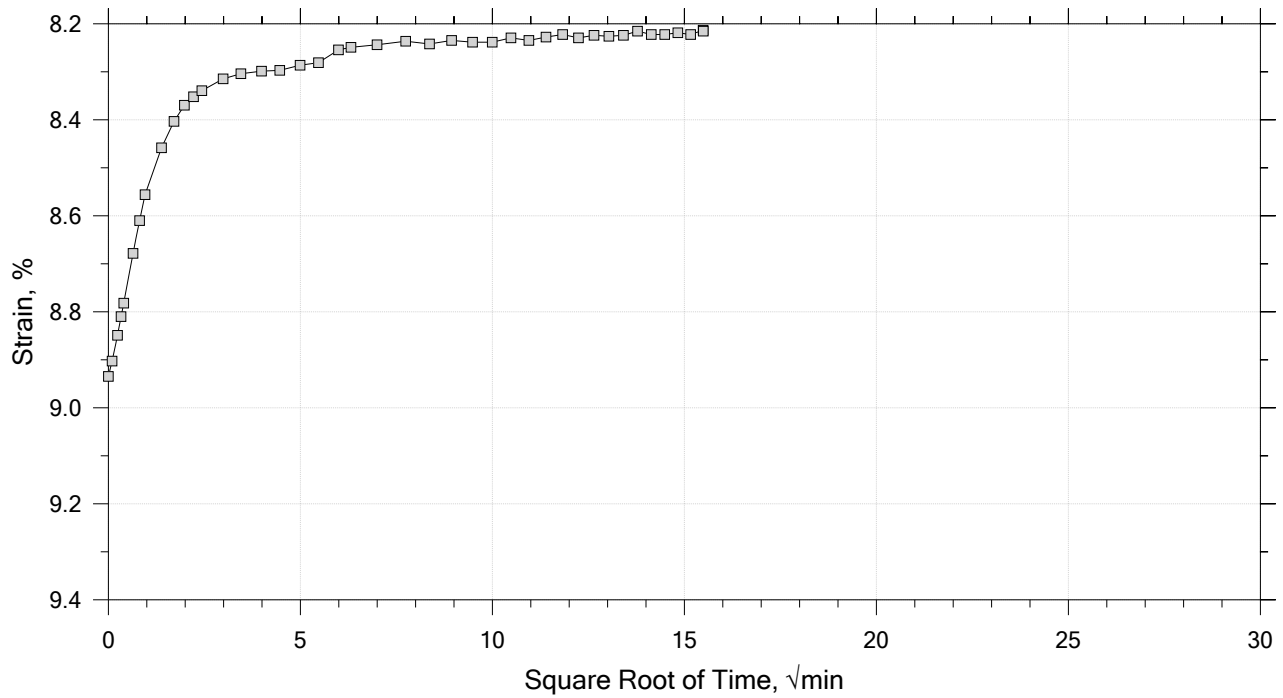
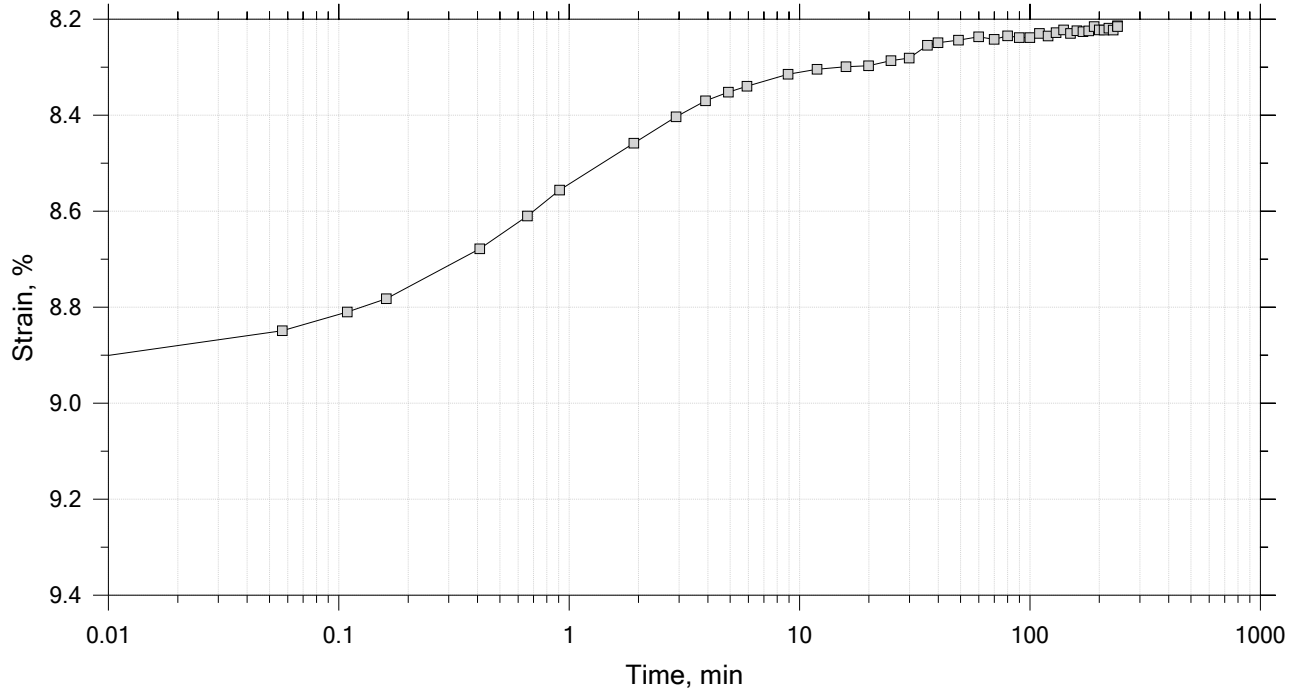
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	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 13 of 15

Constant Load Step

Stress: 4 tsf



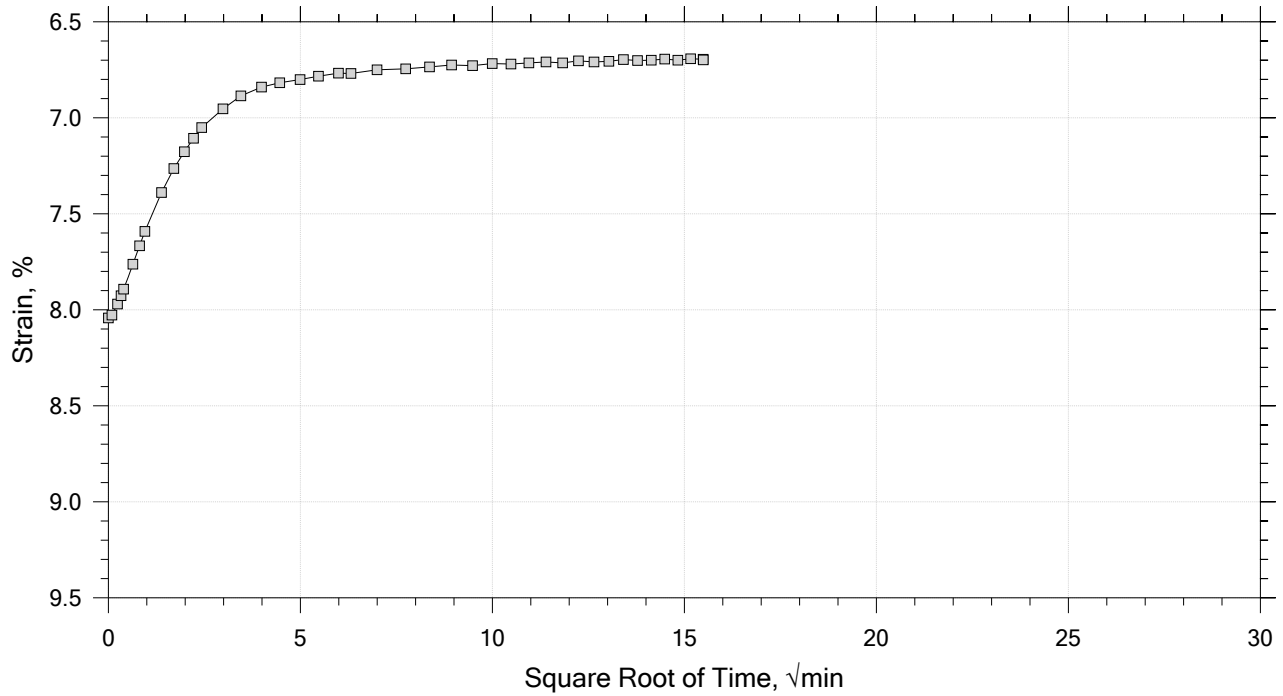
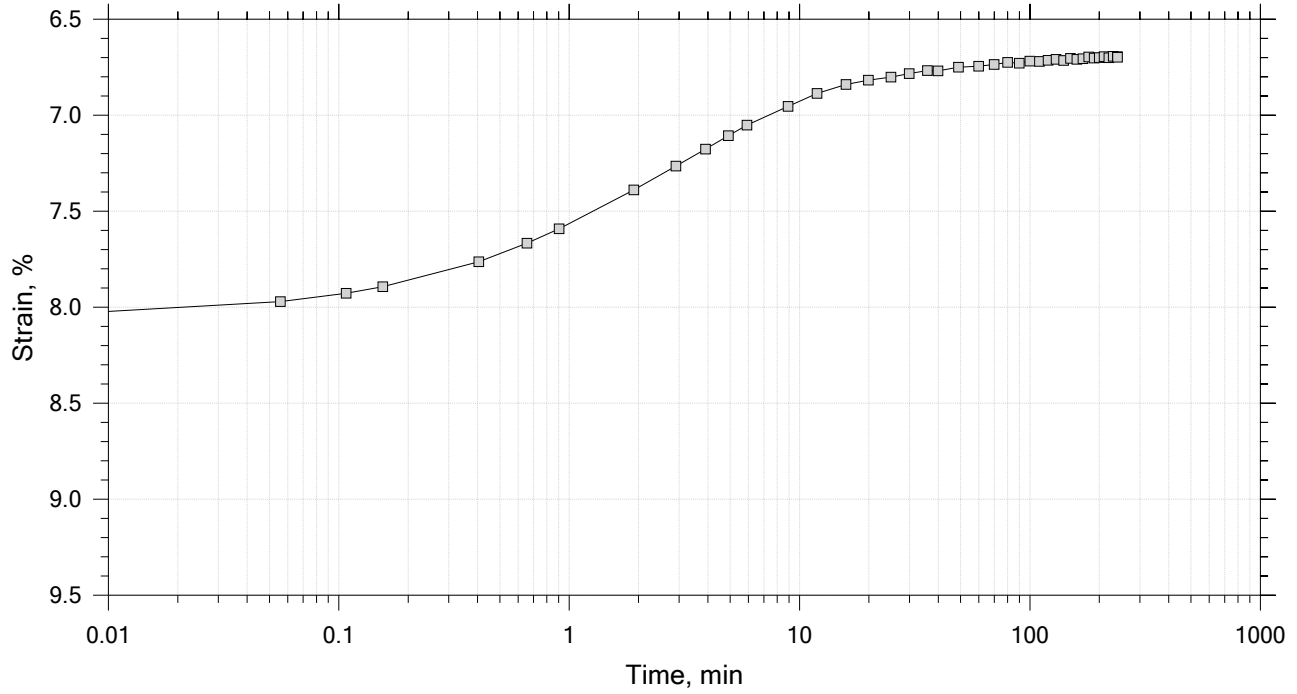
	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 14 of 15

Constant Load Step

Stress: 1 tsf



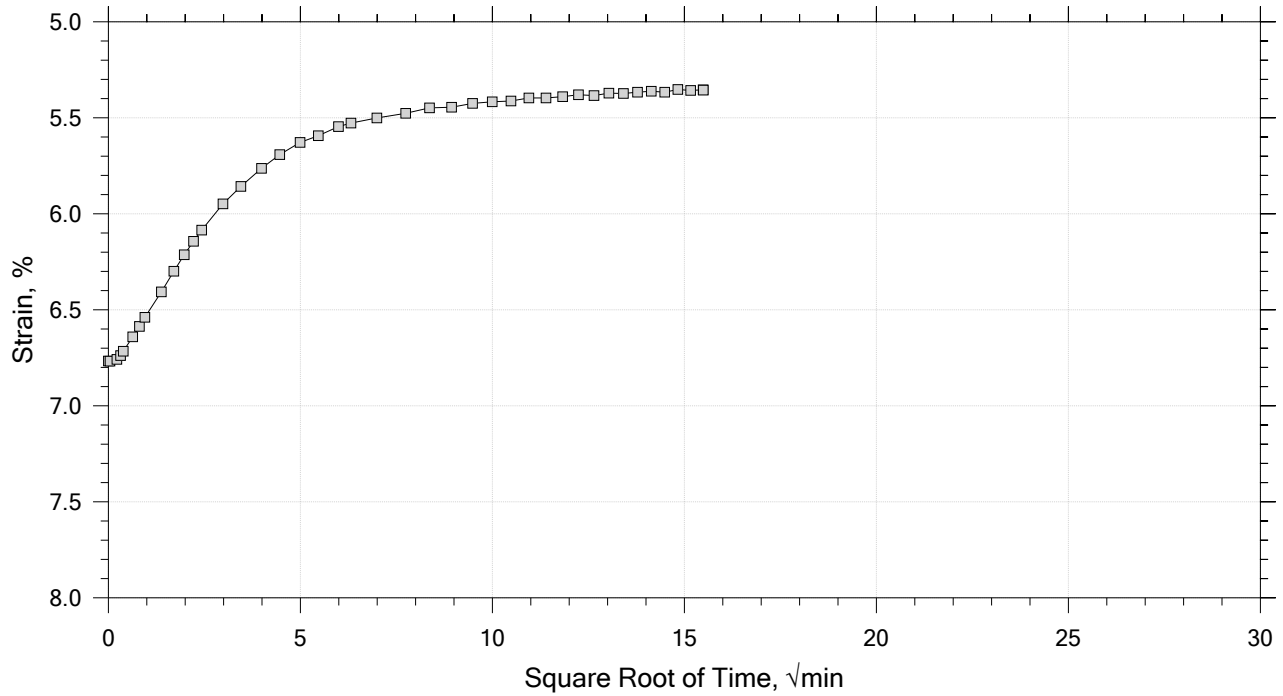
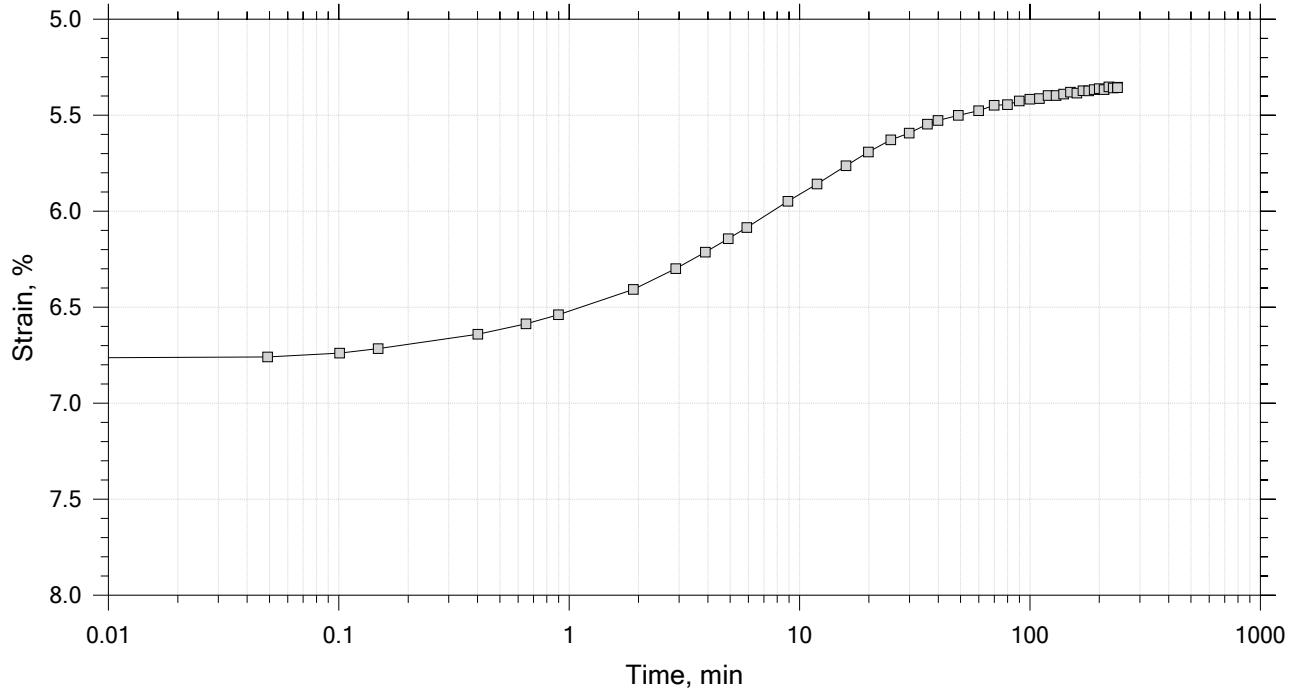
	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 15 of 15

Constant Load Step

Stress: 0.25 tsf




	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.78	Liquid Limit: 63
Initial Height: 1.00 in	Initial Void Ratio: 0.911	Plastic Limit: 30
Final Height: 0.98 in	Final Void Ratio: 0.878	Plasticity Index: 33

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	0105	RING		0167
Mass Container, gm	8.4	108.74	108.74	8.38
Mass Container + Wet Soil, gm	101.67	262.69	262.77	162.16
Mass Container + Dry Soil, gm	80.36	225.8	225.8	125.25
Mass Dry Soil, gm	71.96	117.06	117.06	116.87
Water Content, %	29.61	31.51	31.58	31.58
Void Ratio	---	0.91	0.88	---
Degree of Saturation, %	---	96.22	100.00	---
Dry Unit Weight, pcf	---	90.848	92.419	---


Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

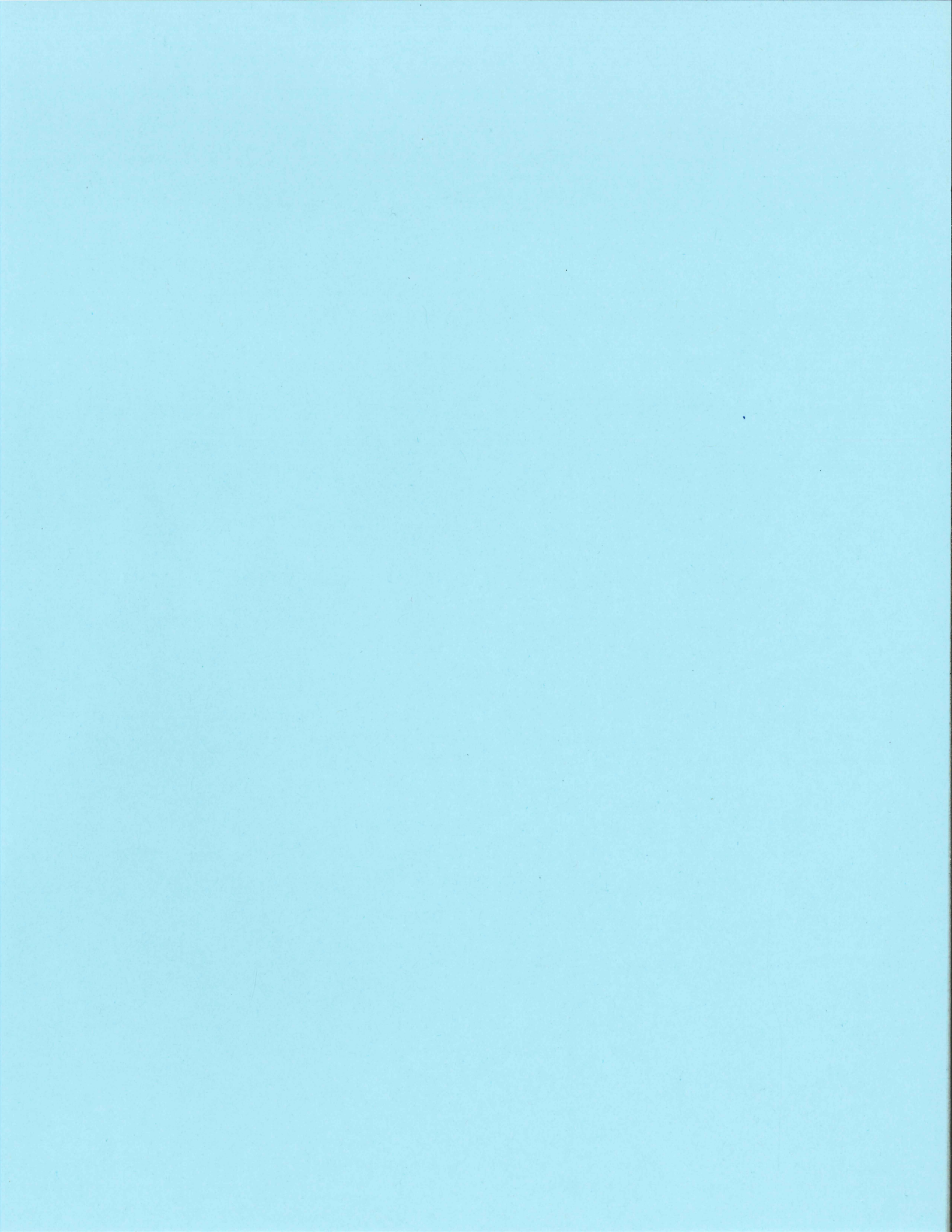
	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

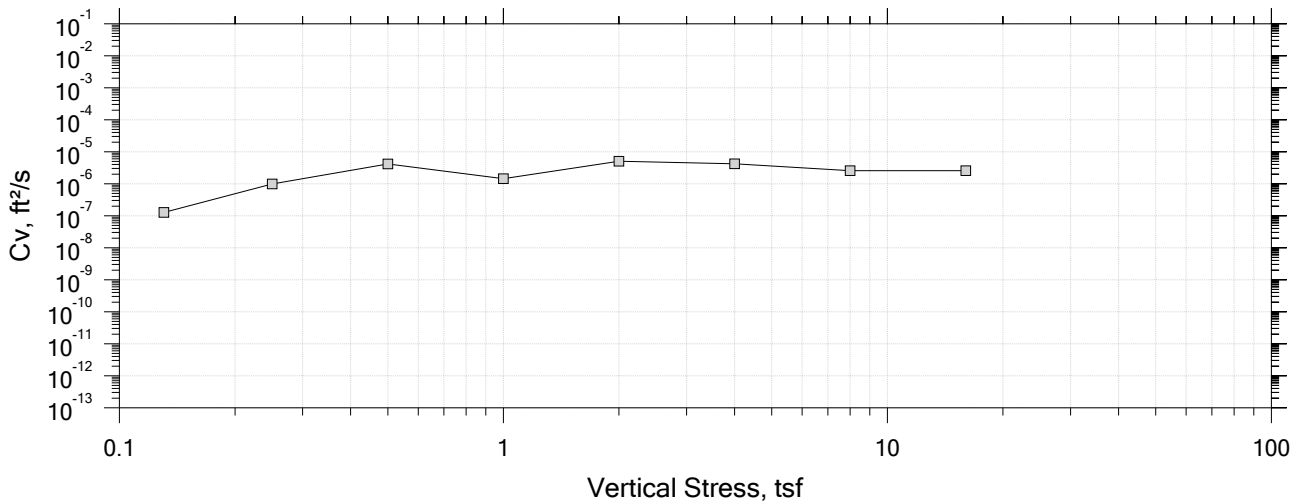
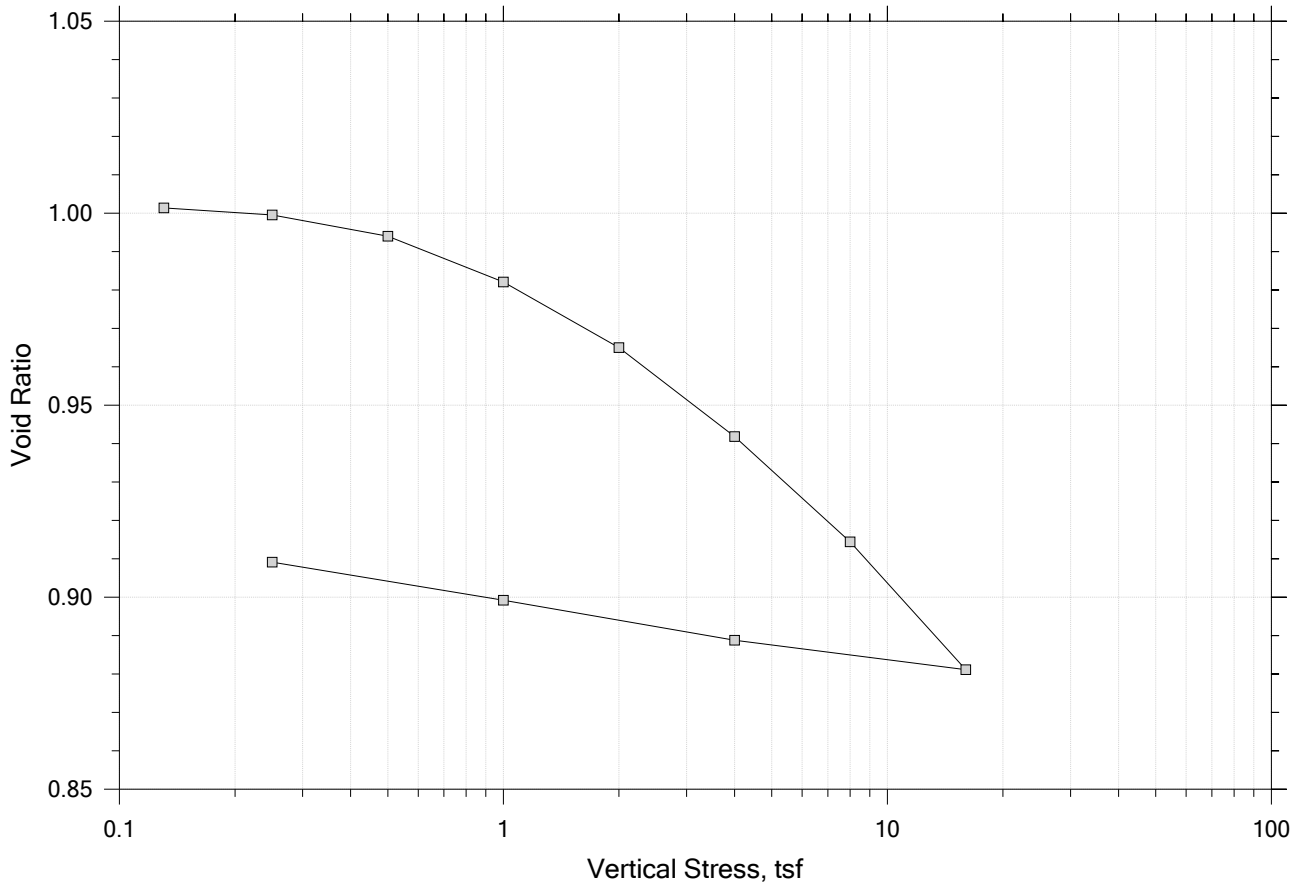
Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft ² /s	Mv 1/tsf	k ft/day
1	0.150	0.009674	0.892	0.967	0.128	1.90e-04	6.46e-02	3.32e-02
2	0.250	0.01087	0.890	1.09	29.545	8.14e-07	1.19e-02	2.62e-05
3	0.500	0.01483	0.882	1.48	8.116	2.95e-06	1.58e-02	1.26e-04
4	1.00	0.02163	0.869	2.16	6.813	3.47e-06	1.36e-02	1.27e-04
5	0.500	0.02032	0.872	2.03	12.647	1.86e-06	2.63e-03	1.32e-05
6	0.250	0.01887	0.875	1.89	9.607	2.46e-06	5.80e-03	3.84e-05
7	0.500	0.01906	0.874	1.91	9.328	2.53e-06	7.54e-04	5.15e-06
8	1.00	0.02197	0.869	2.20	9.743	2.42e-06	5.83e-03	3.80e-05
9	2.00	0.03092	0.851	3.09	4.476	5.20e-06	8.95e-03	1.25e-04
10	4.00	0.04384	0.827	4.38	3.459	6.57e-06	6.46e-03	1.14e-04
11	8.00	0.06323	0.790	6.32	3.532	6.22e-06	4.85e-03	8.14e-05
12	16.0	0.09256	0.734	9.26	4.424	4.72e-06	3.67e-03	4.66e-05
13	4.00	0.08215	0.754	8.22	3.626	5.64e-06	8.67e-04	1.32e-05
14	1.00	0.06698	0.783	6.70	7.439	2.82e-06	5.06e-03	3.85e-05
15	0.250	0.05356	0.808	5.36	25.840	8.39e-07	1.79e-02	4.05e-05


	Project: Calhoun UTL Firetower Wtr. Tank	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-1	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-1	Test Date: 6/19/24	Depth: 18-20 ft
	Test No.: IP-1	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish brown clay		
	Remarks: System K, Swell Pressure = 0.15 tsf		
Displacement at End of Increment			



One-Dimensional Consolidation by ASTM D2435 - Method B

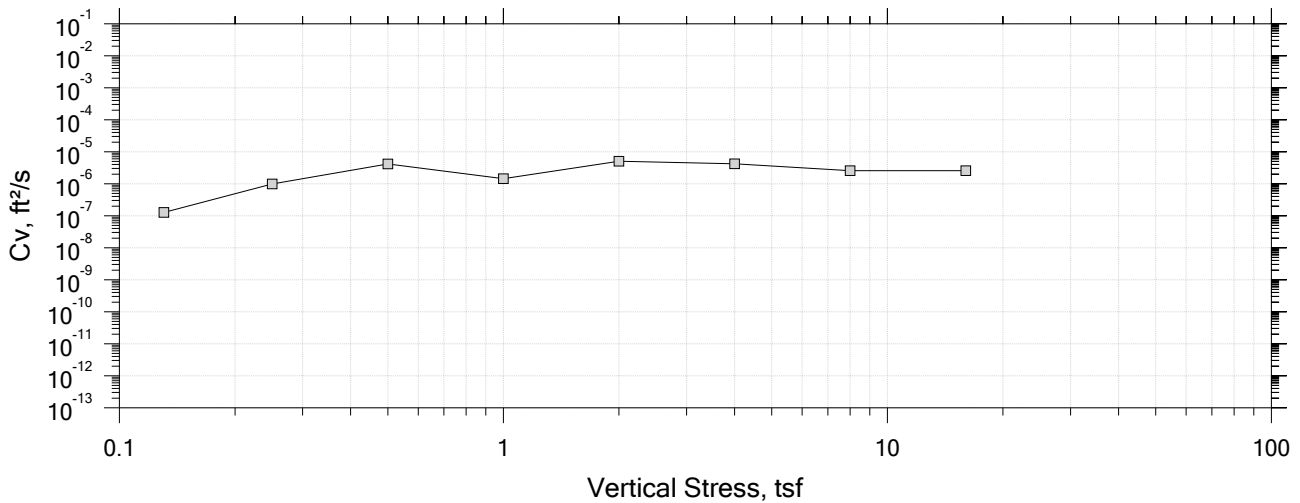
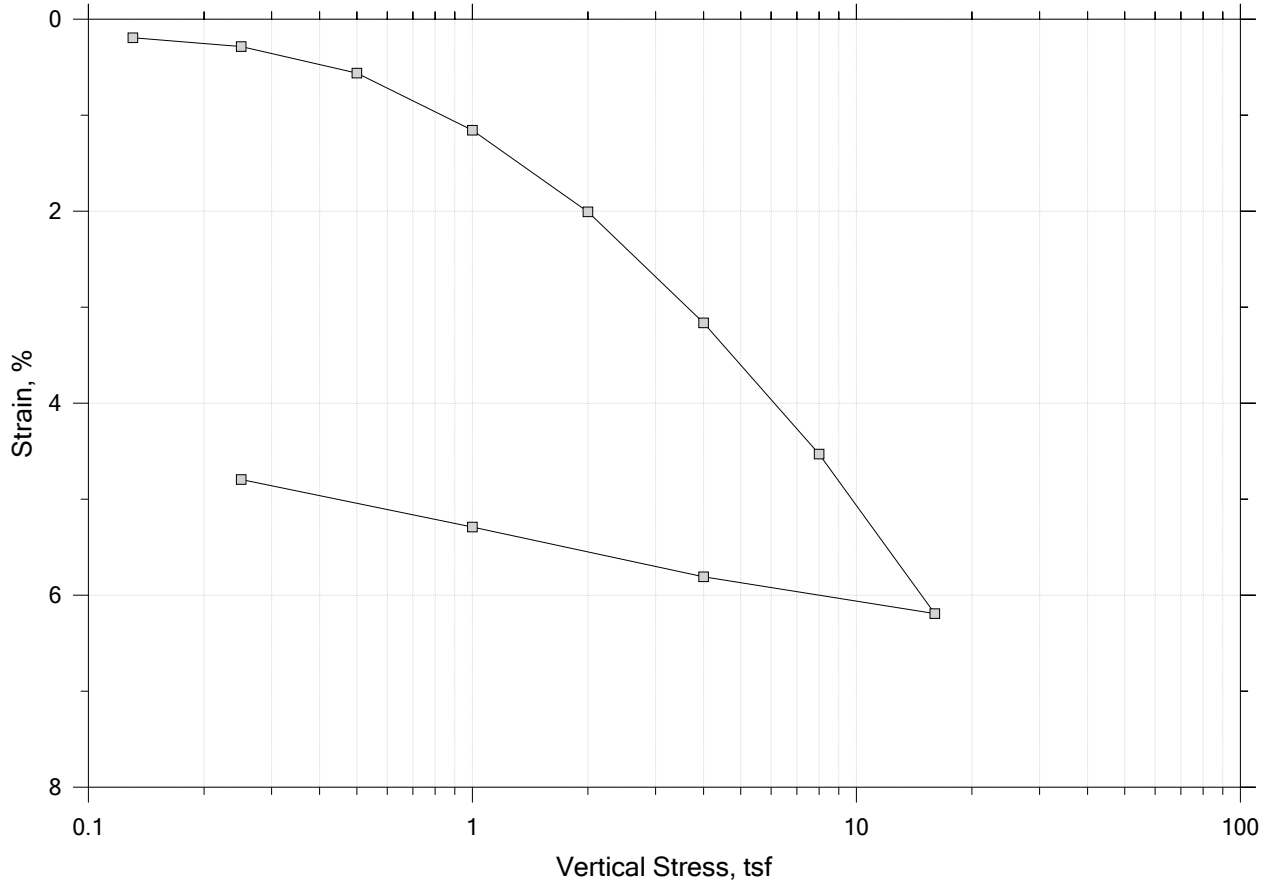
Summary Report




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

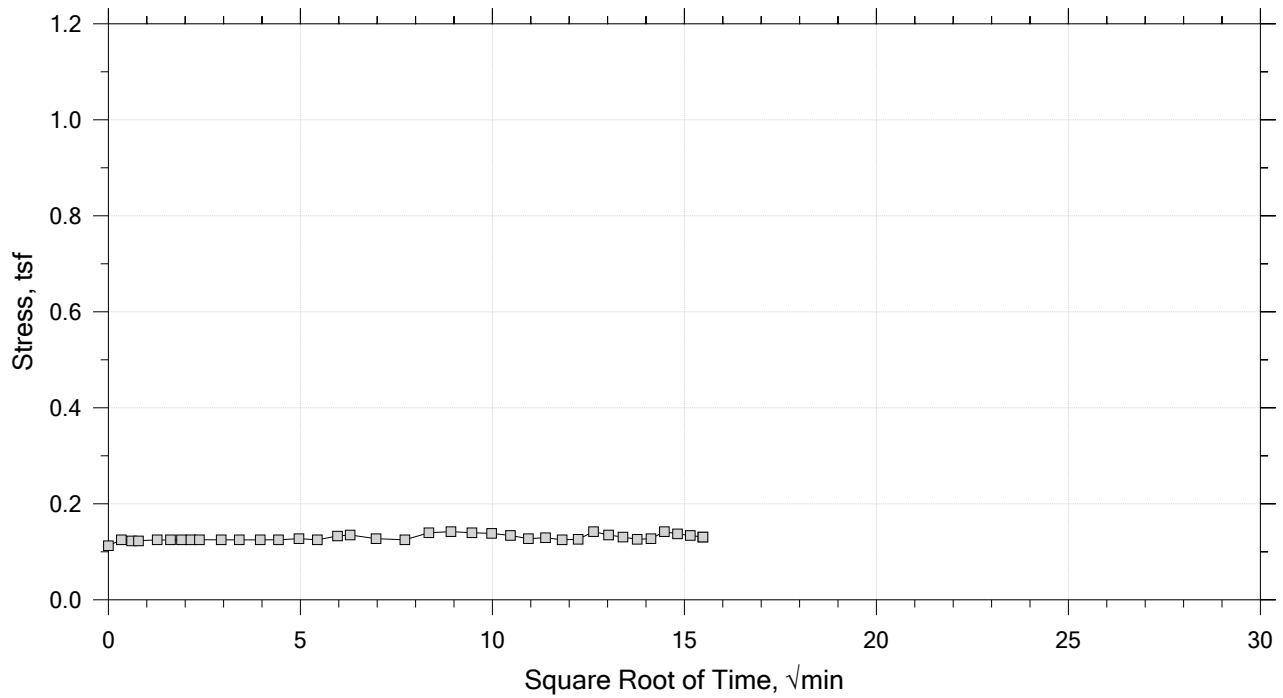
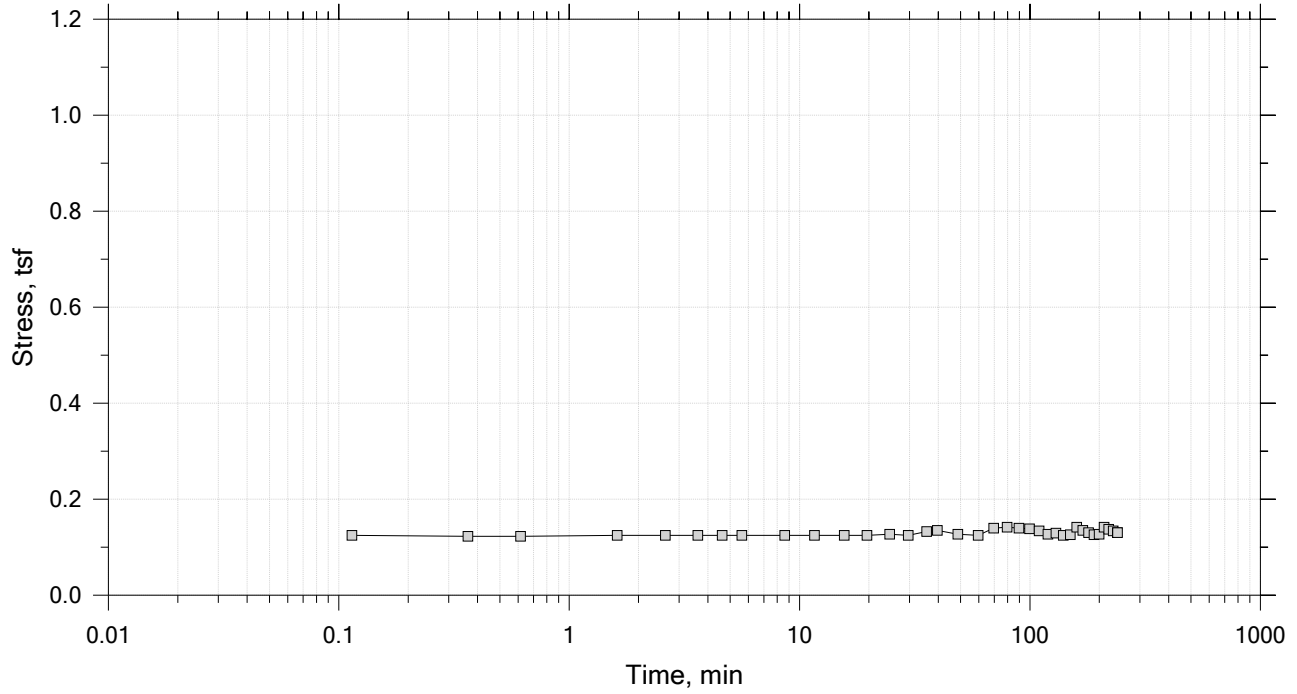
Summary Report




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

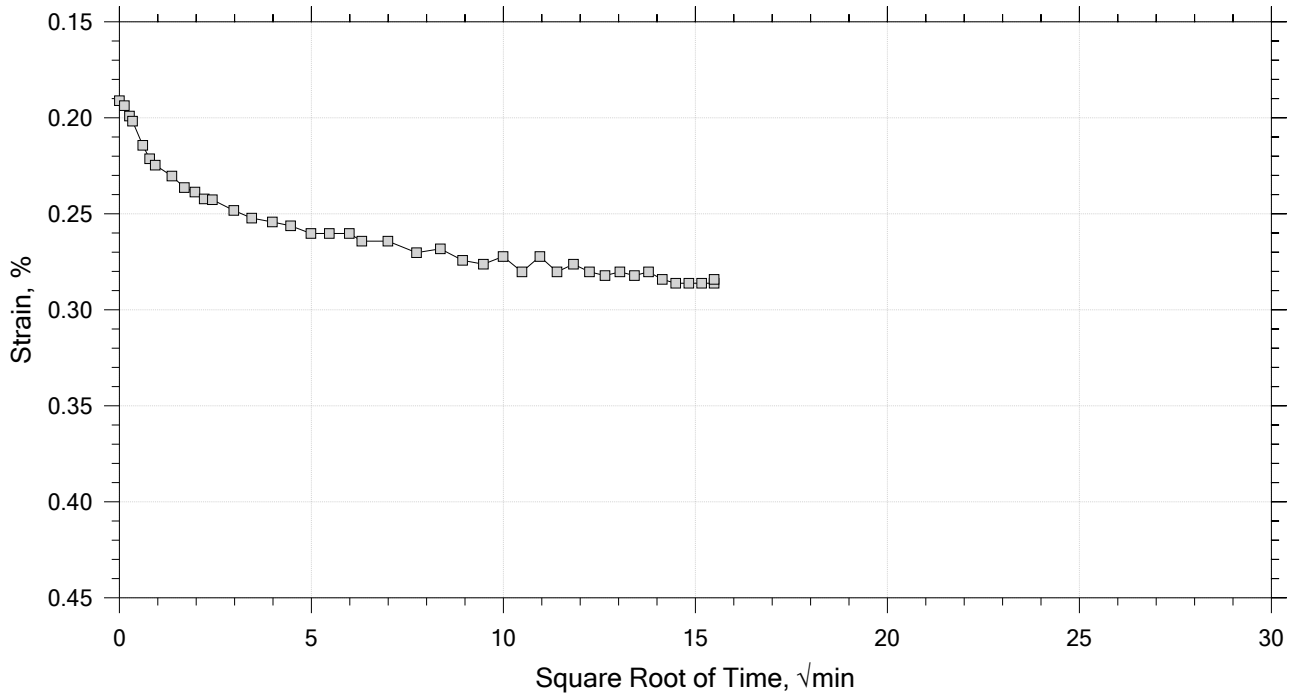
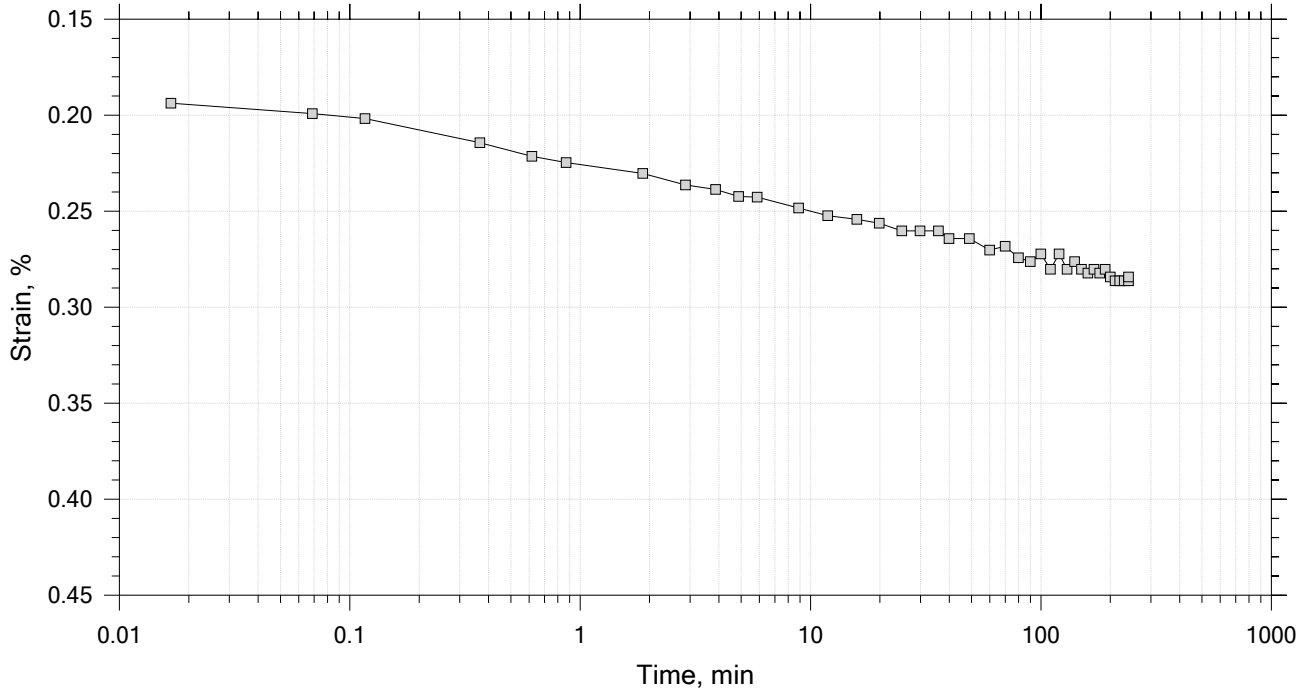
Time Curve 1 of 11
 Constant Volume Step
 Stress: 0.13 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

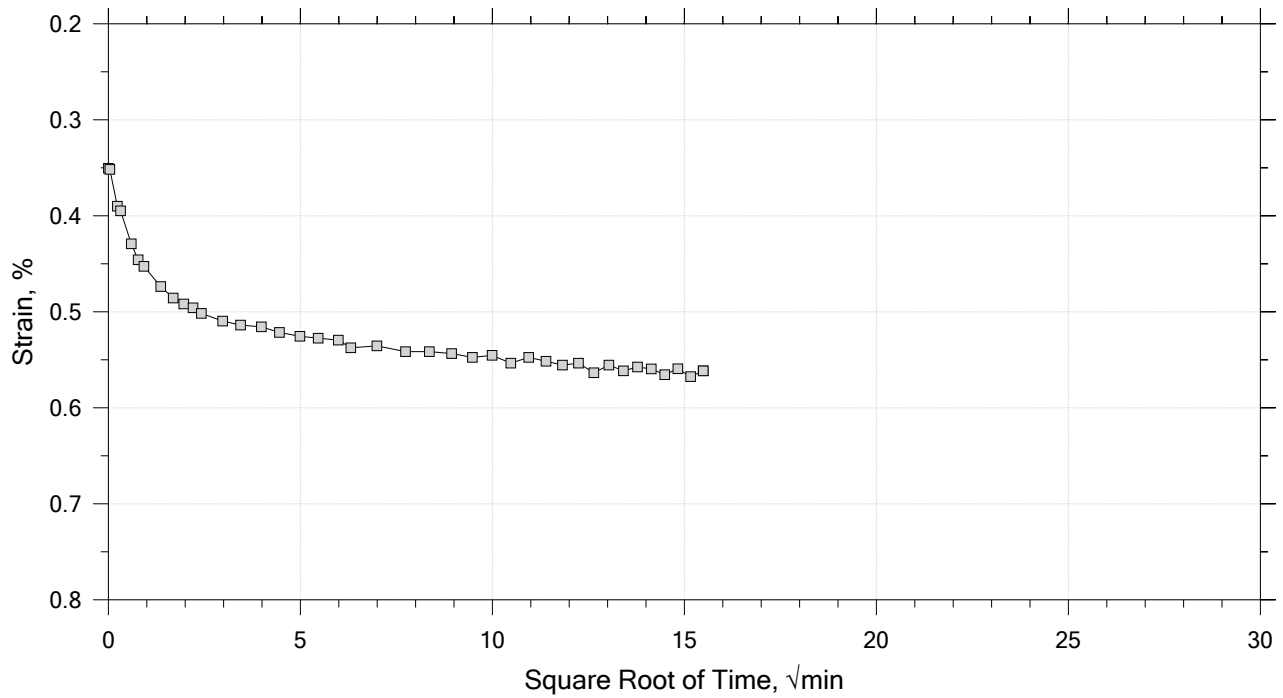
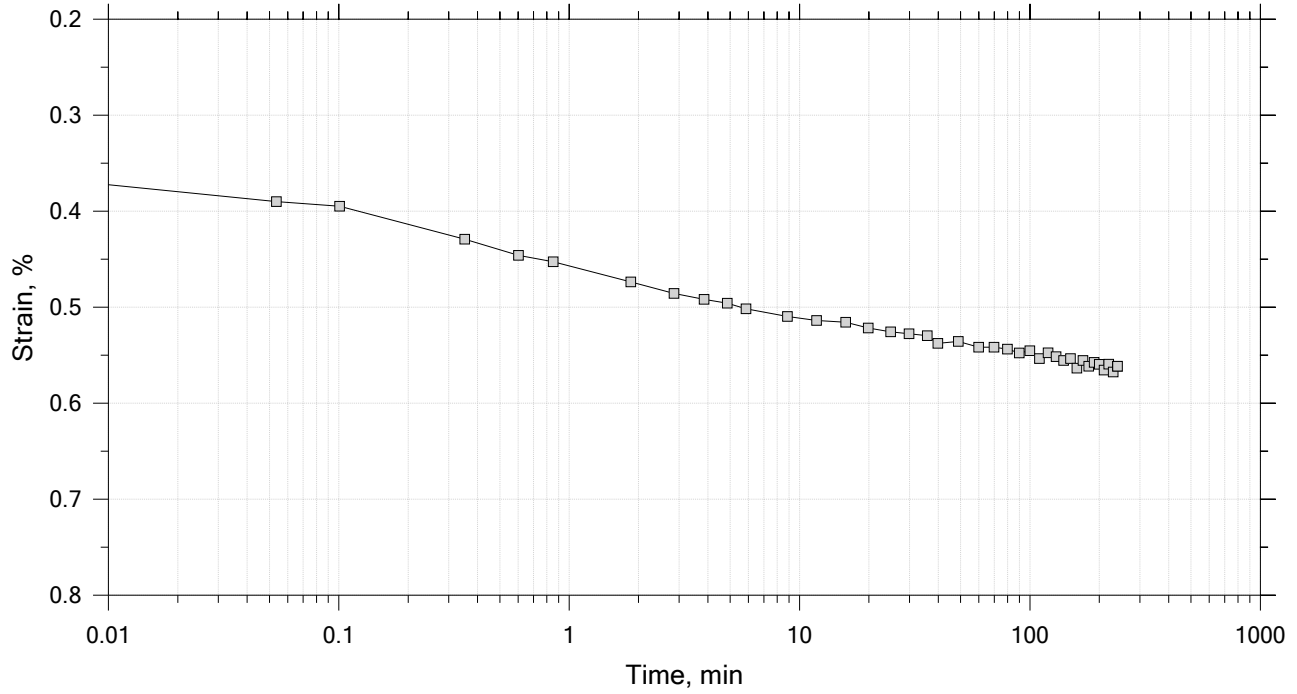
Time Curve 2 of 11
Constant Load Step
Stress: 0.25 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

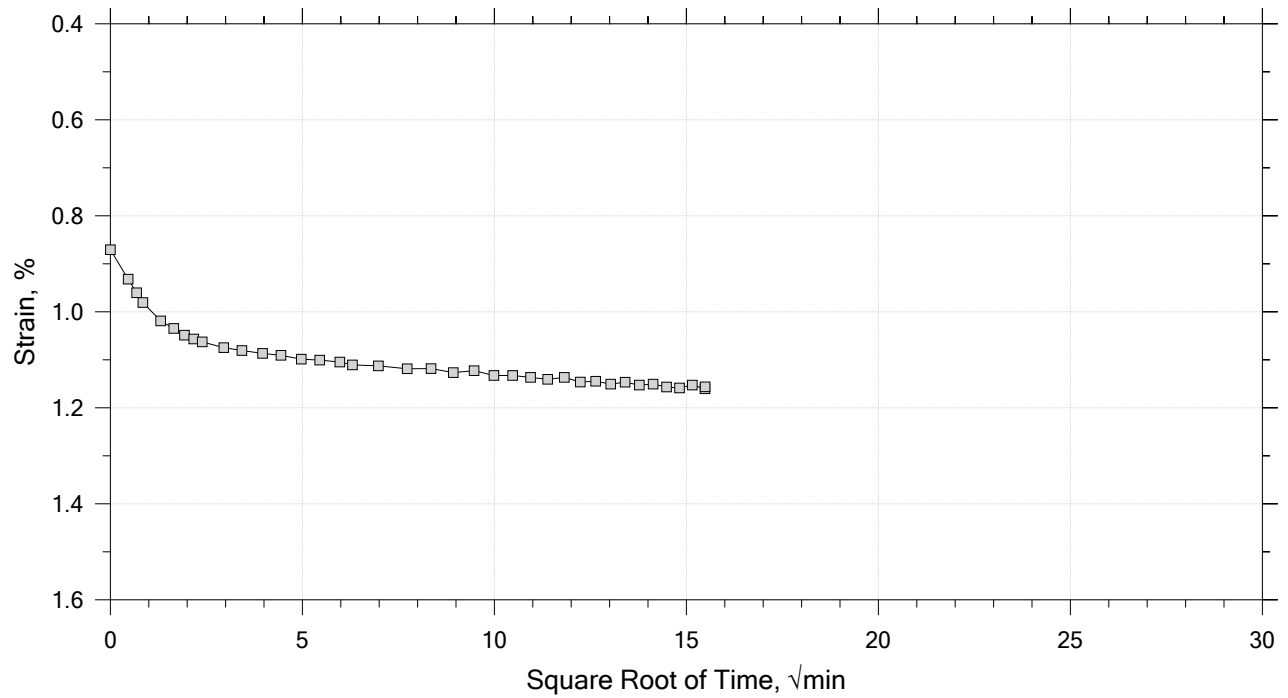
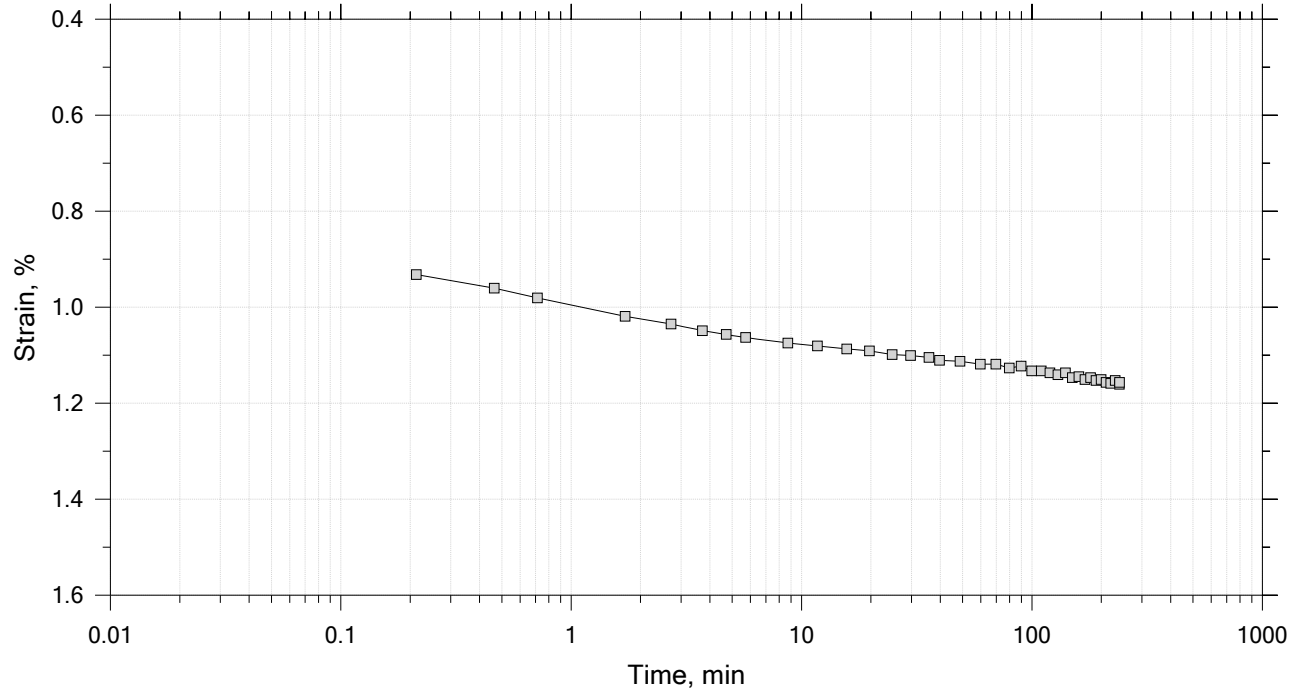
Time Curve 3 of 11
 Constant Load Step
 Stress: 0.5 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

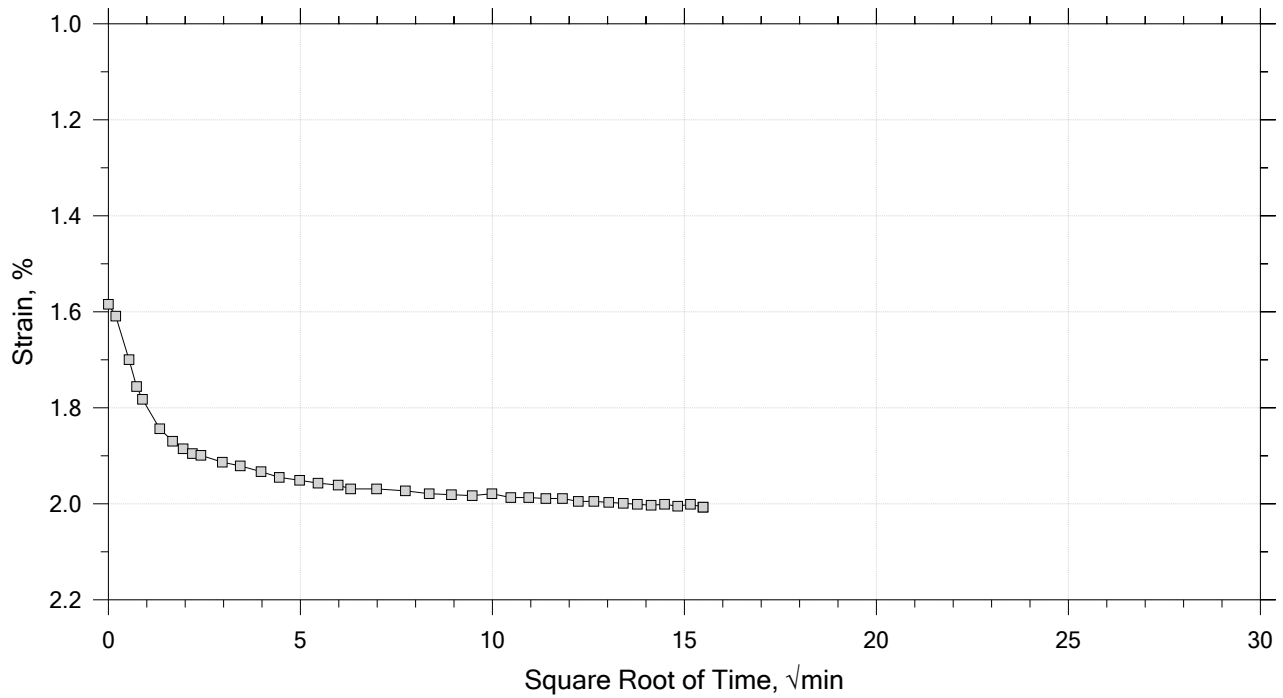
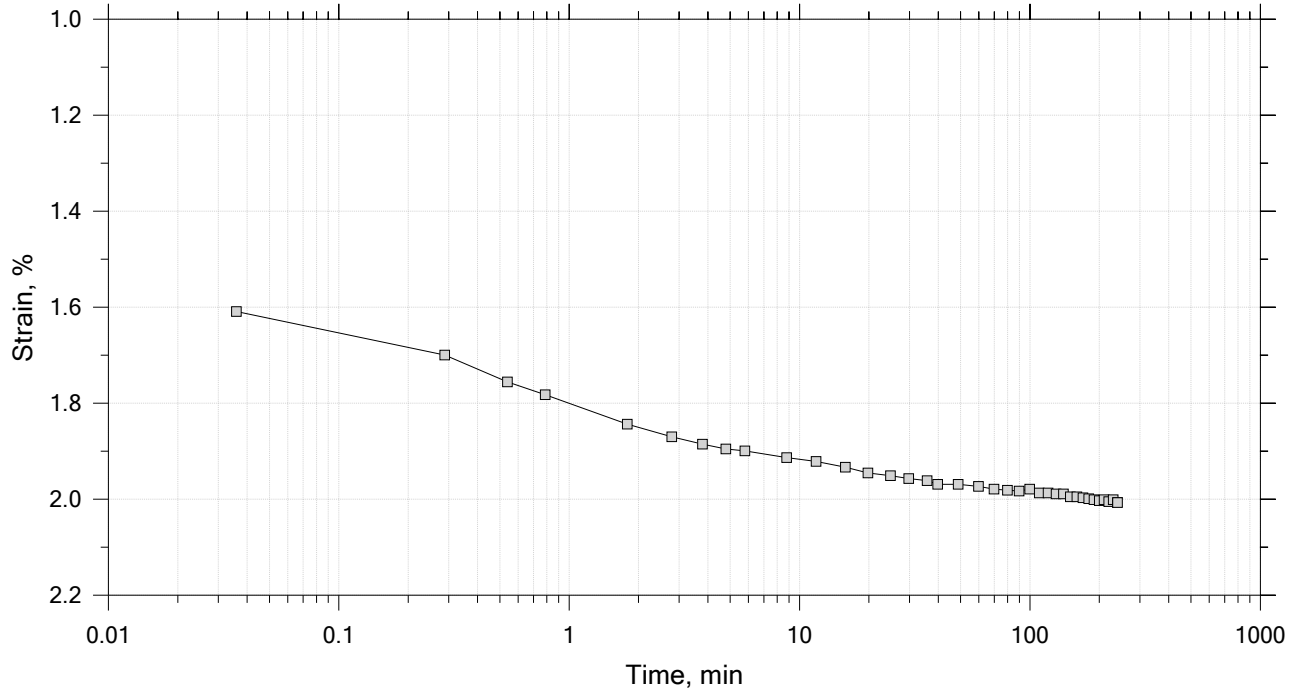
Time Curve 4 of 11
 Constant Load Step
 Stress: 1 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

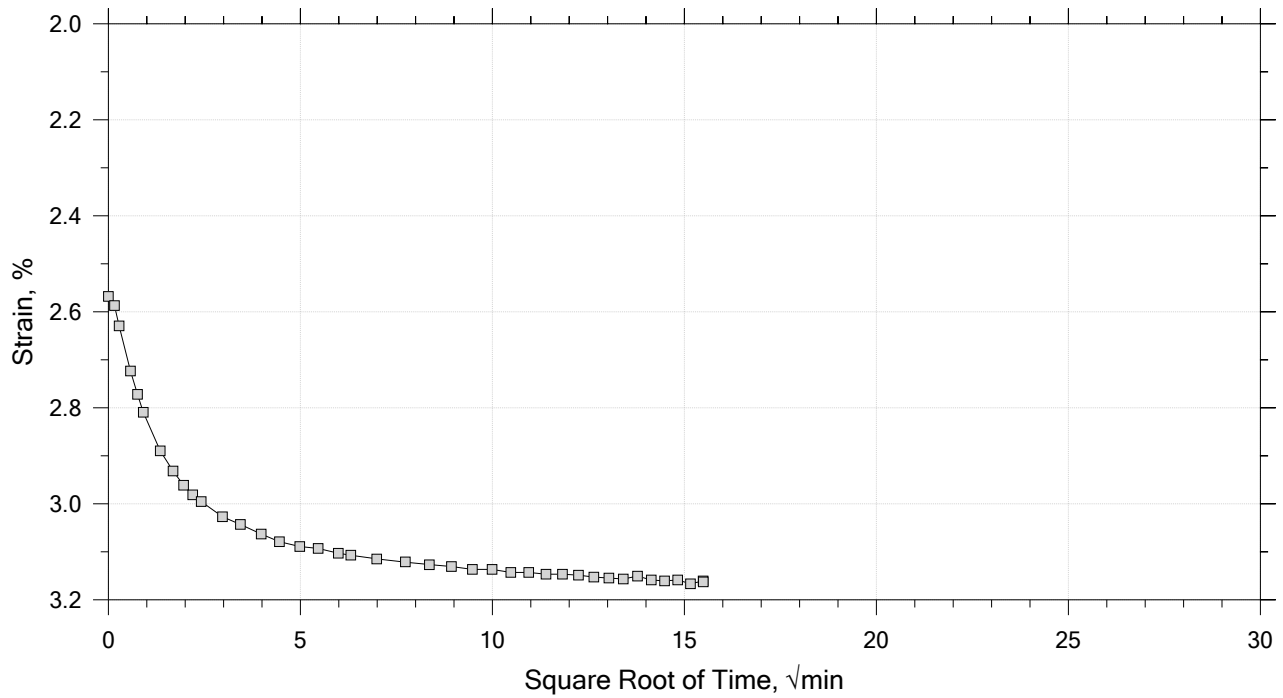
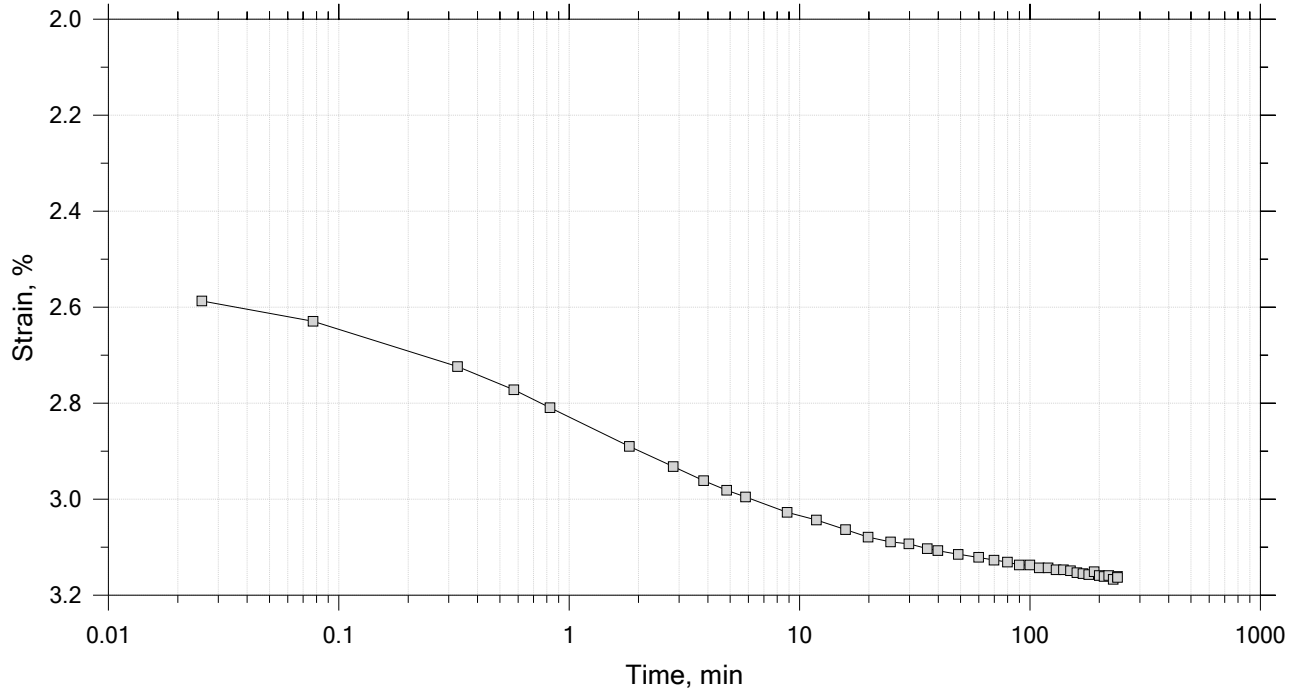
Time Curve 5 of 11
 Constant Load Step
 Stress: 2 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

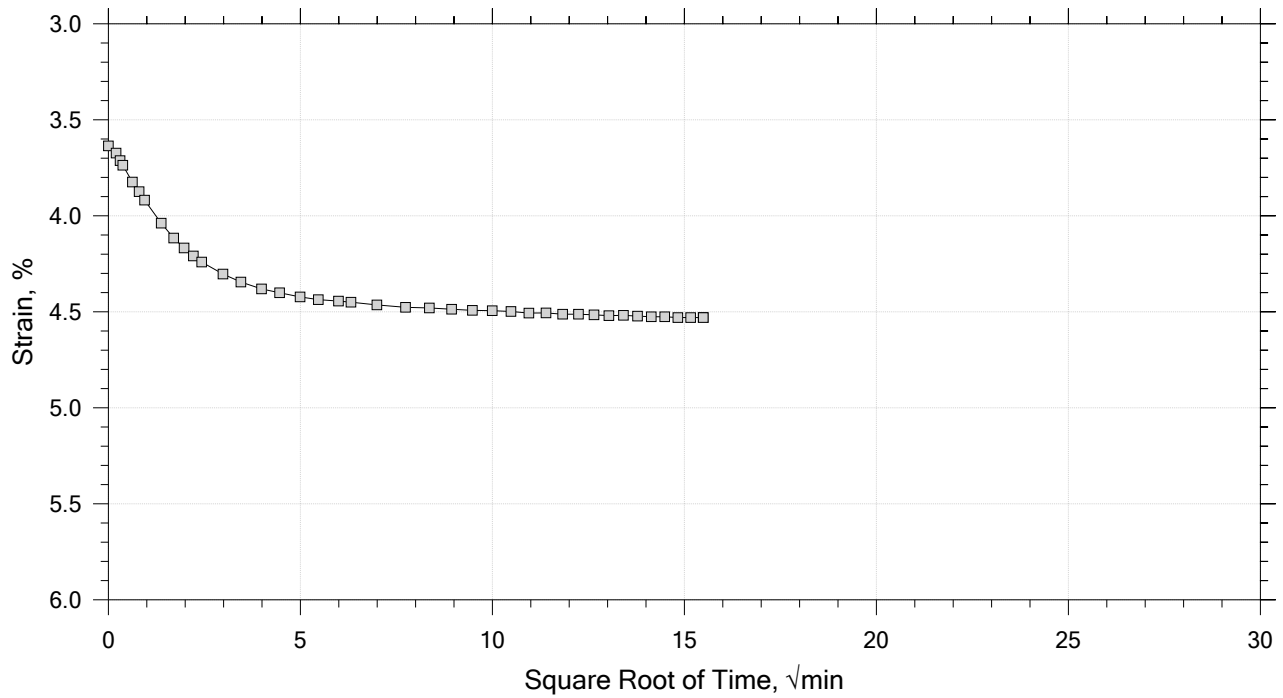
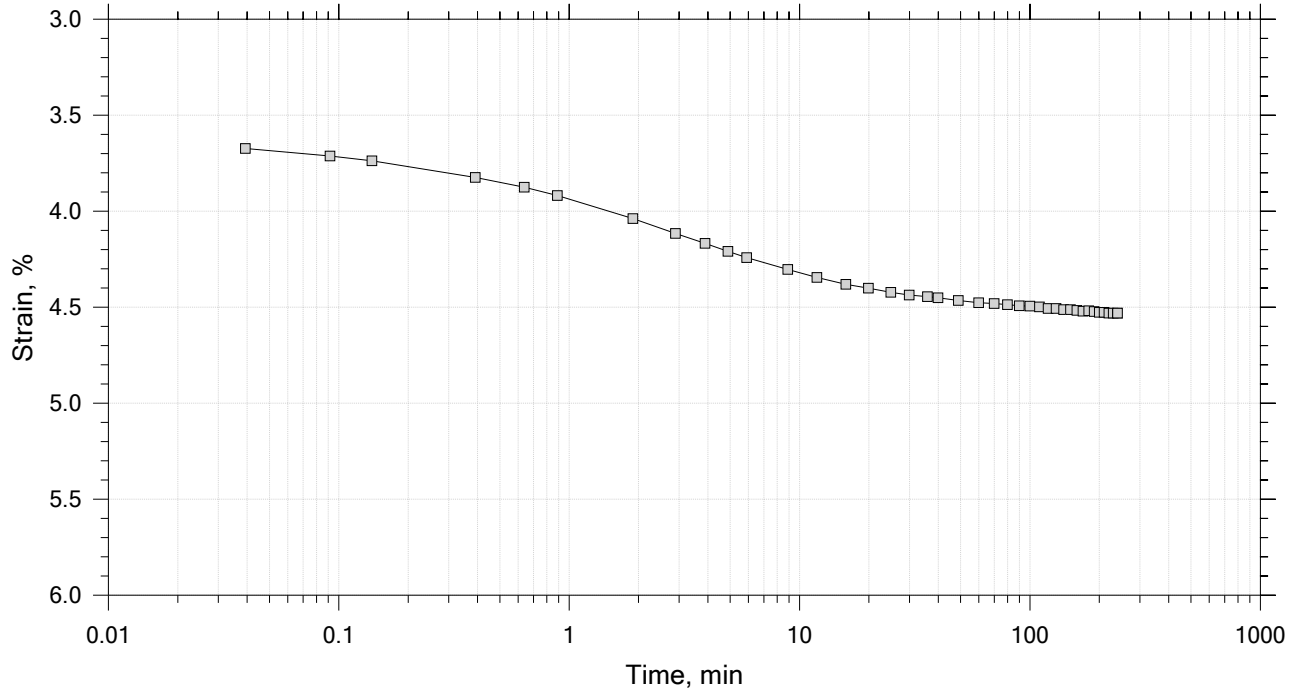
Time Curve 6 of 11
 Constant Load Step
 Stress: 4 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

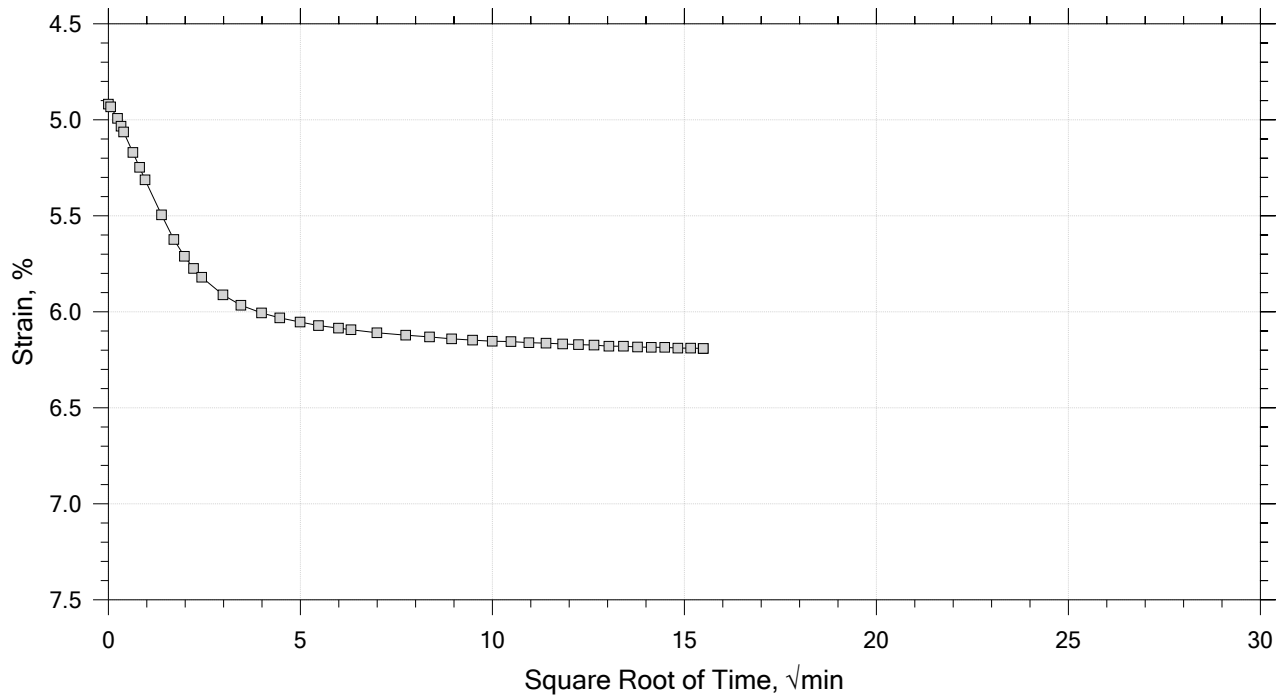
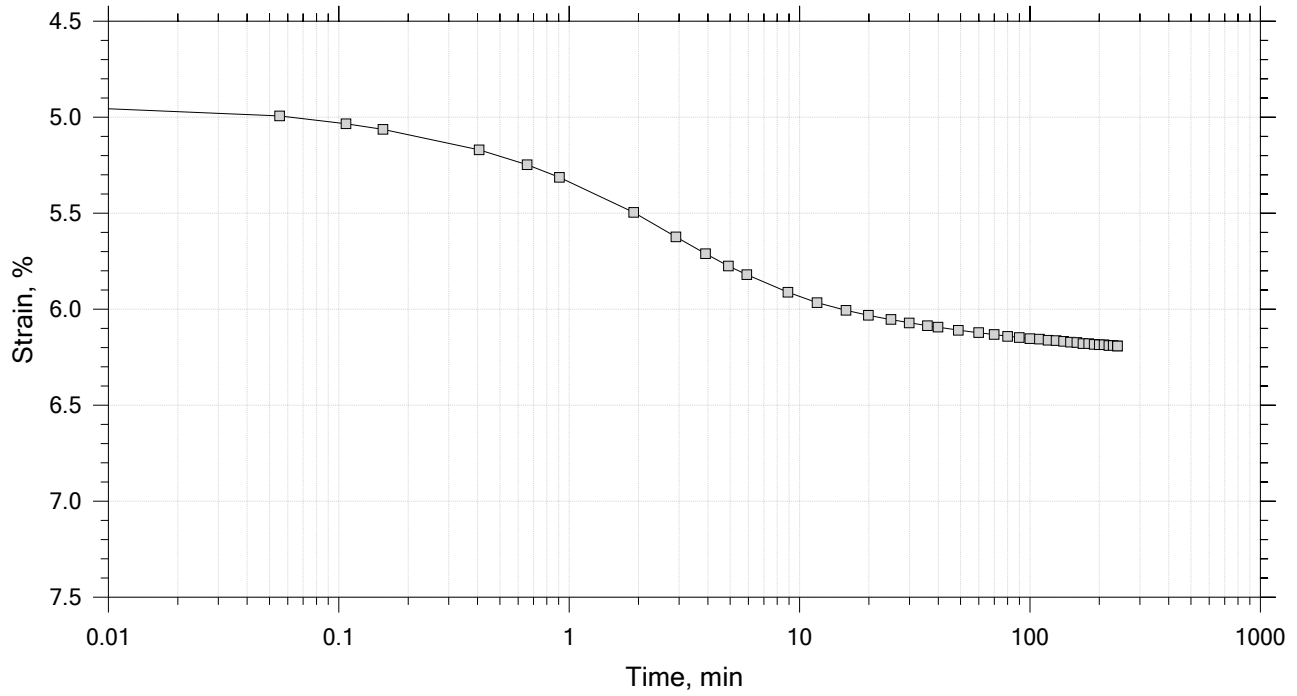
Time Curve 7 of 11
 Constant Load Step
 Stress: 8 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

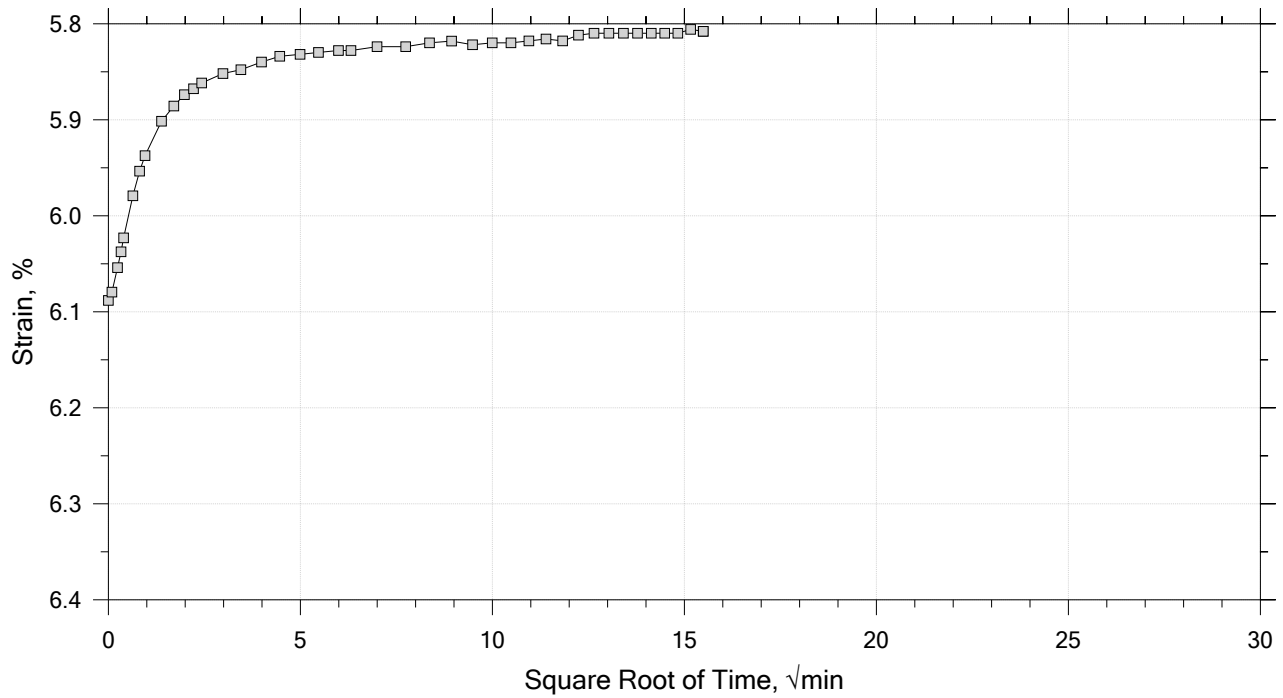
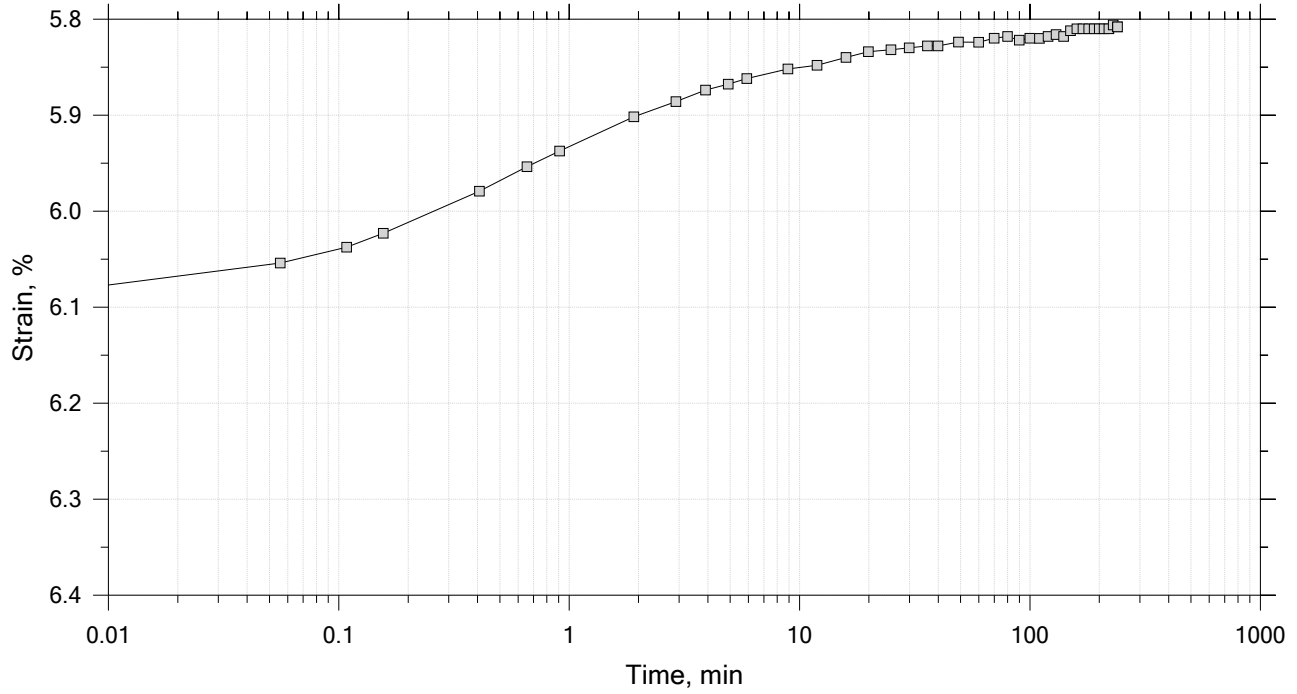
Time Curve 8 of 11
 Constant Load Step
 Stress: 16 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 9 of 11
 Constant Load Step
 Stress: 4 tsf



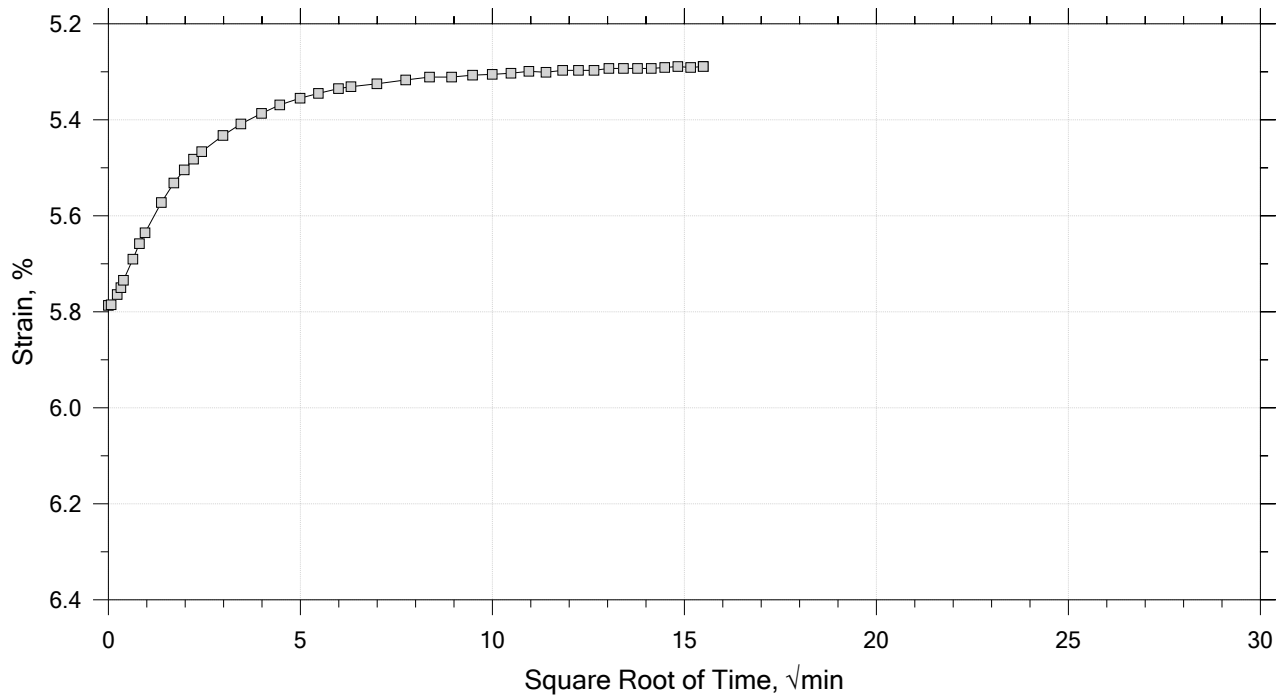
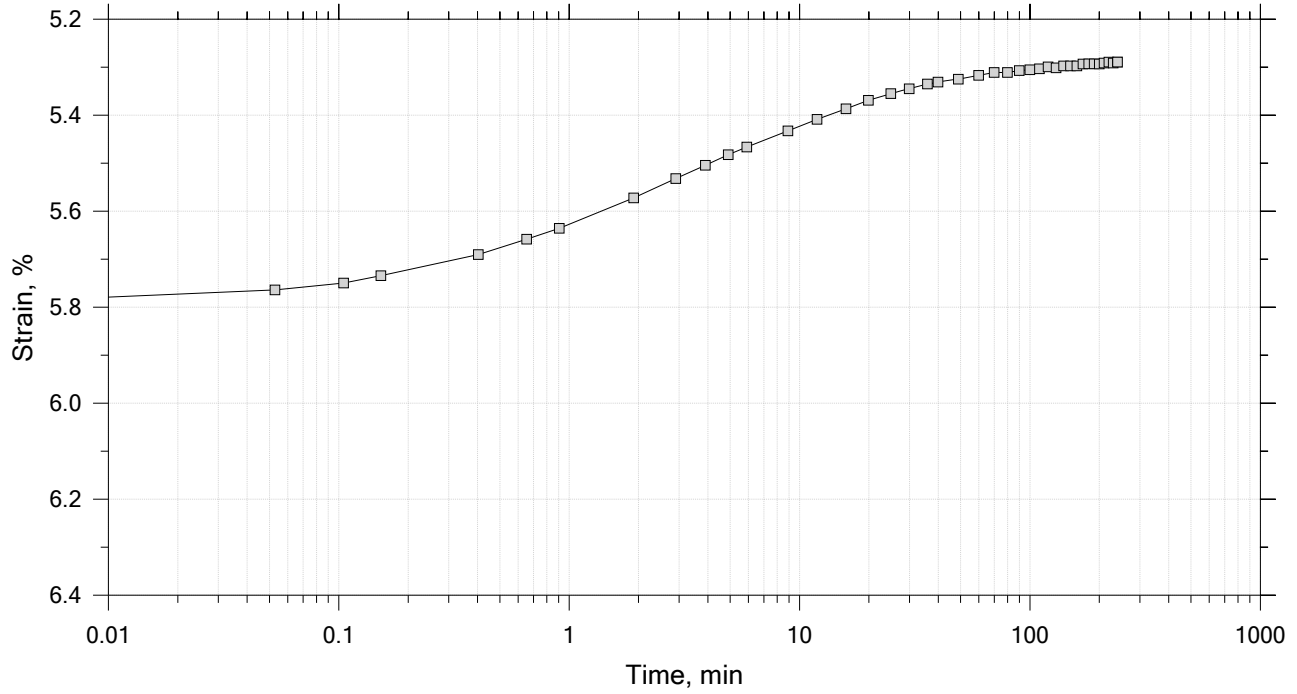
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	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 10 of 11

Constant Load Step

Stress: 1 tsf



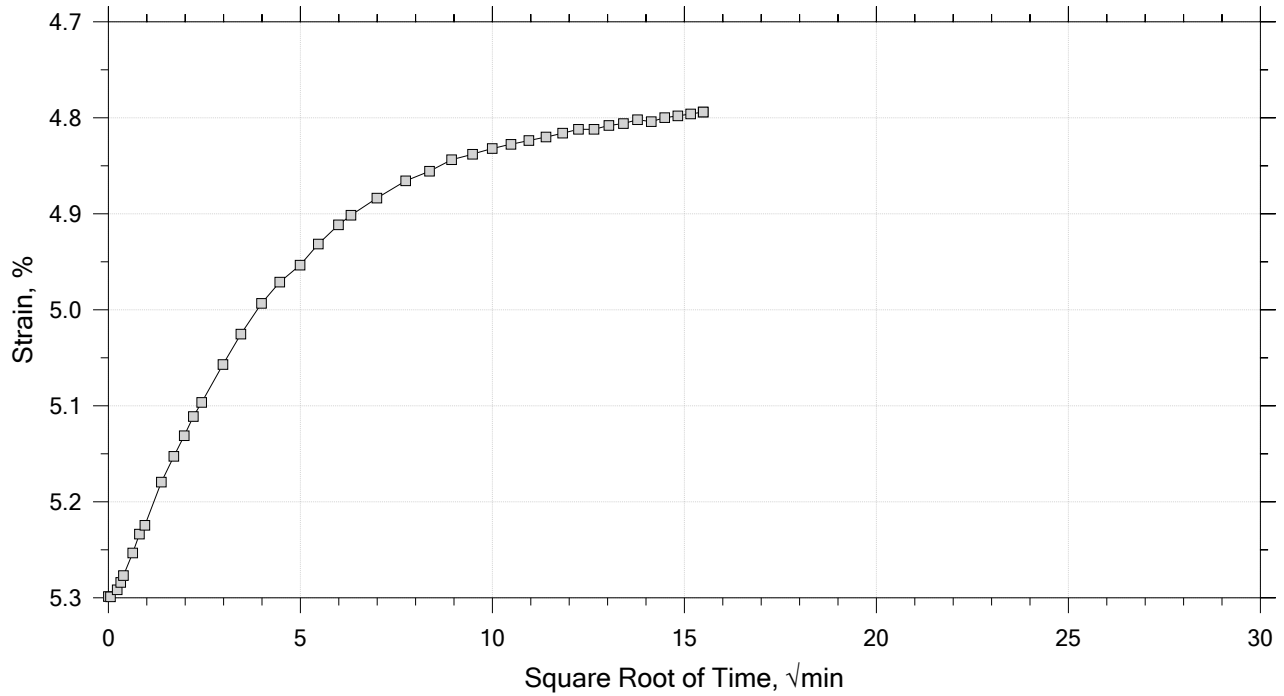
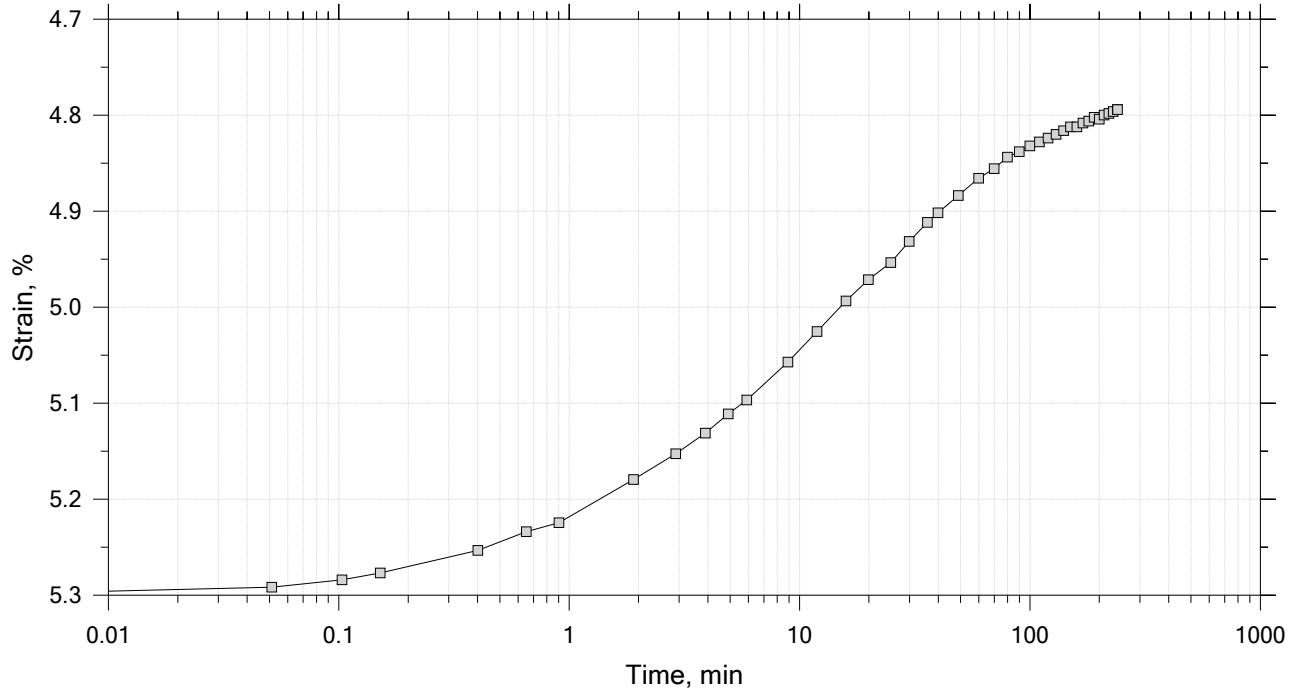
	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		


One-Dimensional Consolidation by ASTM D2435 - Method B

Time Curve 11 of 11

Constant Load Step

Stress: 0.25 tsf




	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Specimen Diameter: 2.50 in	Estimated Specific Gravity: 2.72	Liquid Limit: 70
Initial Height: 1.00 in	Initial Void Ratio: 1.01	Plastic Limit: 30
Final Height: 0.91 in	Final Void Ratio: 0.835	Plasticity Index: 40

	Before Test Trimmings	Before Test Specimen	After Test Specimen	After Test Trimmings
Container ID	0034	RING	Sys E	GA0045
Mass Container, gm	8.37	108.06	108.06	8.36
Mass Container + Wet Soil, gm	127.62	252.85	250.68	150.86
Mass Container + Dry Soil, gm	99.28	217.19	217.19	117.4
Mass Dry Soil, gm	90.91	109.13	109.13	109.04
Water Content, %	31.17	32.67	30.69	30.69
Void Ratio	---	1.01	0.83	---
Degree of Saturation, %	---	88.43	100.00	---
Dry Unit Weight, pcf	---	84.695	92.563	---


Note: Specific Gravity and Void Ratios are calculated assuming the degree of saturation equals 100% at the end of the test. Therefore, values may not represent actual values for the specimen.

	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		

One-Dimensional Consolidation by ASTM D2435 - Method B

Square Root of Time Coefficients

Step	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt. T90 min	Cv ft ² /s	Mv 1/tsf	k ft/day
1	0.130	0.001934	1.00	0.193	192.597	1.27e-07	1.48e-02	5.08e-06
2	0.250	0.002842	1.00	0.284	24.866	9.82e-07	7.60e-03	2.01e-05
3	0.500	0.005615	0.994	0.561	5.836	4.17e-06	1.11e-02	1.25e-04
4	1.00	0.01156	0.982	1.16	16.673	1.45e-06	1.19e-02	4.64e-05
5	2.00	0.02007	0.965	2.01	4.698	5.06e-06	8.51e-03	1.16e-04
6	4.00	0.03163	0.942	3.16	5.553	4.19e-06	5.78e-03	6.54e-05
7	8.00	0.04530	0.914	4.53	8.836	2.57e-06	3.42e-03	2.37e-05
8	16.0	0.06191	0.881	6.19	8.570	2.56e-06	2.08e-03	1.44e-05
9	4.00	0.05808	0.889	5.81	3.311	6.55e-06	3.19e-04	5.64e-06
10	1.00	0.05289	0.899	5.29	8.820	2.48e-06	1.73e-03	1.16e-05
11	0.250	0.04794	0.909	4.79	30.802	7.18e-07	6.60e-03	1.28e-05

	Project: Cslhoun Utilities	Location: Calhoun, Gordon County, GA	Project No.: GTX-319291
	Boring No.: B-4	Tested By: jbh	Checked By: mcm
	Sample No.: UDS-2	Test Date: 6/19/24	Depth: 30-32 ft
	Test No.: IP-2	Sample Type: intact	Elevation: ---
	Description: Moist, yellowish red gravelly clay		
	Remarks: System E, Swell Pressure = 0.13 tsf		
	Displacement at End of Increment		

TIDEFLEX MIXING SYSTEM (TMS)

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PRELIMINARY DESIGN REPORT

Tank Name: New Fire Tower Road 2.0MG Reservoir

Water Utility/Owner: Calhoun Utilities, GA

Consultant:

CONTENTS

TMS - GENERAL ARRANGEMENT DRAWING

CFD MODELING

TMS - MIXING ANALYSIS

WATER AGE ANALYSIS

MANIFOLD HYDRAULICS / SYSTEM HEAD CURVE- FILL CYCLE

MANIFOLD HYDRAULICS / SYSTEM HEAD CURVE- DRAW CYCLE



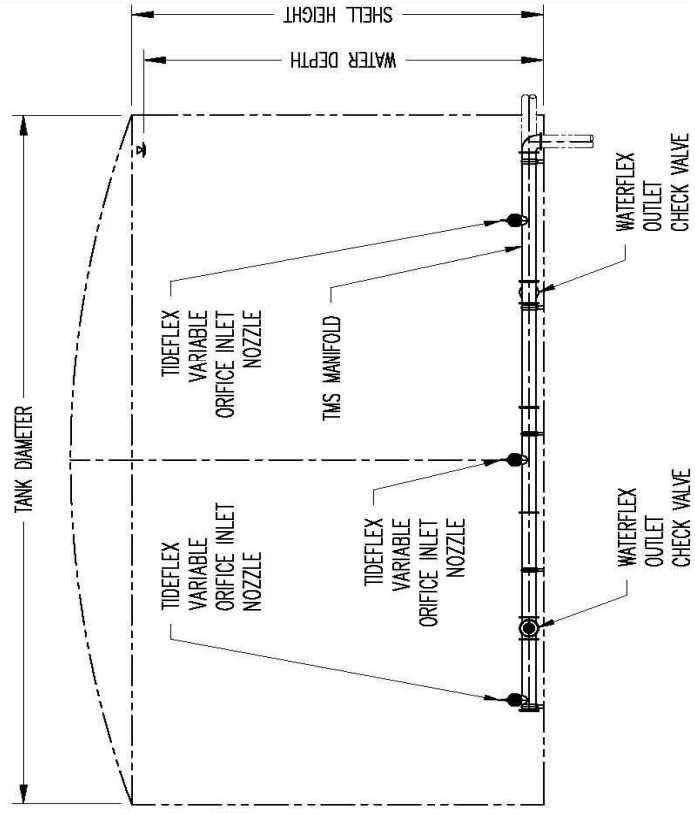
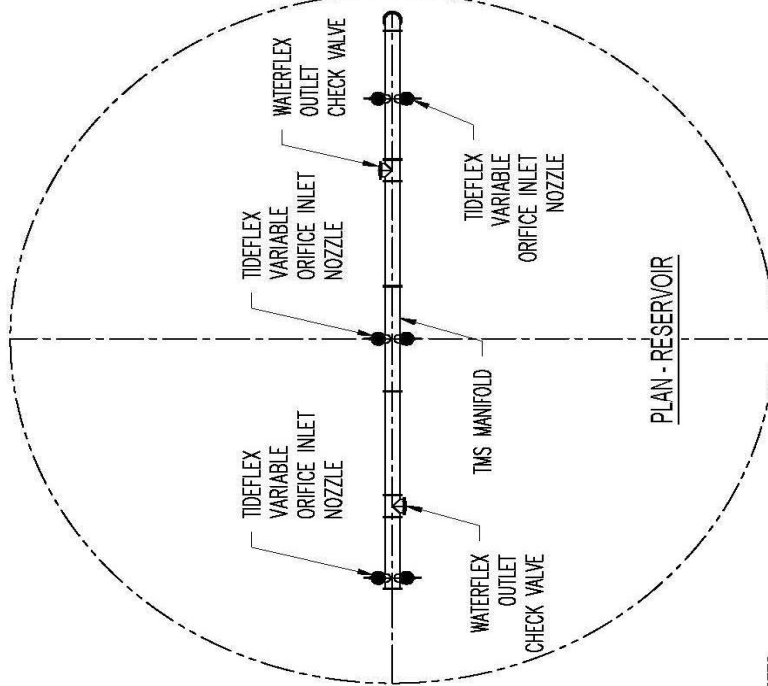
Analysis By:

Ron Koch



April 1, 2026

FINAL MIXING SYSTEM DESIGN AND ALL SUPPORTING CALCULATIONS TO BE SUPPLIED BY RED VALVE COMPANY



- NOTES:**
- DO NOT USE THIS DRAWING FOR CONSTRUCTION. DRAWING INTENDED AS A GENERAL REPRESENTATION ONLY.
 - QUANTITY, SIZE, ELEVATIONS, LOCATIONS, AND DISCHARGE ANGLES OF TIDEFLEX INLET NOZZLES AND/OR OUTLET CHECK VALVES ARE TANK-SPECIFIC BASED ON HYDRAULICS, MIXING AND TURNOVER CRITERIA.
 - CARBON AND STAINLESS PIPE SECTIONS MAY BE SUPPLIED WITH PLAIN ENDS TO BE BUTT WELDED IN THE FIELD.

REV	BY	APVD	DATE	ECC#	DESCRIPTION

Red Valve

Tideffex

Red Valve Company, Inc.
750 Hadley Drive, Suite 400
Fosberg Plaza, Building #6
Pittsburgh, PA 15220 USA
Phone: 412-278-0044
Fax: 412-278-5410
Email: INFO@REDVALVE.COM

NOT FOR CONSTRUCTION

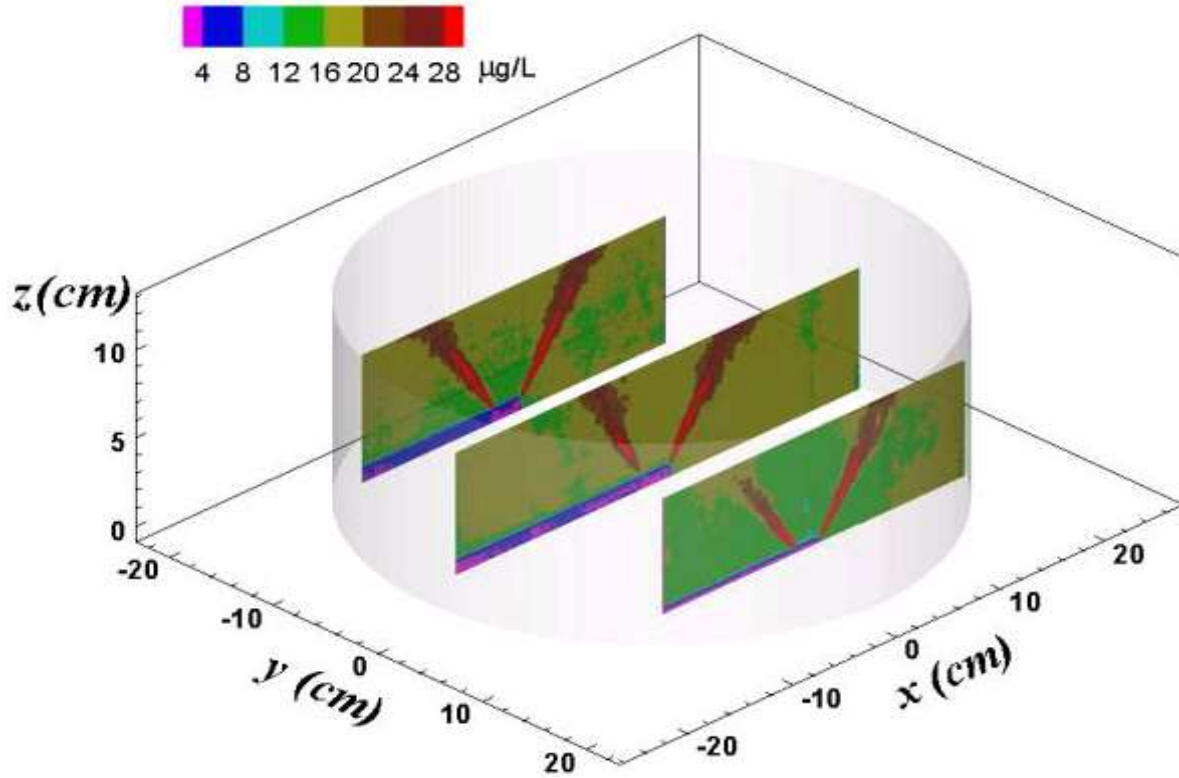
TMS GENERAL ARRANGEMENT FOR GROUND LEVEL CIRCULAR RESERVOIRS

PART NO.	ORDER NO.	REVISION NO.	B
APPLICATION: (TMS) TIDEFLEX MIXING SYSTEM	DWG. NO.	TMS-CIR12	SHEET NO. 10F1
DWG. BY: DJJ	DATE: 10-16-07		

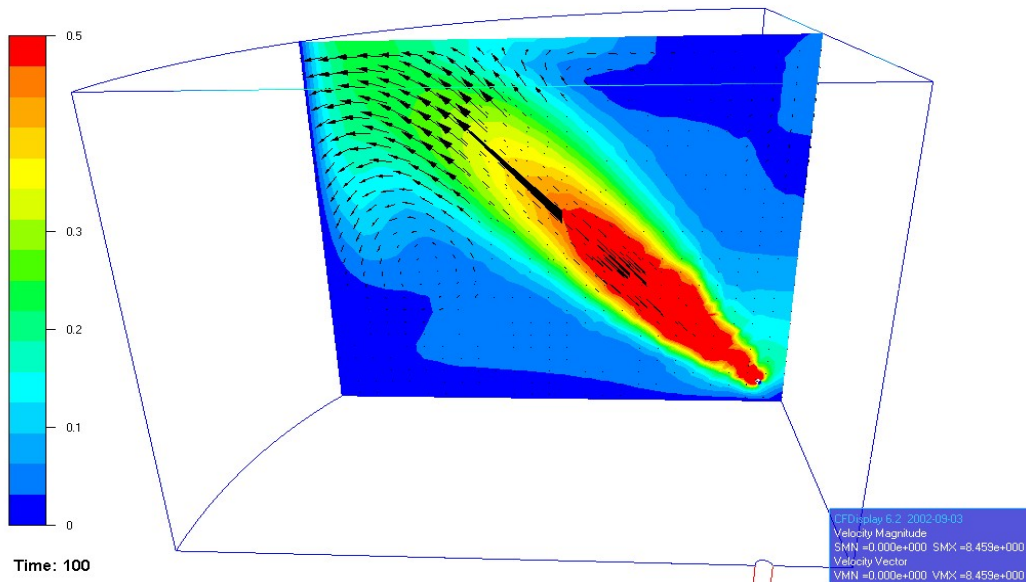
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Computational Fluid Dynamics (CFD) Modeling

Below are CFD and Scale Modeling images showing representative velocity magnitude contour and vector images of this TMS configuration in a circular



CFdesign for Windows 5.0



Time: 100

Tideflex®

TIDEFLEX RESERVOIR MIXING ANALYSIS

New Fire Tower Road 2.0MG Reservoir Calhoun Utilities, GA

The Reservoir Mixing Analysis (RMA) is to be supplied to the water utility/owner as it provides guidance on the tank turnover/fluctuation required to ensure complete mixing with the TMS installed. Maintaining water quality in tanks and reservoirs is a combination of achieving complete mixing AND tank turnover to minimize water age. It is critical to achieve complete mixing to prevent a localized increase in water age (and associated water quality problems) due to short-circuiting and dead zones.

The RMA calculates the dependent variables and uses the mixing time formula to calculate the "Theoretical Mixing Time" (MT) at various filling flow rates. The MT is the fill time required to achieve complete mixing. The required drawdown (in feet), % turnover, and the required volume exchange (in gallons) are calculated based on these mixing times. These values are shown in the "Guide to Tank Fluctuation and Turnover" section of the RMA. A slightly greater drawdown/turnover is typically recommended to be conservative.

Within the "Guide to Tank Fluctuation and Turnover" is a "Minimum Tank Fluctuation Target". This is applicable for tanks that operate in fill-then-draw. This is the minimum amount the tank should be drawn down on the draw cycles to ensure complete mixing on the fill cycles. This data is intended to be used by operators in conjunction with SCADA and strip charts (where applicable) to verify adequate tank turnover and to determine "pump on" and "pump off" set points (where applicable). For tanks that operate in simultaneous fill and draw, the "Theoretical Mixing Time" (fill time required to achieve complete mixing) should be used to ensure the minimum fill time required is achieved.

The RMA also provides data on the time required to draw down the tank, at various draw rates, to the required level as determined by the mixing time calculations.

Note, the data provided on the required drawdown, % turnover and volume exchange are to ensure complete mixing of the tank volume to prevent water quality problems associated with short-circuiting, incomplete mixing, and increased water age. A water age evaluation of the entire distribution system may dictate greater tank turnover than provided with the RMA. As long as the actual tank turnover/fluctuation is equal to or greater than that provided with the RMA, the tank will be completely mixed.

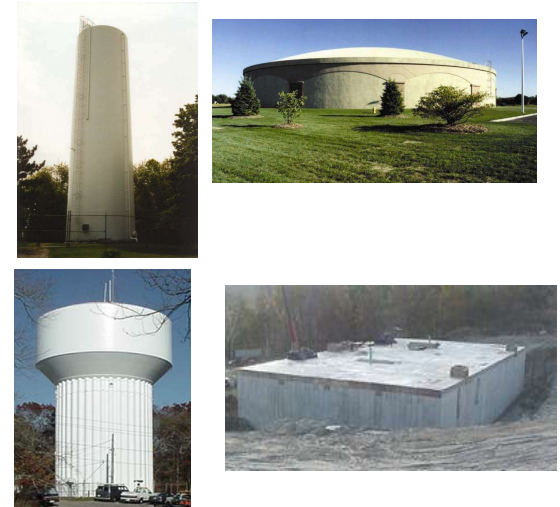
Ice Formation Disclaimer:

The Mixing Times and Turnover required to achieve complete mixing as presented in this report are solely with respect to water quality - to ensure consistent temperature and disinfectant residuals thru the water volume. In colder climates, the turnover required to mitigate or eliminate ice formation in winter may be greater than the required turnover to mix the tank for water quality. It is the responsibility of the consulting engineer and/or owner to determine the amount of turnover required to mitigate ice formation or to implement additional preventative measures such as a recirculation pump and/or submersible heater.

RESERVOIR / TANK NAME: New Fire Tower Road 2.0MG Reservoir

CONSULTANT: [Redacted] **UTILITY / OWNER:** Calhoun Utilities, GA
 Contact: [Redacted] Contact: Kurt T. McCord, P.E.
 Address: [Redacted] Address: [Redacted]
 phone [Redacted] phone [Redacted]
 fax [Redacted] fax [Redacted]
 email [Redacted] email [Redacted]

RED VALVE REP.: Eco-Tech **ANALYSIS BY:** Ron Koch
 Contact: Herb Timmerman



** If "Effective" Tank Diameter is shown, the tank diameter is calculated to make the volume compute correctly. Mixing times are based on volume.

RESERVOIR / TANK DATA		INLET / OUTLET PIPES		FILL / DRAW RATES	
Tank Diameter	90 ft	Outlet Dia. =	16 in	Fill Rates (gpm)	Draw Rates (gpm)
Tank Depth (SWD) to HWL	41.83 ft	* Effective Diameter of TMS (See Note 1)			
Depth to LWL	33.464 ft	Effec. Dia (in) =	AT	500	100
Tank Volume	1,990,648 Gallons	Effec. Dia (in) =	AT	750	500
Tank Volume	266,111 ft ³	Effec. Dia (in) =	AT	1000	1000
Gallons Per Foot =	47,589	Effec. Dia (in) =	AT	1500	3000

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FILL	Time to Fill Tank from Empty to H.W.L		Time to Fill to 1' Depth		Input Fill Time (Hours)	Resulting Increase in Water level (ft)	Volume Change (gallons)
	(Hours)	(Days)	(Minutes)	(Hours)			
INLET FLOW RATES (gpm)							
500.0	66.35	2.76	95.18	1.59	4.4	2.8	131,648.48
750.0	44.24	1.84	63.45	1.06	3.2	3.1	145,299.50
1000.0	33.18	1.38	47.59	0.79	2.6	3.3	155,717.53
1500.0	22.12	0.92	31.73	0.53	1.9	3.6	171,425.31

GUIDE TO TANK FLUCTUATION AND TURNOVER

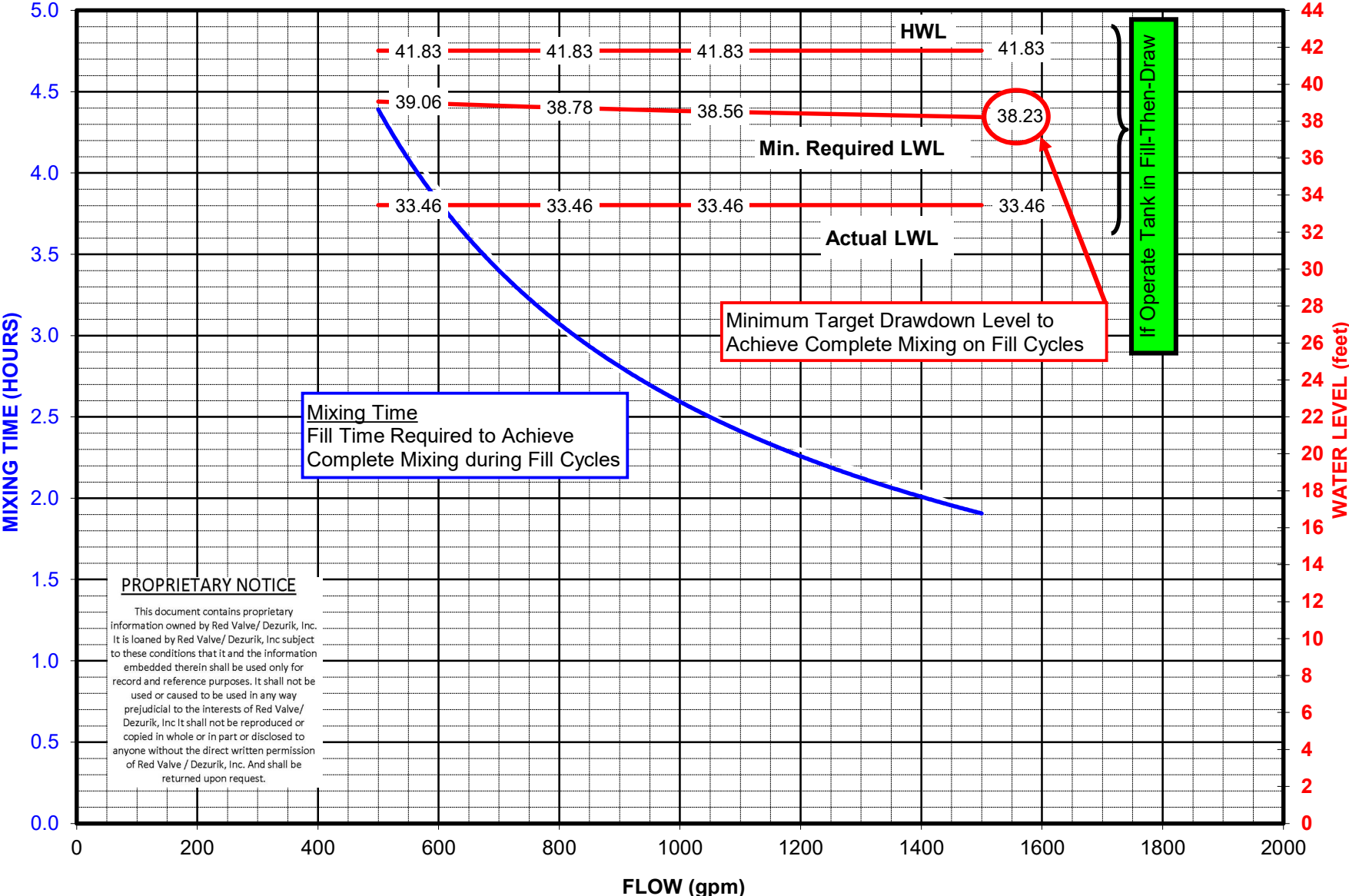
FILL	Jet Velocity (fps)	JV ² / 2g (feet)	Reynold's Number	Inlet Momentum (ft ⁴ / min ²)	Velocity Gradient, G (1/sec)	Theoretical Mixing Time (Fill Time Req'd for Complete Mixing) MT = K * V^(2/3) / M^(1/2)		Req'd Drawdown on Previous Draw to Mix on Next Fill (feet)	% Turnover Required (%)	Volume Exchange Required (gallons)
						(Minutes)	(Hours)			
INLET FLOW RATES (gpm)								(SEE NOTE 2)	(SEE NOTE 2)	(SEE NOTE 2)
500.0	6.39	0.64	372,751	25,645	2.65	263.3	4.4	2.8	6.6	131,383
750.0	7.87	0.96	506,595	47,368	4.00	193.7	3.2	3.1	7.3	145,317
1000.0	9.14	1.30	630,270	73,319	5.36	155.7	2.6	3.3	7.8	155,271
1500.0	11.31	1.99	858,778	136,121	8.13	114.3	1.9	3.6	8.6	171,196
						MINIMUM TANK FLUCTUATION TARGET				

DRAW	TIME TO DRAW TANK FROM FULL TO EMPTY		Time to Draw Down 1' Depth		Pipe Velocity (fps)	Volume Exchange Required (gallons)	Draw Time Required (Hours)
	(Hours)	(Days)	(Minutes)	(Hours)			
OUTLET FLOW RATES (gpm)							
100	331.77	13.82	475.89	7.93	0.16	171,196	28.5 @ 100 gpm Draw Rate
500	66.35	2.76	95.18	1.59	0.80	171,196	5.7 @ 500 gpm Draw Rate
1000	33.18	1.38	47.59	0.79	1.59	171,196	2.9 @ 1000 gpm Draw Rate
3000	11.06	0.46	15.86	0.26	4.78	171,196	1.0 @ 3000 gpm Draw Rate

*** NOTE: 1. TIDEFLEX VALVES ARE INHERENTLY A VARIABLE ORIFICE SO THE TMS EFFECTIVE DIAMETER VARIES WITH FLOW RATE**
2. MIXING TIME EQUATIONS DO NOT ACCOUNT FOR DIFFERENCES IN TEMPERATURE BETWEEN INLET WATER AND TANK (BUOYANT JETS)
THESE CALCULATIONS MAY UNDERESTIMATE THE FILL TIME REQUIRED FOR MIXING.

TMS - Mixing Time and Minimum Required Drawdown

New Fire Tower Road 2.0MG Reservoir





WATER AGE ANALYSIS

For Tanks That Operate in
FILL - THEN - DRAW
(Not simultaneous fill and draw)

Actual/Predicted Daily Turnover and Water Age

High Water Level (HWL) = 41.83 ft	Turnover = 8.4 feet	Ave. Water Age = 5.0 days
Low Water Level (LWL) = 33.46 ft	20.0 %	(Assumes tank is mixed. CAUTION: A single inlet pipe often does not mix. Water age could be much higher)
	398,117 gal	

Turnover Required for TMS to Achieve Complete Mixing

(GOAL: For Required Turnover for Complete Mixing to be Less Than Actual/Predicted Turnover)

The TMS will mix the tank with Turnover = 3.6 feet	Ave. Water Age = 11.6 days
(see Mixing Analysis)	(Water age if tank turnover was the minimum required to achieve complete mixing)
	8.6 %
	171,420 gal

RESULT

Is Actual Turnover Greater than Required Turnover to Mix with TMS? YES

If Yes, the TMS will Completely Mix the Tank. Applicable Water Age is from Actual/Predicted Turnover
If No, Tank May not be Completely Mixed but Will Not Short-Circuit. The TMS Separates the "Inlet" and "Outlet" and will Draw the Oldest Water from the Tank First

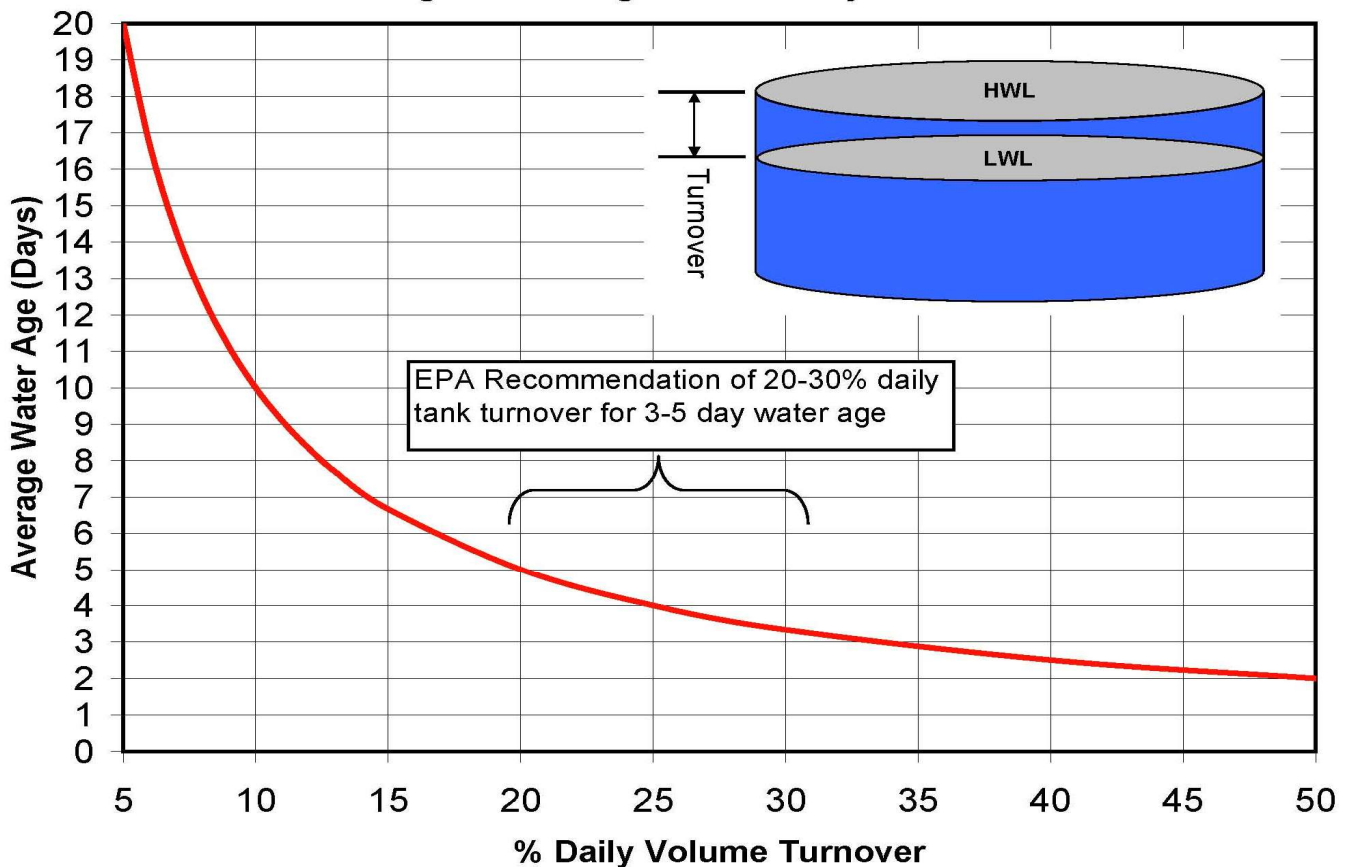
WATER QUALITY:

* Maintaining storage tank water quality is a function of:

- 1) Maximizing volume turnover to minimize water age. See Water Age vs. Turnover Guideline below.
- 2) Achieving complete mixing to avoid a localized increase in water age due to incomplete mixing and short-circuiting

* The TMS design addresses #2. Consultant and/or Owner to address #1 by looking at the "operation" of the distribution system and tank in order to maximize turnover. See Water Age vs. Turnover Guideline below.

Average Water Age vs. % Daily Turnover





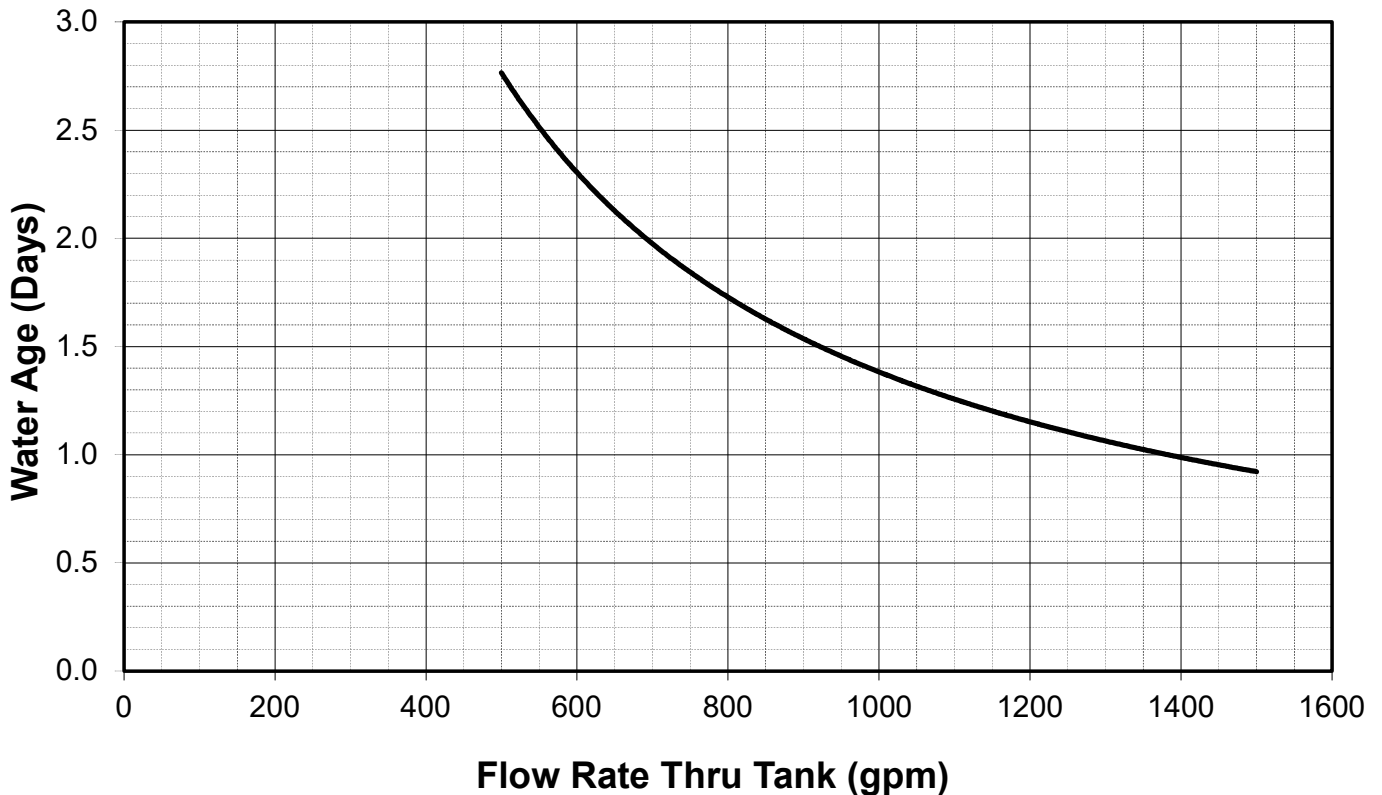
WATER AGE ANALYSIS

For Tanks That Operate in
SIMULTANEOUS FILL & DRAW
(Not fill-then-draw)

Tank Volume (Gallons)	Flow Rate (gpm)	WATER AGE (Assumes fill/drawing 24 hours per day)			Mixing Time from Mixing Analysis (Hours)
		(Minutes)	(Hours)	(Days)	
1,990,648	500.0	3,981	66.4	2.76	4.4
	750.0	2,654	44.2	1.84	3.2
	1000.0	1,991	33.2	1.38	2.6
	1500.0	1,327	22.1	0.92	1.9

These Water Age Calculations are valid if the tank is completely mixed.
(TMS will completely mix tank if the actual fill time is greater than the theoretical mixing time as shown here and on Mixing Analysis)

Water Age vs. Flow Rate Thru Tank



WATER QUALITY:

* Maintaining storage tank water quality is a function of:

- 1) Maximizing volume turnover to minimize water age. The greater the flow rate thru the tank, the lower the water age.
 - 2) Achieving complete mixing to avoid a localized increase in water age due to incomplete mixing and short-circuiting
- Ensure that tank is filling for longer than what is shown on the theoretical mixing time in the mixing analysis

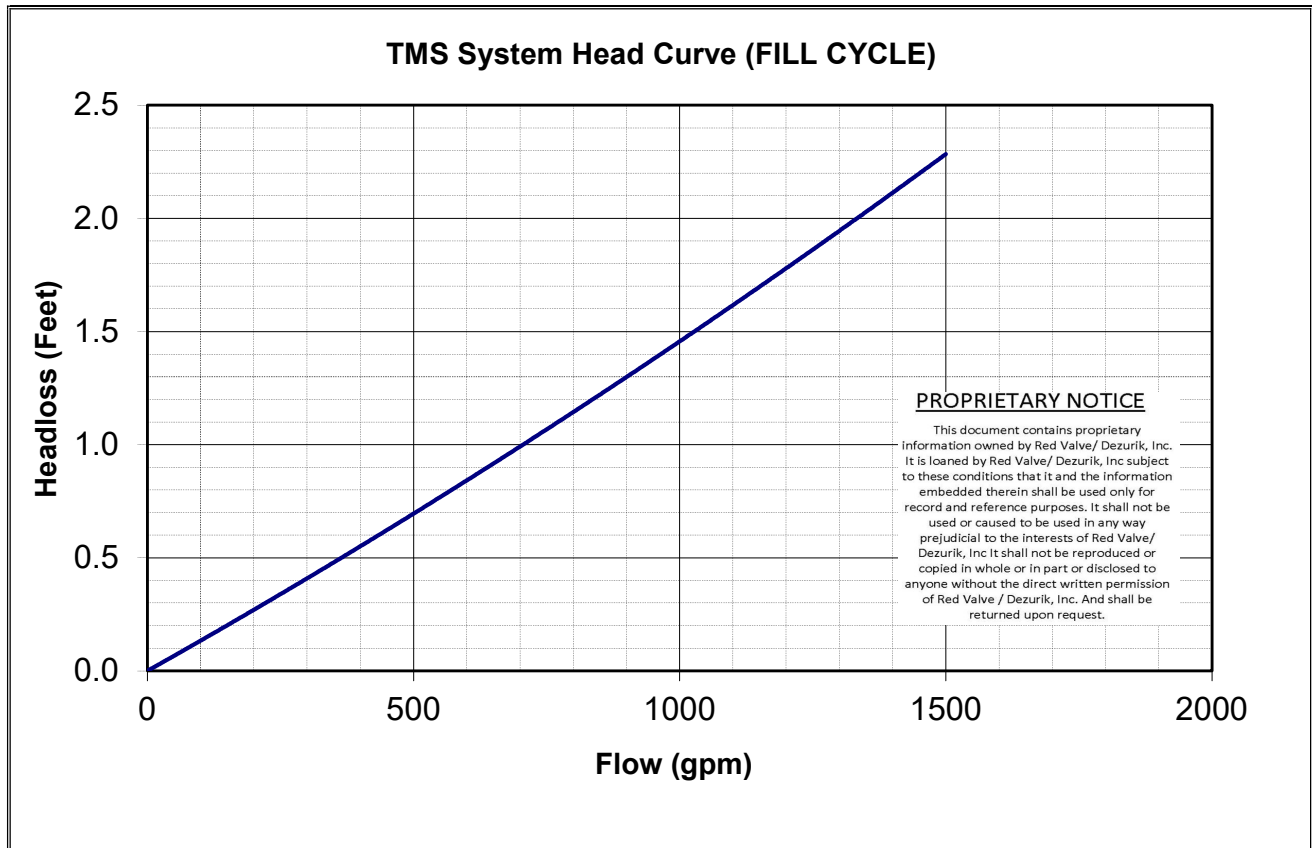


TMS Manifold Hydraulics (FILL CYCLE)

Reservoir Name: **New Fire Tower Road 2.0MG Reservoir**
Reservoir Size: **90' Dia. x 42.08'**
Reservoir Capacity: **2.0 MG**
End User: **Calhoun Utilities, GA**
Consultant:

Ambient Density = **62.4 lbm/ft³**
Effluent Density = **62.4 lbm/ft³**
dS/S = **0**
C = **100 Hazen Williams Coeff.**
Cd = **0.95 Cd**

Flow Rate (gpm)	Jet Velocity (fps)	Friction Headloss (ft)	Total Headloss (ft)
500.0	6.4	0.03	0.7
750.0	7.9	0.07	1.1
1000.0	9.1	0.12	1.5
1500.0	11.3	0.25	2.3





TMS Manifold Hydraulics (DRAW CYCLE)

Reservoir Name: New Fire Tower Road 2.0MG Reservoir

Reservoir Size: 90' Dia. x 42.08'

Reservoir Capacity: 2.0 MG

End User: Calhoun Utilities, GA

Consultant:

Ambient Density = 62.4 lbm/ft³

Effluent Density = 62.4 lbm/ft³

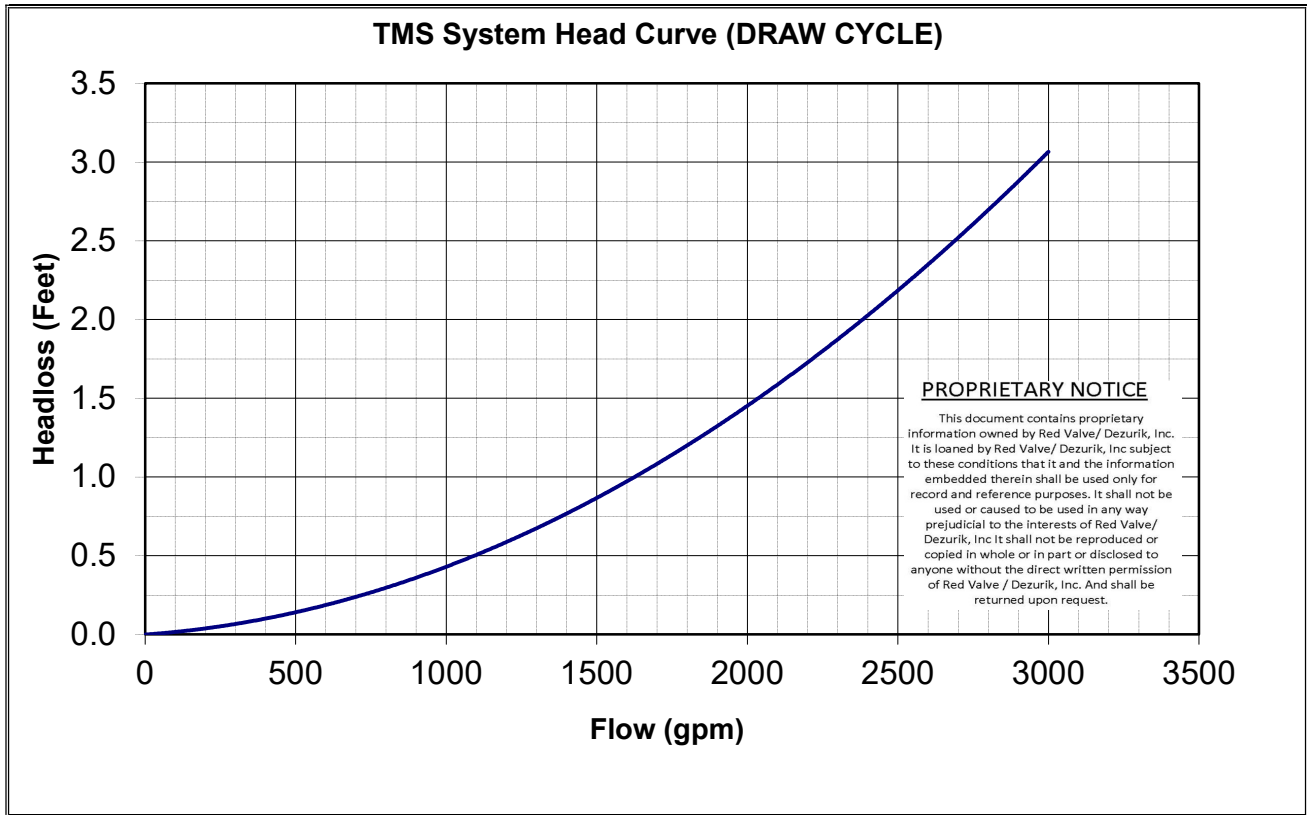
dS/S = 0

C = 100 Hazen Williams Coeff.

Cd = 0.95 Cd

Flow Rate (gpm)	WF-3 Headloss (ft)	Friction Headloss (ft)	Total Headloss (ft)
100.0	0.0	0.0	0.0
500.0	0.1	0.0	0.1
1000.0	0.4	0.1	0.4
3000.0	2.5	0.5	3.1

TMS DRAW HYDRAULICS ONLY APPLIES IF WATER IS DRAWN FROM TANK THRU TMS



SECTION 01020 ALLOWANCES

PART 1 – GENERAL

- A. The Contractor shall include in the Bid Total the allowances stated herein. These allowances shall cover manufactured equipment or services that will be provided to the contractor by others. The contractor shall cause the work covered by these allowances to be provided by such suppliers as the Owner may select. The Contractor's cost for handling, coordinating and any other costs that are necessary to complete these items but not specifically covered in the allowance shall be included in the Contractor's lump sum bid. The final amount of any allowance item listed herein shall be adjusted accordingly by change order to reflect actual cost.

PART 2 – PRODUCT

- A. An allowance in the amount of \$5,000 has been allocated for Electric Utility Provider services, which shall be utilized for holding or relocating power poles. Charges must be authorized in writing by the Project Engineer in advance. Contractor will be eligible but limited to a 10% mark-up for overhead and profit. Contract change orders shall be enforced for anything over and above this amount. Owner has sole discretion to authorize the use of these funds.
- B. An allowance in the amount of \$10,000 has been allocated for Geotechnical Engineering services. Charges must be authorized in writing by the Project Engineer in advance. Contractor will be eligible but limited to a 10% mark-up for overhead and profit. Contract change orders shall be enforced for anything over and above this amount. Owner has sole discretion to authorize the use of these funds.
- C. An allowance in the amount of \$50,000 has been allocated for Supplemental Work Additions (SWA's). SWA shall be utilized to incorporate cost changes for any additional authorized work into the scope of work up to the amount budgeted above. Contract change orders shall be enforced for contract changes over and above this amount. These SWA's shall authorize the Contractor to perform additions to work, but the Contractor shall perform no work until written authorization has been delivered to the Contractor by the Owner. Contractor should not expect that any SWA's will be issued; SWA's shall be issued at the discretion of the Engineer.

The value of any work covered by a SWA shall be determined in one of the following ways:

1. Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the item involved (subject to the provisions of General Conditions, paragraphs 11.9.1 through 11.9.3, inclusive).
2. By mutual acceptance of a lump sum by Contractor and the Owner.
3. On basis of invoices plus a 10% Contractor's Fee for overhead and profit.
4. On the basis of time and materials.

PART 3 – EXECUTION

- A. Amounts stated shall include all taxes, coordination and handling that may be required to provide the equipment to the owner. Owner may choose to delay the purchase of equipment to the end of the contract.

END OF SECTION

**SECTION 01025
MEASUREMENT AND PAYMENT
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**SECTION 01025
MEASUREMENT AND PAYMENT**

PART 1. GENERAL

1.1 SCOPE OF WORK

- A. This Section describes the methods by which the measurement of quantities and the payment of work will be governed on this Project. The Bid Form prices will be used in conjunction with the Measurement and Payment Section to determine actual payment amounts.
- B. The project is to be bid as one contract.
- C. Defect assessment and non-payment for rejected work.

1.2 MEASUREMENT OF WORK

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. The Contractor shall measure completed work prior to the preparation of a payment request, then the Engineer or his representative will field verify the quantities after submission of the payment request.
- C. Unit quantities shall be measured in place on a monthly basis.
- D. Materials that must be measured as delivered shall be measured at the time of delivery by the Contractor. Only the uninstalled items (i.e. staging area materials) will be counted as stored materials.
- E. Work completed shall be measured for completion against the schedule of values provided by the Contractor in accordance with the General Conditions. Related work necessary for a complete and operational job, such as relocation of mail boxes, removal of trees, relocation of utilities, graveling / maintaining driveways, field engineering, clearing and grubbing, traffic control, etc., not specifically identified as a pay item shall be included in the unit price bid. No additional payments will be made for such activities.

1.3 ESTIMATED QUANTITIES

- A. All estimated quantities for unit price items, stipulated in the BID FORM, or other Contract Documents, are approximate and are to be used as a basis for comparing the bids submitted for the Project. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis

of payment for work and materials will be the actual amount of work done and materials furnished. The Contractor agrees to make no claim for damages, anticipated profits or otherwise on account of any difference between the amounts of work actually furnished and the estimated amounts included in the BID FORM. The Contractor will not be paid for any work which exceeds the quantity set forth in the BID FORM without a change order issued before the work is performed unless specifically ordered in writing by the Engineer. The Contractor will provide assistance to the Engineer to check quantities and elevations when so requested.

1.4 MEASUREMENT OF QUANTITIES

- A. Measurement by Weight – Concrete reinforcing steel, ductile iron pipe fittings, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- B. Measurement by Volume – Measured by cubic dimension using mean length, width and height or thickness.
- C. Measurement by Area – Measured by square dimension using mean length and width or radius.
- D. Linear Measurement – Measured by linear dimension, at the item centerline or mean chord.
- E. Stipulated Sum/Price Measurement – Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.5 PROGRESS PAYMENTS

- A. Progress payments shall be based on the quantity of units installed.
- B. All items of Work not specifically listed in the Bid Schedule shall be considered incidental to the construction, and the cost of all such work and material shall be included in the prices bid for various items listed.
- C. All items listed for measurement and payment shall include all machinery, plant, materials and labor, etc., to successfully and satisfactorily complete Work specified.
- D. Payment – The Contractor will receive payment only for the items listed in the Bid Schedule of his contract, and no separate payments will be made for the work under any section of the Contract Documents except as provided for in the Bid Form. Where measurements are required to be made by the Engineer, for the payment of a pay item, the failure of the Contractor to give the adequate notification or failure of the Contractor to give the engineer assistance for the measurement shall result in the forfeiture of payment for the work or item which was not measured.

- E. Work to be paid for as a “Lump Sum” shall be measured for completion against the “Schedule of Values” provided by the Contractor. The “Schedule of Values” shall be submitted at the Preconstruction conference and shall include quantities and prices of items aggregating the total “Lump Sum” and will subdivide the work into component parts in sufficient detail to serve as the basis for progress payments during construction.

PART 2. PRODUCTS

2.1 STORED MATERIALS

- A. Partial payment shall be made for approved materials stored at the project site, provided invoices for said materials are furnished in accordance with payment request submittal and shop drawings for said materials have been approved. All costs associated with covering and protecting equipment and materials shall be bore by the contractor.

PART 3. EXECUTION

3.1 SITE CLEARING (SECTION 02230)

No separate payment will be issued for site clearing and grubbing under this project. Any associated costs shall be incorporated into the lump sum price for grading complete.

3.2 EARTHWORK (SECTION 02300)

- A. Measurement: Grading Complete and Storm Drainage Improvements will be measured on a lump sum basis. More specifically, this bid item shall include all earthwork, clearing & grubbing, dirt stockpiling, hauling of excess soil and debris, soil compaction, soil stabilization, soil nail wall design/construction, finished grading, gravel access driveway, storm drainage structures, drainage piping, and all other work that involves the conditioning or movement of dirt and rainwater with exception to waterline trenching.
- B. Payment: Compensation for Grading Complete and Storm Drainage Improvements will be issued according to the unit price provided in the Bid Form, which shall cover all labor, fuel, materials, equipment, and related services necessary to complete the work according to the construction plans and technical specifications. Partial payments for stored materials and the percentage of work completed may be issued if the Contractor furnishes material invoices and a detailed breakdown of the lump sum work.

3.3 SOIL NAIL WALL (SECTION 02301)

No separate payment will be made for the design or installation of the soil nail wall. All costs associated with preparation, designing, drilling, grouting, wire netting, plating, shotcrete spraying, testing, and any other related tasks shall be incorporated into the lump sum price for grading complete and storm drainage improvements.

3.4 EXCAVATION, TRENCHING, AND BACKFILL (SECTION 02315)

No separate payment will be made for open trench excavations to install water mains, storm drainage pipe, or any other on-site facilities. All costs associated with trenching and backfilling shall be incorporated into the lump sum price of the respective facility being installed (i.e. waterline or storm drainage pipe).

3.5 ROCK REMOVAL (SECTION 02316)

A. Measurement

1. Rock Removal Base Cost: Quantities for rock removal base cost shall be expressed in cubic yards of rock excavated. Cubic yards of rock removal shall be determined by multiplying the total by the width and by the depth of rock excavated and then dividing by 27 to convert to cubic yards. No allowance shall be made for excavating to extra widths, sloping sides, or for physical limitations of the Contractor's equipment.
2. Rock Removal Premium Cost: Quantities for rock removal premium cost shall be the same as described in Section 3.5.A.1.

B. Payment

1. Rock Removal Base Cost: Payment for rock removal base cost under these specifications shall be made for the quantities determined in the manner specified above. The unit price for rock removal base cost is for the normally anticipated cost of rock excavation, the cost of additional bedding and backfill material as specified and all costs incidental thereto.
2. Rock Removal Premium Cost: Payment for rock removal premium cost under these specifications shall be made for the quantities determined in the manner specified above. The unit price for rock removal premium cost shall be for all additional costs for rock excavation which, in the opinion of the Contractor, are in excess of the base cost, including but not limited to extra blasting protection, closer grouping of blasting holes, blasting monitoring, additional detonator caps, blasting in water, etc. The contractor shall not bid less than zero (bid a deduct) for the premium cost. Any bids containing a deduct will be declared non-responsive and rejected by the owner.

3.6 SOIL EROSION & SEDIMENT CONTROL (SECTION 02370)

- A. Measurement: All erosion control related work will be measured on a lump sum basis. More specifically, this bid item shall cover the installation and maintenance of erosion control BMPs, mulching, temporary grassing, permanent grassing, fertilizing, and any other means or methods required to control erosion and establish a suitable stand of perennial grass.
- B. Payment: Compensation for Erosion Control Work will be issued according to the unit price provided in the Bid Form, which shall cover all labor, fuel, materials, equipment, and related services necessary to complete the work according to the construction plans and technical specifications. Partial payments for stored materials and the percentage of work completed may be issued if the Contractor furnishes material invoices and a detailed breakdown of the lump sum work.

3.7 WATER DISTRIBUTION (SECTION 02510)

- A. Measurement: All water main improvements will be measured on a lump sum basis. More specifically, this bid item shall include exterior yard piping, hydrant, valves, valve vault, tie-in accommodations, old main abandonment, incidental point repairs, metered service, trenching, backfilling, shoring, flushing, disinfecting, testing and all other work and materials that facilitate the transmission of potable water to and from the new water tank.
- B. Payment: Compensation for Water Main Improvements will be issued according to the unit price provided in the Bid Form, which shall cover all labor, fuel, materials, equipment, and related services necessary to complete the work according to the construction plans and technical specifications. Partial payments for stored materials and the percentage of work completed may be issued if the Contractor furnishes material invoices and a detailed breakdown of the lump sum work.

3.8 FENCING (SECTION 02823)

- A. Measurement: Fencing will be measured on a lump sum basis. More specifically, this bid item shall cover the demolition of the old fence and the installation of temporary and permanent chain link fencing with barb wire used to secure the premises during and after tank construction.
- B. Payment: Compensation for the Security Fencing w/ Gates will be issued according to the unit price provided in the Bid Form, which shall cover all labor, fuel, materials, and related services necessary to complete the work according to the construction plans and technical specifications. Partial payments for stored materials and the percentage of work completed may be issued if the Contractor furnishes material invoices and a detailed breakdown of the lump sum work.

3.9 GRASSING (SECTION 02920)

No separate payment will be issued for temporary or permanent grassing. Any associated costs shall be incorporated into the lump sum price for erosion control work.

3.10 PRECAST STRUCTURES AND GROUTING (SECTIONS 03480 AND 03601)

No separate payment will be issued for precast structures, grouting, or other related work. Any associated costs shall be incorporated into the lump sum price of the respective work type to which it applies. For example, the valve vault would fall under the water main improvements line item and junction boxes would fall under the grading complete and storm drainage improvements.

3.11 GROUND STORAGE TANK (SECTION 11371)

- A. Measurement: Construction of the ground storage tank will be measured on a lump sum basis for the base bid and alternate bid tank sizes. More specifically, this bid item shall include tank foundation, aggregate piers, reinforced concrete tank structure, ladders, rails, safety equipment, hatches, level indicator, vents, overflows, post-construction cleaning, sterilization, materials testing, and any other work or equipment necessary that hasn't been specifically broken-out in the other line items below.
- B. Payment: Compensation for the Ground Storage Tank will be issued according to the unit price provided in the Bid Form, which shall cover all labor, fuel, materials, and related services necessary to complete the work according to the construction plans and technical specifications. Partial payments for stored materials and the percentage of work completed may be issued if the Contractor furnishes material invoices and a detailed breakdown of the lump sum work.

3.12 MISCELLANEOUS WORK ITEMS

- A. Measurement
 - 1. GeoTechnical Engineering Allowance: A lump sum allowance will be available to the Contractor to cover GeoTechnical services used for supplemental soil testing and general consultation during construction but not material testing (which should be included under the ground storage tank line item).
 - 2. Landscaping Allowance: A predetermined allowance has been established for special landscape plantings. This line item has been established for aesthetic enhancements such as ornamental shrubs, groundcovers, stone walkways, etc. as a supplement to grassing and mandatory erosion control

work. All plantings under this line item shall be performed by a landscaping company (other than the general contractor) at the discretion of the Project Engineer.

3. Tideflex Alternative Mixing System: The Tideflex mixing system depicted on construction plan sheet 10 and described in the PDR under general specification section 800 shall be measured as a lump sum deduct. Considering a different yard piping and inlet/outlet design was included under the base bid item #3, this alternate bid item would serve as a substitution if selected. Therefore, the Contractor should consider the elements of the original design that would be eliminated and the elements of the alternative design that would be added in accordance with the details provided for each layout.
4. Butterfly Valve with Spur Gearing Swap: Measurement for the Butterfly Valve Swap will be based on the quantity of valves exchanged. The substitution would eliminate a more expensive gate valve and replace it with a butterfly valve for the specific size(s) listed in the bid form. A decision about the substitutions shall be made by the Owner prior to material submittal approval.

B. Payment:

1. GeoTechnical Engineering Allowance: The City will reimburse the Contractor for GeoTechnical Services rendered on this project up to the amount indicated in the Bid Form. The Design Engineer must authorize the use of these funds before they are expended.
2. Landscaping Allowance: Contractor shall be reimbursed based on actual invoices for landscape plantings and hardscape enhancements in connection with this project. Only supplemental work will qualify for payment.
3. Tideflex Alternative Mixing System: If selected, the deductive price would be combined with the Water Main Improvements LS (bid item #3). Payment would cover all labor, materials, equipment, and subcontracted services necessary to install an operable system. A manufacturer representative must also perform a pre-start up inspection and provide hydraulic computations with mixing times with water age analysis.
4. Butterfly Valve with Spur Gearing Swap: If selected, the deductive price would be combined with the Water Main Improvements LS (bid item #3). The price adjustment should cover all labor, materials, and equipment necessary to make the exchange.

END OF SECTION

SECTION 01030

SPECIAL PROJECT PROVISIONS

PART 1 – GENERAL

1.01 SCOPE

- A. This Section is used to explain and specifically call notice to special issues that the Bidder should consider while preparing his/her Bid.
- B. This Section is also used to include items that fall within the scope of this project but were difficult to convey on the construction plans. They are therefore outlined here and should be included in the contractor's base bid.

1.02 NPDES EROSION CONTROL FEES

- A. This project will disturb less than 1 acre and will therefore be exempt from NPDES monitoring requirements and fees.

1.03 WETLANDS AND STATE WATERS

- A. State waters requiring buffers are not present within the project area.

1.04 ARRANGEMENT OF EQUIPMENT

- A. Unless specifically noted otherwise the arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping and valves and electrical instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the work. Also see "SUBMITTALS".

1.05 REPORTS TO BE USED BY CONTRACTOR IN PREPARATION OF BID

- A. Exploratory reports may be included following the Supplementary Conditions section, which should be utilized by the Contractor in preparation of his/her bidding documents:
 - Geotechnical Exploration Report for the New 2.0MG Ground Storage

Tank, Fire Tower Road, City of Calhoun, Gordon County, Georgia,
prepared by Geosystems Engineering, Inc. dated August 22, 2024.

- B. Exploratory reports shall stand as a formal part of these contract documents.

1.06 USE OF EXISTING PREMISES

- A. The Contractors work force shall not use any of the Owner's existing facilities including rest rooms, break rooms, and/or other facilities. The Contractor shall provide all such facilities for the use of his personnel.

1.07 ACCESS TO SITE

- A. The Contractor shall utilize existing easements and right-of-way when accessing the project site. If Contractor deems it necessary to utilize other points of ingress/egress, Contractor shall immediately notify Owner and Engineer, so appropriate access agreements can be obtained.
- B. Protect all existing roads from damage by construction equipment and activity. All existing roads shall remain open and usable by Owner's personnel and the public at all times. Any damage to existing roads shall be repaired immediately to a condition equal to or better than the original condition.

1.08 WATER SOURCE

- A. The City of Calhoun will supply domestic water (at no cost to Contractor) during construction, filling of tank and pipelines, performing all testing, disinfecting, and providing all other specified required uses of water, after at least 24 hours of advanced notice. With exception to emergency situations, the Contractor isn't allowed to open or close system valves. The City must administer all water system operations in order to maintain adequate pressure and handle customer demands.

1.09 SERVICES OF MANUFACTURERS' REPRESENTATIVE AND OPERATING MANUALS

- A. Bid prices for equipment furnished shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment, and testing of the equipment and to instruct the Owner's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods as required by the installation program or as directed by the Engineer.
- B. See the detailed Specifications for additional requirements for furnishing the services of manufacturer's representatives.

- C. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted before final acceptance.
- D. For equipment furnished under other Divisions, the Contractor, unless otherwise specified, shall furnish the services of accredited representatives of the manufacturer only when some evident malfunction or over-heating makes such services necessary in the opinion of the Engineer.
- E. In addition, four (4) complete sets of operation and maintenance instructions covering all equipment shall be delivered directly to the Design Engineer, Calhoun Utilities. These instructions shall consist of clean, legible, reproducible manufacturer's manuals prepared by the manufacturer exclusively for the equipment furnished under this contract and shall contain no irrelevant material. Instructions shall be written in a clear, concise, easily understandable manner to assist in training personnel and shall include operation procedures, maintenance schedules, lubrication schedules and parts list. These instructions shall include schematic and detail drawings and diagrams as necessary to clearly illustrate the written instructions. In addition to the above, a listing of the complete nameplate data for each piece of equipment shall be attached to these instructions.

1.10 SLEEVES AND OPENINGS

- A. The General Contractor shall provide all openings, channels, chases, etc., and install anchor bolts and other items to be embedded in concrete, as required to complete the Work under this Contract, together with those required by subcontractors, and shall do all cutting and patching, excepting cutting and patching of materials of a specified trade and as stated otherwise in the following paragraph except for Electrical Work. The Electrical Contractor shall provide all openings necessary for his work.
- B. The General Contractor shall coordinate with the Electrical Contractor and all subcontractors to provide all sleeves, inserts, hangers, anchor bolts, etc. of the proper size and material for the execution of the Work. The General Contractor shall be responsible for any corrective cutting and refinishing required to make the necessary openings, chases, etc. In no case shall beams, lintels or other structural members be cut without the written approval of the Engineer.

1.11 PROVISIONS FOR CONTROL OF EROSION

- A. Sufficient precautions shall be taken during construction to minimize the run-off of polluting substances such as silt, clay, fuels, oils, bitumens, calcium chloride, or other polluting materials harmful to humans, fish, or other life, into the supplies

and surface waters of the State. Special precautions shall be taken in the use of construction equipment to prevent operations which promote erosion.

1.12 PROVISIONS FOR THE CONTROL OF DUST

- A. Sufficient precautions shall be taken during construction to minimize the amount of dust created. Wetting down the site may be required or as directed by the Engineer to prevent dust as a result of vehicular traffic.

1.13 CONNECTIONS TO EXISTING SYSTEMS

- A. The Contractor shall perform all work necessary to locate, excavate and prepare for connections to the terminus of the existing mains all as shown on the Drawings or where directed by the Owner. The cost for this work and for the actual connections to the existing system shall be included in the bid for the project and shall not result in any additional cost to the Owner. Said connections shall be made only after approval by the Engineer.

1.14 UTILITY CROSSINGS

- A. It is intended that wherever existing utilities such as water, chemical, electrical or other service lines must be crossed, deflection of the pipe within recommended limits and cover shall be used to satisfactorily clear the obstruction unless otherwise indicated on the Drawings. However, when in the opinion of the Engineer this procedure is not feasible he may direct the use of fittings for a utility crossing as detailed on the Drawings.

1.15 WARRANTIES

- A. All equipment supplied under these Specifications shall be warranted by the Contractor and the equipment manufacturers for a period of one (1) year. Warranty period shall commence on the date of Owner acceptance.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- C. The manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allotted. The Contractor shall be responsible for obtaining equipment warranties from each of the respective suppliers or manufacturers for all the equipment specified.
- D. In the event that the manufacturer is unwilling to provide a one-year warranty commencing at the time of Owner acceptance, the Contractor shall obtain from

the manufacturer a two (2) year warranty starting at the time of equipment delivery to the job site. This two-year warranty shall not relieve the Contractor of the one-year warranty starting at the time of Owner acceptance of the equipment.

1.16 SITE RESTORATION

- A. The Contractor shall remove all excess material and shall clean up and restore the site to its original condition or better. All damage, as a result of work under this Contract, done to existing structures, pavement, driveways, paved areas, curbs and gutters, sidewalks, shrubbery, grass, trees, utility poles, utility pipelines, conduits, drains, catch basins, flagstones, rocked, graveled or stabilized areas or driveways and including all obstructions not specifically named herein, shall be repaired.

1.17 WATER TIGHTNESS

- A. **Special precautions shall be taken in the curing of concrete to reduce concrete cracking as called for in Section 03300.** Each water retaining structure (those which are intended to hold a liquid) shall be filled and tested for leaks by the Contractor with clean water prior to surface coating. Procedure and manner in which any leaks are repaired must meet the approval of the Engineer.

PART 2 - PRODUCTS

2.01 MATERIAL AND EQUIPMENT - GENERAL

- A. These Specifications call attention to certain features, but do not purport to cover all details of construction of the units. However, the Contractor shall furnish and install the mechanisms and/or systems complete in all details and ready for operation when external connections are made. Where components Standard with the manufacturer are not specifically mentioned, such components shall be provided and incorporated in the work as if they had been completely described or detailed, at no additional expense to the Owner.
- B. All steel members used in the fabrication of the equipment shall conform to the requirements of "Specifications for Structural Steel", ASTM A36.
- C. Design and fabrication of structural steel members shall be in accordance with the latest edition of AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings". Zinc Coating (hot dip) for Steel Shapes, Bars, Plates and Strip shall be in accordance with the latest edition of ASTM A123. Zinc Coating (hot dip) for Iron and Steel Hardware shall be in accordance with the latest edition of ASTM A153. All welding shall conform to the latest standards of the American Welding Society.

- D. All parts shall be amply proportioned for all stresses which may occur during fabrication, erection, and operation. All parts of the same size and type shall be identical.

2.02 LUBRICANTS AND FUEL

- A. The Contractor shall provide all mechanical equipment with a sufficient supply of correct lubricants and fuel for starting, testing, and initial 10-day operation period. All lubricants and fuel shall be of types recommended by the applicable equipment manufacturer. The Contractor, subject to the approval of the equipment manufacturer's, shall limit lubricants to the least number or types required for normal maintenance of all equipment.

2.03 LIFTING LUGS

- A. Lifting lugs or lifting eye bolts shall be provided for all equipment or any component weighing 50 pounds or more, for setting of units or future removal. They shall be galvanized or zinc plated steel.

2.04 VIBRATION

- ~~A. Except as subsequently modified for particular cases by these Specifications, all rotating/moving, mechanical equipment shall not exhibit unfiltered readings in excess of the following amplitudes:~~

Speed Range	Antifriction	
	Bearings^a	Sleeve Bearings^b
900 rpm and below	3.0 mils	3.5 mils
901-1800 rpm	2.2	3.0
1801-3000 rpm	1.3	2.5
3001-4500 rpm	1.0	2.0
4501 and above	0.5	1.6

- ~~1. Measured on bearing housing in vertical axial and horizontal direction.~~
- ~~2. Relative shaft to casting motions for both rigid mounted and isolator mounted equipment.~~
- ~~B. Axial shaft vibration displacements (relative to casing) shall not exceed 50 percent of the maximum lateral shaft vibration displacements (relative to casing existing at any point along the shaft).~~
- ~~C. The above vibration responses are to include the range from 5.0 Hz to 5000 Hz.~~

~~and shall therefore encompass both low and high frequency responses of the subject equipment. The measurements shall be obtained with the equipment installed and operating at any capacity within the specified operating range. In addition to these maximum unfiltered readings, it is also stipulated that no narrow band spectral acceleration component, whether subrotational, higher harmonic or asynchronous multiple of running speed, shall exceed 40 percent of the synchronous displacement amplitude component without manufacturer's detailed verification of the origin and ultimate effect of said excitation.~~

~~D. A field vibration test will be required of all rotating or reciprocating machinery.~~

2.05 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation as acceptable to the Engineer shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.06 PROVISION FOR TEMPORARY PRESSURE GAUGE CONNECTION

- A. Where pressure gauges are not shown on the suction and discharge piping of pumps and compressors, the Contractor shall make provision for the temporary connection of pressure gauges by providing a 1/2-inch connection and tee handle isolation ball valves or corporation stops.

PART 3 – EXECUTION

3.01 FACTORY INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. The Engineer shall have the right to inspect and test all materials or equipment prior to shipment from the point of manufacture.
- B. Vibration testing, as noted in this Section shall be performed for all applicable units. In addition, where noted in the individual Sections, or where required by the referenced standard specification, the units (and system where applicable) shall have additional required factory tests performed. At least 30 days notice shall be given to the Engineer to allow the opportunity for the Engineer to be present at the test.
- C. Where a factory test is required, no materials or equipment shall be shipped until the factory test (and shop drawings) are acceptable to the Engineer (See Paragraph 3.03.G).

- D. Additional information on factory inspection and testing of pipes is included under the respective pipe Sections.
- E. Unless otherwise noted the manufacturer will furnish all necessary labor, equipment, tools, and incidentals required for proper factory testing of equipment and correction of deficiencies, at no change in Contract Price.

3.02 SHOP AND FIELD PAINTING/COATING

- A. Reference Section 11371 for details.

3.03 SHIPPING, HANDLING, DELIVERY AND STORAGE

- A. All parts and equipment shall be properly crated, packaged, sealed and/or otherwise protected so that no damage or deterioration will occur during shipping, delivery, handling, or while stored for a prolonged period on the Site.
- B. Heavy items shall be packed for fork lift truck handling and/or with hook or sling for crane handling. All items subject to water damage shall be packed or provided with waterproof covers suitable for outdoor storage. All packing shall be strong, durable, and rugged and shall be designed to prevent uneven forces on the items. Fragile items shall be suitably protected with special padding and shall be so marked.
- C. Each package shall be delivered with a complete packing list attached. Packing lists will make reference to the respective package number and shall completely itemize, by description and quantity, the contents of each package.
- D. The finished surfaces of all exposed openings shall be protected by wooden blank flanges, strongly built and securely bolted thereto, or other protection acceptable to the Engineer. Finished iron or steel surfaces not otherwise coated shall be properly protected to prevent rust and corrosion.
- E. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- F. The manufacturer's instructions and recommendations shall be followed for unloading, transporting, or otherwise handling units. Suitable slings or similar lifting devices shall be utilized to prevent strains.
- G. Items shall not be shipped until factory testing (where required) and shop drawings information is acceptable to the Engineer. The intent of this requirement is to reduce on-site storage time prior to installation and operation. Under no circumstances shall units be delivered to the Site more than one month prior to installation without written authorization from the Engineer.

H. Site Storage

1. All units having moving parts such as gears, electric motors, and instruments shall be stored in a temperature controlled building acceptable to the Engineer until such time as to be installed.
2. All units shall be stored fully lubricated with oil, or grease, unless otherwise instructed by the Manufacturer.
3. Manufacturer's storage instructions shall be carefully studied by the Contractor and reviewed with the Engineer.
4. Attention is directed to the Contractor's need to manually rotate units' moving parts periodically per the manufacturers' recommendations prior to the Owner's final acceptance (including in storage).
5. Lubricants shall be changed upon completion of installation, and as frequently as required, or recommended by the Manufacturer, during the period between installation and acceptance. New lubricants shall be put in at the time of acceptance.
6. Prior to acceptance of any item, if so required by the Engineer, the Contractor, at his own expense, shall have the Manufacturer inspect and certify that the unit's condition has not been detrimentally affected by any long storage period. Such certifications by the Manufacturer shall be deemed to mean that the unit is judged by the Manufacturer to be in a condition equal to that of unit that has been shipped, installed, tested, and accepted in a minimum time period. As such, the Manufacturer will guarantee the unit equally in both instances. If such a certification is not given when requested, the unit shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

3.04 INSTALLATION OF EQUIPMENT

- A. See Paragraph 1.06 for required manufacturer's services. Unless otherwise noted the Contractor will furnish and pay for and coordinate all necessary labor, equipment, tools, water, and power required to install, service, and make adjustments necessary for the proper installation and shall perform the installation.
- B. Ensure proper installation of all items in accordance with manufacturer's recommendations and instructions in the locations(s) shown to produce a complete workable system; particularly to ensure the correct alignment of drivers and pumps, etc. All units shall be aligned on their foundations by qualified

millwrights after their sole plates have been shimmed level at the anchor bolts. Set all anchor bolts in place and tighten all nuts against the shims. After the foundation alignments have been considered acceptable to the Engineer, securely bolt in place the bedplates or wing feet of the equipment. Make further and final alignment checks and any adjustments before grouting in the sole plates. Under no circumstances will "pipe springing" be allowed. See also Paragraphs 2.08 and 2.09.

- C. Wedges, Shims, filling pieces, keys, packing, grout, or other materials necessary to align, level, and secure equipment in place shall be furnished and install by the Contractor. All parts intended to be plumb, level or perpendicular must be exactly so. Any grinding required to bring parts to proper bearing shall be done at the expense of the Contractor.
- D. Normal installation procedures for all items (including Owner furnished items if any) such as: making connections, adjusting packing, aligning, connection of bases, coupling, wiring, piping, shimming, assembly of normally shipped loose components, use of drift pins, deburring, identification of wires at terminals, following manufacturer's instructions and similar items of standard installation practice shall be performed by the Contractor whether specifically mentioned herein or not. References are made to: AISC "Code of Standard Practices" Section 5-180; "Standards of the Hydraulic Institute"; American Welding Society Standards, applicable government codes.
- E. Installation shall include furnishing the grease and lubrication for testing.
- F. The contractor will be responsible for provision and placement of locks on all lockable access hatches on the Project site. Locks should all be keyed to the same key. Locks should be heavy duty, laminated and rust proof.

3.05 FIELD TESTING AND CORRECTION OF DEFICIENCIES

- A. Field testing shall not be conducted until the installation is certified (in writing) as acceptable by the Manufacturer. Field testing may not be required for all items. Testing shall be conducted in accordance with the individual specifications.
- B. The Contractor shall furnish to the Owner and Engineer, at least 90 days prior to scheduled field testing, a list of those special items needed to test the equipment and for use during normal operation and maintenance.
- B. See Paragraph 1.06 for required Manufacturer's services. Unless otherwise noted the Contractor will furnish and pay for all necessary labor, equipment, tools, incidentals, required for proper testing and initial operation. Unless otherwise noted the Contractor will operate the equipment and conduct the field test(s).

- D. Field testing shall be as set out in the individual Specifications and herein for vibration and noise, and shall also include the lubrication system and its components. Field testing shall be witnessed by, and acceptable to, the Manufacturer's representative and the Engineer, unless otherwise noted.
- E. All defects recorded during the above field tests and all defects and failures occurring within the Correction Period shall be corrected by and at the expense of the Contractor, in accordance with Article 13 of the General Conditions.
- F. In the event the items or system performance does not meet the requirements of the Specifications, the necessary corrective measures shall be made at the expense of and by the Contractor, unless otherwise specifically noted, and the item or system retested. If the items or system remains unable to meet the design requirements to the satisfaction of the Engineer, they shall be removed and replaced with satisfactory items or system(s) at the Contractor's expense, unless otherwise specifically noted.
- G. The above testing and/or correction procedures shall continue until the items are acceptable to the Engineer.

3.06 PIPE MARKING

- A. Ensure that correct pipe identification and flow direction marking is properly carried out to the satisfaction of the Engineer.

END OF SECTION

**SECTION 01050
SURVEYING AND FIELD ENGINEERING**

PART 1 – GENERAL

1.01 SCOPE OF WORK

- A. Work covered in this Section includes the surveying and field engineering required to complete the project and meet the provisions of this document.

1.02 QUALITY CONTROL

- A. Contractor will employ a Land Surveyor registered in the State of Georgia and acceptable to the Owner/Engineer when required for property line issues resulting from Contractor's actions.

1.03 SUBMITTALS

- A. Submit name, address, telephone number and registration number of surveyor prior to beginning work.
- B. Upon request, submit documentation verifying accuracy of survey work. Documentation may include, but is not limited to, original field notes, worksheets, cutsheets, etc.
- C. Submit a set of "as-constructed" drawings.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.01 SURVEY REQUIREMENTS

- A. Construction Staking – The Contractor shall provide all construction staking using recognized surveying and engineering practices. The surveyor will locate lines, grades and locations called for in the contract drawings. The Owner will provide a suitable number of benchmarks and monuments for Contractor to use as a reference.
- B. "As Built Drawings" – Contractor shall maintain record drawings for the project. The final "as constructed" drawings will show the horizontal location of all water mains, force mains, gravity sewers, services, service lines, valves, hydrants, bends, etc. All horizontal locations shall be referenced to the established coordinate systems or to existing streets, roads or major structures. The Engineer will provide a set of prints for the Contractor's use in completing this work. The City will also take survey shots on the newly installed utilities prior to backfilling for their GIS records.

END OF SECTION

**SECTION 02230
SITE CLEARING**

PART 1. GENERAL

1.1 WORK INCLUDED

- A. Furnish all necessary labor, equipment, material and transportation and performing all operations necessary for removal of surface debris, trees, shrubs, and other plant life.

1.2 RELATED WORK

- A. Section 02220 – Demolition
- B. Section 02300 – Earthwork

1.3 REFERENCED STANDARDS

- A. Conform to applicable code for environmental requirements, disposal of debris, burning debris on site, use of herbicides.
- B. Coordinate clearing work with the appropriate utilities companies.

PART 2. PRODUCTS (Not Used)

PART 3. EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify a waste area salvage area for placing removed materials.

3.2 CLEARING & GRUBBING

- A. Clear areas required for access to site and execution of Work. Clearing shall consist of the felling and cutting of trees into sections, and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the area to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be burned or removed completely from the site, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inch or more in diameter. Limbs and

branches to be trimmed shall be neatly cut close to the hole of the tree or main branches. Cuts more than 1-1/2 inch in diameter thus made shall be painted with approved treewound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations, by the erection of timber barriers or by such other means as the circumstances require. Such barriers must be placed and be approved by the OWNER before construction observations can proceed (See 3.02). Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work.

- B. Grubbing shall consist of the removal and disposal of stumps, roots larger than one (1) inch in diameter, and matted roots from the designated grubbing areas. This material, together with logs and other organic or metallic debris not suitable for building of pavement subgrade or building pads, shall be excavated and removed to a depth of not less than 18-inches below the original surface level of the ground in embankment areas and not less than 2-feet below the finished earth surface in excavated areas. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 PROTECTION

- A. All trees on the site will be saved except those marked specifically on the site by the Owner's representative for removal during construction. No trees, either those marked for removal on the site or any other tree, may be removed from the site prior to the preconstruction conference. All trees not to be removed will be protected from injury to their roots and to their top to a distance of three (3') feet beyond the drip-line and no grading, trenching, pruning, or storage of materials may go in this area except as provided by a stakeout by a Owner's representative. The Contractor will pay a penalty for any tree removed from the site which has not been marked specifically for removal. The Contractor also will pay for any tree which dies due to damage during construction. This applies to all trees on the site whether or not they are shown on the plans.
- B. The Contractor shall not be held accountable for damages to trees resulting from placement of fill or removal of soils where such action is required by the contract documents. Any tree, the trunk of which is within 10 feet of any footing or trench, shall be exempt from these penalties except that the Contractor shall exercise all reasonable precautions to preserve even these trees. The contractor agrees to pay penalties as established below in the event that he or any of his subcontractors causes the loss or removal of trees designated to be saved under the provisions of the Agreement.

The penalty is as follows:

Tree Diameter at a Point
4 Feet Above Existing Grade

Penalty

6" – 8"	\$750.00
8" – 11"	\$1,100.00
12" – 23"	\$1,600.00
24" – 35"	\$2,000.00
36" and larger	\$5,000.00

- C. Trees to be graded by the Owner's representative as to variety, condition and site importance with the above figures acting as a maximum penalty with the lowest assessment amount to be no less than one-half of the above penalty figures.
- D. Protect bench marks, survey control points, and existing structures from damage or displacement.
- E. Protect all utilities that remain.
- F. Clearing operations shall be conducted so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and so as to provide for the safety of employees and others.

3.4 REMOVAL

- A. Where indicated or directed, trees and stumps shall be removed from areas outside those areas designated for clearing and grubbing. The work shall include the felling of such trees and the removal of their stumps and roots. Trees shall be disposed of as hereinafter specified.
- B. Remove debris, rock, and other extracted plant life from site.
- C. Partially remove paving, curbs; as indicated. Neatly saw cut edges at right angle to surface.

3.5 DISPOSAL

- A. Disposal of trees, branches, snags, brush, stumps, etc., resulting from the clearing and grubbing shall be the responsibility of the Contractor and shall be disposed of by burning, removal from the site of this work, or a combination of both. All costs in connection with disposing of the material will be at the Contractor's expense. Material disposed of by burning shall be burned in a manner that will avoid all hazards, such as damage to existing structures, construction in progress, trees and vegetation. The Contractor shall be responsible for compliance with all local and State laws and regulations relative to the building of fires. Disposal by burning shall be kept under constant attendance until the fires have burned out or extinguished. All liability of any nature resulting from the disposal of the cleared and grubbed

material shall become the responsibility of the Contractor. The disposal of all materials cleared and grubbed will be in accordance with the rules and regulations of the State of Georgia. No material will be burned unless directed to do so by the OWNER. The Contractor shall obtain a permit to burn on site from the local fire department, before beginning the work.

END OF SECTION

SECTION 02300 EARTHWORK

PART 1 GENERAL

1.01 SCOPE

- A. Work under this section shall include all excavation, handling, re-handling, backfilling, compaction of earth material and disposal of any and all deleterious materials encountered during excavation. Other work under this section shall include all dewatering of excavated areas or trenches, backfilling around structures, preparation of subgrades, surfacing and grading and other incidental or appurtenant earthwork operations necessary to complete work in a satisfactory manner. Moreover, the Contractor must assume all responsibility for any added obstacles or conditions, foreseen or unforeseen, and encountered or manifest during the execution of the work.
- B. Contractor shall provide all service, labor, materials, and equipment required for all earthwork and related operations necessary to complete the work as shown on drawings or specified in these specifications, or as determined in the field jointly by Contractor and Engineer.
- C. Tests for compaction and density shall be conducted by an independent testing laboratory selected by Contractor and approved by Engineer. Costs of compaction tests performed by an independent testing laboratory shall be paid for directly by Contractor. Contractor shall make all necessary excavations and shall supply samples of materials necessary for conducting compaction and density tests. Cost of all retests made necessary by failure of materials to conform to requirements of these specifications shall be paid for by Contractor.

1.02 RELATED WORK

- A. Section 02230 – Site Clearing (Not Used)
- B. Section 02315 – Excavation, Trenching and Backfill of Utility System
- C. Section 02316 – Rock Removal
- D. Section 02370 – Soil Erosion Control
- E. Section 02920 – Grassing

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)

ASTM C 136	Sieve Analysis of Fire and Coarse Aggregates, latest edition
ASTM D 422	Particle-Size Analysis of Soils, latest edition
ASTM D 1140	Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve, latest edition
ASTM D 1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method, latest edition
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. Ft. (2,700 kN-m/cu.m.)), latest edition
ASTM D 2167	Density and Unit Wright of Soil in Place by the Rubber Balloon Method, latest edition
ASTM D 2487	Classification of Soils for Engineering Purposes (Unified soil Classification System), latest edition
ASTM D 2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), latest edition
ASTM D 2937	Density of Soil in Place by the Drive-Cylinder Method, latest edition
ASTM D 3017	Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth), latest edition
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils, latest edition

- B. Georgia Department of Transportation Standard Specification, Construction of Roads and Bridges (Georgia D.O.T. Specifications).

1.04 DEFINITIONS

- A. Compaction – The degree of compaction is specified as percent compaction. Maximum or relative densities refer to dry soil densities obtainable at optimum moisture content.
- B. Excavation Slope – Excavation slope shall be defined as an inclined surface

formed by removing material from below existing grade.

- C. Embankment Slope – Embankment slope shall be defined as an inclined surface formed by placement of material above existing grade.
- D. Topsoil – Material obtained from excavations suitable for topsoil is defined as natural, friable soil, characteristic of representative soils in the vicinity that produce heavy growths of crops, grass, or other vegetation. Topsoil shall be free from roots, stones greater than two inches, and other materials that hinder grading, planting, and maintenance operations, and free from objectionable weed seeds and toxic substances.

1.05 QUALITY ASSURANCE

- A. Soil Tests – The Contractor shall arrange for a certified testing service approved by the Engineer to provide all testing services required by this section. The testing service shall take samples and perform moisture content gradation, compaction, and density tests during placement of backfill materials to check compliance with these specifications at locations selected by the Engineer. The Contractor shall remove surface material at locations designated by the Engineer and provide such assistance as necessary for sampling and testing. The Engineer may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these specifications.

Tests will be performed in accordance with the following:

<u>Test</u>	<u>Standard Procedure</u>
Moisture content	ASTM D 3017
Gradation	ASTM C 136
Density in-place	ASTM D 1556
Moisture-density relationships	ASTM D 1557

Test results will be furnished to the Engineer.

1.06 CONDITIONS

- A. Elevations of the existing ground and the elevations of existing grades of structures are believed to be reasonably correct, but do not purport to be absolutely so, and, together with any schedule of quantities are presented only as an approximation. The Contractor shall satisfy himself, however, by actual examination of the site of the work as to the existing elevations and the amount of work required under these sections. If the Contractor is not willing to accept any ground surface elevations indicated upon the Drawings for payment, he shall so

notify the Engineer prior to starting any excavation work.

- B. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- C. The Contractor shall locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

- D. All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments, pavement, drainage ditches and channels shall be maintained by Contractor in good condition at all times until final acceptance by Owner. All damage caused by erosion or other construction operations shall be repaired by Contractor using materials of same type as damaged material.
- E. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of type, character, composition, or condition thereof.
- F. Earthwork within rights-of-way of State Department of Transportation, County Road Department, City Street Department, or utility companies shall be done in accordance with requirements and provisions of permits issued by those agencies for construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these Specifications.
- G. Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water will not be interrupted in existing gutters, other surface drains, or temporary drains. Material for backfill or for protection of excavation in public roads from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be provided to all fire hydrants, water valves, meters, and private drives.

- H. All earthwork operations shall comply with applicable OSHA Construction Standards.
- I. It is understood and agreed that Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. Contractor shall be responsible for providing all services, labor, equipment, and materials necessary or convenient to him for completing the work within the time specified in these specifications.

1.07 PROJECT RECORD DOCUMENTS

- A. Accurately record location of utilities remaining, rerouted utilities, and new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.08 PROTECTION

- A. Protect trees, shrubs, lawns, and other features remaining as portion of final landscaping. Protect benchmarks, R/W markers, monuments, iron pins, property corner markers, etc. If such markers are disturbed or destroyed, Contractor shall provide services of a registered land surveyor to replace the markers at no expense to the owner.

PART 2 PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory soil materials are limited to soils classified in accordance with ASTM D 2487 as GM, GC, SW, SP, SM, SC, ML, and CL.

Unsatisfactory soil materials are classified in accordance with ASTM D 2487 as Pt, OH, OL, CH, and MH.
- B. Satisfactory soil materials shall be free of clay, rock or gravel larger than 2” in any dimension, debris, waste, frozen materials, organics, vegetation and other deleterious matter.
- C. Borrow shall consist of sand or sand-clay soils capable of being readily shaped and compacted to the required densities, and shall be free of roots, trash and other deleterious material.
- D. All soils used for structural fills shall have a PI (plastic index) of less than 10 and a LL (liquid limit) of less than 30. Fill soils shall be dried to appropriate moisture

contents prior to compaction.

- E. Additionally, fill soils used for the top 2 feet of fill beneath roads and parking lots shall have no more than 15% passing the #200 sieve. Fill soils used for house lots shall have no more than 25% passing the #200 sieve.
- F. Contractor shall furnish all borrow material.
- G. Contractor shall be responsible for and bear all expenses in developing borrow sources including securing necessary permits, drying the material, haul roads, clearing, grubbing, and excavating the pits, haul roads, placing, restoration of pits and haul roads to a condition satisfactory to property owners and in compliance with applicable state and local laws and regulations.

2.02 SOURCE QUALITY CONTROL

- A. If tests indicate materials do not meet specified requirements, change material and retest.
- B. Provide materials of each type from same source throughout the work.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known below grade utilities. Stake and flag locations.
- C. Identify and flag above grade utilities.
- D. Maintain and protect existing utilities remaining which pass through work area.
- E. Notify all utility companies prior to grading and where required to remove utilities.
- F. Upon discovery of unknown utility or concealed conditions, discontinue affected work; notify Owner/Engineer immediately.

3.02 DEWATERING

- A. Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work.

Dewatering shall be accomplished by methods that will ensure a dry excavation and preservation of final lines and grades of bottoms of excavations. Methods of dewatering may include sump pumps, well points, deep wells, or other suitable methods, which do not damage or weaken structures, foundations, or subgrades. Shallow excavations may be dewatered using open ditches provided such ditches are kept open and free-draining at all times. Dewatering methods used shall be acceptable to Engineer. Footing pits or trenches shall be protected by small earth dikes and plastic covers when they are left open in rainy weather.

- B. Unless specifically authorized by Engineer, groundwater encountered within the limits of excavation shall be depressed to an elevation not less than twelve (12) inches below the bottom of such excavation before pipe laying or concreting is started and shall be so maintained. No concrete structures shall be exposed to unequal hydrostatic forces until the concrete has reached its specified 28-day strength. Water shall not be allowed to rise above bedding during pipe laying operations. Contractor shall exercise care to prevent damage to pipelines or structures resulting from flotation, undermining, or scour. Dewatering operations shall commence when ground or surface water is first encountered and shall be continued until such time as water can safely be allowed to rise in accordance with provisions of this section.
- C. Standby pumping equipment shall be kept on the job site. A minimum of one standby unit (one for each ten in the event well points are used) shall be available for immediate installation should any pumping unit fail. Installation of well points or deep wells shall be adequately sized to accomplish the work. Drawings or design of proposed well point or deep well dewatering systems shall be submitted to Engineer for review.
- D. Contractor shall not operate dewatering devices (i.e., pumps, etc.) before the hour of 8:00 AM and after the hours of 8:00 PM in a residential area unless otherwise approved by Engineer or Owner.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with foundation backfill at no cost to Owner. Foundation backfill shall be placed in bottom of trench to within 6" of the bottom of pipe. Six (6) inches of bedding stone shall be placed over the top of the foundation backfill.
- F. Contractor shall dispose of water from the work in a suitable manner without damage to adjacent property. Conveyance of water shall be such as to not interfere with construction operations or surrounding property owners. No water shall be drained into work completed or under construction without prior consent of Engineer. Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

- G. Storm water runoff shall be controlled by means of temporary erosion control methods specified in Section 02370 – Soil Erosion Control, as shown on drawings or as directed by Engineer.
- H. Water shall be disposed of in such a manner as not to be a menace to public health and in accordance with applicable Environmental Protection Agency, Corps of Engineers, and State Environmental Protection Division standards and permits.
- I. Permanent French drains under and around structures shall be installed where shown. Excavation of a trench as shown on the drawings is required. A non-woven drainage geotextile such as Polyfelt TS700 shall be initially draped in the trench. No. 57 stone shall be placed in the trench followed by a 6-inch diameter perforated PVC pipe as shown on the drawings. Crushed stone shall be placed such that the granular layer is extended to finished grade. Filter fabric shall be lapped over the top of the stone. The permanent French drain must have daylight into a lower elevation area of the site. A headwall and an animal screen shall be provided at the outlet end of the pipe to protect it from future clogging.

3.03 SHEETING, SHORING AND BRACING

- A. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross-braces, in good serviceable condition.
- B. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
- C. Maintain shoring and bracing in excavation regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

3.04 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated or graded and stockpile in designated area. Remove excess topsoil not being reused from site.
- B. Do not excavate wet topsoil.
- C. Stockpile topsoil to height not exceeding 8 feet. (Cover to protect from erosion).

3.05 GENERAL EXCAVATION

- A. Excavation shall include removal of all material from an area necessary for the construction of a structure, dam or dike. Excavations shall provide adequate working space and clearances for the work to be performed therein. Excavation for structures shall conform to the elevations and dimensions shown with a

tolerance of plus or minus 0.10 feet.

- B. Contractor shall be responsible for any problems caused to property owners in residential areas due to excessive dust caused by excavation operations. Preparations shall be made by Contractor to control excessive dust in or near any residential area.
- C. Where quicksand, soft clay, spongy, swampy or other materials unsuitable for subgrade or foundation purposes are encountered below excavation limits, they shall be removed to a level of suitable material as directed by the soils engineer. Areas so excavated shall be backfilled with Class D concrete or with foundation backfill to the original excavation limit unless otherwise directed by the soil engineer.
- D. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of next day until excavations are backfilled. All excavations shall be barricaded in such a manner as to prevent persons from falling or walking into any excavation.

3.06 BORROW EXCAVATION

- A. Wherever the backfill of excavated areas or the placement of embankments or other fills require material not available at the site, suitable material shall be obtained from other sources. This may require the opening of borrow pits at points not immediately accessible to the work. In such cases, Contractor shall make arrangements with the property owner and shall pay all costs incident to the borrowed material including royalties, if any, for the use of the material. Before a borrow pit is opened, the quality and suitability of the material to be obtained shall be approved by the Soils Engineer. Any soil tests required for approval of the borrowed material proposed shall be at the Owner's expense.

3.07 SUBSURFACE OBSTRUCTIONS

- A. In excavating, backfilling, and laying pipe, care must be taken not to remove, disturb, or injure any existing water, telephone, gas pipes, storm drainage pipe, headwalls or catch basins, or other conduits or structures, without the approval of the Engineer. If necessary, the Contractor at his own expense, shall sling, shore up, and maintain such structures in operation, and shall repair any damage to them. Before final acceptance of the work, he shall return all such structures to as good condition as before the work started.
- B. The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any pipe, conduit, etc., and shall abide by their regulations

governing such work. In the event that any subsurface structure becomes broken or damaged in the execution of the work, the Contractor shall immediately notify the proper authorities, and shall be responsible for all damage to persons or property caused by such breaks. Failure of the Contractor to promptly notify the affected authorities shall make him liable for any needless loss so far as interference with the normal operation of the utility.

- C. When pipes or conduits providing service to adjoining buildings are broken during progress of the work, the Contractor shall repair them at once.
- D. Delays such as would result in buildings or residences being without services overnight or for a needlessly long period during the day will not be tolerated. Should it become necessary to move the position of a pipe, conduit or structure, it shall be done by the Contractor in strict accordance with the instructions given by the Engineer or the utility involved.
- E. The Owner or the Engineer will not be liable for any claim made by the Contractor based on underground obstructions being different from that indicated in these Contract Documents or plans.

3.08 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. Materials removed by excavation, which are suitable for the purpose, shall be used to extent possible for backfilling pipe trenches and for making embankment fills, subgrades or for such other purposes as may be shown on Drawings. Materials not used for such purposes shall be considered waste material and shall be disposed of at the Contractor's expense.
- B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands.
- C. Unsuitable materials, consisting of rock, wood, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material so designated by the soils engineer, shall be removed from the work site and disposed of by Contractor at his expense.
- D. No waste material shall be dumped on private property unless written permission is furnished by owner of property and unless a dumping permit is issued from local jurisdiction.

3.09 ROCK REMOVAL

See Section 02316.

3.10 COMPACTION

- A. Control soil compaction and moisture content during construction in accordance with the following requirements.
- B. Fill Placement – Once the subgrade has been approved, the exposed surface and all subsequent fill lifts (placed in 8” maximum loose lifts) shall be compacted to at least 95% of the maximum dry density in accordance with ASTM D 698, current edition. These soils shall be placed maintaining the moisture content within 3% of the optimum moisture content as determined by the geotechnical engineering technician.

3.11 BACKFILL AND FILLS

- A. Place acceptable soil material in layers to required elevations.
- B. Ground Surface preparation – Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under “Compaction” for particular area classifications, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

- C. Placement and Compaction – Place backfill and materials in layers not more than 6” in loose depth for material compacted by heavy compaction equipment and not more than 4” in loose depth for material compacted by hand operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

3.12 TOLERANCES

- A. Unpaved areas within 0.1 feet of elevations shown on the drawings provided such deviation does not create low spots that do not drain.

- B. Paved Areas – Subgrade to within 0.05 feet of the drawing elevations less the compacted thickness of the base and paving.
- C. Building Pads – Subgrade to within 0.05 feet of the drawing elevations less the thickness of the concrete slab.

3.13 FINISHED GRADING

- A. All areas covered by the project including excavated and filled sections and adjacent transition areas shall be smooth graded and free from irregular surface changes.
- B. Degree of finish shall be that originally obtainable from either blade grader or scraper operations supplemented with hand raking and finishing, except as otherwise specified.
- C. The finished surface of unpaved areas shall be not more than 0.10' above or below the established grade or approved cross-section.
- D. Ditches and lagoon banks shall be finish graded, dressed and seeded within fourteen (14) calendar days of work to reduce erosion and permit adequate drainage.

3.14 PROTECTION

- A. Graded areas shall be protected from traffic, erosion, settlement, or any washing away that may occur from any cause prior to acceptance.
- B. The Contractor shall be responsible for protection of below grade utilities shown on the drawings or indicated to him by the Owner at all times during earthwork operations.
- C. Repair or re-establishment of graded areas prior to final acceptance shall be at the Contractor's expense.
- D. Site drainage shall be provided and maintained by Contractor during construction until final acceptance of the project. Drainage may be by supplemental ditching or pumping if necessary, prior to completion of permanent site drainage.

3.15 DRAINAGE

- A. The Contractor shall be responsible for providing surface drainage away from all construction areas. This shall include maintenance of any ditches that exist or may be constructed by others in the immediate vicinity of the work. Contractor

shall provide proper and effective measures to prevent siltation of wetlands, streams, and ditches both on the Owner's property, and those properties downstream.

3.16 PRE-DENSIFICATION AND PROOFROLLING

- A. At completion of clearing, grubbing and stripping of topsoil, stump holes or other depressions shall be cleared of loose material and debris and shall then be backfilled with approved fill. The backfill shall be placed in six-inch thick loose lifts and compacted to 95% of the maximum dry density in accordance with the ASTM D 698, current edition.
- B. Following the clearing and grubbing of trees and underbrush and stripping of topsoil, the fill subgrade shall be evaluated by the geotechnical engineer or his representative prior to fill placement. Proof-rolling of the subgrade soils shall be performed where possible. Proof-rolling shall be accomplished with a loaded dump truck or other approved rubber-tired equipment. Overlapping passes of the vehicle shall be made across the site in one direction and then at right angles to the original direction.
- C. Proof-rolling shall not be performed on excessively soft areas or areas of high water table. Recommendations for these areas will be made by the geotechnical engineer at the time of construction. These recommendations may include undercutting soft areas, trenching of soils for drainage or the placement of bridge lifts.

3.17 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction – Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed. An experienced geotechnical engineer shall observe all proof-rolling and all fill and liner placement. Submit one copy of results of all compaction tests and observations of pre-densification to Owner and Engineer.
- B. Perform field density tests in accordance with ASTM D 2937 (drive cylinder method), ASTM D 2167 (rubber balloon method), as applicable, or nuclear method ASTM D 2922.
- C. Perform at least one field density test for each layer of fill for every 5,000 square feet of area.
- D. If in opinion of Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, provide additional compaction and testing at no additional expense.

- E. Testing will be the responsibility of the Owner. Contractor shall coordinate with Inspector for testing.

END OF SECTION

SECTION 02301
SOIL NAIL WALL SPECIFICATIONS

SCOPE OF WORK

- A. The work shall consist of designing and constructing a temporary soil nail retaining wall or other approved temporary excavation shoring at the location and grades shown on the drawings. The work incorporates all labor, plans, drawings, design calculations and all material and equipment required to design and construct the soil nail wall in accordance with this Specification.
- B. The work includes excavating in staged lifts; drilling of the soil nail drill holes to the diameter and length required to develop the design soil nail capacity; grouting the nails; providing and installing bearing plates, washers, nuts, and other required miscellaneous materials; and constructing a temporary shotcrete face or different type of facing in accordance with the approved soil nail wall plans.
- C. The soil nail wall contractor will be fully responsible for the wall layout including the alignment, dimensions and elevations of each and every element of the wall. Control points for the wall layout will be established at the site by others, prior to construction.

MATERIALS

A. Soil Nails

- 1. *Nail Solid Bar.* AASHTO M31/ASTM A615, Grade 60 or 75. Bare deformed bar, continuous without splices or welds, new, straight and undamaged. Threaded, a minimum of 6 in. on the wall anchorage end, to allow proper attachment of bearing plate and nut. Threading may be continuous spiral deformed ribbing provided by the bar deformations (continuous thread bars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, provide the next-larger bar number designation from that shown by the approved soil nail wall plans.
- 2. *Bar Coupler.* Bar couplers shall develop the full ultimate tensile strength of the bar as certified by the manufacturer.

B. Soil Nail Appurtenances

- 1. *Centralizer.* Manufactured from Schedule 40 PVC pipe or tube, steel, or other material not detrimental to the nail steel (wood shall not be used); securely attached to the nail bar; sized to position the nail bar within 1 in. of the center of the drill hole; sized to allow tremie pipe insertion to the bottom of the drill hole; and sized to allow grout to freely flow up the drill hole.

2. *Nail Grout.* Neat cement or sand/cement mixture with a minimum 3-day compressive strength of 1,500 psi and a minimum 28-day compressive strength of 3,000 psi, per AASHTO T106/ASTM C109.
 3. *Fine Aggregate.* AASHTO M6/ASTM C33.
 4. *Portland Cement.* AASHTO M85/ASTM C150, Type I, II, III, or V.
 5. *Admixtures.* AASHTO M194/ASTM C494. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to review and acceptance by the Engineer. Accelerators are not permitted. Expansive admixtures may only be used in grout used for filling sealed encapsulations. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.
 6. *Film Protection.* Polyethylene film per AASHTO M171.
- C. Bearing Plates, Nuts, and Welded Stud Shear Connectors.
1. *Bearing Plates.* AASHTO M183/ASTM A36.
 2. *Nuts.* AASHTO M291, grade B, hexagonal, fitted with beveled washer or spherical seat to provide uniform bearing.
 3. *Shear Connectors.* AASHTO Construction Specifications, Section 11.3.3.1.
- D. Welded Wire Fabric. AASHTO M55/ASTM A185 or A497.
- E. Reinforcing Steel. AASHTO M31/ASTM A615, Grade 60, deformed.
- F. Geocomposite Sheet Drain. Manufactured with a drainage core (e.g., geonet) and a drainage geotextile attached to or encapsulating the core. Drainage core to be manufactured from long chain synthetic polymers composed of at least 85 percent by mass of polypropylenes, polyester, polyamine, polyvinyl chloride, polyoleofin, or polystyrene and having a minimum compressive strength of 275 kPa (40 psi) when tested in accordance with ASTM D 1621 Procedure A. The drainage core with the geotextile fully encapsulating the core shall have a minimum flow rate of 1 liter per second per meter of width tested in accordance with ASTM D 4716. The test conditions shall be under an applied load of 69 kPa (10 psi) at a gradient of 1.0 after a 100-hour seating period.
- G. Underdrain and Perforated Pipe
1. *Pipe.* ASTM 1785 Schedule 40 PVC solid and perforated wall; cell classification 12454-B or 12354-C, wall thickness SDR 35, with solvent weld or elastomeric joints.

2. *Fittings*. ASTM D3034, Cell classification 12454-B or C, wall thickness SDR 35, with solvent or elastomeric joints.
- H. Temporary Shotcrete. Submit for approval, all materials, methods, and control procedures for this work.

CONTRACTOR QUALIFICATIONS

- A. The temporary soil nail retaining wall or approved alternate temporary excavation shoring shall be designed and installed by a specialty excavation/shoring contractor. The specialty contractor shall be identified in the construction proposal at the bid opening. No substitution will be permitted after the bid opening without written approval of the Engineer. Substitution after the bid opening will not be grounds for changes in the bid price.
- B. The specialty contractor shall have completed at least 3 permanent soil nail retaining wall projects during the past 3 years totaling at least 10,000 ft² of wall face area and at least 500 soil nails.
- C. The soil nail wall contractor's work must be under the direction of a Registered Professional Engineer with experience in the construction of permanent soil nail retaining walls on at least 3 completed projects over the past 3 years. The soil nail wall contractor's on-site supervisors and drill operators must have experience installing permanent soil nails on at least three projects over the past 3 years.

SOIL NAIL WALL DESIGN REQUIREMENTS

- A. Design the soil nail wall using the Allowable Stress Design (ASD) method, also known as Service Load Method (SLD), as outlined in FHWA Geotechnical Engineering Circular No. 7. "*Soil Nail Walls*." The soil nail wall design shall meet the minimum factors of safety for temporary structures as listed in Table 5.3: *Minimum Recommended Factors of Safety for the Design of Soil Nail Walls using the ASD Method*, on page 112 of Circular No. 7.
- B. Limited data on the subsurface conditions at the site are presented in the attached *Preliminary Subsurface Investigation Report*, GeoSystems Project No. 12-2335, dated July 20, 2012, by GeoSystems Engineering Inc. The soil nail wall contractor is solely responsible for his interpretation of this subsurface data.
- C. Base the design on presumptive soil parameters of 0 psf for cohesion (c), 30 degrees for the angle of internal friction (ϕ) and 120 pcf for the unit weight. The soil nail wall contractor shall verify the design soil parameters through verification and proof testing of the soil nails during construction.
- D. Class II corrosion protection requirements will apply to the soil nail wall construction.

DESIGN SUBMITTALS

- A. At least 30 calendar days before the planned start of the wall excavation, submit complete design calculations and working drawings to the Engineer for review and approval. Include all wall elevations, details, dimensions, quantities, ground profiles and cross-sections necessary to construct the wall. Verify the limits of the wall and ground survey data before preparing the drawings. The drawings and calculations shall be signed and sealed by a Professional Engineer registered in the State of Georgia. The Engineer will approve or reject the soil nail wall contractor's submittals within 15 calendar days after the receipt of the complete submission. The soil nail wall contractor will not begin construction or incorporate materials into the work until the submittal requirements are satisfied and found acceptable to the Engineer.

CONSTRUCTION SUBMITTALS

- A. The soil nail wall contractor is responsible for providing the necessary survey and alignment control during the excavation for each lift, locating drill holes and verifying limits of wall installation. At least 15 days before starting the soil nail work, submit a Construction Plan to the Engineer that includes the following:
 1. The start date and proposed detailed wall construction sequence.
 2. Drilling and grouting methods and equipment, including the *drill hole diameter proposed to achieve the design pullout resistance values shown on the approved soil nail wall contractor's plans* and any variation of these along the wall alignment.
 3. Nail grout mix design, including compressive strength test results (per AASHTO T106/ASTM C109) supplied by a qualified independent testing lab verifying the specified minimum 3-day and 28-day grout compressive strengths. Previous test results for the same grout mix completed within one year of the start of grouting may be submitted for verification of the required compressive strengths.
 4. Nail grout placement procedures and equipment.
 5. Temporary shotcrete materials and methods.
 6. Soil nail testing methods and equipment setup.
 7. Identification number and certified calibration records for each test jack and pressure gauge and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, the device identification number, and the calibration test results and shall be certified for an accuracy of at least 2 percent of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.

8. Manufacturer Certificates of Compliance for the soil nail ultimate strength, nail bar steel, Portland cement, centralizers, and bearing plates.
- D. The Engineer shall approve or reject the soil nail wall contractor's Construction Plan within 7 calendar days after the submission. Approval of the Construction Plan does not relieve the soil nail wall contractor of his responsibility for the successful completion of the work.

STORAGE AND HANDLING

- A. Store and handle soil nail bars in a manner to avoid damage or corrosion. Replace bars exhibiting abrasions, cuts, welds, weld splatter, corrosion, or pitting.

EXCAVATION

- A. The height of exposed unsupported excavation face cut shall not exceed the vertical nail spacing plus the required reinforcing lap or the short-term stand-up height of the ground, whichever is less. Complete excavation of each lift to the wall excavation line and apply shotcrete in the same work shift, unless otherwise approved by the Engineer. Application of the shotcrete may be delayed up to 24 hours if the soil nail wall contractor can demonstrate that the delay will not adversely affect the excavation face stability.
- B. Excavation of the next-lower lift shall not proceed until nail installation, reinforced shotcrete placement, attachment of bearing plates and nuts, and nail testing have been completed and accepted in the current lift. Nail grout and shotcrete shall have cured for at least 72 hours or attained at least their specified 3-day compressive strength before excavating the next underlying lift.

NAIL INSTALLATION

- A. Provide nail length and drill hole diameter necessary to develop the load capacity to satisfy the acceptance criteria for the design load designated on the approved soil nail wall plans. Drill holes for the soil nails at the locations, elevations, orientations, and lengths shown on the approved soil nail wall plans. Drilling equipment and methods shall be in accordance with the accepted installation methods submitted by the soil nail wall contractor. The use of drilling muds or other fluids to remove cuttings will not be allowed. If caving ground is encountered, use cased drilling methods to support the sides of the drill holes. Install nail bars within ± 6 inches of the nail head location and ± 3 degrees of the inclination as shown on the approved soil nail wall plans. Provide centralizers sized to position the bar within 1 in. of the center of the drill hole. Position centralizers as shown on the approved soil nail wall plans so that their maximum center-to-center spacing does not exceed 8 feet. Also locate centralizers within 1.5 ft from the top and bottom of the drill hole.

GROUTING

- A. Grout the drill hole after installation of the nail bar and within 2 hours of completion of drilling. Inject the grout at the lowest point of each drill hole through a grout tube, casing, hollow-stem auger, or drill rods. Keep the outlet end of the conduit delivering grout below the surface of the grout as the conduit is withdrawn to prevent the creation of voids. Completely fill the drill hole in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test bond length of proof tested production nails.
- B. Test nail grout according to AASHTO T106/ASTM C109 at a frequency of one test for every 25 cy of grout placed or a minimum of one test per each day of grout placement. Provide grout test results to the Engineer within 24 hours of testing.

NAIL TESTING

- A. Perform both verification and proof testing of designated test nails. Perform verification tests on sacrificial test nails at locations mutually agreed upon by the Engineer and the soil nail wall contractor. Perform proof tests on production nails at locations selected by the Engineer. Testing of any nail shall not be performed until the nail grout and shotcrete facing have cured for at least 72 hours or attained at least their specified 3-day compressive strengths.
- B. Testing equipment shall include 2 dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The pressure gauge shall be graduated in 75 psi increments or less. Measure the nail head movement with a minimum of 2 dial gauges capable of measuring to 0.001 in.
- C. Maintaining drill hole stability of the temporary unbonded nail length for subsequent grouting is the soil nail wall contractor's responsibility. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing; the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at no additional cost to the owner.

VERIFICATION TESTING OF SACRIFICIAL NAILS

- A. Perform verification testing prior to installation of production nails to confirm the appropriateness of the soil nail wall contractor's drilling and installation methods, and verify the design nail pullout resistance.
- B. Verification test nails shall have both bonded and unbonded lengths. Along the unbonded length, the nail bar is not grouted. The unbonded length of the test nails shall be at least 3 ft. The bonded length of the soil nail during verification tests (L_{BVT}) shall be at least 10 ft but not longer than a maximum length ($L_{BVT\ max}$) such that the nail load does not exceed 90 percent of the nail bar tensile allowable load during the verification test.

Therefore, the following requirements shall be met:

$$10 \text{ ft} \leq L_{BVT} \leq L_{BVT \text{ max}}$$

The length $L_{BVT \text{ max}}$ is defined as:

$$L_{BVT \text{ max}} = C_{RT} \times A_t \times f_y / Q_{ALL} \times FS_{Tver}$$

where,

C_{RT} = Reduction coefficient. Use $C_{RT} = 0.9$ for Grade 60 and 75 bars.

A_t = Nail bar cross-sectional area.

f_y = Nail bar yield tensile strength.

Q_{ALL} = Allowable pullout resistance per unit length (pullout capacity per unit length divided by the factor of safety against pullout failure)

FS_{Tver} = Factor of safety against tensile failure during verification tests (use 2.5 or, preferably, 3).

The maximum bonded length shall be preferably based on production nail maximum bar grade. Provide larger bar sizes, if required, to meet the 10-ft minimum test bonded length requirement at no additional cost.

The Design Test Load (DTL) shall be determined as follows:

$$DTL = L_{BVT} \times Q_{ALL}$$

DTL shall be calculated based on as-built bonded lengths.

- C. Perform verification tests by incrementally loading the verification test nails to failure or a maximum test load of 300 percent of the DTL in accordance with the following loading schedule. Record the soil nail movements at each load increment.

Verification Test Loading Schedule

Load	Hold Time
0.05 DTL max.(AL)	1 minute
0.25 DTL	10 minutes
0.50 DTL	10 minutes
0.75 DTL	10 minutes
1.00 DTL	10 minutes
1.25 DTL	10 minutes
1.50 DTL (Creep Test)	60 minutes
1.75 DTL	10 minutes
2.00 DTL	10 minutes
2.50 DTL	10 minutes max.
3.00 DTL or Failure	10 minutes max.

0.05 DTL max.(AL)	1 minute (record permanent set)
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The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 5 percent of the DTL. Dial gauges should be set to “zero” after the alignment load has been applied. Following application of the maximum load (3.0 DTL) reduce the load to the alignment load (0.05 DTL maximum) and record the permanent set.

- D. Hold each load increment for at least 10 minutes. Monitor the verification test nail for creep at the 1.50 DTL load increment. Measure and record nail movements during the creep portion of the test in increments of 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. Maintain the load during the creep test within 2 percent of the intended load by use of the load cell.

PROOF TESTING OF PRODUCTION NAILS

- A. Perform successful proof testing on 5 percent of the production soil nails in each nail row or a minimum of 2 per row. The Engineer shall determine the locations and number of proof tests prior to nail installation in each row. Production proof test nails shall have both bonded and temporary unbonded lengths. The temporary unbonded length of the test nail shall be at least 3 ft. The bonded length of the soil nail during proof production tests, L_{BPT} , shall be at least 10 ft with a maximum length ($L_{BPT\ max}$) such that the nail load does not exceed 90 percent of an allowable value of the nail bar tensile load during the proof production test. Therefore, the following requirements shall be met:

$$10\ ft \leq L_{BPT} \leq L_{BPT\ max}$$

The length $L_{BPT\ max}$ is defined as:

$$L_{BPT\ max} = C_{RT} \times A_t \times f_y / Q_{ALL} \times FS_{Tproof}$$

where,

C_{RT} = Reduction coefficient. Use $C_{RT} = 0.9$ for Grade 60 and 75 bars.

A_t = Nail bar cross-sectional area.

f_y = Nail bar yield tensile strength.

Q_{ALL} = Allowable pullout resistance per unit length (pullout capacity per unit length divided by the factor of safety against pullout failure)

FS_{Tproof} = Factor of safety against tensile failure during proof production tests (use 1.5).

The maximum bonded length shall be based on production nail maximum bar grade. Production proof test nails shorter than 12 ft in length may be constructed with less than the minimum 10-ft bond length.

The Design Test Load (DTL) shall be determined as follows:

$$DTL = L_{BPT} \times Q_{ALL}$$

DTL shall be calculated based on as-built bonded lengths.

- B. Perform proof tests by incrementally loading the proof test nail to 150 percent of the DTL in accordance with the following loading schedule. Record the soil nail movements at each load increment.

Proof Test Loading Schedule

Load	Hold Time
0.05 DTL max.(AL)	Until Movement Stabilizes
0.25 DTL	Until Movement Stabilizes
0.50 DTL	Until Movement Stabilizes
0.75 DTL	Until Movement Stabilizes
1.00 DTL	Until Movement Stabilizes
1.25 DTL	Until Movement Stabilizes
1.50 DTL (Max. Test Load)	Creep Test (see below)

The alignment load (AL) should be the minimum load required to align the testing apparatus and should not exceed 5 percent of the DTL. Dial gauges should be set to “zero” after the alignment load has been applied.

- C. The creep period shall start as soon as the maximum test load (1.50 DTL) is applied and the nail movement shall be measured and recorded at 1 minute, 2, 3, 5, 6, and 10 minute intervals. Where the nail movement between 1 minute and 10 minutes exceeds 0.04 in., maintain the maximum test load for an additional 50 minutes and record movements at 20 minutes, 30, 50, and 60 minutes. Maintain all load increments within 5 percent of the intended load.

TEST NAIL ACCEPTANCE CRITERIA

- A. A test nail shall be considered acceptable when all of the following criteria are met:
1. For verification tests, the total creep movement is less than 0.08 in. between the 6- and 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.
 2. For proof tests, the total creep movement is less than 0.04 in. during the 10-minute readings or the total creep movement is less than 0.08 in. during the 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.

3. For verification and proof tests, the total measured movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test nail unbonded length.
4. A pullout failure does not occur at 3.0 DTL under verification testing and 1.5 DTL test load under proof testing. Pullout failure is defined as the inability to further increase the test load while there is continued pullout movement of the test nail. Record the pullout failure load as part of the test data.

TEST NAIL REJECTION

A. If a test nail does not satisfy the acceptance criterion:

5. For verification test nails, the Engineer will evaluate the results of each verification test. Installation methods that do not satisfy the nail testing requirements shall be rejected. The soil nail wall contractor shall propose alternative methods and install replacement verification test nails. Replacement test nails shall be installed and tested at no additional cost.
6. For proof test nails, the Engineer may require the soil nail wall contractor to replace some or all of the installed production nails between a failed proof test nail and the adjacent passing proof test nail. Alternatively, the Engineer may require the installation and testing of additional proof test nails to verify that adjacent previously installed production nails have sufficient load carrying capacity. Installation and testing of additional proof test nails or installation of additional or modified nails as a result of proof test nail failure(s) will be at no additional cost.

WALL DRAINAGE NETWORK

A. If required, install and secure all elements of the wall drainage network as shown on the approved soil nail wall plans. The drainage network shall consist of a network of geocomposite drain strips, PVC connection pipes, wall footing drains, and weepholes. Exclusive of the wall footing drains, all elements of the drainage network shall be installed prior to shotcreting.

1. *Geocomposite Drain Strips.* Install geocomposite drain strips centered between the columns of soil nails. The drain strips shall be at least 300 mm (12 in.) wide and placed with the geotextile side against the ground. Secure the strips to the excavation face and prevent shotcrete from contaminating the geotextile. Drain strips will be vertically continuous. Make splices with a 300 mm (12 in.) minimum overlap such that the flow of water is not impeded. Install drain plate and connector pipe at base of each strip. Repair any damage to the geocomposite drain strip, which may interrupt the flow of water.

2. *Footing Drains.* Install footing drains at the bottom of the wall as necessary. A drainage geotextile shall envelope the footing drain aggregate and pipe and conform to the dimensions of the trench. Overlap the drainage geotextile on top of the drainage aggregate. Replace or repair any damaged or defective drainage geotextile.

SHOTCRETE FACING

- A. Provide temporary shotcrete facing in accordance with *Specification for Shotcrete* (ACI 506.2). Shotcrete may also be used to complete the top ungrouted zone of the nail drill hole and completely fill the drill hole void near the face.
 1. Shotcrete shall consist of a mixture of Portland cement (ASTM C150, Type I or II), sand, aggregate, and water so proportioned and mixed to be pumped and pneumatically projected at high velocity onto the excavation surface. Mixture shall be proportioned to provide a minimum compressive strength of 4000 psi at 28 days.
 2. Aggregate and cement may be batched by weight or by volume. Mixing equipment shall be capable of thoroughly mixing the material in sufficient quantity to maintain placing continuity. Ready mix shotcrete shall be delivered and placed within 90 minutes of being batched unless approved otherwise by the Engineer and shall comply with ASSHTO M 157.
 3. Reinforcement shall consist of standard AASHTO M31/ASTM A615, Grade 60; deformed reinforcing bars positioned and sized in accordance with the approved soil nail wall plans.
 4. Prior to shotcrete placement, all loose soil and loose dried shotcrete from previous placement operations shall be removed from the excavation cut face. Shotcrete shall not be placed on frozen surfaces and no shotcrete work will be performed if the air temperature is below 4 degrees Celsius (40 degrees Fahrenheit).
 5. A clean, dry, oil free supply of compressed air sufficient for maintaining adequate nozzle velocity for all parts of the work shall be maintained at all times. The equipment shall be capable of delivering the premixed material accurately, uniformly, and continuously through the delivery hose.
 6. The Contractor shall ensure that the thickness of shotcrete satisfies the minimum shotcrete thickness shown on the approved soil nail wall plans.

SECTION 02315
EXCAVATION, TRENCHING, AND BACKFILL FOR UTILITY SYSTEMS

PART 1. GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment and incidentals necessary to perform all excavation, trenching and back fill required to complete the work shown on the Drawings and specified herein. The work shall include, but is not limited to; excavation for pipe, manholes, vaults, electrical manholes, hand holes, conduits, cables, raceways, and ducts; all backfilling, embankment and grading; disposal of waste and surplus materials; and all related work such as sheeting, bracing and dewatering.
- B. Loam, if any, excavated under this Section and deemed unsuitable for backfill may be salvaged by the Contractor.
- C. Obtain materials required for backfill, fill, or embankments in excess of that available on the site from other sources. Include all costs of obtaining off-site materials in the contract price.

1.2 RELATED WORK

- A. Section 02300 – Earthwork
- B. Section 02530 – Sanitary Sewer Collection System
- C. Section 02920 – Grassing

1.3 REFERENCES

- A. American Society for Testing and Materials.
- B. Federal Register (CFR) – 29 CFR Part 1926 Subpart P

1.4 TESTING SERVICES

- A. The Contractor shall obtain the service of a certified testing service to perform all compaction tests specified herein **unless specified otherwise in the BID FORM or Measurement and Payment**. The cost of these services shall be at the Contractor's expense and shall be factored into his unit prices as outlined in the Bid Schedule.
- B. Soil testing shall be performed by an accredited testing laboratory selected by the Contractor, unless noted otherwise, and approved by the Owner. Tests shall be performed in accordance with applicable ASTM or AASHTO standard methods,

unless otherwise specified.

- C. All materials to be used in the work shall be tested prior to the use to show conformance with the requirements of these specifications. Test reports shall be delivered to the Engineer in duplicate prior to use of any material in the work.
- D. Materials being used in the work, which have been tested previously, may be subjected to further tests from time to time and may be rejected if found defective. Rejected materials shall be removed from the project immediately, notwithstanding the results of former tests to which they have been subjected.
- E. Soil tests shall be performed on subgrades prior to the placement of fill or backfill materials. Tests shall also be performed immediately after the placement of each layer of fill or backfill materials to show conformance with the field density and optimum moisture requirements of these specifications.
- F. If the Engineer determines, based on tests reports and inspections, that subgrades or layers which have been placed are below the specified density, the Contractor shall provide additional compaction and testing at no additional expense to the Owner.

1.5 PROTECTION

- A. Sheeting and/or bracing may be necessary for construction of this division.
- B. Dewatering and Drainage
 - 1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed sub-grade foundation condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The Contractor shall engage a Geotechnical Engineer, Registered in the State of Georgia where required, to design the dewatering system. The Contractor shall submit to the Engineer for review the design of the dewatering systems prior to commencing work.
 - 2. The Contractor shall furnish, install, maintain, operate and remove a temporary dewatering system consisting of trenches, sump pits, deep wells, well points, or other methods as required to lower and control the groundwater level so that the pipes may be installed in the dry. The Contractor shall assume full responsibility for the design and installation of an adequate dewatering system. The Contractor shall, at his own expense, correct all damage resulting from inadequacy of the dewatering system or from flooding of the construction site from other causes.

3. The Contractor shall maintain the water level below the excavated area for the various phases of the work continuously and shall make such provisions as may be necessary to avoid interruptions due to weather, labor strikes, power failures, or other delays. He shall provide and have ready for immediate use at all times diesel or gasoline powered standby pumping units to serve the system in case of failure of the normal pumping units.
4. Piping and boiling, or any form of uncontrolled seepage, in the bottom or sides of the excavation shall be prevented at all times. If for any reason the dewatering system is found to be inadequate to meet the requirements set forth herein, the Contractor shall at his own expense make such additions, changes and/or replacements as necessary to provide a satisfactory dewatering system.
5. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the sub-grade soils at proposed bottom of excavation. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding ground.
6. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
7. The Contractor shall take all additional precautions to prevent uplift during construction. The Contractor shall maintain the groundwater level below the pipe so flotation is prevented.
8. Drainage water shall be disposed of through a desilting basin which will prevent the discharge of sediment into any surface waters or existing drains, and to prevent flow or seepage back into the excavated area.
9. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.
10. Removal of dewatering equipment shall be required; the material and equipment constituting the system, shall be removed by the Contractor.
11. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater quality.

C. Culverts and Ditches

1. Protect drainage culverts from damage. If damaged, restore to satisfactory condition at no cost to the Owner.
2. If it is necessary to remove a culvert, do not replace until the proposed pipeline is installed and trench backfilled and compacted to the subgrade of the culvert. Replace culverts to the line and grade established by the Owner.
3. Backfill minor drainage ditches so that the upper one foot of material between ditch banks is topsoil, loam, or clay.
4. Compact this material for the full ditch width to a minimum of 95% of maximum density as determined by ASTM D 1557.
5. Ditches steeper than 2:1 slope shall be protected and reinforced with a synthetic fiber or grid material. Contractor has the option not to use reinforcement for slopes 2:1 or flatter. Correct any ditch erosion occurring as a result of pipeline construction at no cost to the Owner.

D. Water, Gas, Telephone, Power, Cable

1. Protect all other utilities from damage. Notify utility owner prior to start of excavation. If, during the work the utility is damaged, notify the utility company and the Owner immediately. Do not attempt to repair or replace damaged utilities unless so directed by the utility company and approved by the Engineer. Payment for restoration of damaged utilities shall be the Contractor's responsibility.

1.6 JOB CONDITIONS

A. Soils

1. The contractor shall examine the site and review the available test borings or undertake his own soil borings prior to submitting his bid, taking into consideration all conditions that may affect his work. The Owner and Engineer will not assume responsibility for variations of subsoil quality or conditions at locations other than places shown and at the time the investigation was made. The Contractor shall accept the site in its existing condition, and shall assume the risk of encountering whatever materials as may occur. Refer also to the paragraph of Differing Site Conditions, in the Supplementary Conditions. Soil borings, if furnished, are indicative of the soils encountered at the particular location of the borings at the time the borings were taken. The Contractor shall make his own determination of the soil structure and site conditions as it may affect the work.

B. Existing Utilities

1. CALL BEFORE YOU DIG – At least (3) days prior to beginning any work, the Contractor shall request a field locate of existing underground utilities in the work area through Georgia’s Utility Protection Center by calling 800-282-7411. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
2. Should uncharted, or incorrectly charted, piping appear in the excavation, consult the Engineer and the Owner of such piping or utility immediately for directions.
3. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
4. Demolish and completely remove from site existing underground utilities indicated on the Drawings to be removed.

C. Protection of Persons and Property

1. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

1.7 SUBMITTALS

- A. Submit to the Engineer for review the proposed methods of construction, including dewatering, excavation, filling, compaction, and backfilling for the various portions of the work. Review shall be for method only. The Contractor shall remain responsible for the adequacy and safety of the methods.
- B. Submit to the Engineer for review representative samples of each type of proposed fill material weighing approximately 50 lbs at least 15 days prior to the date of anticipated use of such material.

PART 2. PRODUCTS

2.1 MATERIALS

- A. Backfill materials shall be natural or processed mineral soils, blasted and crushed rock, or masonry rubble. Fill materials shall be free of all organic material, trash, snow, ice, frozen soil or other objectionable materials. Clay soils having a natural

in-place water content in excess of 30 percent are considered unsuitable for stockpiling and/or future use. Fill materials to be used have been classified under categories specified below.

B. Embedment materials listed here include a number of processed materials plus the soil types defined by the USCS Soil Classification Systems in ASTM D2487. These materials are grouped into categories according to their suitability for this application:

1. Class I: Angular 6 to 40 mm (1/4 to 1-1/2 inches), graded stone including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
2. Class II: Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class.
3. Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.
4. Class IV: Silt, silty clays and clays including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, CH and CL are included in this class. These materials are not to be used for bedding, haunching or initial backfill.
5. Class V: This class includes the organic soils OL, OH and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inches) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching and initial backfill.

C. Granular Fill, shall be sound, hard, durable crushed stone meeting the following gradation requirements and shall conform to ASTM C33, Size No. 57.

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1-1/2-in	100
1-in	90-100
1/2-in	26-60
No. 4	0-7
No. 8	0-3

D. Riprap shall be sound, durable rock which is roughly rectangular shape and of suitable quality to insure permanence in the condition in which it is to be used. Rounded stones, boulders, sandstone or similar soft stone will not be acceptable. Material shall be free from overburden, spoil, shale, and organic material. Each load

of riprap shall be reasonably well graded from the smallest to the maximum size specified and shall conform to State of Georgia Department of Transportation Standard Specifications Section 805. Riprap shall consist of a durable field or quarry stone shaped roughly as rectangular blocks. Riprap shall weigh between 50-100 lbs. each with at least 60 percent weighing over 100 lbs. and no more than 10 percent shall weigh 50 lbs. or Less. One dimension of each exposed riprap shall be not less than 12-in. The joints in the riprap shall be filled with spalls of suitable size to construct a solid, stable slope, free from large voids and defects.

- E. Sand shall conform to ASTM Standard C33 for concrete sand.

PART 3. EXECUTION

3.1 EXCAVATION

- A. It is the responsibility of those performing excavation and trenching to conform to all State and Federal Laws and Regulations, and local ordinances relation to safety life, health and property including but not limited to OSHA regulations, 29 CFR PART 1926, Subpart P, Paragraph 1926.650 through 1926.652 during all excavations and trenching. All excavations shall be adequately guarded with barricades and light in compliance with all OSHA and Georgia Department of Transportation requirements so as to protect the public from hazard. Excavations adjacent to existing or proposed buildings and structures or in paved streets or alleys shall be sheeted, shored and braced adequately to prevent undermining or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition.
- B. The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures in the trench zone may be determined before being damaged. He shall be held responsible for the repair or replacement of such structures when broken or otherwise damaged because of his operations.
- C. The Contractor shall make explorations and excavations at no additional charge to the Owner to determine the location of existing underground structures.
- D. Utilities and other piping shall be laid in open trenches as shown and specified. Trenches shall be excavated to the designated lines and grades, beginning at the outlet end and progressing toward the upper end in each case. Trenches for pipe shall be shaped to the lower 1/3 of the pipe and provide uniform and continuous bearing. Bell holes shall be dug to allow ample room for working fully around each joint.
- E. The trench width should be based on the pipe diameter being installed. More specifically the trench width should be approximately the pipe diameter plus six

inches on both sides to allow clearance in areas of rock and adequate space for proper compaction during installation of bedding, handling, and initial backfill. Sides of trenches shall be sheet piled and braced where soil is unstable nature. Above the top of the pipe, trenches may be sloped. The ridge of the trench above this level may be wider for sheeting and bracing and the performance of the work.

- F. Trenches shall be excavated on the alignments shown on the Plans, and to the depth and grade necessary to accommodate 48 inches of cover over the water mains, unless prior approval is obtained from the Engineer. Where elevations of the invert or centerline of a pipe are shown at the ends of a pipe, the pipe shall be installed at a continuous grade between the two elevations.
- G. Excavation in excess of the depth required for proper shaping shall be corrected by bringing to grade the invert of the ditch with compacted coarse, granular material at no additional expense to the Owner. Bell holes shall be excavated to relieve bell of all load, but small enough to insure that support is provided throughout the length of the pipe barrel.
- H. Excavation in excess of the depths required for manholes and other structures shall be corrected by placing a subfoundation of 1500 psi concrete, at no additional expense of the Owner.
- I. If trenches are excavated to widths in excess of those specified, or if the trench walls collapse, the pipe shall be laid in accordance with the next better class of bedding at the expense of the Contractor.

3.2 TRENCHES

- A. Trenches shall be maintained in a safe condition to prevent hazardous conditions to persons working in or around the trench.
- B. Braced and sheeted trenches and open trenches shall comply with all State and Federal Laws and Regulations, and local ordinances relating to safety, life, health and property.
- C. The top portion of the trench may be excavated with sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, utilities, etc. The bottom of the trenches shall be graded to provide uniform bearing and support each section of the pipe on undisturbed soil every point along its entire length, except for the portions of the pipe sections excavated for bell holes and for the sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and in order that the pipe rests upon the trench bottom for its full length and shall be only of such length, depth and width for making the particular type of joints. The bottom of the trench shall be rounded so that at least the bottom one-third of the pipe shall rest on undisturbed earth for the full length of the barrel as jointing operations will permit. This part of the

excavation shall be done manually only a few feet in advance of the pipe laying by workmen skilled in this type of work.

- D. The sides of all trenches and excavation for structures shall be held by stay bracing, or by skeleton or solid sheeting and bracing according to conditions encountered, to protect the excavation, adjoining property and for the safety of personnel. Bracing and shoring may be removed when the level of the backfilling has reached the elevation to protect the pipe work and adjacent property. When sheeting or shoring above this level cannot be safely removed, it may be left in place. Timber left in place shall be cut off at least 2 feet below the surface. No sheeting below the level of the top of the pipe may be removed.
- E. Trenches shall be kept free of water. No structure shall be built or pipe shall be laid in water, and water shall not be allowed to flow over or rise upon any concrete, masonry or pipe until the same has been inspected and the concrete or joint materials has thoroughly set. All water pumped, bailed or otherwise removed from the trench or other excavation shall be conveyed in a proper manner to a suitable place of discharge where it will not cause injury to the public health or to public or private property or to work completed or in progress, or to the surface of the streets or cause any interference with the use of same by the public.

3.3 PILING EXCAVATED MATERIALS

- A. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing roadways.

3.4 LIMIT TO LENGTH OF OPEN TRENCH

- A. Pipe trenches shall not be excavated more than 400 feet in advance of pipe laying and all work shall be performed to cause the least possible inconvenience to the public. Adequate temporary bridges or crossings shall be constructed and maintained where required to permit uninterrupted vehicular and pedestrian traffic.

3.5 REMOVAL OF UNSUITABLE MATERIAL

- A. Should over depth excavation be necessary to remove unsuitable material and to replace with satisfactory material, the Contractor will be paid for this work in accordance with Section 01025 for removal and replacement of unsuitable material, based on the following requirements:
 - 1. When the trench is excavated to the plan depth or as required by these Specifications, and soft or other material not suitable for bedding purposes is encountered in the trench, the Contractor shall immediately notify the Engineer for inspection and measurement of the unsuitable material to be removed.

2. No over depth excavation or backfilling of the over depth excavated trench shall start until proper measurements of the trench have been taken by the Engineer for the determination of the quantity in cubic yards of unsuitable material excavated. Backfill material and backfilling shall conform to the requirements specified in 3.08 below.
3. No payment will be made for any over depth excavation of soft unstable material due to the failure of the Contractor to provide adequate means to keep the trench dry.
4. No payment will be made for any over depth excavation of the unsuitable material and replacement not inspected and measured by the Engineer prior to excavation.

3.6 BEDDING AND HAUNCHING OF GRAVITY SEWER PIPE

- A. Bedding for PVC gravity sewer pipe shall be in accordance with ASTM D 2321, as amended to date, the manufacturer's recommendations and these specifications. All gravity sewer pipes (including service lines) shall have a minimum Type 5 bedding for PVC pipe and Type 4 for ductile iron pipe, but where designated in the Drawings and Specifications, Type 2, or 3 may be required. Type 1 embedment is not permitted without approval of the Engineer. Bedding material shall be included in the unit price bid for the work in which it pertains.
1. Type 1 - Flat Bottom Trench. Flat bottom trench on undisturbed earth with excavation for Bells. General backfill shall be as specified in Paragraph 3.08 Backfilling.
 2. Type 2 - Flat Bottom Trench. Flat Bottom Trench on undisturbed earth with excavation for Bells. Select backfill shall be placed and lightly tamped to the top of the pipe. Select and General backfill shall be as specified in Paragraph 3.08 Backfilling.
 3. Type 3 - Loose Soil Bedding. Pipe bedded in 4- in. minimum Select Material. Select backfill shall be placed and lightly consolidated to a level of 6-inches minimum over the top of the pipe. Select and general Backfill shall be as specified in paragraph 3.08 Backfilling.
 4. Type 4 - Granular Bedding. Pipe bedded in granular material to a depth of 1/8 outside pipe diameter or 6-inch minimum granular material, whichever is greater, on a flat trench bottom. The bedding material shall be placed under the haunches of the pipe with a shovel or other suitable tool to a height of 1/4 outside pipe diameter of the pipe. The initial select backfill shall be hand placed to a level of 12-inches minimum over the top of the pipe and shall consist of finely divided select materials free from debris,

organic material and large rocks and stones. It shall be placed and tamped in layers not over 6-inches thick to at least 90% Standard Proctor, AASHTO T-99 (95% under road crossings).

5. Type 5 - Granular Bedding. Pipe bedded in to a depth of 1/8 outside pipe diameter or 6-inch minimum granular material, whichever is greater, on a flat trench bottom. **For the City of Calhoun**, bedding material shall be placed under the haunches of the pipe with a shovel or other suitable tool to a height of ~~1/2 outside pipe diameter~~ **6" above top** of the pipe. The initial select backfill shall be hand placed to a level of 12-inches minimum over the top of the pipe and shall consist of finely divided select materials free from debris, organic material and large rocks and stones. It shall be placed and tamped in layers not over 6-inches thick to at least 95% Standard Proctor, AASHTO T-99.
- B. Class I materials defined in Paragraph 2.01 shall be used for bedding and haunching for both PVC and DI pipe as shown on the Drawings. Class II,III, IV, and V materials will not be permitted for bedding and haunching under any conditions. Embedment material around the pipe shall be installed with care to insure that sufficient material has been worked under the haunch of the pipe to provide adequate side support. Precautions must be taken to prevent movement of the pipe while placing the bedding and backfill material.
- C. Bell holes shall be provided in all classes of bedding to relieve pipe bells of all loads, but small enough to insure that support is provided throughout the length of the pipe barrel.
- D. Avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill and general backfill material shall be done in such a way so that compaction equipment will not have a damaging effect on the pipe.
- E. If the trench is excavated in excess of those dimensions detailed on the Drawings or to depths greater than shown on the Drawings, or if the trench walls collapse, pipe shall be laid in accordance with the requirements for at least the next better class of bedding or as directed by the Engineer at the expense of the Contractor.
- F. The trench depth shall be as shown on the Plans. If a trench depth is not shown, then the trench depth shall be the minimum depth of cover as required by the pipe manufacturer.

3.7 BEDDING OF PRESSURE PIPE

- A. A pipe for water lines and forcemains shall be laid on foundations prepared in accordance with ANSI/AWWA C600 for ductile iron pipe and AWSI/AWWA C605 for PVC Pipe as modified herein, and in accordance with the various classes of bedding required by the trench width and trench depth for the size of pipe to be laid.

The minimum bedding allowed will be Type 2 for both PVC and Ductile Iron Pipe. Bedding shall be included in the appropriate unit price bid for the work in which it pertains. Blocking shall not be used to bring the pipe to grade.

- B. Bell Holes: Bell holes shall be provided in all classes of bedding to relieve pipe bells of all load, but small enough to insure that support is provided throughout the length of the pipe barrel.
- C. Class I materials as defined in Paragraph 2.01 shall be used for bedding and haunching for both PVC and D.I. waterlines and forcemains when rock is encountered, over excavation occurs or subgrade stabilization is required. A minimum of 6" of granular crushed stone shall be used as bedding.
- D. Overwidth Excavation: If trenches are excavated to widths in excess of those specified or if trench walls collapse, pipe shall be laid in accordance with the requirements for at least the next better class of bedding at the expense of the Contractor.
- E. Borrow Backfill: Borrow backfill will be required if there is not sufficient suitable material available from other parts of the work to backfill the trenches. Borrow backfill from approved borrow pits shall be used. Only those soils in the borrow pits that meet the specified requirements for suitable material shall be used.
- F. Compaction of foundation, bedding, haunching and initial backfill shall extend to the trench wall.
- G. Embedment material in the area around the pipe shall be installed with care. Care shall be used to insure that sufficient material has been worked under the haunch of the pipe to provide adequate side support. Precautions must be taken to prevent movement of the pipe during placing of the material through the pipe haunch.
- H. Avoid contact between the pipe and compaction equipment. Compaction of haunching, initial backfill and backfill material shall be done in such a way so that compaction equipment will not have a damaging effect on the pipe.
- I. The trench depth shall be as shown on the plans or as required to provide the minimum depth of cover as required by the pipe manufacturer.

3.8 BACKFILLING

- A. Backfilling consists of placing suitable materials removed during the excavation into the excavated areas, placing embedment materials and compacting the same to a density equal to or greater than what exists before excavation or as specified herein.
- B. Under backfilling information is also included removal of excess materials and debris from the site, leveling all depressions caused by operation of equipment and

maintaining the backfilled areas until accepted by the Owner.

- C. All backfill material shall be free of stones, concrete and clay lumps larger than 1/3 cubic foot. Roots, stumps and rubbish which will decompose will not be permitted in the backfill. Backfill material shall have its moisture content corrected, as may be necessary before being placed in the trench to bring the moisture content to approximately "optimum" for good compaction. Any rock, stone, concrete, clay lumps larger than 1/3 cubic foot in volume, rubbish and debris shall be removed from the site and disposed of by the Contractor in a lawful manner.
- D. Backfilling operations in this work are referred to herein as Backfilling at the Pipe Zone, Type "A" and Type "B".
- E. Backfilling in the excavated areas below parts of proposed structures shall be referred to hereinafter as Type "A" Backfilling.
- F. Where trenches cross or extend under structures or into present roadways, future roadways or parking areas as shown on the Plans, the backfilling shall be referred to hereinafter as Type "B" Backfilling.
- G. Backfilling at the Pipe Zone: Throughout the entire construction, backfilling at the pipe zone shall include bedding and shall be as follows: Backfill material shall be placed below, around each side, and over the top of the pipe, in approximately horizontal layers to a height of 12 inches over the top of the pipe. Layers shall be of such thickness to facilitate the required compaction. This backfill shall be well compacted by using mechanical tamping equipment in such manner as not to damage the pipe, pipe joints or shift the pipe alignment. Workmen shall not be permitted to walk over the pipe until at least 12 inches of compacted fill has been placed over the pipe. The Contractor shall not use water to obtain compaction except for adding water to the backfill material before placing in the trench to bring the moisture content to approximately "optimum" for good compaction.
- H. Type "A" Backfilling: Type "A" backfilling consists of placing sand and gravel or other suitable materials excavated from the trench in the trench in 6 inch thick layers from a point 18 inches above the top of the pipe and mechanically tamped or compacted by rolling until the backfill density after compaction is equal to 98 percent of the maximum density obtainable at optimum moisture content as determined by the Standard proctor Test (ASTM D698). No water shall be used to secure compaction except for adding water to the backfill material before placing in the trench to bring moisture content approximately "optimum" for good compaction. Each 6 inch thick layer shall be mechanically tamped before additional backfill material is placed in the excavated area.
- I. Type "B" Backfilling: Type "B" Backfilling consists of placing sand and gravel or other suitable material excavated from the trench in the trench in 12 inch thick compacted layers from a point 18 inches above the top of the pipe. Each 12 inch

thick layer shall be compacted before additional backfill material placed in the excavation. Only mechanical tamping, use of roller or small tractor will be allowed. the density of the backfilled material after compaction shall be equal to 95 percent of the maximum density obtainable at optimum moisture content as determined by the Standard Proctor Test (ASTM D698). Except in the upper 12 inches, water shall be added to backfill material only before being placed in the trench in order to bring the moisture content to approximately "optimum" for good compaction.

3.9 PROTECTION OF WATER SUPPLY PIPES

- A. Horizontal Separation: Sewers and force mains shall be laid at least 10 feet horizontally from any existing or proposed watermain. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, such deviation may allow installation of the sewer or force main closer to the watermain, provided that the watermain is in a separate trench or on a undisturbed earth shelf located on the side of the sewer or force main and at an elevation so the bottom of the watermain is at least 18 inches above the top of the sewer or force main.
- B. Crossings: Sewers and force mains crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the watermain and the outside of the sewer or force main. This shall be the case where the watermain is either above or below the sewer or force main. The crossing shall be arranged so that the sewer or force main joints will be equidistant and as far as possible from the watermain joints. Where a watermain crosses under a sewer or force main, adequate structural support shall be provided for the sewer or force main to prevent damage to the watermain.
- C. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer or force main shall be designed and constructed equal to water pipe, and shall be pressure tested to assure water tightness prior to backfilling.

3.10 UTILITY CONSTRUCTION IN OTHER EXCAVATION

- A. Where utilities are required to be constructed in areas also requiring excavation and backfill for other work, coordinate the work so that the parts come together properly and the construction of the various parts can be done without damage to other parts. Place bedding which will form bearing for pipes, using suitable material and shaping to the lower 1/3 of the pipe to provide uniform and continuous bearing. Compaction of backfill material which will form bearing shall be equal to that specified hereinbefore under Type "A" Backfilling. After the pipe or other utility is placed, backfilling shall proceed as specified hereinbefore following the requirements specified under "Backfilling at the Pipe Zone," "Type 'A' Backfilling", and "Type 'B' Backfilling" as applicable.

3.11 TESTING

- A. General: The Engineer and/or Owner shall select a qualified independent testing laboratory for the purpose of identifying soils, checking densities, and classifying soils materials during construction. All testing will be paid for by the Contractor unless specified otherwise in the BID FORM and Measurement and Payment. Copies of all test results shall be furnished to the Engineer in duplicate.
- B. Moisture-Density Tests: Testing shall be in accordance with ASTM Methods D698 and D1557. A test shall be performed on each type of material used in the work regardless of source. Tests will be accompanied by particle-size analyses of the soils tested (ASTM Methods D421 and D422). Changes in color, gradation, plasticity or source of fill material will require the performance of additional tests. Copies of all test results shall be furnished to the Engineer.
- C. Field Density Tests: All loose fill lifts shall be placed in layers not deeper than twelve (12) inches. Layers under all areas, including paved areas shall be compacted to at least 95% of the maximum density as determined by the Standard Proctor Test, for the full depth of the trench.
- D. Submittals
1. The soils technicians will submit formal reports of all compaction tests and retests. The reports are to be furnished to the Owner and the Engineer as soon as possible upon completion of the required tests.
 2. This report information is to include but not be limited to the following:

Date of the test and date submitted.

Location of test.

Wet weight, moisture content and dry weight of field sample.

Description of soil.

Maximum dry density and moisture content of the lab sample which best matches the field sample in color, texture, grain size and maximum dry density.

Ratio of field dry density to maximum lab dry density expressed as a percentage.

Comments concerning the field density passing or failing the specified compaction.

Comments about recompaction if required.

E. Compaction Results

1. If any compaction tests reveal that fill or backfill is not compacted as specified, the Contractor shall scarify and recompact as required to achieve the specified density. Additional compaction tests shall be made to verify proper compaction. These additional tests, required due to failure of the original test shall be paid for by the Contractor without reimbursement by the Owner.
2. The soils technician is to advise the Engineer and the Contractor's Superintendent immediately of any compaction tests failing to meet the specified minimum requirements. No additional lift is to be placed on a lift with any portion failing.

3.12 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

- A. Excavation, Trenching and Backfilling Operations: Excavation, trenching and backfilling along highways, streets and roadways shall be in accordance with the applicable regulations of the State Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair. Construction activities must also comply with all applicable county and local requirements.
- B. Protection of Traffic: Provide suitable signs, barricades and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All signs removed by reason of construction shall be replaced as soon as condition which necessitated such removal has been cleared. No highway, street or roadway shall be closed without first obtaining permission from the proper authorities.
- C. Construction Operations: The Contractor shall construct all work along highways, streets and roadways using the following sequence of construction operations, so as to least interfere with traffic:
 1. Stripping: Where the pipe line is laid along road shoulders, sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.
 2. Trenching, Laying and Backfilling: Excavate trenches, install pipe line and backfill. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations. Trenches shall be progressively backfilled and consolidated and excess material removed immediately.
 3. Shaping: Immediately after completing backfilling operation, reshape any damage to cut and fill slopes, side ditch lines, and shall replace top soil, sod and any other materials removed from shoulders.

- D. Excavated Material: Excavated material shall not be placed along highways, streets, and roadways in such manner as to obstruct traffic. Roadways and pavement will be maintained free of earth material and debris.
- E. Drainage Structures: All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.
- F. Maintaining Highways, Streets, Roadways and Driveways
 - 1. The Contractor shall furnish a road grader which shall be available for use at all times for maintaining highways, streets and roadways. All such streets, highways and roadways shall be maintained in suitable condition until completion and final acceptance of the work.
 - 2. Repair all driveways that are cut or damaged. Maintain them in suitable condition until completion and final acceptance of the work.

3.13 REMOVING AND RESETTING FENCES

- A. Where existing fences must be removed to permit construction, the Contractor shall remove such fences. As construction progresses, reset the fences in their original location and to their original condition. All costs of removing and re-setting fences and such temporary works as may be required shall be included in the prices for the utility line.

3.14 PROTECTING TREES, SHRUBBERY AND LAWNS

- A. Trees and shrubbery along trench lines shall not be disturbed unless absolutely necessary. Trees and shrubbery necessary to be removed shall be properly heeled-in and re-planted. Heeling-in and re-planting shall be done under the direction of an experienced nurseryman.
- B. Where utility trenches cross established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replaced. Topsoil underlying lawn areas shall likewise be removed and kept separate from general excavated materials. Removal and replacement of sod shall be done under the direction of an experienced nurseryman.

3.15 REMOVE AND REPLACE PAVEMENT

- A. Pavement and base course which must be removed for constructing sewers, manholes, forcemains, water lines, and all other appurtenances in streets shall be replaced as specified in Section 02740.
 - 1. The top 18 inches of subgrade material immediately under the paving base

and also road shoulder shall be carefully removed and kept separate from the rest of the excavated material. This material shall be placed in the top 18 inches of the backfill. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with crushed stone or gravel. Settlement in trenches shall be refilled with crushed stone or gravel, and such maintenance shall continue until replacement of pavement.

2. Where utility lines are constructed on unpaved streets, roads or easements, the top 18 inches of soil shall be stripped and windrowed separate from the excavation from trenches. After the line has been installed and the backfill completed within 18 inches of the original grade, the salvaged surfacing shall be replaced. This work shall be considered as general clean up along with the removal of surplus excavated materials from the site and the restoring of the surface outside trench limits to its original condition, the cost of which shall be included in the price bid for the utility line.

3.16 WALKS, DRIVES, CONCRETE CURB AND GUTTER

- A. Walks and drives removed or damaged during the course of construction shall be replaced with Class "A" Concrete at the thickness detailed in the construction drawings. They will be cut to a neat edge with a masonry saw after backfilling and compacting trench in 6-inch layers to a density not less than 98 percent at + 2 percent of optimum moisture content as determined by the Standard Proctor Test.
- B. Concrete curb and gutter sections removed or damaged during the course of construction shall be replaced in full sections with concrete having a compressive strength of at least 3,000 psi.

3.17 SURFACE WATER CROSSINGS

- A. At the above water crossings, the pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repairs or replacement.
- B. At underwater crossings a minimum of two (2) feet shall be provided over the pipe.

3.18 MEASUREMENT AND PAYMENT

- A. The work specified in this Section will not be measured for direct payment except those items specifically stated in this Section and for which bid prices are requested in the Bid Proposal.

END OF SECTION

**SECTION 02316
ROCK REMOVAL**

PART 1. GENERAL

1.1 SCOPE OF WORK

- A. Removal of all rock materials discovered during excavation for the purpose of construction. Removal shall include drilling and/or blasting incidental thereto and disposal of excavated materials.
- B. When necessary for prosecution of the Work, the use of explosives to assist rock removal may be exercised by Contractor provided this use is in compliance with all local, State, Federal and other Governmental regulations applying to transportation, storage, use and control of explosives.

1.2 RELATED WORK

- A. Section 02300 – Earthwork
- B. Section 02315 – Excavation, Trenching and Backfill for Utility Systems

1.3 REFERENCES

- A. NFPA 495 – Code for the manufacture, Transportation, Storage, and Use of Explosive Materials.
- B. OSHA 2207 – Construction Industry Standards, Subpart T – Demolition.

1.4 QUALITY ASSURANCE

- A. Explosives Firm – Company specializing in explosives for disintegration of subsurface rock with documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for explosive disintegration of rock.
- B. Obtain permits from authorities having jurisdiction before explosives are brought to site or drilling is started.
- C. All explosives shall be stored securely in compliance with all laws and ordinances, and all such storage places shall be clearly marked **DANGEROUS EXPLOSIVES**. Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives or blasting agents. Locked storage shall be provided satisfactory to the Engineer, never closer than 1,000 feet

from any road, building, or camping area.

PART 2. PRODUCTS

2.1 MATERIALS

- A. Rock (Definition) – Solid mineral material with a volume in excess of ½ cubic yard that cannot be broken down and removed by use of heavy construction equipment, such as a Caterpillar 215 or equivalent, bulldozer such as a Caterpillar D8K equipped with single tooth hydraulic ripper, ¾ cubic yard capacity power shovel, rooters, etc., and without drilling or blasting. Materials which can be loosened with a pick, hard pan, boulders less than ½ cubic yard in volume, chert, clay, soft shale, soft and disintegrated rock and any similar material shall not be considered as rock. (All materials to be considered unclassified or common excavation).
- B. Explosives – Shall be suitable for intended purposes at the Contractor’s option subject to review by Owner and Engineer.
- C. Delay Devices – Type recommended by explosives firm to be used as accessory to explosives. Subject to review by Engineer.
- D. Blasting Mat – When the use of explosives is necessitated during prosecution of the Work, Contractor shall incorporate the use of blasting mats or type recommended by explosives firm to lessen the danger of projectiles occasionally resultant from blasting of rock.

PART 3. EXECUTION

3.1 INSPECTION

- A. Contractor shall verify site conditions and note irregularities affecting work of this Section prior to performing any operations involving explosives. Contractor shall submit to Owner for a review a detailed plan for using explosives to include, but not limited to:
 - 1. Sequence of Work
 - 2. Equipment
 - 3. Protection to be provided for existing structures to remain
 - 4. Personnel
 - a. Training

- b. Previous experience with the use of explosives in similar situation
- B. Beginning work of this Section means acceptance of existing condition.
- C. Rock in utility trenches shall be excavated over the horizontal limits of excavation and to depths as follows:

Size of Pipeline (Inches)	Depth of Excavation Below Bottom of Pipe (Inches)
Less than 4	6
4 to 6	8
Over 8	12

Space below grade for pipe shall then be backfilled with minus ¾-inch crushed rock or gravel or other approved materials and tamped to proper grade.

3.2 ROCK REMOVAL – MECHANICAL METHOD

- A. Excavate for and remove rock by the mechanical method.
- B. Where pipes are constructed on concrete cradles, rock shall be excavated to bottom of cradle as shown on plans.
- C. Where rock foundation is obtained at grade for over 50 percent of area of any one structure, the portion of foundation that is not rock shall be excavated below grade to reach a satisfactory foundation of rock. The portion below grade shall be backfilled with Class C concrete.
- D. Where rock foundation is obtained at grade for less than fifty (50%) of any one structure and satisfactory rock cannot be found over the remaining area by reasonable additional excavation, the rock shall be removed for a depth of twelve (12) inches below grade and the space below grade shall be backfilled with brushed stone as specified for pipelines.
- E. Rock excavation near existing pipelines or other structures shall be conducted with utmost care to avoid damage. Injury or damage to other structures and properties shall be promptly repaired to the satisfaction of Owner and by Contractor at his own expense.
- F. Rock excavation for all structures and adjacent trenches under this contract and any other rock excavation directed by Owner shall be completed before construction of any structure is started in the vicinity.
- G. Remove excavated material from site.

- H. Contractor shall correct unauthorized rock removal by backfill to grade with Class C concrete in accordance with backfilling and compaction requirements of Section 02300 - Earthwork and Section 02315 – Excavation, Trenching, and Backfill for Utility Systems at his own expense.

3.3 ROCK REMOVAL – EXPLOSIVES METHODS

- A. If rock is uncovered requiring the explosives method for rock disintegration and removal, the Engineer shall be notified immediately so that the surface can be examined. Blasting will not be permitted unless written authorization is given by Engineer. (All materials removed shall be considered common excavation).
- B. The Contractor shall notify any owners of adjacent buildings or structures, and any public utility owners having structures or other installations above or below ground, in writing prior to use of explosives. Such notice shall be given sufficiently in advance so that they may take such steps as they may deem necessary to protect their property from injury and/or damage.
- C. Rock excavation by use of explosives shall be conducted with due regard for safety of persons and property in the vicinity and in strict conformance with requirements of local, State and Federal ordinance, laws and regulations governing the use of explosives.
- D. Blasting shall be conducted so as not to endanger persons or property, and whenever required, the blast shall be covered with mats or otherwise satisfactorily confined. The contractor shall be held responsible for and shall make good any damage caused by blasting or accidental explosions.
- E. The Contractor shall permit only authorized and qualified persons to handle and use explosives.
- F. Smoking, firearms, matches, open flame lamps, and other fires, flame or heat producing devices and sparks shall be prohibited in or near explosive magazines or while explosives are being handled, transported or used.
- G. No person shall be allowed to handle or use explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs.
- H. All explosives shall be accounted for at all times. Explosives not being used shall be kept in a locked magazine, unavailable to persons not authorized to handle them. The Contractor shall maintain an inventory and use record of all explosives. Appropriate authorities shall be notified of any loss, theft, or unauthorized entry into a magazine.
- I. No explosives or blasting agents shall be abandoned.

- J. Contractor's employees authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution including, but not limited to, visual and audible warning signals. Flags or barricades, to ensure safety.
- K. It shall be contractor's responsibility to incorporate the use of seismic monitoring should rock excavation, by use of explosives, occur within 150 feet of any residential structure and within 300 feet of any miscellaneous structure. Blasting conducted near dams or bridge foundations shall incorporate the use of a seismic monitor should such blasting occur within 25 feet of said dam and/or bridge foundation. Contractor shall maintain all seismic records and blasting logs to be furnished to Engineer upon request.
- L. Disintegrate rock and remove from excavation.
- M. Cut away rock at excavation bottom for form level bearing.
- N. Remove shaled layers to provide sound and unshattered base for pipe foundations.
- O. Remove excavated material from site.
- P. Correct unauthorized rock removal or overbreak in accordance with backfilling and compaction requirements at his expense.

3.4 FIELD QUALITY CONTROL

- A. Provide for visual inspection of bearing surfaces and cavities formed by removed rock for inspection by Engineer or his representative prior to laying of pipe.

END OF SECTION

SECTION 02350
SHEETING, SHORING, AND BRACING

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies requirements for sheeting, shoring, and bracing of trenches and excavations greater than 5 feet in depth. Where sheet piling, shoring, sheeting, bracing or other supports are necessary, they shall be furnished, placed, maintained, and except as shown or specified otherwise, removed by the Contractor.

1.2 DESIGN REQUIREMENTS

- A. The design, planning, installation and removal, if required, of all sheeting, shoring, sheet piling, lagging, and bracing shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
- B. The Contractor shall design sheeting, shoring, and bracing in accordance with the OSHA Safety and Health Standards as well as state and local requirements.
- C. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
- D. When the construction sequence of structures requires the transfer of bracing to the completed portions of any new structure or to any existing structure, the Contractor shall provide the Engineer with a complete design analysis of the expected impact of that bracing on the structure. This action shall in no way absolve the Contractor of responsibility of damage resulting from said bracing.

1.3 REFERENCES

- A. OSHA 2207 Revised 1987 – OSHA Safety and Health Standards

1.4 SUBMITTALS

- A. Prior to starting any excavation work requiring sheeting, shoring, and bracing, the Contractor shall submit his plans for trench and excavation support systems to the Engineer for review and comment. No excavations shall be started until the Contractor has obtained written acceptance of the trench support system. Said acceptance will be to assure the Owner of the Contractor's general compliance with the required codes and shall not be construed as a detailed analysis for adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving the Contractor of his overall responsibility and liability for the work.

Submittals shall include the following:

1. Design calculations and method of installation and removal of all sheeting, sheet piling, shoring and bracing. Calculations shall be made by a professional structural or civil engineer in the state of the project.
2. Detailed excavation support drawings.

PART 2. EXECUTION

2.1 GENERAL

- A. Contractor shall be responsible for supporting and maintaining all excavations required even to the extent of sheeting and shoring the sides and ends of excavations with timber or other supports. If the sheeting, braces, shores, and stringers or walling timbers or other supports are not properly placed or are insufficient, the Contractor shall provide additional or stronger supports. The requirement of sheeting or shoring or the addition of supports shall not relieve the Contractor of his responsibility for their sufficiency. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to conform to OSHA Safety & Health Standard (29 CFR 1926/1910) OSHA 2207, latest edition.
- B. Excavations adjacent to existing or proposed buildings and structures or in paved streets or alleys shall be sheeted, shored and braced adequately to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition. The Contractor shall be held liable for any damage resulting to such structures or pavements as a result of his operations.
- C. Trench sheeting shall be left in place until the backfilling has been completed to elevation not less than twelve (12) inches above the top of the pipe. Unless otherwise ordered in writing, sheeting shall then be cut off at the top of the lowest set of bracing and the upper section shall be removed. All voids left by sheeting along trenches shall be carefully refilled and rammed with suitable tools.
- D. In unstable ground, sheeting shall be driven to such depth below bottom of the trench or side of the excavation as required to ensure stability.
- E. The need and adequacy of sheeting, shoring, bracing, or other provisions to protect men and equipment in a trench or other excavation shall be the sole and exclusive responsibility of Contractor.
- F. Underpin adjacent structures, which may be damaged by excavation work, including service utilities and pipe chases.

- G. Notify Engineer of unexpected subsurface conditions and discontinue work in affected area until notification to resume work.
- H. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- I. Grade top perimeter of excavation to prevent surface water run-off into excavation.

END OF SECTION

SECTION 02370
SOIL EROSION AND SEDIMENT CONTROL

PART 1. GENERAL

1.1 SCOPE

- A. Erosion and sediment control measures must be employed prior to initiating any construction activity and maintained during the construction period. They shall be employed during the construction period and shall include all measures required to prevent soil erosion from the site until permanent erosion control measures are installed. Work shall be accomplished through, but not limited to, the use of vegetative measures, such as mulching and grassing, and structural practices including berms, dikes, sediment barriers, sediment traps, sediment basins, silt fences, check dams, construction exits, sediment barriers, sediment traps, and slope drains.
- B. Erosion control measures described herein shall be continued until such time as permanent planting and restoration of natural areas is effectively in control of erosion from project site.
- C. Failure to install and maintain temporary erosion control measures throughout the construction period may be cause to halt construction by governing authorities until such measures are correctly installed and operational. Activity covered in this contract is regulated by the State's Erosion and Sediment Control Act (O.C.G.A. 12-7-1, *et seq.*) and NPDES General Permit for Stormwater Discharges Associated with Construction Activity. (GAR 100002)

1.2 RELATED WORK

- A. Section 02371 – Rip-Rap.
- B. Section 02373 – NPDES Stormwater Permitting.
- C. Section 02920 – Grassing.
- D. Construction Drawings.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. Contractor shall comply with applicable codes, rules, ordinances, regulations, and laws of local, municipal, state or federal authorities having jurisdiction over project.
- C. Contractor shall comply with the State's Erosion and Sedimentation Control Act

(latest amendment) and NPDES General Permit for Construction Activity.

- D. "Manual for Erosion and Sediment Control in Georgia" published by the State Soil and Water Conservation Committee of Georgia.

1.4 DEFINITIONS

- A. Final Stabilization: All soil disturbing activities at the site have been completed, and that for unpaved areas and areas not covered by permanent structures, at least 70% of the soil surface is uniformly covered in permanent vegetation or equivalent permanent stabilization measures (such as the use of rip rap, gabions, permanent mulches, or geotextiles) have been employed.
- B. Land-Disturbing Activity: Any activity which may result in soil erosion from water or wind and the movement of sediments into State waters or onto lands within the State, including, but not limited to clearing, grubbing, dredging, grading, excavating, transporting, and filling.

PART 2. PRODUCTS

2.1 FILTER FABRIC

- A. Filter fabric for silt fences shall be pervious synthetic polymer filaments forming a stable network so that fibers retain their relative positions. Filter fabric shall be of the type recommended by its manufacturer for the intended application. The filter fabric shall meet the following requirements:
 - 1. Minimum Grab Strength 150 lbs (by ASTM D 1682)
 - 2. Elongation 25%
 - 3. Retention Efficiency 75%
- B. Silt fence shall be constructed in accordance with details shown on Drawings or may be a prefabricated proprietary type subject to approval by Engineer.

2.2 HAY BALE BARRIERS

- A. Hay bales shall be well compacted straw, standard size, wire bound. Hay bales may be used as an alternate to silt fence as approved by Engineer.

2.3 GRASS

- A. Grass seed for temporary erosion control shall be applied at the rates and dates indicated in the following table.

Species	Rates Per 1,000 sq. ft.	Rates per Acre	Planting Dates by Region		
			Mountains Limestone Valley	Piedmont	Coastal
Barley Alone Barley In Mixtures	3.3 lbs .6 lbs.	3 bu. .5 bu.	9/1-10/31	9/15-11/15	10/1-12/31
Lespedeza, Annual Lespedeza In Mixtures	0.9 lbs. 0.2 lbs.	40 lbs. 10 lbs.	3/1-3/31	3/1-3/31	2/1-2/28
Lovegrass, Weeping Lovegrass In Mixtures	0.1 lbs. .05 lbs.	4 lbs. 2 lbs.	4/1-5/31	4/1-5/31	3/1-5/31
Millet, Browntop Millet In Mixtures	.9 lbs. .2 lbs.	40 lbs. 10 lbs.	4/15-6/15	4/15-6/30	4/15-6/30
Millet, Pearl	1.1 lbs.	50 lbs.	5/15-7/15	5/1-7/31	4/15-8/15
Oats Alone Oats In Mixtures	2.99 lbs. .7 lbs.	4 bu. 1 bu.	9/15-11/15	9/15-11/15	9/15-11/15
Rye (Grain) Alone Rye In Mixtures	3.9 lbs. .6 lbs.	3 bu. .5 bu.	8/15-10/31	9/15-11/30	10/1-12/31
Ryegrass	0.9 lbs.	40 lbs.	8/15-10/31	9/1-12/15	9/15-12/31
Sudangrass	1.4 lbs.	60 lbs.	5/1-7/31	5/1-7/31	4/1-7/31
Triticale Alone Triticale In Mixtures	3.3 lbs. .6 lbs.	3 bu. .5 bu.	N/A	N/A	10/15-11/30
Wheat Alone Wheat In Mixtures	4.1 lbs. .7 lbs.	3 bu. .5 bu.	9/15-11/30	10/1-12/15	10/15-12/31

B. For additional information regarding temporary grassing and mulching, see Chapter 6, Section III of the “Manual for Erosion and Sediment Control in Georgia”.

2.4 FERTILIZER

A. Commercial grass fertilizer shall follow table below.

Types of Species	Planting Year	Fertilizer (N-P-K)	Rate (.lbs/acre)	N top Dressing Rate (.lbs/acre)
Cool season grasses	First	6-12-12	1500	50-100
	Second	6-12-12	1000	---
	Maintenance	10-10-10	400	30
Cool season grasses & legumes	First	6-12-12	1500	0-50
	Second	0-10-10	1000	---
	Maintenance	0-10-10	400	---

Temporary cover crops seeded alone	First	10-10-10	500	30
Warm Season Grasses	First	6-12-12	1500	50-100
	Second	6-12-12	800	50-100
	Maintenance	10-10-10	400	30

B. Agricultural lime to be applied at a rate of one (1) ton per acre.

2.5 MULCH

- A. Dry straw or hay of good quality, free of weed seed – spread at a rate of 2-1/2 tons per acre.
- B. Wood waste, chips, sawdust or bark spread 2 to 3 inches deep (about 6 to 9 tons per acre).
- C. Erosion control matting or netting, such as excelsior, jute, textile and plastic matting, and netting applied in accordance with manufacturer’s recommendations.

2.6 CHEMICALS FOR DUST CONTROL

- A. Calcium chloride, anionic asphalt emulsion, latex emulsion or resin-in-water emulsion or other approved by the Georgia Department of Transportation may be used for dust control.

PART 3. EXECUTION

3.1 GENERAL

- A. All disturbed soil areas except those to support paving shall be graded and protected from erosion by grassing. Storm water conveyance systems shall have sediment barriers installed at all entrances, intersection, change in direction and discharge points.
- B. Erosion control shall be directed toward and have the purpose of controlling soil erosion at its potential source. Downstream sediment entrapment measures shall be employed, but only as a backup to primary control at the source.
- C. A continuing program of installation and maintenance of sediment control measures shall be employed during the construction period.
- D. Erosion Control Schedule

1. Prior to the pre-construction conference, Contractor shall submit to the

Engineer his proposed erosion control plan for the project in accordance with requirements of this section. The schedule shall be based on an analysis of the project conditions and shall be in written form. This schedule shall specifically indicate the sequence of clearing and grubbing, earthwork operations, including trenching and backfilling, construction of permanent erosion control features and the proposed uses of temporary erosion control features. Schedule shall also include proposed methods to prevent pollution of streams, lakes and rivers and other water resources.

2. Contractor shall outline his proposed methods of controlling erosion and preventing pollution on public and construction access roads, staging areas and waste disposal areas.
 3. No work shall be started until the aforementioned plans and schedules have been accepted by Engineer. Contractor will be responsible for accomplishment of work in accordance with accepted plans and schedules. Engineer may approve changes made necessary by unforeseen circumstances that are beyond the control of Contractor.
- E. Engineer has the authority to limit the surface area of erodible earth materials exposed by clearing and grubbing, the surface area of erodible earth exposed by excavation and backfill operations and to direct Contractor to provide immediate permanent or temporary erosion and pollution control measures to prevent contamination of adjacent streams or other water courses.
- F. Clearing and grubbing operations shall be so scheduled and performed that grading operations and permanent erosion control features can immediately follow thereafter, if the project conditions permit, otherwise temporary erosion control measures will be required between successive construction stages.
- G. Engineer will require Contractor to limit the area of excavation, trenching and pipe laying operations in progress commensurate with Contractor's capability and progress in keeping finish grading, mulching, seeding and other permanent and/or temporary measures current with accepted schedule.

3.2 TEMPORARY GRASSING AND MULCHING

- A. Where staged construction or other conditions not controlled by Contractor prohibit the completion of work in a continuous manner; Engineer may order Contractor to apply temporary seeding or temporary mulch to an erodible area.
- B. Temporary grass shall consist of sowing a quick growing species of grass suitable to the area and season. Seeding rates shall be in accordance with Paragraph 2.03. Ground preparation will be limited to blading the area to the amount deemed practical by the Engineer for a seedbed and the elimination of water pockets.

Fertilizer shall be applied at a rate of 14 pounds per 1,000 square feet.

- C. Areas to be mulched need not be to finished grade. The mulched areas may be placed on slopes as steep as 2:1 using a tractor to imbed the mulch into the slope.
- D. Spread wood waste uniformly on slopes that are 3:1 and flatter. No anchoring is needed.
- E. Commercial matting and netting. Follow manufacturer's specifications included with the material.

3.3 GRASSING

- A. See Section 02920 – Grassing.

3.4 SEDIMENT TRAPS

- A. Sediment traps shall be installed by Contractor in accordance with details shown on drawings.
- B. Sediment traps shall be maintained until other erosion control methods can be substituted for them.
- C. Sediment traps shall be cleaned out when they are ½ filled with silt.
- D. Sediment traps shall be removed from the construction area when their use is no longer required.

3.5 SILT FENCES

- A. Temporary silt fences shall be located at all points where surface water can leave the construction area.
- B. Silt fences shall be constructed to remove sediments from flowing water through filtration and sedimentation. Silt fences shall be constructed in accordance with the details shown on drawings.
- C. Silt fences shall be arranged to create ponding behind them. Provision shall be made for removing accumulated sediments and maintaining ponding capacity.
- D. Silt fences shall be removed and the area restored when permanent erosion control is effective.

3.6 GRADING OPERATIONS

- A. Grading operations shall be scheduled so that ground surface will be disturbed for

the shortest possible time before permanent construction is installed. Large areas shall be maintained as flat as possible to minimize soil transport through surface flow.

- B. Wherever steeper slopes or abrupt changes in grade are required, a diversion or berm shall be constructed at the top of slope to cause surface water to flow along the diversion to a control point to be transported down slope in a slope drain. In no case shall surface water be allowed to flow uncontrolled down slopes.

3.7 CONSTRUCTION IN STREAM BEDS

- A. Unless otherwise approved in writing by Engineer, construction operations in rivers, streams and impoundments shall be restricted to those areas that must be entered for the construction of temporary or permanent structures. As soon as conditions permit, rivers, streams and impoundments shall be promptly cleared of all false-work, sheeting or piling which are to be removed, debris and other obstructions. Frequent fording of live streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used whenever an appreciable number of stream crossings are necessary. Unless otherwise approved in writing by Engineer, mechanized equipment shall not be operated in live streams except as may be required to construct channel changes and temporary or permanent structures, and to remove temporary structures.

3.8 RUN-OFF EROSION AND SEDIMENTATION CONTROLS

- A. During construction, route run-off through sedimentation barriers and check dams as practical.
- B. Contractor shall maintain sedimentation devices in functional condition. Sedimentation barriers and check dams shall be cleaned out when these devices are at least 60 percent of their capacity. Defective materials in barriers and check dams shall be replaced.
- C. Contractor shall establish sedimentation barriers at the toe of slopes under construction. These barriers may be relocated and reused after permanent slope stabilization becomes established. As they are relocated, any defective materials shall be replaced. In addition, all debris and silt at previous location will be removed.
- D. A 6-inch minimum thickness of crushed stone construction exit pad shall be located at all access points to site from public streets in accordance with details shown on drawings. All construction vehicles leaving construction site shall have mud cleaned from their tires at these points to protect public streets from the transportation of sediment from site.

3.9 DUST CONTROL

- A. Dust raised from vehicular traffic will be controlled by wetting down the access road with water or by the use of a deliquescent chemical, such as calcium chloride, if the relative humidity is over 30%. Chemicals shall be applied in accordance with the manufacturer's recommendations. There shall be no separate payment to the Contractor for dust control measures. Any costs connected thereto shall be a subsidiary responsibility of the Contractor.

3.10 CLEANUP AND REMOVAL

- A. At the time, that permanent erosion control is effective, temporary devices and their accumulated sediments shall be removed.
- B. Silts and deposits removed from control barriers shall be placed in eroded areas and shall be replanted.

END OF SECTION

**SECTION 02510
WATER DISTRIBUTION**

PART 1. GENERAL

1.1 SCOPE

This section of the Specifications describes products to be incorporated into the water lines and requirements for the installation and use of these items. The Contractor shall furnish all products and perform all labor necessary to fulfill the requirements of these Specifications. It includes, but is not limited to the construction of the following items:

- A. Piping
- B. Valves
- C. Fittings
- D. Connect to Existing System
- E. All necessary appurtenances to convey potable water from the existing system to the location shown on the plans.

1.2 RELATED WORK

- A. Other work required for the construction of the Water Distribution System is specified in the following sections of these specifications:

Section No.	Title
02300	Earthwork
02315	Excavation, Trenching and Backfilling for Utility Systems
02370	Soil Erosion Control
02920	Grassing

1.3 REFERENCES

- A. ASTM D3740 – Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ASTM E329 – Agencies Engaged in the Testing and/or Inspection of Materials as Used in Construction.
- C. ANSI/AWWA C150/A 21.50 – Thickness Design of Ductile Iron Pipe.
- D. ANSI/AWWA C151/A 21.51 – Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
- E. ASTM A139 – Electric-Fusion (Arc) Welded Steel Pipe (NPS 4 and Over).
- F. ASTM C478 – Precast Reinforced Concrete Manhole sections.
- G. ACI 318 – Building Code Requirements for Reinforced concrete.
- H. ASTM C890 – Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
- I. ASTM C891 – Installation of Underground Precast Concrete Utility Structures.

- J. ASTM C913 – Precast Concrete Water and Wastewater Structures.
- K. ASTM A615/A615 M – Deformed and Plain Billet – Steel Bars for Concrete Reinforcement.
- L. ANSI/AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.
- M. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
- N. AASHTO T191– Density of Soil In-Place by the Sand-Cone Method.
- O. ASTM D2922 – Test methods for Density of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth).
- P. ASTM D1557 – Laboratory Compaction Character of Soil Using Modified Effort.
- Q. ASTM D1556 – Density and Unit Weight of Soil In-Place By Sand-Cone Method.
- R. ASTM G53 – Operating Light and Water-Exposure Apparatus (Fluorescent UV – Condensation Type) for Exposure of Nonmetallic Materials.
- S. ANSI/AWWA C111/A 21.11 – Rubber-Gasket Joints for DI Pressure Pipe/ Fittings.
- T. ASTM A 377 – Index of Specifications for Ductile Iron Pressure Pipe.
- U. ANSI/AWWA C600 – Installation of Ductile Iron Water Mains and appurtenances.
- V. AWWA C651 – AWWA Standard for Disinfecting Water Pipes
- W. AWWA/ANSI C800 – Underground Service Line Valves and Fittings

1.4 OPTIONS

- A. The specifications describe several materials. Where manufacturers and models of equipment are named in the specification, it is intended that these are to describe the quality and function required. The Contractor may use equipment or materials of other manufacturers provided they are reviewed and accepted by the Engineer and the Owner as meeting the specifications.
- B. The Contractor will furnish the Engineer and the Owner a description of all materials before ordering. The Engineer will review the Contractor’s submittals and provide in writing an acceptance or rejection of material. However, an acceptance of any material by the Engineer does not relieve the Contractor of this responsibility to meet the requirements of the construction plans or these specifications.

1.5 QUALITY ASSURANCE

- A. Material and equipment shall be the standard product of a manufacturer who has manufactured them for a minimum of 2 years and who provides published data on the quality and performance of the project.
- B. A Subcontractor for any part of the work must have experience on similar work and if required, furnish the Engineer with a list of projects and the Owners or Engineers who are familiar with his competence.
- C. Devices, equipment, structures, and systems not designated by the Engineer that the Contractor wishes to furnish shall be designed either by a registered professional engineer or by someone the Engineer approved as qualified. If required, complete

design calculations and assumptions shall be furnished to the Engineer or the Owner before acceptance.

- D. All testing of the piping shall be made by the Contractor with equipment qualified by the Owner, Engineer, or utility company and in the presence of the Engineer, Owner and utility company. The Engineer or his representative reserves the right to accept or reject testing equipment.
- E. Soil testing shall be done by a testing laboratory regularly engaged in soil testing, and shall be approved by the engineer prior to engagement. Mill certificates of test on materials made by manufactures will be accepted provided the manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests that are spot checked by an outside laboratory, and furnishes satisfactory certificates with the name of the one making the test.
- F. The details of all welded joints shall comply with all of the requirements for joints, which are accepted without qualification test under the “Code of Arc and Gas Welding in Building Construction of the American Welding Society”. Workmanship shall conform to A.I.S.C. Specifications for Fabrication and Erection. All work shall be executed by skilled workmen under experienced supervision. All welding shall be done by welders who have been previously qualified by tests as prescribed in the “American Welding Society Standard Qualification Procedure” to perform the type of work required. Welders shall have passed the qualification test (Qualification tests using procedures covered in AWSS B3.0 Part II) within the preceding 12 months.

1.6 PRODUCT DELIVERY, STORAGE & HANDLING

- A. Material shall be unloaded in a manner that will avoid damage and shall be stored where it will be protected and will not be hazardous to traffic. If stored on private property, the Contractor shall obtain permission for the property owner and shall repair any damage caused by the storage. Material shall be examined before installation and neither damaged nor deteriorated material shall be used in the work.

1.7 SEQUENCING, SCHEDULING

- A. The Contractor shall arrange his work so that sections of mains between valves are tested, sterilized, placed in service as soon as reasonable after it is placed.

1.8 ALTERNATIVES

- A. The intention of these specifications is to produce the best system for the Owner. If the Contractor suggests that alternate material, equipment or procedures will improve the results at no additional cost, the Engineer and the Owner will examine the suggestion and if it is accepted, it may be used. The basis upon which

acceptance of an alternate will be given its value to the Owner, and not for the convenience of the Contractor.

1.9 GUARANTEE

- A. The Contractor shall guarantee the quality of the materials, equipment, and workmanship for 12 months after acceptance of the completed Project. Defects discovered during that period shall be repaired by the Contractor, at no cost to the Owner. The Performance Bond shall reflect this guarantee.
- B. The manufacturers of equipment, valves, pumps, controls, measuring devices and special equipment shall test the equipment at field conditions for compliance with the specifications. The manufacturer shall guarantee his product to be free from defects in material and factory workmanship for a period of 1 year from date of acceptance of the completed project, provided the product is properly installed, serviced and operated under normal conditions and according to the manufacturer's instructions. The manufacturer shall furnish a replacement for any component that proves defective during the guarantee period, except such items which are seals. The Contractor shall furnish the services of a representative of the manufacturer to check the installation after it is completed and to furnish the Engineer with a certificate that the equipment meets the specifications and will perform as required. The manufacturer shall furnish four field trips to the plant by a service representative during the first year after completion of the Project at no cost to the Owner.

1.10 EXISTING UTILITIES

- A. All known utility facilities are shown schematically on plans, and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown on plans will not relieve the Contractor of his responsibility under this requirement. "Existing Utilities Facilities" means any utility that exists on the project in its original, relocated or newly installed position. The Contractor will be held responsible for the cost of repairs to damaged underground facilities; even when such facilities are not shown on the plans. The Contractor shall contact all utility companies prior to beginning the work and request an accurate field location of their respective utility lines.
- B. Damage to any part of the existing water system and facilities by the Contractor or Subcontractors, that is required by the User's and Owner's forces, shall be charged to the Contractor on the basis of time and material, plus 30% for overhead and administration.

1.11 REQUIREMENTS OF REGULATORY AGENCIES

- A. Water mains shall be sterilized to meet the requirements of the appropriate Regulatory Agency. Sterilization shall be in accordance with AWWA Standards C-651, latest revision.

1.12 CONNECT NEW MAIN TO EXISTING SYSTEM

- A. Unless prior written authorization is granted by the Engineering Manager or Director, utility contractors will not be allowed to make connections to any active part of Calhoun's existing water system. The Contractor shall contact the Distribution Superintendent to coordinate tie-ins at least 14 days in advance of construction.

1.13 ACCEPTANCE OF PORTIONS OF WORK

- A. The Owner reserves the right to accept and use any portion of the work whenever it is considered in the public interest to do so.

1.14 RECORD DATA

- A. It will be required of the Contractor to keep accurate, legible records of the location of any deviations from the construction drawings, any additional items or structures to the construction drawings, and all utilities encountered which are not shown on the construction drawings. These records will be made available to the Engineer before his inspection for incorporation into the Engineer's Record Drawings.

PART 2. PRODUCTS

All materials provided shall be in conformance with the requirements and standards set forth in The Facility Owner's Standard Specifications, current published edition. All pipeline and appurtenance materials in contact with potable water shall be National Sanitation Foundation (NSF) 61 Certified.

Pipes and appurtenances shall comply with Section 1417(a)(1) of the Safe Water Drinking Act as amended in 2011 which prohibits the use of any pipe, any pipe or plumbing fitting or fixture, and solder, or any flux, after June 1986, in the installation or repair of (i) any public water system; or (ii) any plumbing in a residential or non-residential facility providing water for human consumption, that is not lead free as defined in Section 1417(d).

A. Ductile Iron Pipe and Fittings

1. Ductile iron pipe shall meet the latest edition of ANSI/AWWA C150/A21.50 and C151/A21.51 for the class and joint specified with a nominal laying length of 18 (5.5 m) to 20 feet (6 m). Joints for buried ductile iron pipe shall be mechanical or push-on joints. Unless specified otherwise in The Facility Owner's Standard Specifications, ductile iron pipe diameters 12 inch (300 mm) or less shall be minimum Pressure Class 350, while pipe diameters greater than 12 inch (300 mm) shall be minimum Pressure Class 250.

2. Interior surfaces of ductile iron pipe and fittings shall be cement mortar lined in accordance with AWWA C104.
3. Ductile iron shall have an exterior coating as specified in AWWA C151 for ductile iron pipe and AWWA C153/C110 for ductile iron fittings.
4. Buried ductile iron pipe and fittings shall be polyethylene encased at locations indicated on the Plans or as conditions warrant. Polyethylene encasement tubing shall be in accordance with ANSI/AWWA C105/A21.5 and ASTM A674 and shall have a minimum thickness of 8 mils. Polyethylene encasement tubing shall be blue in color to designate potable water.
5. Fittings: Ductile iron fittings shall be cement lined and meet the requirements of ANSI/AWWA C153/A21.53 or ANSI/AWWA C110 A21.10 with a minimum pressure rating of 250 psi. Ends shall be restrained mechanical joint. All ductile iron fittings shall bear the NSF approval seal for potable water pipe. Only domestically manufactured fittings are allowed.
6. Mechanical Joint Fittings: Mechanical joints consisting of bell, socket, gland, gasket, bolts, and nuts shall conform to ANSI/AWWA C111/A21.11.
7. Push-On Joints: Push-on joints shall be designed in accordance with ANSI/AWWA C111/A21.11. Joint lubrication shall be as furnished by the manufacturer.
8. Rubber gasket joints for push-on or mechanical joints shall conform to the requirements of ANSI/AWWA C111/A21.11.
9. Restrained Joints: Restrained joints shall be provided as shown on the Plans and where required for thrust restraint. Restrained joints shall not require field welding or grooves cut into the pipe barrel for restraint. The restraining joints for mechanical joint fittings shall conform to the requirements of ANSI/AWWA C111/A21.11 with assembly in conformance with AWWA C600 and manufacturer's recommendations. Restrained joints for pipe shall be push-on vulcanized rubber gasket type with embedded stainless steel locking segments (equivalent to "Fast-Grip Gasket" or "Field Lok 350 Gasket") or with ductile iron locking retainer (equivalent to "Flex-Ring", "HDSS", or "TR Flex" and shall have a minimum rated working pressure of 250 psi.
10. Mechanical joint retainer glands may be used to restrain mechanical joint fittings to the plain end of ductile iron pipe and fittings. Restrainer glands shall be manufactured of ductile iron per ASTM A536.

11. Corrosion-resistant bolts used with ductile iron joints shall be high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.
12. Only manufacturers in the continental United States will be allowed to furnish ductile iron pipe and fittings.

B. High Density Polyethylene Pipe (HDPE)

1. HDPE pipe size 2-inch shall be PE 4710 high density, extra-high molecular weight polyethylene manufactured from first-quality high density polyethylene resin containing no additives, fillers, or extenders. The HDPE pipe shall have an ASTM D3350 cell classification of PE 445574C, shall meet the requirements of AWWA C906, and shall be sized based upon the iron pipe size (IPS), outside diameter (OD) sizing system. The HDPE pipe shall be a minimum DR 9, pressure class 200 psi, and shall bear the NSF approval seal.
2. HDPE pipe shall be blue or marked with a permanent blue stripe to designate potable water.
3. Joints shall be made by butt fusing sections of pipe with manufacturer-approved equipment.
4. Fittings shall be standard dimension red brass with NPT threads paired with a brass compression adaptor sized for IPS HDPE. Material shall conform to ASTM B43 with a working pressure of 150 psi or greater. All fittings and nipples shall conform with the lead-free plumbing requirements as defined by the U.S. Safe Drinking Water Act. All connections must be generously wrapped with plumber's tape prior to assembly.

C. PVC Pipe for Service Casing

1. For longside services 1-inch or smaller, the Contractor should use 2-inch PVC sleeves to span beyond the pavement base course such that leaks will not undermine the roadway and repairs can be made without interruption to traffic.
2. Polyvinyl-chloride pipe shall be either extruded SDR 21 meeting the requirements of ASTM D1784 with embedded gasket conforming to ASTM F477 or injection molded Schedule 40 IPS conforming to ASTM D1785 with cell class of 12454 as identified in ASTM D1784.

D. Brass Pipe

1. Brass pipe shall be standard dimension red brass with NPT threads with a working pressure of 150 psi or greater. All fitting and nipples shall conform with the lead-free plumbing requirements as defined by the U.S. Safe Drinking Water Act. All connections must be generously wrapped with plumber's tape prior to assembly.

2. Brass will be allowed for specific threaded connections within the meter box on service lines 2-inch or smaller.

E. Steel Casing Pipe

1. All materials, design, fabrication, handling, and testing of steel casing pipe shall conform to the requirements of ASTM A139, AWWA C200 and AWWA Manual M11 "Steel Pipe – A Guide for Design and Installation."
2. Steel casing pipe shall be new, smooth-wall, carbon steel pipe conforming to ASTM Specification A139, Grade B with a minimum yield strength of 35,000 psi. Steel casings shall be used with the size, minimum thickness, length, and coating specified on the Plans or The Facility Owner's Standard Specifications.
3. Additional anti-corrosion measures, as specified by the manufacturer or indicated on the Plans, shall be provided at connectors, couplings, rollers, restraints, etc.
4. Unless specified otherwise in the Plans or The Facility Owner's Standard Specifications, casing pipe end seals shall consist of 1/8-inch (6 mm) thick flexible synthetic rubber boot with adjustable stainless steel banding straps. The annular space of the casing shall not be filled with concrete or grout.
5. Casing spacers shall consist of a stainless steel shell, PVC ribbed liner, and non-conducting separators to keep the carrier pipe from touching the casing pipe. Spacers shall be provided at a maximum of 10-foot intervals and within 2 feet (0.6 m) of the end of the casing pipe.

F. Tracer Wire

1. Unless otherwise specified by the Plans or The Facility Owner's Standard Specifications, open cut installations of all water mains and services shall include at minimum #12 AWG tracer wire. Pipe installed by directional drill shall be at minimum insulated #8 AWG tracer wire. Wire shall be solid copper insulated with blue HDPE jacketing installed along pipe, wrapped around service line stub outs and stubbed into valve boxes for locating purposes. Wire shall be properly spliced to provide continuous conductivity.

G. Warning Tape

1. Water mains shall be installed with polyethylene film warning tape manufactured for marking and identifying underground water utilities. Tape shall be a minimum of 2 inches (50 mm) wide and 5.5 mils thick, blue in color, with continuously printed letters reading "CAUTION BURIED WATER LINE BELOW".

H. Gate Valves

1. Gate valves 2 inches and larger shall be of the resilient seat type meeting the requirements of AWWA C515. Valves shall be iron body, bronze trimmed, with non-rising stems, and shall be fusion-bonded epoxy coated per ANSI/AWWA C550. Valves shall have a minimum design working pressure of 200 psi. Furnish Mueller A-2361 or approved equal by Facility Owner.
2. Valves shall be manually operated by nut and open counter-clockwise unless specified otherwise on Plans or Owner's Standard Specifications.
3. The resilient seating arrangement shall provide zero leakage at the design working pressure when installed with line flow in either direction. All ferrous surfaces inside and outside shall have a fusion bonded epoxy coating. All valves shall be provided with O-ring seals. The design and machining of valves shall be such as to permit replacing the O-ring seals in the valves while in service without leakage.
4. All gate valves, when fully opened, shall have an unobstructed waterway diameter equal to or larger than the full nominal diameter of the valve.
5. In general, valves 12" or smaller shall be designed for vertical installation. Valves larger than 12" shall be installed in the horizontal position with bevel gears, extended gear case, and tracks.
6. Valves 3" and larger shall include mechanical joints, bolts, glands, gaskets, and all other materials necessary to join to existing work. Valves smaller than 2" shall be threaded (NPT, female).
7. Provide brass identification tag imprinted with "WATER", valve size, valve type, and direction and number of turns to open. Provide a ¼-inch (8 mm) hole in the brass tag and attach the tag to the end of the locate wire (twist wire around tag). Tag shall be 2-inch (50 mm) diameter and ⅛-inch (6 mm) thick brass with a ¼-inch (8 mm) hole.
8. Provide brass identification tag imprinted with "WATER", valve size, valve type, and direction and number of turns to open. Provide a ¼-inch (8 mm) hole in the brass tag and attach the tag to the end of the locate wire (twist wire around tag). Tag shall be 2-inch (50 mm) diameter and ⅛-inch (6 mm) thick brass with a ¼-inch (8 mm) hole.

I. Butterfly Valves

1. Butterfly valves shall be of the tight-closing, rubber seated type, with rubber seat positively locking in place sealing against flow from either direction. Valves shall be hand operated with cast or ductile iron bodies. Valves shall conform to the requirements of AWWA C504, Class 250B, and shall be fusion-bonded epoxy coated per ANSI/AWWA C550. Acceptable manufacturers include Dezurik, Pratt, or Val-Matic.
2. Valves shall have a 2-inch (50 mm) square operating nut and shall be installed with extension stems to extend the operating nut in accordance with the project details. Valves shall open by turning the operating nut counter clockwise unless specified otherwise on the Plans or Owner's Standard Specifications.
3. Valve shafts shall be of 304 or 316 stainless steel.

4. Buried butterfly valve end connections shall be installed using restrained mechanical joints.
5. Flanged valves shall be fully faced and drilled in accordance with ANSI Standard B16.1, Class 125.
6. Provide brass identification tag imprinted with “WATER”, valve size, valve type, and direction and number of turns to open. Provide a ¼-inch (8 mm) hole in the brass tag and attach the tag to the end of the locate wire (twist wire around tag). Tag shall be 2-inch (50 mm) diameter and ⅛-inch (6 mm) thick brass with a ¼-inch (8 mm) hole.

J. Tapping Sleeves and Valve Assembly

1. Tapping sleeves sizes 4-inch to 12-inch shall be fabricated completely from stainless steel grade 304 or 316 per ASTM A240. All welding shall be passivated to return the welded steel to its original corrosion resistant state. Sleeves shall be pressure rated for 250 psig working pressure. Flange branches shall be double welded with an outer structural weld and inner fusion weld. Acceptable models include PowerSeal 3490AS, Mueller H-304SS, or JCM 432.
2. Tapping sleeves larger than 12-inch shall be ductile iron of the split-sleeve, mechanical joint type. Tapping sleeves shall be rated for a minimum 250 psi working pressure in accordance with ANSI/AWWA C110/A21.10. An acceptable model is Mueller H-615 with carbon steel bolts or approved equal.
3. Tapping sleeve shall have an outlet flange per ANSI B16.1, Class 125 standard.
4. Tapping valves shall be manufactured with an integral tapping flange inlet having a raised lip design and mechanical joint outlet, non-rising stem, resilient seated gate valves meeting the applicable requirements of ANSI/AWWA C509/C515 and C550 with a minimum design working pressure of 250 psi.
5. The Contractor shall determine the outside diameter of the existing main before ordering the sleeve
6. Tapping valves shall be specifically designed for pressure tapping with sufficient seat opening to allow full diameter taps to be made.
7. Tapping valves shall be furnished with a combination flange and mechanical joint for connecting the branch to the main.

K. Valve Boxes

1. All valves shall be equipped with valve boxes. The valve boxes shall be heavy, roadway type boxes. The valve box cover shall be marked “WATER VALVE” or “WATER”.
2. Valve box shall be the two-piece cast iron variety and materials shall conform to the requirements and standards set forth in the Owner’s Standard Specifications, current published edition.
3. The valve boxes shall be adjustable up or down from the nominal required cover over the pipe. Extensions shall be provided as necessary. A precast concrete ring shall be placed around the valve box opening when outside of paved areas.

L. Service Connection Assemblies

1. Water service connections and plumbing should conform to the standards set forth in The Facility Owner's Standard Specifications and relevant local and/or state plumbing codes or to the Standard Plumbing Code as applicable within the jurisdiction in which the system is located.
2. Service connection assemblies shall be provided for all new service line connections to existing meters. Existing service lines indicated for replacement shall be replaced with new materials from the water main to the existing or new water meter.
3. Service connection assemblies shall include:
 - a. Service saddle
 - b. Corporation stop
 - c. Service line
 - d. Longside PVC sleeve
 - e. Brass fittings
 - f. Curb stop (in-line, prior to meter setter)
 - g. Water meter box
 - h. Water meter (Furnished by City)
 - i. Meter setter (with a second curb stop and backflow preventer)
 - j. Backflow preventer (separate Pay Item for new service connections)
 - k. Customer shut-off valve w/ handhole box

M. Service Saddles

1. Tapping saddle shall have a nylon coated ductile iron with stainless steel double tie straps and nuts with pressure rating not less than that of the pipe to which it is to be connected. Mueller DR2S or Romac 202S/202NS.
2. Saddles shall have a nitrile O-ring gasket embedded in the body, with compatible threading between the saddle and corporation stop. Saddles shall conform to ANSI/AWWA C800 standards.
3. The service saddle shall provide full support around the circumference of the pipe, providing a bearing area of sufficient width so that pipe will not distort when the saddle is tightened.

N. Water Service Line

1. Polyethylene (PE) pipe for water service lines shall conform to AWWA C901 and ASTM D-2737 and shall be 250 psi pipe, SDR 9 for copper tube size (CTS). Polyethylene extrusion compound from which the polyethylene pipe is extruded shall comply with applicable requirements for PE 4710 ultra-high molecular weight polyethylene plastic material as specified in AWWA C901.
2. Marking on the PE service pipe shall include the nominal pipe or tubing size, the type of plastic material, the standard thermoplastic pipe dimension ratio or the pressure rating in psi, the ASTM designation with which the pipe complies, and manufacturer's name or trade mark and code. It shall also include the NSF seal of approval for use with potable water.

3. Plastic stiffeners should be used inside the CTS PE tubing at all connection points.
4. Water service line fittings shall be as indicated in the Owner's Standard Specifications.

O. Corporation and Curb Stops

1. Corporation stops, curb stops, and other appurtenances for plastic service lines shall meet the requirements of ASTM B62 and AWWA C800.
2. Corporation stops shall be manufactured from non-lead cast brass body with a machined fitting surface and CC threading. The corporation shall be pressure rated to no less than 250 psi. AY McDonald 74101BQ.
3. Curb stops shall be ball valve type and made of non-lead brass. Pipe connections shall be suitable for the type of service pipe used and shall be pressure rated for no less than 250 psi. AY McDonald 76100WQ or Mueller B25209N.

P. Water Meters

1. Water meters will be furnished by the Facility Owner.

Q. Meter Setter

1. Each meter assembly should be equipped with a copper/brass yoke with built-in angle ball valve and angle dual check. AY McDonald 724-207WDQD 33x992 or 724-207WDQD 33.

R. Meter Boxes

1. Water meter boxes and lids shall be fabricated from cast iron with a single 2" AMR/TR hole. Meter setter shall be fully encased by the meter box with some extra room for hand tools. Sigma MB382T.

S. Customer Shut-off Valve with Box

1. Behind the meter, Contractor shall install a handwheel gate valve for the customer to turn the water on and off. Matco 514T04LF with NDS 6" Overlapping D109-B box or approved equal.

T. Concrete Thrust Collars and Blocking

1. Concrete used for thrust collars or blocking shall meet the "Class A" requirements listed in GDOT Section 500.
2. Thrust collars shall include welded-on collars attached by the pipe manufacturer or retainer glands. Concrete shall be poured continuous around the pipe and bear against undisturbed earth.
3. Reinforcing steel shall meet the requirements set forth in Plans or Owner Spec.
4. Mechanical joint restraints shall be utilized in addition to thrust blocks.

U. Fire Hydrant Assembly

1. Fire hydrants shall be the dry barrel type and shall conform to the requirements of ANSI/AWWA C502 and local code requirements, Mueller

Super Centurion. The valve opening shall not be less than 5 ¼ -inch. All hydrants shall be complete including valve, anchor coupling, tee, and restraining glands.

2. Hydrants shall be suitable for working pressure of 250 psi and shall be hydrostatically factory tested to 500 psi.
3. All working parts, including the seat ring, shall be removable through the top without excavating or disturbing the barrel of the hydrant.
4. Hydrants shall be constructed with a lubricant chamber which encloses the operating threads and which provides automatic lubrication of the threads and bearing surfaces each time the hydrant is operated. This assembly shall be comprised of a top O-ring serving as a dirt and moisture barrier and a lower O-ring which will serve as a pressure seal. Hydrants shall include two 2½-inch (65 mm) hose nozzles with National Standard Fire Hose Threads and one factory-installed 5" STORZ connector unless specified otherwise in the Plans or Owner's Standard Specifications. Hydrant threads shall comply with the specifications of the local agency providing fire service.
5. Hydrant nozzle shall be constructed to face in any direction at any time by removing the safety flange bolts and revolving the head without digging or shutting off water.
6. Hydrants shall have pentagon operating nut measuring 1½-inch (40 mm) point to flat and shall open by turning counter-clockwise.
7. Hydrant shall have a safety-type vertical barrel with a minimum 3½-foot bury and be designed with safety flange and/or bolts to protect the barrel and stem from damage, eliminate flooding, and allow rapid replacement if hydrant is struck. All risers necessary for deeper bury applications shall be provided by the hydrant manufacturer.
8. Hydrants shall include positive, automatic drain valves which shall be fully closed when the main valve is open.
9. Bottom inlet of hydrant shall be provided with mechanical joint connection complete with accessories as specified and shall be 6-inch (150 mm) nominal diameter.
10. Fire hydrant shall be painted above ground with rust inhibiting enamel paint in accordance with The Facility Owners Standard Specifications.
11. Hydrant assemblies shall be restrained from the hydrant to the tee at the main.

V. Backflow Prevention Devices

1. Backflow prevention devices shall be installed where indicated on the Plans and shall meet all applicable AWWA, State, and local code/ordinance requirements.
2. Backflow preventer materials shall conform to the requirements and standards set forth in The Facility Owner's Standard Specifications and Cross-Connection Control Program.

W. Steel Casing

1. Casing pipe shall be new carbon steel, conforming to ASTM A-139, Grade B, electric fusion welded, having a minimum yield strength of 35,500 psi. The exterior of the steel casing shall be coated with a coal tar varnish. End seals and bolt-on SS casing spaces with insulated skids shall be used on each cased road bore. For road crossings, the contractor shall meet or exceed the minimum dimensions outlined in the table below.

<u>Pipe Dia. (Inches)</u>	<u>Casing(Inches)</u>	<u>Wall Thickness</u>
4	12”	0.250
6	16”	0.250
8	16”-18”	0.250
10	20”	0.375
12	24”	0.375
16	28”	0.500
18	30”	0.500
20	32”	0.500
24	36”	0.500

X. Flush/ Blow-off Assembly (2”)

1. Flush assembly shall consist of a Kupferle Mainguard #77 with gate valve per Utility Owner’s Standard Spec.

PART 3. EXECUTION

3.1 ON-SITE OBSERVATION

- A. The Engineer shall have the right to require that any portion of the work be done in his presence and if any work is covered up after such instruction, it shall be exposed by the Contractor for observation. However, if the Contractor notifies the Engineer that such work is scheduled and the Engineer fails to appear within 48 hours, the Contractor may proceed without him. All work done and materials furnished shall be subject to review by the Engineer or Project Representative. All improper work shall be reconstructed and all materials which do not conform to the requirements of the specifications shall be removed from the work upon notice being received from the Engineer for the rejection of such materials. The Engineer shall have the right to mark rejected materials so as to distinguish them as such.
- B. The Contractor shall give the Project Engineer or project Representative a minimum of 48 hours notice for all required observations or tests.
- C. It will also be required of the Contractor to keep accurate, legible records of the location of all water lines, service laterals, valves, fittings, and appurtenances. These records will be prepared in accordance with the paragraph on “Record Data” in the Supplementary Conditions. Final payment to the Contractor will be withheld until all such information is received and accepted.

3.2 HANDLING MATERIALS

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. All materials dropped or dumped will be subject to rejection without additional justification.
- B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling.
- C. Distribution: Distribute and place pipe and materials to not interfere with traffic. Do not string pipe more than 300 feet beyond the area where pipe is being laid. Do not obstruct drainage ditches.
- D. Storage: Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Do not interfere with other contractors right to access.

3.3 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

Install pipelines and accessories along highways, streets and roadways in accordance with the applicable regulations of the County, City, and/or the Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.

- A. Protection of Traffic: Provide and maintain suitable signs, barricades and lights for protection of traffic.

Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street, or roadway without first obtaining permission from the proper authorities.

Provide flagmen to direct and expedite the flow of traffic.

- B. Construction Operations: Perform all work along highways, streets and roadways to least interfere with traffic.
 - 1. Stripping: Where the pipe line is laid along road shoulders, strip and stockpile all sod, topsoil and other material suitable for shoulder restoration.
 - 2. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

3. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.
- C. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off of the pavement.
- D. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material and free to drain at all times.
- E. Maintaining Highways, Streets, Roadways and Driveways: Maintain streets, highways, and roadways in suitable condition for movement of traffic until completion and final acceptance of the work. Use steel running plate to maintain traffic until pavement replacement is completed.

NOTE: Traffic must be maintained at all times. When one lane is closed, flagmen must be utilized to maintain traffic flow.

Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work.

3.4 EXISTING UNDERGROUND UTILITIES AND OBSTRUCTIONS

- A. It is the responsibility of the Contractor to locate all existing utilities along the path of his construction. The drawings shall indicate underground utilities or obstructions that are known to exist. Where these or unforeseen underground utilities are encountered, the location and alignment of the water main may be changed, upon written approval of the Engineer and Owner, to avoid interference.

3.5 CONNECTIONS TO EXISTING PIPE LINES

- A. Before laying pipe, the Contractor shall locate the points of connection to existing pipe lines and uncover as necessary for the Engineer and Owner to confirm the nature of the connection to be made. The Contractor shall furnish materials and make the connection to all existing pipelines. The Contractor will be observed during construction of tie-ins by the Owner and the Engineer. The Contractor shall use all available practices and resources to minimize the time the customers are without water. The Contractor shall notify affected customers of a water outage at least 24 hours in advance.

3.6 LAYING PIPE

- A. General – Ductile iron pipe shall be laid in accordance with AWWA C-600; PVC pipe shall be laid in accordance with AWWA C 605, ASTM D 2774, UNI-Bell UNI-B 3 and the pipe manufacturer's recommendations; HDPE pipe shall be laid in

accordance with the AWWA C 906, ASTM D2321, and the pipe manufacturer's recommendations.

B. Construction Methods:

1. Field Inspection: All pipe and accessories shall be laid, jointed, tested for defects and for leakage with pressure and chlorinated in the manner herein specified in the presence of the Engineer or his authorized representative and subject to their approval.
2. Handling Pipe and Accessories:
 - a. Care: Pipe, fittings, valves and other accessories shall be unloaded at the point of delivery, hauled to and distributed at the site of the project by the contractor; they shall at all times be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists, slid, or towed on skid-ways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.
 - b. At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench and shall be laid on high ground so that it will not be in a drainage way.
 - c. Bell Ends, How Faced: Pipe shall be placed on the site of the work parallel with the trench alignment and with the bell ends facing the direction in which the work will proceed, unless otherwise directed by the Engineer.
 - d. Pipe Kept Clean: The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.
 - e. Detection Tape: Marking tape shall be buried a minimum of 12" and a maximum of 18" below finish grade. The tape shall be placed during backfill.
 - f. Tracing Wire: Tracer wire will be installed on the top of the pipe and looped up to surface level in all valve boxes and at all service laterals. Tracer wire shall be taped to the top of pipelines at a minimum of 5 ft intervals in a uniform, continuous manner. This tracing wire system shall be checked and tested by the Contractor, in the presence of the Engineer or OWNER, prior to acceptance of the water main installation. All equipment, meters, detectors, etc.,

needed for testing shall be furnished by the Contractor.

- g. Curb Marking: In projects with curb and gutter streets, all service laterals shall be clearly marked by embossing letters in curb perpendicular to the appurtenance. The embossed letter shall be stamped in the curb perpendicular to the appurtenance. The embossed letter shall be stamped in the curb during installation and shall consist of a minimum 3” tall letter indicating type of appurtenance. Lettering shall be “S” for sewer services, and “W” for water services.
- h. Locator Posts: Installation of posts shall be installed in a true vertical plane directly over the pipe. Post should be driven at a uniform anchoring depth of 18 to 24 inches. The tracing wire shall be brought to the surface and attached to the locator post with non corrosive hardware.

3. Alignment and Grade:

- a. General: All pipe shall be laid and maintained in the required lines and grades, with fittings and valves at the required locations, with joints centered and spigots home, and with all valve stems plumb.
- b. Depth of Pipe: Where pipe is laid in roadways and parkways of streets, the top of the barrel of the pipe shall have a minimum cover of forty-eight inches below the curb line of the street or where not curb line has been established, below the existing ground line. Where the pipe is laid in open, unsubdivided areas, a minimum of forty-eight inches of cover is required. A greater depth of cover is required in certain sections of the main, such as railroad crossings, valve locations and other sections of special construction, and within State and Federal highway rights-of-way.
- c. Prior Investigation – Prior to excavation, investigation shall be made to the extent necessary to determine the location of existing underground structures and conflicts. Care shall be exercised by the Contractor during excavation to avoid damage to existing structures. The pipe manufacturers recommendations shall be used when the water main being installed is adjacent to a facility that is catholically protected.
- d. Unforeseen Obstructions – When obstructions that are not shown on the plans are encountered during the progress of work and interfere so that an alteration of the plans is required, the Owner will alter the plans, or order a deviation in line and grade, or arrange for removal, relocation, or reconstruction of the

obstructions.

- e. Clearance – When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the acceptance of the Owner, to provide clearance as required by federal, state, and local regulations or as deemed necessary by the Owner to prevent future damage or contamination of either structure.

4. Excavation and Preparation of Trench:

See Section 02315

5. Pipe Handling:

- a. Manner of Hauling Pipe and Accessories: Proper implements, tools and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe, fittings and valves shall be carefully lowered into the trench piece by piece by means of derrick ropes or other suitable tools or equipment, in such manner as to prevent damage to pipe to pipe or accessories be dropped or dumped into the trench.
- b. Inspection: Before lowering and while still suspended, the pipe shall be inspected for defects. Any defective, damaged or unsound pipe shall be rejected.
- c. Pipe Kept Clean: All foreign matter or dirt shall be removed from the pipe, and it shall be kept clean by approved means during and after laying.
- d. Laying of the Pipe: The spigot shall be centered in the bell, the pipe forced "home" and brought into true alignment; it shall be secured there by earth carefully tamped under and on each side of it, excepting at the bell holes. Care shall be taken to prevent dirt from entering the joint space. No "blocking up" of pipe or joints will be permitted. The joint shall be made as hereinafter described.
- e. Trench Water Entering Pipe: At times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means and no trench water shall be permitted to enter the pipe.
- f. Cutting Pipe: Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe.

- g. Bell Ends Face Direction of Laying: Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying; and for lines on an appreciable slope, bells shall, at the discretion of the engineer face up-grade.
 - h. Permissible Deflections at Joints: Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, the degree of deflection shall be according to manufacturer's recommendations.
 - i. Unsuitable Conditions for Laying Pipe: No pipe shall be laid in water, or when the trench conditions or the weather is unsuitable for such work.
6. Jointing Pipe-Mechanical Joints: The following steps shall be taken in making mechanical joints:
- a. All lumps, blisters and excess coal-tar enamel shall be removed from socket and spigot of the pipe.
 - b. Wash socket and plain end with soapy water containing chloride solution; then slip gland and gasket over plain end. The small side of gasket and lip gland shall face bell.
 - c. Paint gasket with soapy solution containing chlorine.
 - d. Push gasket into position, being sure it is evenly seated in socket.
 - e. Slide gland into position; insert bolts and run nuts up finger tight.
 - f. Tighten bolts to uniform tightness with correct ratchet wrench. The first bolt tightened shall be the bottom bolt, then top. All other bolts shall be tightened in sequence at 180 degrees apart.
7. Setting, Hydrants, Valves, Valve Boxes and Fittings:
- a. General: Hydrants, valves and pipe fittings shall be set and jointed to new pipe in the manner heretofore specified for cleaning, laying and jointing pipe. Hydrants and valves shall be installed plumb. Valve-operating stems shall be oriented in a manner to allow proper operation.
 - b. Valve Boxes: Cast iron valve boxes shall be firmly supported, and maintained centered and plumb over the wrench nut of the gate valve, with box cover.
8. Plugging Dead Ends: Standard plugs shall be inserted into the bells of all

dead ends of pipes, tees or crosses and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the manner specified above.

9. Thrust Blocking:

- a. Concrete having compressive strength of not less than 3000 psi shall be used as a cradle or thrust blocking where shown on the plans or where directed by the Engineer. Bends exceeding 22-1/4 degrees, crosses with one opening plugged, and all tees shall be backed with concrete as a thrust block. Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on ground in each instance shall be that shown on the plans. The blocking shall be so placed that the pipe fitting joints will be accessible for repair. No extra payment will be made for the thrust blocks.
- b. Anchorage for Hydrants – A concrete block 1' x 1' x 2' shall be poured between the back of the hydrant and undisturbed earth of the trench side without covering weep holes and bolts. Joint restraints equivalent to Megalugs manufactured by EBAA Iron may be used in lieu of concrete blocking.

10. Flushing: Foreign material left in pipelines during installation often results in valve- or hydrant-seat leakage during pressure tests. Every effort shall be made to keep lines clean during installation. Through flushing is recommended prior to a pressure test. Flushing should be accomplished by partially opening and closing valves and hydrants several times under expected line pressure, with flow velocities adequate to flush foreign material out of the valves and hydrants (minimum of 2.5 ft/s).

11. Pressure and Leakage Tests:

- a. Pressure During Test: Immediately after the pipe has been laid and backfilled, but prior to the placement of pavement, each valved section of newly laid pipe shall be subjected to a leakage and pressure test. For any section being tested the pressure applied shall be such that at the highest point in the section, the pressure shall be 150 pounds per square inch.
- b. Duration of Test: The duration of each pressure test shall be two (2) hours.
- c. Procedures: Each valved section of pipe shall be slowly filled with water and the specified test pressure, measured at the point of highest elevation shall be supplied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection,

and all necessary apparatus, gauges, and meters shall be furnished by the contractor. The contractor shall furnish all necessary labor and assistance in conducting the tests. The owner will furnish, through connections made by the contractor to existing mains, water for filling the lines for making the test.

- d. Expelling Air Before Tests: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation and afterward tightly plugged.
- e. Examination Under Pressure: At intervals during the test, the route of the pipeline shall be inspected to locate any leaks or breaks. Any cracked or defective joints, cracked or defective pipe, fittings or valves discovered in consequence of this pressure test shall be removed and replaced with sound material in the manner provided and the test shall be repeated until satisfactory results are obtained.
- f. Permissible Leakage: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, of any valved section thereof, to maintain the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation will be accepted if leakage is greater than that determined by the formula:

For PVC Installations:
$$L = \frac{ND(P)^{0.5}}{7,400}$$
 Where:

L is the allowable leakage, in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

For Ductile Iron Installations:
$$L = \frac{ND(P)^{0.5}}{133,200}$$
 Where:

L is the allowable leakage in gallons per hour; N is the length of pipeline tested in feet; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch gauge.

Leakage valves determined by the above formula are to be found in the following Table.

Allowable Leakage for Water Main Installation (Per 1,000 ft)
in Gallons per Hour

Nominal Pipe Diameter, Inches	Average Test Pressure in Pipeline			
	150 PSI		200 PSI	
	PVC	DI	PVC	DI
4"	0.33	0.37	0.38	0.43
6"	0.50	0.55	0.57	0.64
8"	0.66	0.74	0.76	0.85
10"	0.83	0.92	0.96	1.06
12"	0.99	1.10	1.15	1.28

12. Backfilling, Cleaning Up and Maintaining Surfaces:

See Section 02315

13. Disinfection of Mains: The contractor shall disinfect all new mains, in accordance with AWWA C651 furnishing all labor, equipment and material necessary for the complete disinfection of the mains as hereinafter provided. Mains shall be disinfected by the application of a chlorinating agent into the water used for the initial filling of the mains. The chlorinating agent may be chlorine gas-water mixture, calcium hypochlorite in water, or chlorinated lime of known chlorine content in water and shall be fed through a suitable solution feed device. Please note that the "tablet method" listed in AWWA C651 is strictly prohibited. The chlorinating agent shall be applied at or near the beginning point from which the main is being filled and shall be injected into the main through a corporation cock tapped into the horizontal exit of the newly laid main. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly and the rate of application of the chlorinating agent shall be in such proportion to the rate of the water entering the pipe that the chlorine dose applied to the water shall be at least 50 ppm. The chlorine treated water shall be retained in the new main at least 24 hours and a 10 ppm of residual chlorine shall remain after the 24-hour period. Following chlorination all treated water shall be flushed from the mains until replacement water shall have a chlorine content of not more than 0.1 ppm in excess of the residual in water from the supplying main and in any event not less than 0.2 ppm. Samples of the water shall be taken from several points in the new lines and submitted to a State Approved lab for bacteriological analysis. Should the analysis show contamination, the system shall be re-chlorinated and further samples taken and submitted for analysis until no contamination is indicated. A de-chlorinating agent shall be used prior to discharging disinfection water into an environmentally sensitive area.

3.7 WATER SERVICE CONNECTIONS

A. New Metered Services

1. Water service connections shall be installed to the properties adjacent to the water transmission mains both to the same side of the roadway (Short Side Service) and to the opposite side of the roadway (Long Side Service) as directed by the Owner.
2. Water service connections installed under roadway shall be pulled through a bored hole approximately equal in diameter to the external diameter of the service line. No casing will be required. Minimum cover under roadway shall be four feet. At other locations minimum cover shall be two feet.
3. Installation shall conform to the details for water service connections appearing schematically on the Drawings. Contractor shall provide any and all appurtenant work required to provide the intended water service connections. This shall include but is not limited to materials and installation of a new corporation stop, service line, new curb stop, meter box, meter, back flow preventer, and backfilling all trenches.

B. Transfer of Water Services: The Contractor shall perform the transfer of services in a manner to avoid extended water outages to residents and business in the area. The new water mains shall be installed and tied-in before transferring any services. After the new main is tested and sterilized, the contractor shall transfer water services to the new main and then make the remaining connections to existing mains as required.

1. Transfer of a service shall consist of tapping the new main, installation of corporation cock, curb stop, backflow preventor, service line, meter and meter box and tying to the existing service line. The corporation stop on the existing service line shall be abandoned when the new service connections is ready to be installed. The Contractor shall install the new corporation cock, curb stop, service line, meter, meter box and any miscellaneous appurtenances to complete the transfer.
2. At locations where existing water main and services are to be abandoned, Contractor shall locate, disconnect, plug and abandon existing service laterals outside existing pavement area. Contractor will not be required to disconnect existing services at abandoned main.
3. Some transfers of service may require a meter box relocation. If right-of-way boundaries have altered since the original installation of service, then the meter box and its contents shall be moved to the back of the right-of-way as illustrated on the construction plans.

4. Contractor shall note the type of existing service tubing and location. In transferring services, contractor may encounter copper tubing, galvanized pipe or polyvinylchloride pipe. All existing tubing from the meter to the water main shall be replaced with polyethylene tubing.

END OF SECTION

**SECTION 02720
AGGREGATE BASE COURSE
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SECTION 02720
AGGREGATE BASE COURSE

PART 1. GENERAL

1.1 SCOPE

- A. This section specifies requirements for furnishing materials and constructing a quality controlled graded aggregate base course on a compacted subgrade, for flexible pavements.
- B. Contractor shall provide all service, labor, materials, and equipment required for the aggregate base course necessary to complete the work as shown on the drawings or specified in these specifications, or as determined in the field jointly by the Contractor and Engineer.

1.2 RELATED SECTIONS

- A. Section 02300 – Earthwork
- B. Section 02740GA – Asphalt Concrete Paving

1.3 REFERENCES

- A. AASHTO T 96 latest edition – Resistance to Abrasion of Small Size Coarse Aggregate by Use of Los Angeles Machine.
- B. AASHTO T 180 latest edition – Moisture – Density Relations of Soils Using a 10-lb (4.5 kg) Rammer and an 18-in. (457 mm) Drop.
- C. ASTM D 1556 latest edition – Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- D. ASTM D 1557 latest edition – Laboratory Compaction Characteristics of Soil Using Modified Effort.
- E. ASTM D 2167 latest edition – Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- F. ASTM D 2922 latest edition – Density of Soil and Soil-Aggregate in place by Nuclear Methods (Shallow Depth).
- G. ASTM D 3017 (1993) latest edition – Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- H. ASMT D 3740 latest edition – Minimum Requirements for Agencies Engaged in the

Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

- I. ASTM E 329 latest edition – Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

1.4 REGULATORY REQUIREMENTS

- A. Perform all work in accordance with the Department of Transportation, State of Georgia, Standard Specifications, Construction of Road and Bridges, current edition.

1.5 TESTING

- A. Laboratory tests for moisture, density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).
- B. In place density tests in accordance with ASTM D 1556 or ASTM D 2922.
- C. Testing laboratory shall operate in accordance to ASTM D 3740 and E 329 and shall be accepted by the Engineer.
- D. The testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any of the tests.
- E. Testing shall be the responsibility of the Contractor and shall be performed at the Contractor's expense by a commercial testing laboratory that operates in accordance with subparagraph C above.
- F. Test results shall be furnished to the Engineer.
- G. ON SITE OBSERVATIONS OF WORK: The Owner's Representative or Engineer will have the right to require that any portion of the work be done in his presence and if the work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to the Owner. However, if the Contractor notifies the Owner that such work is scheduled, and the Owner fails to appear within 48 hours, the Contractor may proceed without him. All work done and materials furnished shall be subject to review by the Owner, Engineer or Project Representative. Improper work shall be reconstructed, and all materials, which do not conform to the requirements of the specifications, shall be removed from the work upon notice being received from the Engineer for the rejection of such materials. The Engineer shall have the right to mark rejected materials so as to distinguish them as such.

The Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

PART 2. PRODUCTS

2.1 MATERIALS

- A. Coarse Aggregate: Aggregate retained on the No. 4 sieve shall consist of durable, angular fragments of gravel or crushed stone obtained from an approved quarry, and shall be capable of withstanding the effects of handling, spreading, and compaction with minimum degradation.
- B. Fine Aggregate: Material passing the No. 4 sieve shall consist essentially of particles produced from the crushing of coarse aggregate at the approved source. Other types of fine aggregate, if permitted for use, shall meet the Georgia Department of Transportation’s requirements.
- C. Grading: The Graded Aggregate Base Course material shall be of uniform quality throughout. The graded aggregate may be produced from an approved source or deposit which will yield a satisfactory mixture conforming to all requirements of these Specifications after it has been crushed or processed as a part of the mining operations, or the material may be furnished in two sizes of such gradation that when combined in the central mix plant the resultant mixture shall conform to the required Specifications. In addition, the aggregate shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material and shall be durable and sound. The aggregate shall meet the applicable requirements of Section 815 – Graded Aggregate of the Department of Transportation, State of Georgia, Standard Specifications, Construction of Roads and Bridges, Current Edition.

The material shall meet the following gradation:

Sieve Size	Percent by Weight Passing
2”	100
1-1 ½ “	95-100
1”	75-95
3/8”	40-75
#4	30-60
#10	20-45
#40	15-30
#200	5-20
Liquid Limit	0-25
Plasticity Index	0-6

PART 3. EXECUTION

3.1 SUBGRADE PREPARATION

- A. Verify subgrade has been inspected, is dry, and gradients and elevations are correct.
- B. The subgrade shall be leveled to the lines and grades of the plans and cleaned of all foreign substances prior to constructing the base course.
- C. Do not place base on soft, muddy or frozen surfaces.
- D. Correct irregularities in subgrade gradient and elevation by scarifying, reshaping, and recompacting.
- E. Thorough compaction of the subgrade with appropriate equipment. In general the upper 12 inches of the subgrade should be compacted to at least 100% of AASHTO T-99 maximum dry density. Sheepsfoot rollers usually perform well in cohesive soils such as clays and silts. Vibratory rollers and pneumatic tired rollers can be used in cohesionless soils as sands.
- F. The surface of the subgrade shall be checked by the Engineer or his representative for adequate compaction and surface tolerances. Ruts or soft yielding spots that may appear in areas of the subgrade course having inadequate compaction, and areas not smooth or which vary in elevation more than 3/8-inch above or below the required grade established on the plans shall be corrected to the satisfaction of the Engineer or his designated representative. Base material shall not be placed until subgrade has been properly prepared and test results have so indicated.

3.2 AGGREGATE PLACEMENT

- A. Aggregate shall be placed with an acceptable spreader in accordance with Department of Transportation, State of Georgia, Standard Specifications for Construction of Roads and Bridges, Current Edition, Section 300 and in accordance with all terms include in these specifications. (The spreader shall contain a hopper, and adjustable screed and be so designed that there will be a uniform, steady flow of material from the hopper. The spreader shall be capable of laying material without segregation across the full width of the lane to a uniform thickness and to a uniform loose density.) Spreaders are not required on curb and gutter road sections.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- F. While at optimum moisture ($\pm 1 - \frac{1}{2} \%$), compact the base course with rollers capable of obtaining the required density. Vibratory, flatwheel, and other rollers accepted by the Engineer may be used to obtain the required compaction. Rolling shall continue until the base is compacted to 95% of the maximum laboratory dry density as determined by ASTM D 1557 or AASHTO T 180. In-place density of the compacted base will be determined in accordance with ASTM D 1556 or ASTM D 2922.

3.3 TOLERANCES

- A. Flatness: Maximum variation of $\frac{1}{4}$ inch measured with an acceptable 10-foot straight edge.
- B. Scheduled Compacted Thickness: Within $\frac{3}{8}$ inch.
- C. Variation from Design Elevation: Within $\frac{3}{8}$ inch.
- D. Depth measurements for compacted thickness shall be made by test holes through the base course. Where the base course is deficient, correct such areas by scarifying, adding base material and recompacting as directed by the Engineer. Measurements shall be made at staggered intervals not to exceed 250 feet for two-lane streets and roads.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 – Quality Control
- B. Density and moisture testing will be performed in accordance with AASHTO T 180.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests:
 - 1. Base Density – One (1) test per 5,000 square feet.

END OF SECTION

SECTION 02823

CHAIN LINK FENCING AND GATES

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall furnish all labor, materials, equipment, and miscellaneous items as necessary for the installation of a complete chain link fence system. Fencing shall be installed in the location as shown on the Construction Drawings in complete conformity with the Manufacturer's written recommendations and as specified herein.
- B. Security fencing for the Contractor is at the Contractor's option and is not included as part of the work specified.

1.02 RELATED SECTIONS

- A. Section 02300 – Earthwork

1.03 REFERENCES

- A. ASTM A 90-95 – Standard Test Method for Weight of Coating
- B. ASTM A 116-88 – Zinc Coated (Galvanized) Steel Woven Wire Fence Fabric
- C. ASTM A 130-92 – Zinc Coated (Galvanized) Steel Barbed Wire.
- D. ASTM A 123-89 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
- E. ASTM A 153-95 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- F. ASTM A 392-91 – Zinc Coated Steel Chain Link Fence Fabric
- G. ASTM A 569/A 569 M-91a (1993) – Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality.
- H. ASTM A 491-94 – Aluminum Coated Steel Chain Link Fence Fabric
- I. ASTM F 668-95 – PVC Coated Steel Chain Link Fence Fabric

- J. ASTM A 428-89 – Test Method for Weight of Coating on Aluminum Coated Iron or Steel Articles
- K. ASTM C 94-94 – Ready Mix Concrete
- L. ASTM F 567-93 – Installation of Chain Link Fence
- M. ASTM F 669-92 – Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence
- N. ASTM F 10893-3 – Pipe, Steel, Hot-Dipped, Zinc-Coated (Galvanized) Welded, for Fence Structures
- O. ASTM F 1234-93 – Protective Coatings on Steel Framework for Fences.
- P. Chain Link Fence Manufacturers Institute (CLFMI) – Product Manual

1.04 SUBMITTALS

- A. Submittals for Review:
 - 1. Product Data: Provide data on fabric, posts, accessories, fittings, and hardware.
 - 2. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- B. Submittals for Information:
 - 1. Manufacturer’s Installation Instruction: Indicate installation requirements.
- C. Submittals for Closeout:
 - 1. Project Record Drawings: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials with the manufacturer’s tags and labels intact.
- B. Provide storage and protection in accordance with the manufacturer’s requirements.

- C. Materials should be unloaded in a manner that will avoid damage and shall be stored where it will be protected and will not be hazardous to traffic. The Contractor shall repair any damage caused by the storage. Material shall be examined before installation and neither damaged nor deteriorated material shall be used in the construction of the chain link fence.

1.06 QUALITY ASSURANCE

- A. Standards of manufacturer shall comply with the standards of the Chain Link Manufacturers Institute and these Specifications.
- B. Provide fencing as a complete unit produces by a single manufacturer including the required erection accessories, fittings, fasteners, and all other necessary appurtenances.
- C. Manufacturer: The Company must specialize in manufacture ring chain link fences and it's products specified in this section and must have a minimum of three years experience.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Overall height for new fencing shall be six feet including three strands of barbed wire on malleable iron post tops. Posts shall be set a no more than 10 foot centers, a full three feet deep in concrete footings, poured the full size of the holes as excavated. Corner posts shall have the necessary strut and tie bracing. Gates shall be provided of the size and at the locations indicated on the Construction Drawings.
- B. Where fencing crosses ditches, steep grades, and other unusual conditions, make special provisions to insure that the security, appearance, maintainability, and permanence of the standard fencing are equaled or exceeded.

2.02 MATERIALS

- A. Wire: Fabric shall be of the "chain link" type, composed of individual wire pickets, helically wound and interwoven to form a square mesh. Wire used in the fabric shall be #9 W & M gage, of basic open hearth steel, containing not less than 0.20% copper, and having a tensile strength after galvanizing of 90,000 psi. Fabric shall be woven so as to form mesh two inches square and shall measure six feet in width. The wire ends at the edges of the fabric shall be cut diagonally, and twisted to form barbs. The fabric shall be hot dipped

galvanized after weaving, to produce a zinc coating weighing not less than 1.4 oz. per square foot of wire surface. Zinc coating shall withstand six one-minute dips, when tested by methods outlined in ASTM Specification No. 391 Class I, or the latest revision thereof.

- B. Line Posts: Line posts shall be 2" O.D. galvanized steel pipe weighing 2.72# per foot of length.
 - 1. Post shall be high carbon rail steel for rolled sections or of new high carbon steel for tubular sections. All posts shall be hot galvanized to withstand twelve one-minute dips when tested by methods outlined above.
- C. Top Rails: Top rails shall be of new 1-5/8" O.D. schedule 10 steel pipe in random lengths averaging not less than 20 feet and joined with pressed steel sleeves. Rail and sleeves shall be hot dipped galvanized to produce a zinc coating equal to that of the fabric.
- D. Fabric Ties: Fabric ties for attaching fabric to line posts, top rail, or top wire, shall be galvanized wire of approved gauge and design. Ties shall be located on top rail every 24 inches and on line posts every 14 inches.
- E. Barbed Wire: The fabric shall be surmounted with three strands of barbed wire. Each strand shall consist of two No. 12-1/2 W & M gage twisted copper bearing steel line wires, hot dip galvanized with No. 14 W & M gage galvanized steel 4-point barbs spaced not more than four inches apart.
- F. Barbed Wire Extension: All intermediate and corner posts shall be equipped with extension arms for supporting barbed wire. The base shall be of malleable iron and the extension presses Armco Ingot Iron, hot galvanized after the fabrication. The intermediate arm shall have provision for passing top rail, and corner arm casting equipped with setscrew.
- G. End and Corner Posts: Shall be hot galvanized basic open hearth or copper-bearing steel pipe, three-inch OD, weighing 5.79 pounds per foot.
- H. Swing Gate Posts: Shall be same as end posts but in the following sizes:

Pipe Size OD	Weight Per Foot	Gate Opening	Gate Opening
		Single Inclusive	Double Inclusive
3"	5.79 lbs.	To 6'	Up to 12'
4"	9.11 lbs	Over 6' to 13'	Over 12'-26'

6-5/8"	19.97 lbs.	Over 13' to 18'	Over 26'-36'
8-5/8"	25.00 lbs.	Over 18' to 32'	Over 36'-64'

- I. Brace and Tension Bands: Bands shall be unclimbable bevel ledge type with 3/8" diameter square shouldered, galvanized carriage bolts, non-removable from outside fence.
- J. Bracing: All terminal posts shall be braced by means of 1-5/8" OD horizontal compression members, securely attached to terminal and first line posts with malleable iron fittings and beveled edge bands, and shall be truss braced from first line post to bottom of terminal posts with 1/2" rod and turn buckle. Corner posts shall be braced in each direction.
- K. Tension Bars: Tension bars for attaching fabric to terminal posts shall be 3/16" x 3/4" high carbon steel attached to terminal post by means of beveled edge bands.
- L. Swing Gate Frames: Swing gate frames shall be 2' OD Schedule 40 Pipe 2.72 #/Ft. with internal bracing of 1-5/8" OD Schedule 40 Pipe 2.27 #/Ft.
- M. Gate Fillers: Gate frames shall be filled with same specifications of fabric as is used in line of fence.
- N. Hinges: Hinges shall be double-clamping offset type, allowing gates to swing back parallel with line of fence and shall be made of malleable iron and foregings.
- O. Latches: Latches shall be of eccentric double-locking type which engage strikes securely bolted to either gate frame or gate post at both top and bottom and in case of double gates engage also a heavy malleable iron non-freezing gate stop anchored in concrete footing. For walk gates up to and including 4' opening, a malleable iron gravity type latch shall be furnished which automatically engages pin welded in gate frame. All latches shall be made so as to be readily locked with padlock.
- P. Gate Keeper: Each gate frame shall be equipped with a keeper which automatically engages the gate frame when swung to the open position.
- Q. Miscellaneous Fittings: All fittings entering into the fence, necessary to make a complete installation, shall be malleable iron, pressed steel, or foregings. All material shall be thoroughly galvanized by the hot dip method.

- R. Quality: All fencing, posts, and gates shall be of a quality equal to standard seven foot fencing as furnished and erected by Hurricane Fence Company or Cyclone Fence Company.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Fence installation shall not be started before the final grading is complete, with finished grade elevations established, unless otherwise permitted.
- B. Excavation: Drill holes of diameters and spacings shown, for post footings in firm, undisturbed or compacted soil.
 - 1. Excavate holes to the minimum diameters as recommended by fence manufacturer.
 - 2. Excavate hole depths approximately 3 inches lower than the post bottom, with bottom of posts set not less than 36 inches below the surface when in firm undisturbed soil.
 - 3. If solid rock is encountered near the surface, drill into rock at least 12 inches for line posts and at least 18 inches for end, pull corner, and gate posts. Drill hole at least 1 inch greater diameter than the largest dimension for the post to be placed. If solid rock is below soil overburden, drill to full depth required. Penetration into rock need not exceed the minimum depths specified above.
- C. Setting Posts: Remove loose and foreign materials from sides and bottoms of holes and moisten soil prior to placing concrete.
 - 1. Center and align posts in holes 3 inches above bottom of excavation.
 - 2. Place concrete around posts in a continuous pour and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
 - 3. Trowel finish tops of footings and slope of dome to direct water away from posts. Extend footings for gate posts to underside of bottom hinge. Set keeps, stops, sleeves, and other accessories into concrete as required.

4. Grout in posts set into sleeved holes, concrete constructions or rock excavations with non shrink Portland cement grout or other acceptable grouting material.
- D. Concrete Strength: Allow concrete to attain at least 75% of its minimum 28 day compressive strength, but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire or fabric is installed. Do not stretch and tension fabric and wires and do not hang gates until the concrete has attained its full design strength.
- E. Top Rails: Run rail continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.
- F. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- G. Tension Wire: Install tension wires by weaving through the fabric and tying to each post with not less than 6 gauge galvanized wire or by securing the ore to the fabric.
- H. Fabric: 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. Repair damaged coatings in the shop or during field erection by recoating with manufacturer's recommended repair compound, applied per manufacturer's directions.
- J. Stretch Bars: Thread through or clamp to fabric 4 inches on center and secure to posts with metal bands spaced 15 inches on center.
- K. Barbed Wire: Install three parallel wires on each extension arm; on security side of fence, unless otherwise indicated. Pull wire taut and fasten securely to each extension are.
- L. Tie Wires: Use U-shaped wire appropriate for the diameter of pipe. Attach pipe and fabric firmly with tie wire ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
- M. Fasteners: Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.02 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all debris and equipment. Repair all damage resulting from chain link fence installation.

END SECTION

**SECTION 02920
GRASSING
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**SECTION 02920
GRASSING**

PART 1. GENERAL

1.1 SECTION INCLUDES

- A. Ground preparation, seeding, planting grass, fertilizing, and mulching of graded areas behind structures, over pipelines, in rights-of-way, roadway shoulders, and any other disturbed area.
- B. Seed Protection.
- C. Maintaining seeded areas until final acceptance.

1.2 RELATED SECTIONS

- A. Section 02300 – Earthwork
- B. Section 02370 – Erosion and Sedimentation Control

1.3 MEASUREMENT AND PAYMENT

- A. There will be no separate measurement or payment for Grassing. Grassing should be a subsidiary obligation of the Contractor in the restoration of disturbed areas. The cost of grassing shall be included in the line item to which it pertains.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Damaged packages are not acceptable.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Damaged bags are not acceptable.
- C. Deliver sod on pallets.
- D. All materials shall be acceptable to Engineer prior to use.

1.5 PLANTING DATES

- A. This specification provides for the establishment of a permanent grass cover between the dates of March 1 and September 30. If finished earth grades are not completed in time to permit planting and establishment of the permanent grass

during the favorable season between the dates specified above unless otherwise accepted, the Contractor will be required to plan a temporary cover to protect the new graded areas from erosion and to keep windblown dust to a minimum. The temporary cover shall be planted between October 1 and February 28 unless otherwise permitted.

PART 2. PRODUCTS

2.1 SEED

- A. All grass seed shall be certified by the Georgia Department of Agriculture.
- B. All grass seed shall be in undamaged containers showing percentage of seed mix, year of production, net weight, date of packaging and location of packaging.
- C. Selected grasses shall be appropriate for the season site as specified by the manual.
- D. Selected seed shall be equal type and grade to the previously existing grass.
- E. The Engineer reserves the right to test, reject, or accept all seed before seeding.

2.2 FERTILIZER

- A. Commercial fertilizer of approved type, conforming to table below.

Types of Species	Planting Year	Fertilizer (N-P-K)	Rate (lbs./acre)	N Top Dressing Rate (lbs./acre)
Cool season grasses	First	6-12-12	1500	50-100
	Second	6-12-12	1000	---
	Maintenance	10-10-10	400	30
Cool season grasses & legumes	First	6-12-12	1500	0-50
	Second	0-10-10	1000	---
	Maintenance	0-10-10	400	---
Warm season grasses	First	6-12-12	1500	50-100
	Second	6-12-12	800	50-100
	Maintenance	10-10-10	400	30
Warm season grasses & legumes	First	6-12-12	1500	50
	Second	0-10-10	1000	---
	Maintenance	0-10-10	400	---

2.3 SEEDING SCHEDULE

A. Schedule

Species	Rates Per Acre	Rates per 1,000 sq. ft.	Planting Dates by Region		
			M-L	P	C
Bahia, Pensacola Alone or with temporary cover	60 lbs.	1.4 lbs	---	4/1-5/31	3/1-5/31
With other perennials	30 lbs.	0.7 lb.			
Bahia, Wilmington Alone or with temporary cover	60 lbs.	1.4 lbs.	3/15-5/31	3/1-5/31	---
With other perennials	30 lbs.	0.7 lb.			
Bermuda, Common (Hulled seed) Alone	10 lbs.	0.2 lb.	---	4/1-5/31	3/15-5/31
With other perennials	6 lbs.	0.1 lb.			
Bermuda, Common (Unhulled seed) With temporary cover	10 lbs.	0.2 lb.	---	10/1-2/28	11/1-1/31
With other perennials	6 lbs.	0.1 lb.			
Bermuda Sprigs Common lawn and Forage hybrids	40 cu. ft.	0.9 cu. ft.	4/1-6/15	4/1-6/15	4/1-5/31
	Sod plugs 3'x3'				
Centipede	Block Sod Only	Block Sod Only	---	11/1-5/31	11/1-5/31
Crown Vetch With winter annuals Or cool season grasses	15 lbs.	0.3 lb.	9/1-10/15	9/1-10/15	---
Fescue, Tall Alone	50 lbs.	1.1 lbs.	3/1-4/15	9/1-10/15	---
With other perennials	30 lbs.	0.7 lb.	8/15-10/15		
Lespedeza, Sericea Scarified	60 lbs.	1.4 lbs.	4/1-5/31	3/15-5/31	3/1-5/15
Lespedeza, Shrub (Lespedeza Bicolor or Lespedeza Thumbergii) Plants	3'x3' spacing		10/1-3/31	3/15-5/31	11/15-2/28
Lovegrass, Weeping Alone	4 lbs.	0.1 lbs.	4/1-5/31	3/15-5/31	3/1-5/31
With other perennials	2 lbs.	0.05 lbs.			
Maidencane sprigs	2'x3' spacing		2/1-3/31	2/1-3/31	2/1-3/31

Panicgrass, Atlantic coastal	20 lbs.	0.5 lbs.	---	3/1-4/30	3/1-4/30
Reed Canary Grass With other perennials	50 lbs. 30 lbs.	1.1 lbs. 0.7 lbs.	8/15-10/15	9/1-10/15	---
Sunflower, Aztec Maximillian	10 lbs.	0.2 lbs.	4/15-5/31	4/15-5/31	4/1-5/31

- B. In areas where existing grass is to be matched, contractor shall sow seed at the rate and dates recommended by seed distributor.

2.4 LIME

- A. Agricultural grade, ground limestone.

2.5 SOD

- A. Sod shall be densely rooted, good quality grass, free from noxious weeds. The sod shall be obtained from areas where the soil is reasonably fertile. The sod shall be raked free of all debris and the grass mowed to two inches before cutting. The sod shall contain practically all of the dense root system and not be less than one (1) inch thick. Sod shall be cut in uniform strips not less than twelve (12) inches in width and not less than twenty-four (24) inches in length.

2.6 ACCESSORIES

- A. Straw Mulch: Oat or wheat straw reasonably free from weeds, foreign matter detrimental to plant life, and in dry condition.
- B. Excelsior Mulch: Excelsior mulch shall consist of wood fibers cut from sound, green timber. The average length of the fibers shall be 4 to 6 inches. The cut shall be made in such a manner as to provide maximum strength of fiber, but at a slight angle to the natural grain of the wood so as to cause splintering of the fibers when weathering in order to provide adherence to each other and to the soil.
- C. Wood cellulose fiber shall be made from wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer. It shall remain in uniform suspension in water under agitation and blend with grass seed and fertilizer to form homogenous slurry. The mulch fibers shall intertwine physically to form a strong moisture holding mat on the ground surface and allow rainfall to percolate into the underlying soil. The mulch shall be heat processed so as to contain no germination or growth-inhibiting factors. It shall be dyed (non-toxic) an appropriate color to facilitate metering of material.

2.7 PRODUCT REVIEW

- A. The Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

PART 3. EXECUTION

3.1 GENERAL

- A. All areas that are disturbed by the work, including trenches and ungraded clear areas, except areas to be paved, shall be provided with a full stand of permanent grass.
- B. Concentrated flow areas, all slopes steeper than 2.5:1 and with a height of ten feet or greater, and cuts and fills within stream buffers, shall be stabilized with sod and/or the appropriate erosion control matting or blanket. Appropriate matting or blankets shall be specified by the Engineer on the Drawings.

3.2 PREPARATION

- A. The areas to be seeded shall be made smooth and uniform and shall conform to the finished grade indicated on the plans.
- B. Remove foreign materials, plants, roots, stones, and debris from surfaces to be seeded.
- C. Grassing areas, if not loose, shall be loosened to a minimum depth of 3 inches before fertilizer, seed, or sod is applied.

3.3 STAND OF GRASS

- A. Before acceptance of the seeding performed for the establishment of permanent vegetation, the Contractor will be required to produce a satisfactory stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and the winter weather and be capable of re-establishment in the spring.
- B. Before acceptance of the seeding performed for the establishment of temporary vegetation, the Contractor will be required to produce a stand of grass sufficient to control erosion for a given area and length of time before the next phase of construction or the establishment of permanent vegetation is to commence.

3.4 SEEDING DATES

- A. Seeding shall be performed during the periods and at the rates specified in the

seeding schedules. Seeding work may, at the discretion of the Contractor, be performed throughout the year using the schedule prescribed for the given period. Seeding work shall not be conducted when the ground is frozen or excessively wet. The Contractor will be required to produce a satisfactory stand of grass regardless of the period of the year the work is performed.

3.5 APPLYING LIME AND FERTILIZER

- A. Following advance preparation and placing selected material for shoulders and slopes, lime, if called for based on soil tests and fertilizer, shall be spread uniformly over the designated areas and shall be thoroughly mixed with the soil to a depth of approximately 2 inches. Fertilizer shall be applied at the rate of 1,000 pounds per acre for the initial application unless otherwise directed by the Engineer. Lime shall be applied at the rate determined by the soil test. Unless otherwise provided, lime will not be applied for temporary seeding. In all cases where practicable, acceptable mechanical spreaders shall be used for spreading fertilizer. On steep slopes subject to slides and inaccessible to power equipment, the slopes shall be adequately scarified. Fertilizer may be applied on steep slopes by hydraulic thuds as a mixture of fertilizer and seed. When fertilizer is applied with combination seed and fertilizer drills, no further incorporation will be necessary. The fertilizer and seed shall be applied together when Wood Cellulose Fiber Mulch is used. Any stones larger than 2½ inches in any dimension, larger clod, roots, or other debris brought to the surface shall be removed.

3.6 SEEDING

- A. Seed shall be sown within 24 hours following the application of fertilizer and lime and preparation of the seedbed as specified in Section 3.4. Seed shall be uniformly sown at the rate specified by the use of acceptable mechanical seed drills. Rotary hand seeders, power sprayers or other satisfactory equipment may be used on steep slopes or on other areas that are inaccessible to seed drills.
- B. The seed shall be covered and lightly compacted by means of cultipacker or light roller if the drill does not perform this operation. On slopes inaccessible to compaction equipment, the seed shall be covered by dragging spiked chains, by light harrowing, or by other satisfactory methods.
- C. Apply water with fine spray immediately after each area has been sown.
- D. Do not sow seed when ground is too dry, during windy periods or immediately following a rain.
- E. If permitted by the special provisions, wood cellulose fiber mulch or excelsior fiber mulch may be used.

3.7 SEED PROTECTION (STRAW MULCH)

- A. All seeded areas seeded with permanent grasses shall be uniformly mulched in a continuous blanket immediately following seeding and compacting operations, using at least 2 tons of straw per acre.

3.8 SEED PROTECTION (EXCELSIOR MULCH)

- A. Seed shall be sown as specified in Section 3.6. Within 24 hours after the covering of seed, excelsior mulch shall be uniformly applied at the rate of 2 tons per acre. The mulch may be applied hydraulically or by other acceptable methods. Should the mulch be placed in a dry condition, it shall be thoroughly wetted immediately after placing. The Engineer may require light rolling of the mulch to form a tight mat.

3.9 SEED PROTECTION (WOOD CELLULOSE FIBER MULCH)

- A. After the lime has been applied and ground prepared as specified in Section 3.4, wood cellulose fiber mulch shall be applied at the rate of 1,500 pounds per acre in a mixture of seed and fertilizer. Hydraulic equipment shall be used for the application of fertilizer, seed and slurry of the prepared wood pulp. This equipment shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed and water. The slurry distribution lines shall be equipped with a set of hydraulic spray nozzles, which will provide an even distribution of the slurry on the various areas to be seeded. The slurry tank shall have a minimum capacity of 1,000 gallons.
- B. The seed, fertilizer, wood pulp mulch, and water shall all be combined into the slurry tank for distribution of all ingredients in one operation by the hydraulic seeding method specified herein. The materials shall be combined in a manner recommended by the manufacturer. The slurry mixture shall be so regulated that the amounts and rates of application shall result in a uniform application of all materials at rates not less than the amount specified. Using the color of the wood pulp as a guide, the equipment operator shall spray the prepared seedbed with a uniform visible coat. The slurry shall be applied in a sweeping motion, in an arched stream so as to fall like rain, allowing the wood fibers to build upon each other until an even coat is achieved.

3.10 SODDING

- A. Sod shall be placed between March 1 and December 1 to all existing sodded yards that have been disturbed.
- B. Sod shall be placed within 48 hours of cutting.
- C. Sod shall be moist when laid and placed on moist ground. The sod shall be carefully placed by hand, beginning at the toe of slopes and working upwards. The length of

the strips shall be at right angles to the flow of surface water. All joints shall be tightly butted and end joints shall be staggered at least 12 inches. The sod shall be immediately pressed firmly into the ground by tamping or rolling. Fill all joints between strips with fine screened soil. Sod on slopes shall be pegged with sod pegs to prevent movement. The sod shall be watered, mowed, weeded, repaired or otherwise maintained, to insure the establishment of a uniform healthy stand of grass until acceptance.

3.11 MAINTENANCE

- A. Maintain seeded surfaces until final acceptance.
- B. Maintenance shall consist of providing protection against traffic, watering to ensure uniform seed germination and to keep surface of soil damp, and repairing any areas damaged as a result of construction operations or erosion.
- C. If a poor stand of grass is present, re-seed as required to achieve final stabilization. Replace sod as needed.
- D. After grass has been established, mow as often as needed to maintain height between 4 and 6 inches until final acceptance.

3.12 ACCEPTANCE

- A. Before acceptance of the seeding performed for the establishment of permanent vegetation, the Contractor will be required to produce a satisfactory stand of perennial grass that is fully stabilized against erosion and whose root system shall be developed sufficiently to survive dry periods and the winter weather and be capable of re-establishment in the spring.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 – GENERAL

1.01 SCOPE

- A. Under this heading shall be included designing, furnishing, constructing, adjusting and maintenance of all concrete formwork required for the reinforced concrete shown on the Plans in accordance with the requirements of the Specifications.

1.02 APPLICABLE STANDARDS

- A. Where any material or operation is specified by reference to the following published specifications or standards or the specifications or standards of any other organizations, the referenced specifications or standard shall be as much a part of this Section as is quoted in full herein.
1. American Concrete Institute (ACI).

(a) 347 Recommended Practice for Concrete Formwork

1.03 DESIGN

Design of forms and formwork shall be the responsibility of the Contractor. Design shall include consideration of all dead and live loads which will be exerted on formwork during its period of use. Formwork design shall be performed using the following criteria:

- A. Design Loads.
1. Vertical loads shall include the weight of formwork, the weight of freshly placed concrete and all live loads including the weight of workmen, equipment, materials, runways and impact.
 2. Horizontal loading shall include but not be limited to, wind, cable tension, inclined supports, placement of concrete, and starting and stopping of equipment. Wall forms shall be designed in accordance with American National Standard A58.1, "Minimum Design Loads for buildings and Other Structures", or those required by local building codes, whichever is greatest. Bracing for wall forms shall be designed for a minimum horizontal load of 100 pounds per linear foot of wall, applied at the top.
 3. Lateral pressure of concrete containing no pozzolans or admixtures, having a slump of 4 inches or less, made with Type I cement weighing 150

pounds per cubic foot, and normal internal vibration shall be calculated on the basis of

$$p = 150 h$$

where p is the lateral pressure in pounds per square foot and h is the height of fresh concrete above the point considered in feet. Adjustment shall be made in design of forms for concrete having characteristics different from those described above or for external vibrations of forms.

- B. Safety Factors: Safety factors for formwork accessories shall be as given in Table 2.4 of ACI 347-78. All other components of formwork shall be designed for a safety factor of 2.0 except for those with a potential hazard to life which shall have a safety factor of 3.0.
- C. Design Approval: The Contractor will not be required to submit shop drawings or design calculations for approval. However, in the event that the Engineer requests the design calculations on any part of the formwork, the Contractor shall submit such calculations for review. Such design calculations found not to be in accordance with the criteria specified herein or the failure to provide such calculations upon request from the Engineer shall be cause for all concreting operations to be suspended until design requirements are completed. Review of design calculations or the absence of review will in no respect relieve the Contractor of the responsibility for formwork design or the liability which may result from improper design or the absence thereof.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Material used in formwork shall be selected by the Contractor on the basis of safety and the quality required in the finished work. All material and accessories shall be new and undamaged. New forms may be reused so long as they retain structural integrity and provide the required quality of the finished work. Form coatings sealers, and parting agents shall be used as required by the work and shall be of quality to insure proper function. Such agents shall be used in accordance with manufacturer's recommendations.

PART 3 – EXECUTION

3.01 CONSTRUCTION

- A. General
 - 1. Forms shall be constructed and maintained so as to insure that after removal of forms the finished concrete members will have true surfaces

free of offset, waviness or bulges, and will conform accurately to the indicated shapes, dimensions, lines, elevations, and positions. Form surfaces that will be in contact with concrete shall be thoroughly cleaned before each use.

2. Studs and wales shall be spaced to prevent deflection of form material. Forms and Joints shall be sufficiently tight to prevent leakage of grout and cement paste during placing of concrete. Forms shall be fitted to accurate alignment to assure smooth completed surfaces free from irregularities. Forms shall be readily removable without impact, shock, or damage to the concrete.
- B. Concrete Surfaces to be Exposed: Form surfaces that will be in contact with concrete shall be of material that is non-reactive with concrete and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new 4 foot by 8 foot plywood panels, exterior type, resin-impregnated or plastic faced concrete form. Cut surfaces shall be smooth and treated with form coating. Panel joints that will be in contact with concrete shall be smooth and free of offset. Form materials with defects that will impair the texture and appearance of finish surfaces shall not be used. Form lining, if used, shall be installed over solid backing.
 - C. Concrete Surfaces to be Unexposed: Form surfaces that will be in contact with concrete shall be sound, tight, lumber or other material producing equivalent finish. Forms under dock slabs may be left in place.
 - D. Form Ties: Ties shall be factory-fabricated, removable or snap-off metal ties of design that will not allow form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. The portion of the tie remaining in the concrete after removal of the exterior parts shall be at least 1-1/2 inches back from any surface of the concrete. Bolts and rods that are to be completely withdrawn shall be coated with a non-staining bond breaker.
 - E. Chamfering: External corners shall be chamfered by moldings placed in the forms unless the Plans specifically show that chamfering is to be omitted.
 - F. Coating: Forms shall be coated with form oil or form-release agent before reinforcement is placed. The coating shall be a commercial formulation of satisfactory and proven performance that will not bond with, stain, or adversely effect concrete surfaces, and surfaces to be cured with water or curing compounds. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for unexposed surfaces, may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on

form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

G. Removal of Forms:

1. Removal shall be in a manner to insure complete safety of the structure after the following conditions have been met. Where the structure as a whole is supported, forms for beam sides, and similar vertical structural members may be removed after 72 hours except when curing requirements exceed this time. Supporting forms or shoring shall not be removed until structural members have acquired sufficient strength to support safely their own weight and any construction and/or storage load to which they may be subjected, but in no case shall they be removed before expiration of 7 days, nor shall forms used for curing be removed before expiration of curing period except as specified in Section 03300. Care shall be taken to avoid spilling concrete surfaces or damaging concrete edges.
2. Tie-rods to be entirely removed from the wall shall be loosened 24 hours after concrete is placed, and form ties, except for a sufficient number to hold forms in place, may be removed at that time. Ties wholly withdrawn from wall shall be pulled toward the face that will be concealed from view in the permanent work.

H. Filling of Tie-Rod or Bolt Holes: Filling of tie-rod or bolt holes is specified in Section 03310.

3.02 TOLERANCES

The Contractor shall set and maintain forms to insure completed work within the following tolerance limits:

A. Variations From the Plumb Columns, piers and walls:

1. 1/4 inch in any 10 feet of length and 1 inch maximum for entire length.
2. Corner columns, control joint lines and any other conspicuous lines.
3. 1/4 inch in any 20 feet of length and 1/2 inch maximum for entire length.

B. Variations from plan Levels or Grades Slabs, ceilings, decks and beams:

1. 1/4 inch in any 10 feet of length 3/8 inch in any bay or any 20 feet of length, 3/4 inch maximum for entire length.

2. Exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines: 1/4 inch in any bay or in any 20 feet of length, 1/2 inch maximum for entire length.
- C. Variation of Distances:
1. Between walls, columns, partitions and beams: 1/4 inch per 10 feet of distance but not more than 1/2 inch in any one bay, and not more than 1 inch total variation.
- D. Variations in Opening Sizes and Locations Sleeves, floor openings and wall openings: Minus 1/4 inch, plus 1/2 inch.
- E. Variations in Cross-Sectional Dimensions and Thickness Columns, beams, slabs, decks and walls: Minus 1/4 inch, plus 1/2 inch.
- F. Variations in Plan Lines:
1. Building lines, structure lines: 1 inch from established plan position.
- G. Variations in Footing and Foundation Dimensions:
1. Dimensions in plan: Minus 1/2 inch. Plus 2 inches (concrete only) or plus 3 inches when earth-formed.
 2. Misplacement or eccentricity: 2 percent of member width in the direction of misplacement but not more than 2 inches (concrete only).
 3. Thickness: Minus 5 percent of specified thickness.

END OF SECTION

**SECTION 03150
CONCRETE ACCESSORIES**

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Provide accessories for cast-in-place concrete.

1.02 RELATED WORK

- A. Section 03100, Concrete Formwork
- B. Section 03200, Concrete Reinforcement
- C. Section 03300, Cast-In-Place Concrete

1.03 SUBMITTALS

- A. Submit product data on the following items.
 - 1. Water Stops
 - 2. Tongue and Groove Joint Forms
 - 3. Preformed Expansion Joint Fillers

- B. Submit samples on the following items:
 - 1. Water Stops
 - 2. Precast Concrete Block Supports for Reinforcing Bars

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Precast Concrete Block Supports For Reinforcing Bars: Comply with ACI 315. Provide blocks with No. 4 dowels bent 90° to support top bars.

- B. Membrane: 6 mil polyethylene film.

- C. Water Stops: Polyvinyl chloride meeting all requirements of U.S. Army Corps of Engineer's Specification CRD-C-572 and equal to Burke Water Stops as manufactured by The Burke Company. Provide flat dumbbell type and center bulb type, 9 inches x 3/8-inch at wall thickness of 12-inches or greater, and 6-inches x 3/8-inch at wall thickness less than 12-inches. Provide 6-inch split-ribbed with center bulb type at connections of new concrete structures with existing concrete. Provide water stops as indicated on the Drawings.

- D. Preformed Expansion Joint Filler:
 - 1. Bituminous type conforming to the requirements of ASTM D 994.

2. Nonextruding type, self-expanding cork, 3/4-inch thick or as otherwise shown on the Drawings, conforming to the requirements of ASTM D1752, Type III, and compatible with the specified joint sealant compound.
- E. Joint Sealant: A multipart, gray, polyurethane sealant meeting U.S. Federal Specification TT-S-00227E (3) Type 1, class A self-leveling for horizontal joints, and Type II, Class A, non-sag for vertical joints, and recommended by the manufacturer for continuous immersion in water. Provide sealants as manufactured by Products Research and chemical corporation, Mameco International, The Burke Company, W.R. Meadows, or equal.
- F. Tongue And Groove Joint Forms: 24 gauge steel forms complete with steel stakes and splice plates, designed for joints not to receive a poured seal, and equal to Burke Keyed Kold Joint as manufactured by The Burke Company.
- G. Inserts: Galvanized steel to fit the proposed hanger or support.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Precast Concrete Block Supports For Reinforcing Bars: Provide in sufficient quantity to support reinforcing bars in slabs formed on earth at a spacing not to exceed 4-feet on centers in both directions. Provide blocks with dowels to support top bars. Block supports are not required in slabs formed on tremie concrete, but may be used at the Contractor's option. Blocks are not required for reinforcing bars properly supported from formwork. At other locations, refer to ACI 315 and CRSI MSP-1.
- B. Membrane: Provide polyethylene film under all slabs formed on earth, except for liquid containment structures. Lap membrane sheets 6-inches in the direction of spreading concrete. Do not puncture film.
- C. Water Stops:
 1. Installation: Protect water stops from dirt, oil and concrete spatter and rigidly secure in position by means of split bulkheads and by fastening to reinforcing bars in two directions at not more than 12 inches on centers. Install water stops in construction joints in hydraulic structures required to contain liquid or to resist the entry of groundwater.
 2. Splices: Butt-splice water stops using a thermostatically controlled electric splicing iron as recommended by the manufacturer.

- D. Expansion Joints: Provide expansion joints of size and at locations as shown on the Drawings. Place expansion joint fillers every 30 feet in straight runs of walkways, at right angle turns and wherever concrete butts into vertical surfaces, unless otherwise shown on the Drawings.
- E. Joint Sealants: Provide joint sealants where indicated on the Drawings. Prepare surfaces, prime, prepare materials, all in complete compliance with the manufacturer's instructions.

END OF SECTION

**SECTION 03200
CONCRETE REINFORCEMENT**

PART 1 – GENERAL

1.01 SCOPE

- A. Under this heading shall be included the furnishing, fabricating, delivering and placing of reinforcement steel for all concrete work.

1.02 APPLICABLE STANDARDS

Where any material or operation is specified by reference to the following published specifications or standards or the specifications or standards of any other organizations, the referenced specification or standard shall be as much a part of this Section as if quoted in full herein.

- A. American Concrete Institute (ACI).
1. 315 Manual for Standard Practice Detailing Reinforced Conc. Structure
 2. 318 Building Code Requirements for Reinforced Concrete
- B. American Society for Testing and Materials (ASTM).
1. A82 Cold Drawn Steel Wire for Concrete Reinforcement
 2. A90 Test for Weight of Coating of Zinc-Coated (Galvanized) Iron or Steel Articles
 3. A123 Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip
 4. A 143 Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedures for Detecting Embrittlement
 5. A185 Welded Steel Wire Fabric for Concrete Reinforcement
 6. A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
 7. A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 8. A616 Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
 9. A617 Axle-Steel Deformed and Plain Steel Bars for Concrete Reinforcement
 10. A706 Low-Alloy Steel Deformed Bars for Concrete Reinforcement
- C. American Welding Society (AWS)
1. D1.1-82 Structural Welding Code
- D. Concrete Reinforcing Steel Institute (CRSI)
1. MSP Manual of Standard Practice

1.03 SHIPPING AND STORAGE

- A. Shipping:

1. Reinforcement steel shall be handled and shipped in a manner to avoid bending or other damage to the bars.
2. Bars shall be bundled, preferably for one placement, in accordance with the placement schedule and as follows:
3. Do not bundle bars for separate buildings or large structures together. Bars for small structures may be bundled together but each bar or group of bars which have the same piece mark shall be tagged and coded.
4. Metal tags or approved equal shall be provided labeled with legible marks.
5. All bundles shall be tagged at each end. Tags shall show piece marks corresponding to the mark numbers on the placement Drawings and on the bar list.
6. Bars shall be bundled in the largest size practical for handling and shipping.

B. Storage:

1. Reinforcement steel shall be stored above ground on platforms, skids or other approved supports. Contact with the soil should be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion.
2. Welding electrodes shall be stored in a moisture controlled environment in accordance with AWS and/or the manufacturer's recommendations.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Only new material shall be furnished, and shall be free of loose rust, mill scale, deleterious amounts of salts or coatings which reduces or destroys bond. Tight rust and mill scale or surface irregularities will be acceptable, provided the weight and the dimensions, including height of deformations and tensile properties of a test specimen which has been wire-brushed by hand, are not less than those required by the Applicable Codes and Standards.

B. Metal Reinforcement:

1. Reinforcement shall be deformed reinforcement conforming to ASTM A615, A616, A617, or A706, Grade 60, except Grade 40 and/or plain bars are acceptable when shown on the Contract Plans for the following:
 2. Rebars less than #4 diameter.
 3. Rebars used as stirrups or ties.
- C. Bar Supports and Accessories: Bar supports and accessories shall be galvanized or plastic coated wire conforming with the requirement of ACI 315, Chapter 7, and/or CRSI MSP, and shall be specifically made for the intended use by proprietary manufacturers.
- D. Mechanical Connection and/or Anchorage Devices: Mechanical anchorage devices shall be in accordance with ACI 318, Chapter 12.
- E. Welding Electrodes: Welding electrodes shall be in accordance with AWS D12.1.

PART 3 – EXECUTION

3.01 FABICATION

- A. Reinforcement steel shall be accurately bent, cut or formed to the dimensions and configurations shown on the Plans and within the tolerances specified in CRSI MSP or, ACI 315, Chapter 4.
- B. Reinforcement steel shall be bent cold using pin sizes in accordance with ACI 318. Bars may be preheated only if approved by the Engineer. Also, reinforcement shall not be rebent or straightened without approval by the Engineer.
- C. Reinforcement steel having a reduced section, kinks, visible transverse cracks at bends, or otherwise damaged in any way shall not be used.
- D. The ends of bars which are to be welded or mechanically connected for splices shall be saw cut only.
- E. Spiral reinforcement shall be accurately fabricated to the diameter and pitch shown on the Plans. One and one-half finishing turns shall be provided at both the top and bottom, unless shown otherwise on the Plans.
- F. Reinforcement bars shall not be welded, unless specifically shown on the Plans All the steel reinforcement specifications, except for ASTM A706,

shall be supplemented to require a report of material properties necessary to conform to welding procedures specified in AWS D12.1.

3.02 PLACEMENT

- A. Reinforcement shall be placed in accordance with the Plans.
- B. Only reinforcement that is free of oil, dirt, loose mortar, mud or other non-metallic coatings which reduce bonding capacity shall be installed. After placing, the reinforcement shall be maintained in a clean condition until the concrete is placed.
- C. All intersections of the reinforcement shall be securely tied with 16 gauge minimum, black annealed wire. Crossing bars shall not be tack welded.
- D. Reinforcement supports shall be as specified and shall be supported on non-corrodible metal or plastic-encased spacers, bolsters or chairs. For concrete placement on grade, reinforcement may be supported on precast concrete blocks spaced to maintain required cover, but only where the Contractor can demonstrate that the precast blocks are at least equal in quality to the class concrete specified for the work.
- E. Bars that are partially embedded in concrete shall not be field bent unless concurrence has been obtained from the Engineer. Procedure used shall be based on the Contractor's report and recommendations.

3.03 CONCRETE PROTECTION FOR REINFORCEMENT

- A. Cast-in Place Concrete (non-prestressed): Unless shown otherwise on the Plans, the following minimum concrete cover shall be provided for reinforcement:

	<u>Minimum Cover, Inches</u>
1. Concrete exposed to weather:	
2. Concrete cast against earth	3"
3. #6 and larger bars	2"
4. All #5 and smaller bars	1-1/2"

* The maximum cover shall be no greater than that specified above or shown plus 3/8 inch, except as qualified below.

3.04 SPLICING

- A. Reinforcing Bars: Splices shall be as shown on the Plans or the reviewed placement drawings. When welding is required, comply with Article 3.04 (B) and (C).
- B. Welded and Mechanical Connections: A full welded or mechanical splice connection shall develop, in tension or compression, as required, at least 125 percent of the specified yield strength “ f_y ” of the bar.
- C. Welding: Welding shall be performed in accordance with AWS D12.1.
- D. Spirals: Splices in spiral reinforcement shall be lap splices of 48 diameter length, but not less than 12 inches, or welded.

3.05 SHOP DRAWINGS

- A. Before starting construction operations under this section, detail and placing drawings shall be submitted and approved for the following in conformance with Section 01300, Submittals.
- B. Reinforcement details showing sizes and grades of steel, bending and splicing details, splice locations, placement drawings, concrete protection for steel reinforcement, and accessories including position of reinforcement.

END OF SECTION

SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE

- A. Under this heading shall be included the furnishing of all labor, materials and equipment, tools and energy necessary to accomplish the cast-in-place concrete work to be constructed under this Contract, as shown on the Plans and hereinafter specified.

1.02 RELATED WORK

- A. Section 03100, Concrete Form Work
- B. Section 03150, Concrete Accessories
- C. Section 03200, Concrete Reinforcement

1.03 APPLICABLE STANDARDS

Where any material or operation is specified by reference to the following published specifications or standard or the specifications or standards of any other organizations, the referenced specification or standard shall be as much a part of this Section as if quoted in full herein.

- A. American Concrete Institute (ACI):
 - 1. 214 Recommended Practice for Evaluation of Compression Test results in Field Concrete.
 - 2. 301 Suggested Specifications for Structural Concrete Buildings.
 - 3. 305 Hot Weather Concreting
 - 4. 306 Cold Weather Concreting
 - 5. 315 Manual for Standard Practice Detailing Reinforced Conc. Structure
 - 6. 318 Building code Requirements
 - 7. 347 Recommended Practice for Concrete Formwork
 - 8. 350 Concrete for Sanitary Engineering Structures
 - 9. 605 Recommended Practice for Hot Weather Concreting
 - 10. 613 Recommended Practice for Cold Weather Concreting
 - 11. 614 Recommended Practice for Measuring, Mixing and Placing Conc.

- B. American Society for Testing and Materials (ASTM).
 - 1. A36 Specification for Structural Steel
 - 2. A185 Welded Steel Wire Fabric for Concrete Reinforcement
 - 3. A615 Deformed and plain Billet-Steel Bars for Conc. Reinforcement
 - 4. C31 Making and Curing Concrete Compression and Flexural Test Specimens in the Field
 - 5. C33 Concrete Aggregates

6. C39 Test for Compressive Strength of Cylindrical Concrete Specimens
7. C42 Obtain and Test Drilled Cores and Sawed Beams of Concrete
8. C78 Test for Flexural Strength of Concrete
9. C94 Ready-Mix Concrete
10. C138 Test f Unit Weight, Yield and Air Content (Gravimetric) Concrete
11. C143 Test for Slump of Portland Cement Concrete
12. C150 Portland Cement
13. C171 Sheet Materials for Curing Concrete
14. C172 Sampling Fresh Concrete
15. C192 Making and Curing Concrete Test Specimens in Laboratory
16. C231 Air Content of Freshly Mixed Concrete by Pressure Method
17. C260 Air-Entraining Admixture for Concrete
18. C470 Single Use Molds for Forming 6 x 12 Inch Test Cylinders
19. C494 Chemical Admixtures for Concrete

1.04 QUALITY ASSURANCE

- A. The actual acceptance of aggregates and development of mix proportions to produce concrete conforming to the specific requirements shall be determined prior to the placement of any concrete, by means of laboratory tests made with the constituents to be used on the work.
- B. Plant Qualification: Comply with all requirements of the Check List for Certification of Ready Mix Concrete production Facilities of the National Ready Mixed Concrete Association and ASTM C 94.
- C. Worker Qualifications: Workers with at least 5 years experience in performing concrete work of high quality, including forming, color, texture and finishing and of the size and complexity of this project.
- D. Testing:
 1. Provide testing in accordance with Section 01410. Keep the laboratory informed of testing schedule.
 2. Obtain standard laboratory compressive test cylinders as required by the laboratory when concrete is discharged from the mixer at the point of placing. Test cylinders will be made and cured by the laboratory in accordance with the requirements of ASTM C 31, including a set of 6 cylinders for each 50 cubic yards or fraction thereof placed each day, for each type of concrete. The cylinders will be cured under laboratory conditions and will be tested in two groups of three at 7 and 28 days of age, respectively in accordance with the requirements of ASTM C 39.

3. Air entrainment tests will be made by the laboratory when concrete is discharged from the mixer at the point of placing, for each pour or other volume of concrete for which a set of test cylinders is required in accordance with the previous paragraph. The amount of air entrained will be determined by either the pressure method or the volumetric method in accordance with ASTM C231 or ASTM C173, respectively.
 4. The laboratory will make slump tests of Class A and Class B concrete as it is discharged from the mixer at the point of placing. Slump tests will be made of every batch of concrete placed, and failure to meet specified slump requirements will be sufficient cause for rejection of that batch.
- D. Evaluation And Acceptance of Concrete: Evaluation and acceptance of concrete will be in accordance with ACI-318. Chapter 5.
- E. When high-early-strength portland cement is premilled, the same strength requirements shall apply except that the indicated strengths shall be attained at seven (7) days instead of twenty-eight (28) days.
- F. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.
- G. If, during the progress of the work, the Contractor desires to use materials other than those originally approved, or if the materials from the sources originally approved change in characteristics, the Contractor shall, at his own expense, have to make new acceptance tests of aggregates and establishment of new basic mixtures and submit them to the Engineer for review.
- H. Under special circumstances, the Engineer may allow minor deviations from the material requirements specified, provided the resulting concrete quality is not adversely affected or provided a suitable adjustment in cement content is made to compensate for such deviations without cost to the Owner.

1.05 SUBMITTALS

- A. Submit the following information in accordance with Section 01340.
1. Plant Qualification: Submit satisfactory evidence indicating compliance with the specified qualification requirements.

2. Materials: Submit satisfactory evidence indicating that materials to be used, including cement, aggregates and admixtures meet the specified requirements.
3. Design Mix: Submit the design mix to be used as prepared by qualified persons. The design of the mix is the responsibility of the Contractor subject to the limitations of the Specifications.
4. Submit, at least 24 hours before placing concrete, signed certification providing the following:
 - a. Exact location and portion of structure to be placed.
 - b. Date and time concrete is to be placed.
 - c. Type of concrete to be used (mix), and the method to be used in placing the concrete.
 - d. Estimated quantity of concrete to be placed.
 - e. That line and grade have been checked and grade properly compacted.
 - f. That location, type, size and spacing of reinforcement has been checked and conform to the Drawings.
 - g. That any water stops, construction joints, or seals have been placed and conform to the Drawings.
 - h. That any embedded pipes have been placed, are the correct size and type and conform to the Drawings.
 - i. That any embedded conduits, grounding wires or receptacles have been placed and conform to the Drawings.
 - j. that any embedded anchor bolts, bearing plates, dowels etc. are in place, are of the correct size and are located as indicated on the Drawings.
 - k. That forms are properly located and adequately braced.

1.06 TESTS

- A. All sampling and testing services shall be performed by a testing agency which operates in accordance to ASTM D 3740 and E 329 latest revision and accepted by the Engineer, at the Contractor's expense.
- B. The Contractor shall submit to the Engineer, for review, the concrete materials and the concrete mix designs for each class of concrete proposed for use. This submittal shall include the results of all testing performed to qualify the materials and establish the mix designs. All mix designs shall be proportioned in accordance with Section 3.9 of ACI 301, Method 1 (trial batches) or method 2 (field experience). The average strength used as the basis for selecting proportions shall be specified in paragraph 3.9.2 or ACI 301.
- C. The testing laboratory shall conduct strength tests of the concrete during construction in accordance with Section 16.3.4 of ACI 301. At least one strength test (3 test cylinders) shall be made for each 50 cubic yards or fraction thereof, of each mix design of concrete placed in any 1 day.
- D. Slump tests shall be conducted regularly during construction in accordance with Section 16.3.5 or ACI 301.
- E. The air content of the concrete sample for each strength test shall be determined in accordance with Section 16.3.6 of ACI 301.
- F. Results of all tests shall be submitted to the Engineer, with copies to the Contractor. The test reports shall include the exact location in the work at which the batch represented by a test was deposited.
- G. Evaluation of test results and acceptance of concrete shall be in accordance with chapter 17 of ACI 301.
- H. Conformity of aggregates to these Specifications, and the actual proportions of cement, aggregates, and water necessary to produce concrete conforming to the requirements set forth in Table A, shall be determined by tests made with representative samples of the materials to be used on the work. Tests will be made by an accredited testing laboratory selected by the Contractor and approved by the Engineer.
- I. Cement may be subject to testing to determine that it conforms to the requirements of this Specification. Methods of testing shall conform to the appropriate specification, but the place, time, frequency, and method of sampling will be determined by the Engineer in accordance with the particular need.

- J. Samples of fine and coarse aggregates shall be delivered to the laboratory for examination and testing at least three weeks before the Contractor proposes to use them in the work.
- K. Concrete shall be proportioned to provide an average compressive strength in accordance with ACI 318 part 3, Section 4.3, to establish a standard deviation test records. Where a concrete production facility does not have test records meeting these requirements the test required average compressive strength shall be as shown on Table D.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement:

- 1. Domestic Portland cement conforming to the requirements of ASTM C 150 type I, Type II or Type III. Construct sanitary sewer manholes, wet wells, pump stations and structures exposed to sewage with Type II cement. Use Type III cement for high early strength concrete only for special locations and only with the approval of the Engineer. Use Type I cement for tremie concrete.
- 2. Use only one brand of cement in any individual structure unless otherwise approved by the Engineer. Do not use cement which has become damaged, partially set, lumpy or caked and discard the entire contents of the sack or container which contains such cement. Do not use salvaged or reclaimed cement.

B. Aggregates:

- 1. ASTM C 33. Coarse aggregates shall be size No. 67, ¾-inch to No. 4 or No. 57, 1-inch to No. 4, as shown on the Drawings, unless otherwise directed by the Engineer. Use size No. 8 for filling of cells of masonry units.
- 2. In addition to requirements of ASTM C 33, apply the following criteria for structures exposed to sewage:
 - a. Soft particles: Not more than 2.0 percent.

- b. Chert as a soft impurity (defined in Table 3 of ASTM C 33): Not more than 1.0 percent.
 - c. Total of soft particles and chert as a soft impurity: not more than 2.0 percent.
 - d. Flat and elongated particles (long dimension more than 5 times short dimension): Not more than 15.0 percent.
- C. Water: Potable quality, clean and free from injurious amounts of deleterious materials.
- D. Air Entraining Admixture: ASTM C 260.
- E. Water Reducing and Retarding Admixture.
- 1. Concrete Without Superplasticizer:
 - a. Water Reducing Admixtures: ASTM C494 Type A, equal to Eucon WR-75 by the Euclid Company, pozzolith 200N by Master Builders, Plastocrete 161 by Sika Chemical Corporation, and containing no calcium chloride.
 - b. Water Reducing and Retarding Admixtures: ASTM C494 Type D, equal to Eucon Retarder-75 by the Euclid Company, Pozzoloth 100 XR by Master Builders, Plastiment by Sika Chemical Corporation, and containing no calcium chloride.
 - C. Accelerating Admixtures: ASTM C494 Type C or E, equal to Accelguard 80 by the Euclid Company, Darex Set Accelerator by W.R. Grace, and containing no calcium chloride.
 - 2. Concrete With Superplasticizer:
 - a. Water Reducing, High Range Admixtures: ASTM C494, Type F or G, equal to Eucon 37 by the Euclid Company, Rheobild 716 by Master Builders, Daracem 100 by W.R. Grace, Sikament by Sika Chemical Corporation, and consisting of a second-generation admixture, free of chlorides and alkalis (except for those attributable to water) composed of a synthesized sulfonated complex polymer, enabling the concrete to maintain its rheoplastic state in excess of two hours if necessary.

- b. Manufacturer's Job Site Representation: Provide the services of a competent field service representative from the manufacturer of each of the admixtures selected for use to provide at the job site advice and consultation on the use of the admixture materials, including the effect on the concrete in place, including recommending maximum discharge time for superplasticizer method and procedure to induce superplasticizer into mixer, quantities of admixtures to be used if variations are required because of temperature/humidity, wind, or other environmental considerations, and to be available on short call at any time requested by the Owner, Contractor, or concrete producer.
- F. Curing Compound: ASTM C 309, Type I and Type ID, Class A and Class B, containing no ingredient which would adversely affect the bond of coatings or toppings.
- 1. For exposed concrete not to receive special finishes, protective coatings and/or concrete toppings, provide curing and sealing compound equal to Super Rez-Seal, by Euclid Chemical Co., or Burke Spartan-Cote Cure-Seal Hardener by The Burke Company.
 - 2. For exposed concrete to receive special finishes, protective coatings and/or concrete toppings, provide curing compound equal to Kurez-DR, by Euclid Chemical Co., or Burke Rez-X Curing Compound by The Burke Company.
- G. Mortar for Repair of Concrete: Same materials as used for concrete, except omit coarse aggregate and use not more than one part cement to two and one-half parts sand by damp loose volume. Use no more mixing water than is necessary for handling and placing.
- H. Burlap Mats: Conform to AASHTO Specification M182.
- I. Epoxy Bonding Agent: Euco #452, BurkEpoxy MV, Sikadur Hi Mod, Concessive 1001-LPL, or equal.
- J. Powdered Epoxy Coating For Anchor Bolts: Powdered epoxy resin as manufactured by the 3M Company, Scotchkote No. 213, Armstrong No. R349, or equal.

2.02 MIXES

A. General Requirements:

1. Mix Design: Conform to ACI 318, Section 5.3. Submit data on consecutive tests and standard deviation.
2. Maximum Water-Cement Ratio:
 - .37 (lbs/lb) - Concrete with superplasticizer
 - .45 (lbs/lb) - Class A concrete without superplasticizer
 - .55 (lbs/lb) - Class B concrete without superplasticizer
 - .65 (lbs/lb) - Class C concrete without superplasticizer
3. Air Content: 5 percent plus or minus 1.5 percent (Class A and B).
4. Slump: 4-inches plus or minus 1-inch for Class A and B without superplasticizer.
7-inches plus or minus 1-inch for Class A and B with superplasticizer
8-inches plus or minus 1-inch for tremie concrete.
5. Minimum Compressive Strength at 28 days:
 - Tremie, 4000psi
 - Class A, 4000 psi, structural and slabs on grade
 - Class B, 3000 psi, curbs and sidewalks
 - Class C, 2500 psi thrust blocks and pipe encasement

B. Production of Concrete:

1. General: use ready mixed concrete, batched, mixed and transported in accordance with ASTM C 94, unless otherwise indicated.
2. Air Entraining Admixture: Add admixture into the mixture as a solution measured by means of an approved mechanical dispensing device, and as part of the total mixing water.
3. Water Reducing and Retarding Admixture: Measure and add water reducing and retarding admixture as recommended by the manufacturer. Complete the addition of the admixture within one minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Store,

handle and batch admixtures in accordance with the recommendations of ACI 68.

- C. Delivery Tickets: Conform to ASTM C94, including cement content and water/cement ratio. Furnish ticket for each batch of ready-mixed concrete delivered to the site.
- D. Temperatures: Deliver concrete to site at temperature not higher than 90° F, otherwise, add ice to reduce the temperature, as recommended by ACI.
- E. Modifications To The Mix: Do not make modifications to the mix in the plant or on the job which will decrease the cement content or increase the water-cement ratio beyond that specified.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Preparations Before Placing: Place no concrete until the approval of the Engineer has been received. Ensure that forms are thoroughly clean and reinforcing and all other items required to be set in concrete have been placed and thoroughly secured. Notify Engineer 24 hours before concrete is placed.
- B. Conveying:
 - 1. General: Transport concrete from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete. Place no concrete more than 90 minutes after mixing has begun for that batch.
 - 2. Buckets and Hoppers: Provide buckets and hoppers having discharge gates with a clear opening equal to no less than one-third of the maximum interior horizontal area or five times the maximum aggregate size being used, and having side slopes no less than 60 degrees. Provide controls on gates to permit opening and closing during the discharge cycle.
 - 3. Runways: Provide runways as specified in Section 03100. Use extreme care to avoid displacement of reinforcement during the placing of concrete.

4. Elephant Trunks: Use hoppers and elephant trunks to prevent the free fall of concrete for more than 6-feet.
5. Chutes: Provide metal or metal lined chutes having a slope not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Use chutes more than 20-feet long and chutes not meeting the slope requirements only if they discharge into a hopper before distribution.
6. Pumping Equipment: If required, provide pumping equipment and procedures conforming to ACI 304.2R, placing Concrete by pumping Methods. Measure slump at the point of discharge. Do not allow loss of slump in pumping to exceed 1 ½-inches.
7. Conveying Equipment Construction: Do not use aluminum or aluminum alloy pipe for tremies or pump lines and chutes, except for short lengths at the truck mixer.
8. Cleaning: Clean conveying equipment at the end of each concrete operation.

3.02 MIXING

- A. Concrete shall be ready-mixed, or transit-mixed, as produced by equipment acceptable to the Engineer. No hand mixing will be permitted. Adding water in controlled amounts during the mixing cycle shall be done only with the express approval of, and under the direction of, the Engineer.
- B. Ready-mix or transit-mixed concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the nameplate. Discharge at the site shall be within 1-1/2 hours and within one hour when ambient temperature is above 85 degree F after cement was first introduced into the mix. Central mixed concrete shall be plant-mixed a minimum of 1-1/2 minutes per batch and then shall be truck-mixed or agitated a minimum of 8 minutes. Agitation shall begin immediately after the pre-mixed concrete is placed in the truck and shall continue without interruption until discharge. Transit-mixed concrete shall be mixed at mixing speed for at least 10 minutes immediately after charging the truck, following by agitation without interruption until discharged.
- C. All central plant and rolling stock equipment and methods shall conform to ACI 304, ASTM C 94, and the latest Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready-Mixed Concrete Association.

- D. The retempering of concrete or mortar which has partially hardened, that is, mixing with or without additional cement, aggregate, or water, will not be permitted.
- E. Attention is called to the importance of dispatching trucks from the batching plant so that they shall arrive at the site of the work just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- F. Deliver to the Engineer at the time of each truckload transported to the site a mix ticket, showing at least the following: concrete plant identification, date, quantity of ingredients (including water) added at the batch plant, time of charge, and truck number.

3.03 INSPECTION AND CONTROL

- A. The preparation of forms, placing of reinforcing steel, conduits, pipes, and sleeves, batching, mixing, transportation, placing, curing, and testing of concrete shall be at all times under the inspection of the Engineer.
- B. The Contractor shall engage the services of an accredited testing laboratory approved by the Engineer to establish the basic mixtures of concrete as required by the specifications, to test field control cylinder specimens, and to conduct other tests as specified herein or as deemed required by the Engineer to insure the quality of concrete as specified. All tests shall be performed in accordance with the applicable ASTM standard methods.

3.04 APPLICATION

- A. Placing:
 - 1. General: Deposit concrete continuously, or in layers of such thickness (not exceeding 2-feet in depth) that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. Repair any such seams or planes of weakness with injected epoxy grout and patch to match adjacent surfaces.
 - 2. Supported Elements: Allow at least two hours to elapse after depositing concrete in columns or walls before depositing in beams, girders, or slabs supported thereon.

3. Segregation: Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject the concrete to procedures which cause segregation.
 4. Concrete Under Water: Place all concrete in the dry except for Tremie concrete.
- B. Consolidating Concrete:
1. General: Consolidate concrete by means of internal vibrators operated by competent workmen.
 2. Vibrators: Use vibrators having a minimum head diameter of at least 2-inches, a minimum centrifugal force of 700-pounds and a minimum frequency of 8,000 vibrations per second.
 3. Vibrators for Confined Areas: In confined areas, use additional vibrators having a minimum head diameter of 1 ½-inches, a minimum centrifugal force of 300-pounds and a minimum frequency of 9,000 vibrations per second.
 4. Spare Vibrator: Keep one spare vibrator for each three in use on the site during all concrete placing operations.
 5. Use of Vibrators: Insert and withdraw vibrators at points approximately 18-inches apart. At each insertion operate vibrator for 5 to 15 seconds. Do not transport concrete in the forms by means of vibrators.
- C. Protection: Do not allow rainwater to increase the mixing water or to damage the surface finish. Protect concrete from construction overloads and do not apply design loads until the specified strength has been attained.
- D. Construction Joints: Except as otherwise indicated on the Drawings, provide horizontal construction joints at top of foundation members and slabs on grade and at the soffit of supported slabs and beams. Locate other horizontal and vertical construction joints as indicated on the Drawings. Except in the locations shown, provide no other joints, unless otherwise recommended by the Contractor and approved by the Engineer.
- E. Bonding: Before depositing new concrete on or against concrete that has set, thoroughly clean the surfaces of the set concrete to expose the coarse aggregate and to ensure they are free of laitance, coatings, foreign matter and loose particles.

Retighten forms. Dampen, but do not saturate hardened concrete of joints and then thoroughly cover with a coat of cement grout of similar proportions to the mortar in the concrete. Place the grout as thick as possible on vertical surfaces and at least 1/2-inch thick on horizontal surfaces. Place the fresh concrete before the grout has attained its initial set.

- F. **Embedded Items:** In addition to steel reinforcement, securely place pipes, inserts and other metal objects as shown, specified or ordered to be built into, set in or attached to the concrete. Take all necessary precautions to prevent these objects from being displaced, broken or deformed. Before concrete is placed, take care to determine that all embedded parts are firmly and securely fastened in place as indicated. Thoroughly clean surfaces free from paint and other coating, rust, scale, oil, and any foreign matter. Pressure test embedded pipes for leakage, as specified elsewhere, before concrete is placed. Wrap metal rainwater leaders, firelines and other such piping with at least two thicknesses of 30 lb. Roofing felt before placing concrete. Do not embed wood in concrete. Pack concrete tightly around pipes and other metal work to prevent leakage and to secure perfect adhesion. Adequately protect drains from intrusion of concrete.

- G. **Bonding To Existing Surfaces:** Clean existing concrete surfaces that are to have new concrete bonded thereto of all grease, oil, dust, dirt and loose particles and coat with an epoxy bonding agent just prior to placing of the new concrete. Apply the bonding agent as recommended by the manufacturer and allow the agent to become tacky before the new concrete is placed. Do not allow the bonding agent to overlap or be spilled on the surfaces to be exposed after the work is completed.

3.05 FORM REMOVAL

- A. Maintain formwork in place for the following structural conditions until the concrete has attained the minimum percentage of indicated design compressive strength or for the period of time specified in the following table.

Note: time periods in the table include all days except those in which the temperature falls below 40 degrees F.

<u>Structural</u>	<u>Normal</u>	<u>Normal</u>	<u>Minimum</u>
<u>Member or</u>	<u>Strength</u>	<u>High-Early</u>	<u>Compressive</u>
<u>Condition</u>	<u>Concrete</u>	<u>Strength</u>	<u>Strength for</u>
			<u>Form Removal</u>
			<u>(% Design</u>
			<u>Strength)</u>

Cantilevers	12 days	7 days	90
Over 20 feet between supports	12 days	7 days	90
Stairways	10 days	5 days	80
Floor slabs	5 days	3 days	70
Free standing walls, column And piers	5 days	3 days	70
Walls, piers, columns, sides of beams, footings, slabs on grade, and vertical surfaces	24-48 hours	12-24 hours	70
Front face form of curbs	6-24 hours	6 hours	70

3.06 CONCRETE FINISHING

A. Repair of Surface Defects:

1. General: Repair surface defects, including tie holes immediately after form removal. Dampen the area to be patched and an area at least 6-inches wide surrounding it to prevent absorption of water from the patching mortar. Notify the Engineer prior to commencing operations.
2. Removal of Defective Concrete: Remove all honeycombed and other defective concrete down to sound concrete. Cut edges perpendicular to the surface or slightly under cut. Sand blast surfaces to receive repair.
3. Bonding Grout: Thoroughly dampen surfaces to be patched and apply a coat of bonding grout consisting of one part cement to one part fine sand passing a No. 30 sieve and having the consistency of thick cream.
4. Placing Patching Mortar: After the bonding grout begins to lose its water sheen, apply a premixed patching mortar, thoroughly consolidating it into

place and striking it off so as to leave the patch slightly higher than the surrounding surface. Leave mortar undisturbed for one hour to permit initial shrinkage and then finally finish.

5. Tie Holes: After being cleaned and thoroughly dampened, fill the tie holes solid with patching mortar.

B. Concrete Finishes:

1. Formed Surfaces: After removal of forms, chip off all irregular projections, grind flush with adjacent surfaces and finish concrete surfaces in accordance with the following schedule:

Finish Designation	Area Applied
F-1	Exterior walls below grade not exposed to water: Repair defective concrete, fill depressions deeper than 1/2-inch, and fill tie holes.
F-2	Exterior and interior walls exposed to water: Repair defective concrete, remove fins, fill depressions 1/4-inch or deeper, and fill tie holes.
F-3	Walls of structures of buildings exposed to view and underside of formed floors or slabs: In addition to Finish F-2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume on the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
F-4	Topes of walls, beams and similar unformed surfaces occurring adjacent to formed surfaces: Strike smooth after concrete is placed and float to a texture reasonably consistent with that of formed surfaces.

2. Slab Surfaces:

- a. General: After concrete has been consolidated, finish all concrete slabs with a floated finish. After floating, trowel finish all concrete slabs, except for areas to receive roofing, insulation, tile or topping, and immediately light broom finish. Where a finish is not indicated, provide a troweled finish.

<u>Finish Designation</u>	<u>Area Applied</u>
S-1	Slabs and floors not water bearing: Smooth steel trowel finish.
S-2	Slabs and floors which are water bearing and slab surfaces on which mechanical equipment moves: Steel trowel finish free from trowel marks and all irregularities.
S-3	Slabs, floors and stair treads of structures or buildings exposed to view: Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.
S-4	Slabs and floors at slopes greater than 10%: Steel trowel finish without local depressions or high points. Apply a stiff bristle broom finish. Leave broom lines parallel to the direction of slope drainage.
S-5	Exposed edges of slabs, floors and tops of walls: Finish with a ¼-inch radius edge if a chamfer is not indicated.

- b. Floated Finish: After concrete has been placed, consolidated, struck off and leveled, do not work the surface further until water sheen has disappeared and the surface has hardened sufficiently to

permit floating. During the first floating, check the plainness of the slab with a 10-foot straightedge applied at no less than two angles. Cut down all high spots and fill all low spots to produce a surface having the required tolerance. Then refloat the slab to a uniform sandy texture.

- c. Light Broomed Finish: After floating, power trowel slabs to receive a light broomed finish to produce a smooth surface, relatively free of defects. Before the surface sets, pass a soft broom drag over the surface to produce a surface uniform in texture and appearance.
- d. Troweled Finish: After floating, power trowel slabs to receive a troweled finish to produce a smooth surface, relatively free of defects. Hand trowel after the surface has hardened sufficiently. When a ringing sound is produced as the trowel is moved over the surfaces, perform final troweling by hand to produce a surface which is thoroughly consolidated, free from trowel marks, uniform in texture and appearance and plane to a tolerance of 1/8 inch to 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
- e. Hardener Finish: Where indicated to receive a troweled hardener finish, water cure slabs without application of curing and sealing agent. When slab is at least 28 days old and thoroughly dry, apply the hardener in accordance with the manufacturer's recommendations. Where dry-shake hardener or slip-resistant finish is required, apply the hardener or slip-resistant product prior to complete curing and finishing, in accordance with the requirements and recommendation of the product manufacturer.
- f. Saw Cut Joints: cut joints that are to be saw cut not sooner than 2 hours after the concrete is poured and not later than 8 hours after the pour.

3.07 PROTECTING

A. Curing:

- 1. Immediately after surface defects have been repaired, apply a spray coat of curing compound to all exposed surfaces, including slabs, walls, beams and columns in accordance with the manufacturer's recommendations. Protect exposed steel keyways and other embedded items from the curing

compound. Water cure, as specified in paragraph B hereunder, all concrete surfaces that are to be coated with a coal tar epoxy system, and concrete floors requiring a bond for special finishes.

2. Do not apply curing compound during periods of rainfall. Should the film become damaged from any cause within the required curing period, immediately repair the damaged portions with additional compound. Upon removal of forms, immediately coat the newly exposed surfaces to provide a curing treatment equal to that provided for the surface.
3. Curing and Sealing Compound: Use clear compound conforming to Federal Specification TT-C-800A, 30% solids content minimum, having test data from an independent laboratory indicating a maximum moisture loss of 0.030 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon, and equal to Super Floor Coat or Super Pliocure by The Euclid Chemical Company or Masterseal 66 by master Builders. Furnish manufacturer's certification as required.
4. Apply specified clear curing and sealing compound to all horizontal areas so noted on the Drawings or in the Specifications. Apply immediately after final finishing. Apply this compound to non-structural construction joints of slabs on grade to act as a bond breaker prior to placement of adjacent concrete.

B. Water Curing Method: Cure all concrete that is to be water cured by either the wet burlap method, by continuous fogging or by covering with waterproof sheet.

1. Wet Burlap Method: Cover concrete surface with a double thickness of burlap, cotton mats, or other approved material, kept thoroughly saturated with water. Keep the forms wet until removed and upon removal, start the curing specified herein immediately. Cure the concrete for a period of 7 days for normal Portland cement or 4 days for high early strength cement. Do not submerge concrete poured in the dry until it has attained sufficient strength to adequately sustain the stress involved and do not subject it to flowing water across its surface until it has cured 4 days.
2. Continuous Fogging: Perform continuous fogging by fogging with a nozzle which so atomizes the flow of water that a mist, and not a spray, is formed. Fog the concrete surface regularly without allowing any part of the surface to become dry. Take all necessary precautions to prevent erosion of the concrete surface by the water.

3. **Covering With Waterproof Sheet:** Keep the entire area to be cured continuously wet by fogging, as specified in the fogging paragraph above, for at least 18 hours and then immediately cover with waterproofing curing sheet conforming to ASTM C171, waterproof paper and polyethylene film, free of holes or tears. Keep sheet fully flat, without wrinkles or air bubbles, held down tautly at all edges. Do not use this method on slabs which will be exposed to view.

- C. **Hot Weather Curing:** Curing for hot weather concreting shall be limited to moist curing methods. All exposed concrete and all forms shall be covered with burlap or carpet mats, wetted before placing, and overlapped at least 6 inches. Fog sprays shall be used during finishing operations and until the burlap or carpet mats are placed. Protective mats shall remain in place in a wet condition for 7 days. Protective mats shall remain in place for an additional 3 days without the application of water to permit gradual drying of the concrete surfaces. Forms may be removed after 3 days of moist during provided that protective mats, in a wet condition, are replaced so as to cover all exposed concrete.

3.08 FIELD TESTS

- A. Sets of five field control cylinder specimens shall be taken for every fifty (50) cubic yards of concrete placed. During cold weather concreting, one additional test cylinder shall be taken and cured on the job site under the same conditions as the concrete it represents. Not less than one set of specimens shall be taken on any one day when concrete is being placed. One slump test shall be performed for each set of test cylinders taken and for each concrete mixer truck load deliver. All specimens shall be taken in conformance with ASTM C31. When average ultimate 28-day strength of control cylinders in any set falls below the required ultimate strength or below proportional minimum 7-day strengths where proper relation between 7 and 28-day strengths have been established by tests, proportions, water content, or temperature conditions shall be changed to secure the required strength.

- B. The Contractor shall cooperate in the making of such tests to the extent of allowing free access to the work for the selection of samples, providing heated (when required) moist storage facilities for specimens, affording protection to the specimens against injury or loss through his operations, and furnishing material and labor required for the purpose of taking concrete cylinder samples, curing boxes, and shipping boxes.

- C. Air entrainment shall be measured by the testing laboratory at time of concrete deposit in accordance with ASTM C231.

3.09 DAMAGE TO THE WORK

The requirements of these Specifications are to be considered the minimum with respect to strength, placement, finishing and curing. The Contractor shall extend the requirements of the Specifications as necessary to provide finished work free of defects. Defective work, including low strength, cracked concrete, surface irregularities, exceeding of tolerances, or any other defects which are caused by the Contractor's operations or construction methods shall be removed and replaced at no additional cost to the Owner.

END OF SECTION

SECTION 03480
PRECAST WETWELL, VALVE VAULTS AND METER BOXES

A. General:

1. Section Includes:

- a. Rectangular, monolithic, or sectional precast water and wastewater structures, pipe connectors, and accessories for lift station site.

2. References:

- a. Prestressed Concrete Institute: Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- b. National Precast Concrete Association: Quality Control Manual for Precast Concrete Plants.
- c. American Society for Testing and Materials:
 - 1. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 2. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
 - 3. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
 - 4. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
 - 5. ASTM C913 - Standard Specifications for Precast Concrete Water and Wastewater Structures.
- d. American Association of State Highway and Transportation Officials Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets (AASHTO M198).
- e. American Concrete Institute Building Code Requirements for Reinforced Concrete (ACI 318).
- f. Occupational Safety and Health Administration Standard 1926.704 - Requirements for Precast Concrete.

3. Submittals Shall Be As Follows:

- a. Schedule of precast concrete structure sections to be provided on the project, charting the following:
 1. Sheet number where the precast structure plan & profile is shown on the plans.
 2. Line number (when there is more than one line on the project).
 3. Precast Structure Station number.
 4. Invert Elevation of the influent and effluent line as indicated on the plans.
 5. Top Elevation of the precast structure frame as indicated on the plans.
 6. Top elevation of precast structure base slab as calculated.
 7. Total height of precast structure required from top of base slab to top of frame.
 8. Total height of assembled base, risers and cone or top provided from top of base to top of top.
 9. Manufacturer's Part No. or Catalogue No. and number required of each base, riser, and top provided for the precast structure.
 10. Each Pipe size and type and its Connector's, Part No., distance from top of base slab, and horizontal distances from inner wall corners of precast structure.

- b. Detail of each precast concrete structure to be provided, sealed by the Registered Professional Engineer employed by the manufacturer showing or charting the following:
 1. Manufacturer's Part No. or Catalogue No.
 2. Inside Dimensions
 3. Lay Length excluding base slab
 4. Wall thickness and base or top thickness where applicable
 5. Handling Weight
 6. Wire Size, Spacing and area provided per vertical foot
 7. Reinforcing Bar size and spacing
 8. Design loads
 9. Concrete Mix No. and design strength
 10. Height, width, slope and annular space of the tongue and groove

- c. Pipe Connector Details and Material Specifications

- d. Joint Material Detail, Material Specifications and calculations showing that the joint material cross section is greater than the joint's annular space times its height.

- e. Lifting Device and Hole Detail.

- f. At the request of the Engineer or Owner, submit the following:
1. Structural analysis and design calculations for Precast Components, performed in accordance with applicable codes and standards, showing that allowable stresses will not be exceeded. All calculations must be sealed by a Registered Professional Engineer employed by the Precast Concrete Manufacturer.
 2. Calculations or test results verifying that the lifting device components and holes are designed in accordance with OSHA Standard 1926.704.
 3. Concrete 28 day compression strength results for every day production of Precast Components for the project was performed, showing the required strength according to the guidelines established in ACI 318.
 4. Reinforcing and Cement mill reports for materials used in the manufacture of Precast Components for this project.
 5. The above test reports for similar Precast Components recently produced, submitted prior to production of Precast Components for this project.

4. Qualifications:

- a. The Precast Manufacturer shall comply with one of the following requirements:
1. Manufacture Precast components for the project in a plant certified in the Prestressed Concrete Institute's (PCI) Plant Certification Program.
 2. Manufacture Precast Components for the project in a plant certified in the National Precast Concrete Association's (NPCA) Plant Certification Program.
 3. Retain an independent testing or consulting engineering firm approved by the Engineer for Precast plant inspection. The basis for plant inspection shall be the National Precast Concrete Association Quality Control Manual or the Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products. The above firm shall inspect the precast plant 2 weeks prior to and at 1 week intervals during production of materials for this project and issue a report, certified by a Registered Engineer that materials, methods, products, and quality control meet the requirements of the above quality control manuals.
- b. The Precast Manufacturer shall have a recognized Quality Improvement Process installed at the manufacturing facility.

- c. The Precast Manufacturer shall employ at least one Registered Professional Engineer at the manufacturing facility through the life of the project.
- d. All concrete compressive strength testing shall be performed in a laboratory inspected by the CCRL of the National Bureau of Standards.

5. Environmental Requirements:

- a. Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry, grouting or concreting work.

6. Design Requirements:

- a. Wet well and valve vaults shall be watertight, precast reinforced air-entrained concrete structures.
- b. Lift Station wet well shall be designed to ASTM C890 A8 live loading.
- c. Lift Station valve vault shall be designed to ASTM C890 A16 live loading.
- d. Honeycombed or retempered concrete is not permitted.
- e. Precast manufacturer shall coordinate with manufacturer of access hatches to provide the required hatch opening dimensions and ensure proper reinforcing is obtained between and around hatch openings to provide the specified design loading requirements.

B. Products:

1. Materials:

- a. Concrete: Concrete shall conform to ASTM C913 and as follows:
 - 1. Compressive strength: 5000 psi minimum at 28 days
 - 2. Air Content: 4 percent minimum.
 - 3. Alkalinity: Adequate to provide a Life Factor, $A_z = \text{Calcium Carbonate Equivalent times Cover over Reinforcement}$, no less than 0.35 for bases, risers and tops.
 - 4. Cementitious Materials: Minimum of 564 pounds per c.y..
 - 5. Coarse Aggregates: ASTM C33. Sound, Crushed, Angular Granitic Stone only. Smooth or rounded stone shall not be used.
 - 6. Fine Aggregates: ASTM C33. Free from organic impurities.
 - 7. Chemical Admixtures: ASTM C494. Calcium Chloride or

admixtures containing calcium chloride shall not be used.

8. Air Entraining admixtures: ASTM C260.

- b. Reinforcing: Reinforcing steel shall be ASTM A615 grade 60 deformed bar, ASTM A82 wire or ASTM A185 welded wire fabric.
- c. Lifting Loops: Lift loops shall be ASTM A416 steel strand. Lifting loops made from deformed bars shall not be allowed.
- d. Butyl Rubber Sealant shall conform to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1% volatile matter and suitable for application temperatures between 10 and 100 degrees F.
- e. Butyl Rubber with Bentonite Sealant shall conform to Federal Specification SS-S-210A, ASTM D-297, and containing no asphaltics as follows: maintaining 99% solids with a maximum of 1% volatile matter and suitable for application temperatures between 5 and 125 degrees F.
- f. Epoxy Gels: Epoxy Gels used for interior patching of wall penetrations shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

2. Components:

- a. Precast Component Fabrication and Manufacture shall be as described in this paragraph and as described in the paragraphs for the specific components.
 - 1. Precast Manufacturing: Precast Structures shall be manufactured in conformance with ASTM C913. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable, except form ties through the wall of the product are not allowed. Exterior slab surfaces shall have a float finish. Small surface holes, normal color variations, normal form joint marks, and minor depressions, chips and spalls will be tolerated. Edges may be tooled. Dimensional tolerances shall be those set forth in the appropriate References and specified below.
 - 2. Joints: Joints surfaces for joints between Precast Structure Components shall be keyways or tongue and grooves manufactured to the joint surface design and tolerance requirements of ASTM C913.

3. Lift Inserts and Holes: If used for handling Precast Structures, lift holes and inserts shall be sized for a precision fit with the lift devices, shall not penetrate through the precast structure will and shall comply with OSHA Standard 1926.704.
- b. Precast Base Sections: Base sections shall have the base slab cast monolithically with the walls, or have an approved galvanized or PVC waterstop cast in the cold joint between the base slab and the walls.
- c. Precast Riser Sections: The Minimum Lay Length of Precast Riser Sections shall be 36".
- d. Precast Top Sections: Flat Slab Top Sections shall meet or exceed the design loading requirements of the respective structures as specified in paragraph A.6. above. Transition Top Sections shall provide for transition to other diameter risers, cones, and flat slab top sections with a joint equal to that of a riser section. Venting of top sections shall be as shown on the details.
- e. Pipe to Manhole Connectors: Pipe to Manhole Connectors shall conform to ASTM C923. On large diameter flexible pipes, provisions for control of the pipe OD to within the tolerances of the connector shall be made.
- f. Joint Sealing Materials: Joints shall be sealed internally between the tongue and the groove and additionally around the external perimeter of the joint. Sealants are as follows:
 1. External Seals shall consist of a polyethylene backed flat butyl rubber sheet no less than 1/16" thick and 6" wide applied to the outside perimeter of the joint.
 2. Joints with a perimeter greater than or equal to 18' shall be internally sealed with Butyl Rubber/Bentonite Sealant.
 3. Joints with a perimeter less than 18' shall be internally sealed with Butyl Rubber Sealant.
- g. Hatches: Hatches and doors, frames and grate to be provided as equal to those shown on the precast structure details. Material shall be stainless steel or aluminum as conforming to details per application. For dimensions of castings see precast top details. Hatches shall meet or exceed the design load requirements of the precast top slab sections for valve vaults and wet wells. Hatches shall be of the size and type shown on the plans by Halliday Products, Inc., WACO Products, Inc., or USF Fabrication, Inc.
- h. Lifting Devices: Lifting devices complying with OSHA Standard 1926.704 for handling the Precast Components shall be provided by the Precast

Manufacturer. The design of lifting devices shall comply with ASTM C913, paragraph 5.8 standards.

- i. Liners: Where shown on the plans, the interior of the precast structure shall be lined with a HDPE liner (Agru Sure Grip Concrete Protective Liner or approved equal). The liner shall be installed in accordance with the recommendations of the liner manufacturer. Liner shall have a shear resistance of 4500 lb/stud, pullout resistance of 112 lb/stud, and back pressure resistance of 29 psi. The product shall have a warranty period of 5 years against penetration of hydrogen sulfide gas and sulfuric acids and against leak protection from inflow and infiltration when installation and welding are performed by personnel authorized by the manufacturer.
- j. Ladders: If shown on Precast Structure Details, fixed ladders shall be provided in rectangular structures greater than 8' deep in accordance with all OSHA requirements. Ladders are not required for rectangular structures 8' deep and less.

3. Configuration:

- a. Precast Concrete Structures are to be constructed as specified.
- b. The number of joints is to be minimized. Use no more than 2 sections up to 8' depth and no more than 1 additional section for each 4' of depth.

C. Execution:

1. Examination:

- a. Inspect precast components prior to unloading from the delivery truck.

2. Preparation:

- a. Product Delivery, Storage, and Handling: Coordinate delivery with the manufacturer, handle and store the Precast Components in accordance with ASTM D891 and the manufacturer's recommendations using methods that will prevent damage to the components and their joint surfaces.

3. Placing Precast Concrete Sections:

- a. Excavate to the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6" beyond the precast base and follow ASTM C891 excavation standards.

- b. Set base plumb and level, aligning pipe opening with pipe invert.
- c. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the Butyl Sealant rope directly against base of spigot. Leave prospective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side - not top to bottom.
- d. Set risers and tops, aligning internal wall surfaces, so that proper alignment is achieved, taking particular care to clean, prepare and seal joints.
- e. When recommended by the manufacturer, fill the void between horizontal joint surfaces with a sand cement grout around the outside perimeter.
- f. After joining precast sections, apply the butyl sealant sheet around the outside perimeter of the joint.
- g. Lift Holes leaving less than 2" of wall thickness shall be plugged from the outside using a sand cement mortar. Lift Holes penetrating the wall shall be additionally sealed with an interior application of an epoxy gel 1/8" thick extending 2" beyond the penetration.
- h. Perform the final finishing to the precast interior by filling all chips or fractures greater than 1/2" in length, width or depth and depressions more than 1/2" deep in inverts with a sand cement mortar. Grout joints according to Manufacturers Specifications. Clean the interior of the precast structure, removing all dirt, spills or other foreign matter.

END OF SECTION

**SECTION 11371
GROUND STORAGE TANK**

PART 1 GENERAL

1.01 SCOPE

- A. This specification shall govern all work necessary for the design, submittals, construction and testing of a prestressed concrete tank.
- B. The Contractor shall furnish all labor, materials, equipment, tools, scaffolding, shoring and incidentals required to construct a prestressed concrete tank for potable water storage as shown on the drawings and as specified herein.
- C. The prestressed concrete tank shall have a wire-wound prestressed shotcrete core wall in which a steel shell diaphragm of a height equal to the full wall height has been encased. All prestressing shall be done with high tensile wire permanently bonded to the tank wall. The tank floor shall be a concrete membrane slab. The tank roof shall be a free span concrete dome.
- D. The entire tank, including all portions of the floor, wall, and roof shall be built by a specialty tank contractor, using its own trained personnel and equipment.

1.02 REFERENCES

- A. ACI 372R-03 – Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures.
- B. AWWA D110-04 – Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.
- C. ACI 506R – Guide to Shotcrete.
- D. ASTM A 821/A 821M – Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks.
- E. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy With Improved Formability.
- F. ASCE Standard 7-05 – Minimum Design Loads for Buildings and Other Structures.

G. ASTM C 881/C 881M – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

H. AWWA C652 – Disinfection of Potable Water Storage Tanks.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01300, Submittals, Product Data, and Samples.

B. Shop Drawings: Submit detailed design drawing sealed by a professional engineer registered in the State of Georgia that provide complete plan, elevation, and sectional views showing critical dimensions including:

1. Size, location and number of all reinforcing bars.
2. Thickness of all parts of the tank structure including floor, core wall, dome and covercoat.
3. Prestressing schedule including number and placement of prestressing wires on the tank wall and total applied force per foot of wall height.
4. Location and details of all accessories required.
5. Minimum size of shop drawings shall be 18" x 24".

C. Product Data: Submit concrete design mixes including ingredient proportions, minimum cementitious content, and water/cementitious ratio in accordance with these specifications.

D. Design Data: Submit structural calculations for the tank, signed and sealed by a professional engineer in accordance with Section 1.5 C. of these specifications.

E. Test Reports: Submit concrete strength reports for 7-day and 28-day breaks.

F. Warranty Document: Submit warranty document in Owner's name in accordance with Section 1.6A of these specifications.

G. Project Record Documents: Record actual location layout and final configuration of tank and accessories on shop drawings and submit to engineer after construction of the tank is complete.

H. Submit Operation and Maintenance Manuals in accordance with Section 01730.

1.04 QUALIFICATIONS & EXPERIENCE

A. The tank Construction Company shall have the following qualifications and experience:

- B. The Company constructing the tank shall be a firm with at least ten (10) years experience in the design and construction of wire-wound circular prestressed composite tanks; and shall give satisfactory evidence that it has the skill, reliability, and financial stability to build and guarantee the tank in accordance with the quality required by these specifications. The Company constructing the tank shall have built completely in its own name in the past five years, and be presently responsible for, a minimum of five (5) dome-covered prestressed composite tanks, which meet these specifications, and which are now giving satisfactory service.
- C. The Tank Construction Company shall have on its staff a full-time professional engineer, who shall have no less than five years experience in the design and field construction of circular prestressed composite tanks, and who shall be in responsible engineering charge of the work to be done. All working drawings and design calculations shall carry the seal of such registered professional engineer.
- D. The intent of the Specification is to create a singular responsibility for the design and construction of the prestressed concrete tank. The design and construction of all aspects of the floor, wall, prestressing, shotcrete and dome roof of the prestressed concrete tank must be performed by the tank contractor using its owner-trained personnel and equipment.
- E. Prequalification:
 - a. A responsive prestressed concrete tank bidder shall, no later than 15 days prior to the bid date, submit the following to the engineer for review:
 - i. Complete construction drawings with pertinent section details showing thicknesses and reinforcement size/spacing, including, but not limited to: floor, corewall, dome compression ring, dome shell.
 - ii. Details of applicable appurtenances required by engineer or dictated by site specific parameter (ie: piping inlet, piping outlet, drain, manway, dome probe, handrail ladders, level indicator, hatch, ventilator, overflow, etc.). It will be assumed that appurtenances not detailed are not included in the tank manufacturer's design.
 - iii. Complete design calculations with seismic and sliding analysis if applicable.
 - iv. Firm "as bid" construction schedule showing start window(s) with duration
 - b. Barring issuance of tank related addenda after the prequalification submittal deadline, prequalification submittals will be considered representative of the bidders' design and approach to the project

1.05 STORAGE, PROTECTION, AND CHEMICAL COMPATIBILITY

- A. Equipment and accessories shall be stored and protected in accordance with the manufacturer's recommendations.

1.06 GUARANTEE

- A. The tank Construction Company shall guarantee in writing workmanship and materials on the complete structural portion of the tank for a one-year period from date of acceptance of the work. In case leakage, or other defects appear within the one-year period, the Tank Construction Company shall promptly repair the tank at its own expense upon written notice by the Owner that such defects have been found. Leakage is defined as a stream flow of liquid appearing on the exterior of the tank, or leakage through the base slab, the source of which is from the inside of the tank.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The ground storage tank shall be provided and installed by the CROM Corporation, PreCon Corporation or Engineer approved equal as described in herein. These specifications and drawings represent the acceptable standard of quality, materials and methods of construction. The Contractor shall prepare his Base Bid using either Crom Corporation, Inc., PreCon Corporation or Engineer approved equal and indicate on the Bid Form the tank supplier used in calculating the Base Bid by circling the name of the supplier of the tank in the schedule as indicated.”

2.02 PERFORMANCE

- A. The design shall be in conformance with applicable portions of American Concrete Institute (ACI) 372R-03 Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, AWWA D110-04 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks, and currently accepted engineering principles and practices for the design of such structures.
- B. Capacity: 1,500,000 Gallons
- C. Dimensions: 70 ft Inside Diameter: 52'-2" Sidewall Depth.
- D. Roof Design Loads: Consideration shall be given to all applicable roof design loads in accordance with AWWA D110-04, Section 3.3 and ASCE 7.
- E. Earthquake Design: Fixed percentage method as specified in AWWA D110-04, Section 4.1.

F. The thickness of the core wall shall be calculated so as to accept the initial compressive forces applied by prestressing, hydrostatic stresses induced by contents, and other applicable loads such as soil backfill and wind.

G. Backfill loads shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall.

H. Concrete:

1. Concrete materials shall meet the requirements of ACI 301. Cement shall be Portland Type I / II cement.
2. A maximum of 20% of cementitious material may be fly ash for all concrete mixes.
3. Floor Concrete: Minimum 4000 psi compressive strength at 28 days, maximum $\frac{3}{4}$ " aggregate, 5% +/-1% air content, 4" +/-1" slump.
4. Dome Concrete: Minimum 4000 psi compressive strength at 28 days, maximum $\frac{3}{8}$ " aggregate, maximum 5% +/-1% air content, 4" +/-1" slump.

I. Shotcrete:

1. Shotcrete materials shall meet the requirement of ACI 506. Cement shall be Portland Type I / II cement.
2. A maximum of 20% of cementitious material may be fly ash for all concrete mixes.
3. Core Wall Shotcrete: Minimum 4000 psi compressive strength at 28 days, 4" +/-1" slump.
4. Covercoat Shotcrete: Minimum 3500 psi compressive strength at 28 days, 4" +/-1" slump.
5. Allowable compressive stress due to final prestressing force, f_g :
 - a. 1250 psi + 75t psi/in. with 0.45 f'_g maximum (where f'_g is defined as compressive strength required for final prestressing force and t is the thickness of the core wall in inches).
 - b. Maximum of 2000 psi.
6. Allowable compressive stress due to initial prestressing force, f_{gi} :
 - a. 1250 psi + 75t psi/in. with 0.5 f_{gi} maximum or less (where f_{gi} is defined as compressive strength at time initial prestressing force is applied and t is the thickness of the core wall in inches).
 - b. Maximum of 2250 psi.

J. Prestressing Wire:

1. The prestressing wire shall conform to the requirements of ASTM A821, Type B.
2. Wire size shall be 0.162" (8 gauge), 0.192" (6 gauge) or larger, but no larger than 0.250".
3. Working stress for the tank wall, f_s shall be a maximum of 115,000 psi.

4. Working stress for the dome ring, f_{sd} shall be a maximum of 120,000 psi.
5. Allowable design tensile stress before losses, f_{si} shall be 145,600 psi or no greater than $0.63 f_u$.
6. Ultimate tensile strength, f_u shall be, 231,000 psi or greater for 8 gauge wire, 222,000 psi or greater for 6 gauge.

K. Non-prestressed Mild Reinforcing Steel:

1. Allowable design tensile stress, f_s shall be a maximum of 18,000 psi.
2. Yield strength of reinforcing steel, f_y shall be 60,000 psi.

2.03 FLOOR

- A. Concrete membrane floors shall be a minimum of 4" thick and have a minimum thickness of 8" of concrete over all pipe encasements and around sumps.
- B. A minimum percentage of 0.60% reinforcing steel shall be used in the membrane floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of 2' into the adjacent membrane floor.

2.04 CORE WALL

- A. The core wall shall be constructed of shotcrete, encasing a steel diaphragm continuous the full wall height without horizontal splices.
- B. The thickness of the core wall shall be calculated so as to accept the initial compressive forces applied by prestressing, backfill, and other applicable loads, but in no case be less than 3½" thick.
- C. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.
- D. Interior and exterior surfaces of the core wall shall be water cured for a minimum of 7 days or until prestressing begins.
- E. To compensate for bending moments, shrinkage, differential drying, and temperature stresses, the following reinforcing steel shall be incorporated in the core wall.
 1. The top 2' of core wall shall have not less than 1% circumferential reinforcing.
 2. The bottom 3' of core wall shall have not less than 1% circumferential reinforcing.
 3. Inside Face:
 - a. 26 gauge steel shell diaphragm continuous the full wall height without horizontal splices.

- b. Additional vertical and horizontal reinforcing steel bars as required by design computations.
- 4. Outside Face:
 - a. Vertical reinforcing steel: Minimum of #4 bars at 12" center to center.
 - b. Additional vertical and horizontal reinforcing steel bars as required by design computations.

2.05 STEEL SHELL DIAPHRAGM

- A. A 26 gauge steel tank shell, complying with ASTM A 1008, shall be used throughout the core wall, providing a waterstop. The steel shell diaphragm shall be encased and protected with shotcrete no less than 1" thick at all places.
- B. The steel shell is to be formed and erected so that a mechanical key is created between the shotcrete and diaphragm.
- C. The sheets of steel diaphragm shall be continuous from top to bottom of wall; horizontal joints or splices will not be permitted.
- D. All vertical joints in the diaphragm shall be sealed watertight by epoxy injection.
- E. Epoxy injection shall be carried out from bottom to top of wall, using a pressure pumping procedure, after the steel shell has been fully encased, inside and outside, with shotcrete.
- F. The sealant shall conform to the requirements of ASTM C881, Type III, Grade 1, and shall be 100% solids, moisture insensitive, low modulus epoxy system. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.
- G. The epoxy sealant shall be suitable for bonding to concrete, shotcrete, and steel.
- H. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to this waterstop.

2.06 SHOTCRETE

- A. All shotcrete shall be applied by or under direct supervision of experienced nozzlemen certified by the American Concrete Institute (ACI) as outlined in ACI certification publication CP-60.
- B. Shotcrete mixes shall have a minimum of 1 part cementitious material to 3 parts of sand.
- C. Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding of the following layer.

- D. No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.
- E. No less than 1/8" thick shotcrete shall separate reinforcing steel and prestressing wire.

2.07 DOME ROOF

- A. The dome roof shall be constructed of reinforced concrete and circumferentially prestressed.
- B. Dome shell reinforcement shall consist of reinforcing bars or welded wire fabric meeting ASTM A185, not galvanized. Bolsters for wire fabric and reinforcing bars shall be plastic tipped. Wire ties shall be galvanized.
- C. The dome ring girder shall be prestressed with sufficient wire to withstand the dome dead load and design live loads. The ring girder shall have cross section suitable to accept the applied prestressing forces.
- D. The high water level in the tank shall be permitted to encroach on the dome shell no higher than the upper horizontal plane of the dome ring girder.
- E. Overflow outlets or the overflow pipe shall be capable of providing an overflow open area three times the area of the largest tank pipe.
- F. The dome roof shall be cured for a minimum of 7 days or until prestressing begins.
- G. The dome shall be designed as a free-span, spherical thin shell with one-tenth rise in accordance with the following:
 - 1. Typical Dome Design: The typical dome thickness and steel reinforcement shall meet the requirements of AWWA D110-04, Section 3.6.3. "Thickness and reinforcement". In all cases, the thickness of the dome shall be no less than 3".
 - 2. Dome Edge Design: The dome edge and upper wall shall be designed to resist the moments, thrusts, and shears that occur in this region due to dome and wall prestressing and loading conditions. The following design parameters shall be used.
 - a. Dome Edge Thickness:

(1) A determination of the buckle diameter shall be made, as defined by:

$$d_b = 2.5 \cdot \sqrt{r_d \cdot t_d} \text{ rounded up to the next foot}$$

Where: d_b = buckle diameter in feet
 r_d = dome radius in feet
 t_d = typical dome thickness in feet

(2) Dome edge thickening shall begin at a radial location on the dome, defined as s_2 which is at least one buckle diameter away from the tank wall.

(3) A springline haunch shall be provided, which extends radially from the inside face of the tank wall to radial location s_1 which is defined as:

$$s_1 = 0.6 \cdot \sqrt{1.5 \cdot r_d \cdot t_d} \text{ rounded up to the next foot}$$

This springline haunch shall begin at the inside face of the tank wall with a springline thickness as required by paragraph (6) below and shall end at radical location s_1 with the following thickness:

$$t_{d1} = 1.33 \cdot t_d$$

Where: t_{d1} = minimum thickness at s_1 in feet
 t_d = typical dome thickness in feet at one buckle diameter from tank wall

(4) Beginning at s_1 and continuing to s_2 the dome shell shall be a straight line taper.

(5) Parameters (2), (3), and (4) above are not required for domes where the calculated typical dome thickness is less than 75% of the actual typical dome thickness.

(6) Sufficient concrete thickness at the springline of the dome shall be provided so that no more than 2' of the springline haunch is considered in calculating the effective dome edge ring cross sectional area. Compressive stress in this area shall not exceed 1000 psi when subjected to initial prestressing, offset by dead load only.

b. Dome Edge Steel Reinforcement

(1) Throughout the dome edge, the percentage of steel reinforcement, both radially and circumferentially, shall be no less than 0.25% of the gross cross sectional area of concrete.

- (2) Along the dome edge, steel reinforcement shall be distributed between the upper and lower layers unless finite element analysis calculations indicate that tensile stress does not exist in the concrete along the bottom face of the dome edge. In that case, only top bars are required radially and circumferentially. In addition, radial and circumferential reinforcing bars will not be required along the bottom face of the dome edge where the calculated typical dome thickness is less than 75% of the actual typical dome thickness.
- (3) Where reinforcing bars are required in the bottom layer, they shall be anchored near the tank wall to insure adequate development at the intersection between dome and wall.
- (4) In all cases, the percentage of circumferential steel reinforcement in the first 2' of the dome edge shall be no less than one percent of the gross cross sectional area of concrete.
- (5) Where bottom dome edge steel reinforcement is required, vertical steel reinforcement along the inside face of the tank wall shall be no less than 0.5% of the cross sectional area of wall shotcrete.

2.08 HORIZONTAL PRESTRESSING

- A. Circumferential prestressing of the tank shall be achieved by the application of cold-drawn, high-carbon steel wire complying with ASTM 821 Type B, placed under high tension. A substantial allowance shall be made for prestressing losses due to shrinkage and plastic flow in the shotcrete and due to relaxation in the prestressing steel.
- B. Placement of the prestressing steel wire shall be in a continuous and uniform helix of such pitch as to provide in each lineal foot of core wall height an initial force and unit compressive stress equal to that shown on the design drawings. Splicing of the wire shall be permitted only when completing the application of a full coil of wire or when removing a defective section of wire.
- C. Areas to be prestressed will contain not less than 10 wires per foot of wall for 8 gauge and 8 wires per foot of wall for 6 gauge. A maximum of 24 wires per layer per foot for 8 gauge and 20 wires per layer per foot for 6 gauge will be allowed. Shotcrete shall be used to completely encase each individual wire and to protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires is to be no less than one wire diameter.

- D. Prestressing shall be accomplished by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the drawings.
- E. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. The stress measuring equipment shall include: electronic direct reading stressometer accurate to within 2%, calibrated dynamometers and a test stand to verify the accuracy of the equipment.
- F. After circumferential prestressing wires have been placed, they shall be protected by encasement in shotcrete. This encasement shall completely encapsulate each wire and permanently bond the wire to the tank wall.
- G. When multiple layers of wire are required, shotcrete cover between layers shall be no less than 1/8" thick.
- H. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1" shall be placed over the prestressing wires.

2.09 WALL OPENINGS

- A. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe or sleeve shall be no less than 18" above the floor slab, and the prestressing wires required at the pipe elevation shall be distributed above and below the opening leaving an unbanded strip around the entire tank.
- B. Unbanded strips shall have a vertical dimension of no more than 36" unless an axisymmetric shell analysis is performed to account for shear and moments caused by displacement of the prestressing wires into adjacent bands.
- C. All wall pipes and sleeves passing through the wall shall be sealed to the steel shell diaphragm by epoxy injection.

2.10 TANK ACCESSORIES

- A. The tank construction company shall furnish, install and guarantee for five (5) years the follow tank accessories.

- B. The tank shall have a minimum of one, 1'-3" x 4'-4" rectangular Type 316 stainless steel wall manhole for access to the interior of the tank. The cover and the bolts shall be of Type 316 stainless steel.
- C. Exterior ladder made of T6061 aluminum with safety cage and gate or safety climbing device conforming to applicable OSHA standards.
- D. Interior fiberglass ladder with Type 316 stainless steel fasteners and safety cage or climbing device conforming to applicable OSHA standards.
- E. Roof hatch cover, roof ventilator, and liquid level indicator shall be made of fiberglass with Type 316 stainless steel fasteners.
- F. Through-wall pipe sleeves shall be Type 316 stainless steel sleeves with neoprene modular-seal units using stainless steel tightening bolts.

~~2.11 PAINTING~~

- ~~A. Substrate shall be clean, dry, and free of contaminants prior to coating.~~
- ~~B. Exterior paint system shall consist of the following system:~~
 - ~~1. Two coats of Tnemec Series 156 Enviro-Crete Modified Waterborne Acrylate or Engineer approved equal applied at 4.0 - 6.0 mils per coat. Minimum 8.0 total DFT.~~
- ~~C. Paint shall be applied a minimum of 28 days after final application of shotcrete. All application procedures for paint shall be in accordance with manufacturer's recommendations. COLOR TO BE SELECTED BY OWNER~~

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify elevations, placement and grading for tank prior to starting tank construction.

3.02 INSTALLATION

- A. Tank Floor:
 - 1. The floor shall be vibratory screeded to effect consolidation of concrete and proper encasement of floor reinforcing steel.
 - 2. The floor shall be continuously water cured until tank construction is completed.

B. Tank Wall:

1. The wall shall be constructed in a predesigned manner utilizing steel shell diaphragm, layers of shotcrete and prestressing wire.
2. The diaphragm shall be protected against damage before, during, and after erection. Nail or other holes shall not be permitted in the steel shell for erection or other purposes except for inserting wall pipes or sleeves, reinforcing steel, bolts, or other special appurtenances. Such penetrations shall be sealed with an approved epoxy sealant.
3. Interior and exterior portions of the shotcrete wall shall be water cured for a minimum of 7 days or until prestressing is started.

C. Roof:

1. All concrete shall be consolidated by means of a vibrator for proper encasement of reinforcing steel and welded wire fabric.
2. All surfaces at the joint between the wall and the dome shall be coated with an approved bonding epoxy.
3. Dome shall be water cured for 7 days after casting or until prestressing is completed.

- D. Prestressing: The initial tension in each wire shall be read and recorded to verify that the total aggregate force is no less than that required by the design. Averaging or estimating the force of the wire on the wall shall not be considered satisfactory evidence of correct placement of prestressing wires.

3.03 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Hydrostatic Testing: Test completed tank for liquid tightness by filling tank to its overflow elevation with water provided by Owner. The tank shall remain filled for a period of at least 24 hours to allow for absorption. The liquid volume loss for a period of 24 hours shall not exceed one-twentieth of one percent of the tank capacity. If the liquid volume loss exceeds this amount, leakage shall be considered excessive, and the tank shall be repaired and retested.
2. Concrete and Shotcrete Testing: Test all concrete and shotcrete used in the tank structure in accordance with Section 03300.

3.04 CLEANING AND DISINFECTION

- A. Clean interior and exterior of tank to remove debris, construction items, and equipment.
- B. Disinfection Procedure: Use AWWA C652 Method 2 or 3.
- C. The Contractor shall collect the water samples and the Owner shall perform bacteriological testing.

3.05 WATER FOR CLEANING & TESTING

- A. The Owner will furnish without costs to the Contractor the potable water necessary for hydrostatic testing and disinfecting the tank one (1) time. If tank fails the hydrostatic test and/or the bacteriological test and additional water is needed for re-testing, the Contractor shall reimburse Owner at current commercial rates for all water required for re-testing. See Section 01030 for additional information.

END OF SECTION