



INVITATION TO BID AND INSTRUCTIONS TO BIDDERS

FY2016-180

OAK RIDGE ROWING COURSE SITE IMPROVEMENTS

**NOTE: SUGGESTED SITE VISIT & PRE-BID CONFERENCE
MAY 18 2016 AT 3 P.M., LOCAL TIME, ON SITE,
695 MELTON LAKE DRIVE (SEE ATTACHED PRE-
BID LOCATION MAP)**

BID OPENING

**June 1, 2016
3:00 P.M. Local Time**

**at the
Central Services Complex
City of Oak Ridge
100 Woodbury Lane
P. O. Box 1
Oak Ridge, Tennessee 37831-0001**

**Telephone: (865) 425-1819
Fax: (865) 482-8475
Attn: Lyn Majeski**

CITY OF OAK RIDGE, TENNESSEE
Invitation to Bid and Instructions to Bidders

FY2016-180

May 10, 2016

Project: Oak Ridge Rowing Course Site Improvements

Invitation

Bids will be received by the City of Oak Ridge until 3:00 p.m., local time, June 1, 2016, then publicly opened in the Central Services Complex at 100 Woodbury Lane, Oak Ridge, Tennessee, for furnishing all labor, materials, supplies, tools, and equipment necessary to perform all work and services described in the Contract attached hereto, in strict accordance with the terms and provisions of said Contract and any attachments thereto. (See attached Project Manual prepared by Barge Waggoner Sumner & Cannon, Inc.)

All bids must be completed and submitted on the Bid Form provided. The bids shall be submitted on or before the time set for the opening of bids. Bids received after the time so set are late bids and will not be considered. Late bids, unmarked envelopes, and incorrectly marked envelopes will not be opened. Electronic bids are not accepted.

Suggested Pre-Bid Conference & Site Visit

A suggested pre-bid conference and site visit will be held on May 18, 2016, at 3:00 p.m., local time, at 695 Melton Lake Drive (see attached Pre-Bid Location Map). Prospective Bidders are not required to attend in order to submit a bid, but attendance is recommended. Please contact Lyn Majeski at (865) 425-1819 if directions to the pre-bid conference are needed.

Discrepancies

Should the Bidder find any discrepancies in, or omission from, the bid documents, or should the Bidder be in doubt as to their meaning, the Bidder shall at once notify Lyn Majeski at (865) 425-1819 or lmajeski@oakridgetn.gov and obtain an interpretation or clarification prior to submitting a bid. Any interpretation or clarification given in accordance with this provision shall be in writing and will be distributed to all known Bidders. Only questions answered in writing will be binding. Oral and other interpretations or clarifications will be without legal effect. All questions must be submitted no later than May 25, 2016 for adequate response time.

Prices

The Bidder shall submit unit bid prices as specified on Bid Form. It is agreed that this bid document in its entirety is included in and made a part of the contract between the City and 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.

Withdrawal of Bids

Bids may be withdrawn on written or telegraphic request received from Bidders prior to the time fixed for opening the bids. Such written request must be on company letterhead signed by a company official and must indicate the specific bid project and bid price to be withdrawn in order to verify the identity of the bidder.

Rejection of Bids

The City reserves the right to reject any and all bids when such rejection is in the interest of the City of Oak Ridge; to reject the bid of a Bidder who has previously failed to perform properly or complete on time jobs of a similar nature; to reject the bid of a Bidder who is not, in the opinion of the City, in a position to perform the Contract, and to reject the bid of a Bidder not submitted in accordance with this Invitation to Bid.

References

With the bid, each Bidder shall furnish at least three (3) references for whom work similar to that covered by the specifications herein was performed, the year in which such work was performed and the manner of its execution, and giving such other information as will tend to show the Bidder's ability to perform the required work.

Equipment

The Bidder shall have available under Bidder's control, tools and equipment of the type, character and amount required to complete the proposed work within the specified time. Each Bidder shall furnish a list of the tools and equipment proposed for use on the work if requested.

Personnel

Each Bidder shall have available or shall agree to have available under Bidder's control sufficient equipment and personnel to complete the proposed work within the specified time.

Method of Work

Upon request, each Bidder shall describe the method or methods to be used in the performance of the required work.

Bidders Interested in More than One Bid

A party who has quoted prices to a Bidder is not thereby disqualified from quoting prices to other Bidders or from submitting a bid directly for the work; however, more than one bid for the same work from an individual or entity under the same or different name will not be considered.

Bid Surety

Each bid shall be accompanied by a bid guarantee payable to the City in the amount of ten percent (10%) of the total bid amount. The form of the bid guarantee shall be a bid bond or other suitable instrument (i.e. cashier's check, certified check, or Letter of Credit). The bid guarantees of unsuccessful Bidders shall be return to them by the City within fifteen (15) consecutive calendar days after execution of the Contract.

Drug-Free Workplace Affidavit Form

A Drug-Free Workplace Affidavit form is included in this bid package and must be submitted with the bid.

Insurance

The successful Bidder will be required to maintain Worker's Compensation, Comprehensive General Liability, and Comprehensive Automobile Liability and Property Damage Insurance in accordance with the provisions of the Contract Documents. The City of Oak Ridge, Tennessee shall be named as an additional insured.

Completion and Performance Bond, and Labor and Material Bond

The Contractor agrees to furnish a Completion and Performance Bond in the amount of one hundred percent (100%) of the Contract price with good and sufficient surety or sureties acceptable to the City in connection with the performance of the work under this Contract. The form and conditions of said Completion and Performance Bond shall be as prescribed by the City.

The Contractor agrees to furnish a Labor and Material Bond in the amount of one hundred percent (100%) of the Contract price with good and sufficient surety or sureties acceptable to the City, for the protection of persons furnishing labor and material in connection with the performance of the work under this Contract. The form and conditions of this bond shall be as prescribed by the City.

Award of Contract

The City will make the award as soon as practicable to the lowest responsible Bidder, price and other factors considered, provided it is reasonable and in the best interest of the City. The City reserves the right to award the contract to more than one bidder if in the best interest of the City. The successful Bidder(s) shall be required to execute the Contract attached hereto.

City Officers and Employees Not To Have Financial Interest

No contract shall be made with any officer or employee of the City or any firm or corporation in which any officer or employee of the City has financial interest.

Compliance with All Laws, Ordinances, Statutes, and Regulations

The Contractor shall comply with all federal, state, county and local laws, ordinances, statutes, and regulations. Pursuant to City Code § 5-413, the City may not accept bids from Bidders in default of any payment of any nature due to the City, including but not limited to taxes, licenses and fees.

Anti-Discrimination

The selected Bidder, in performing the work or furnishing the services covered by this project, shall not discriminate against any person because of race, creed, color, national origin, age, sex, sexual orientation, disability, religion or other legally protected status. The City of Oak Ridge encourages the utilization of minority and women-owned businesses in its contracting and subcontracting projects.

Tobacco Products

The selected Bidder and its employees/subcontractors shall comply with all building policies, regulations, schedules and rules as set out and required by the City. Please note smoking (including e-cigarettes) and the use of tobacco products (chewing) is prohibited in City facilities. For any work done at City facilities, any smoking occurring outside of the buildings must occur at least twenty (20) feet away from any entrance, open window or other opening into which smoke could infiltrate into the building. Spent smoking materials are to be properly discarded and not littered on the grounds.

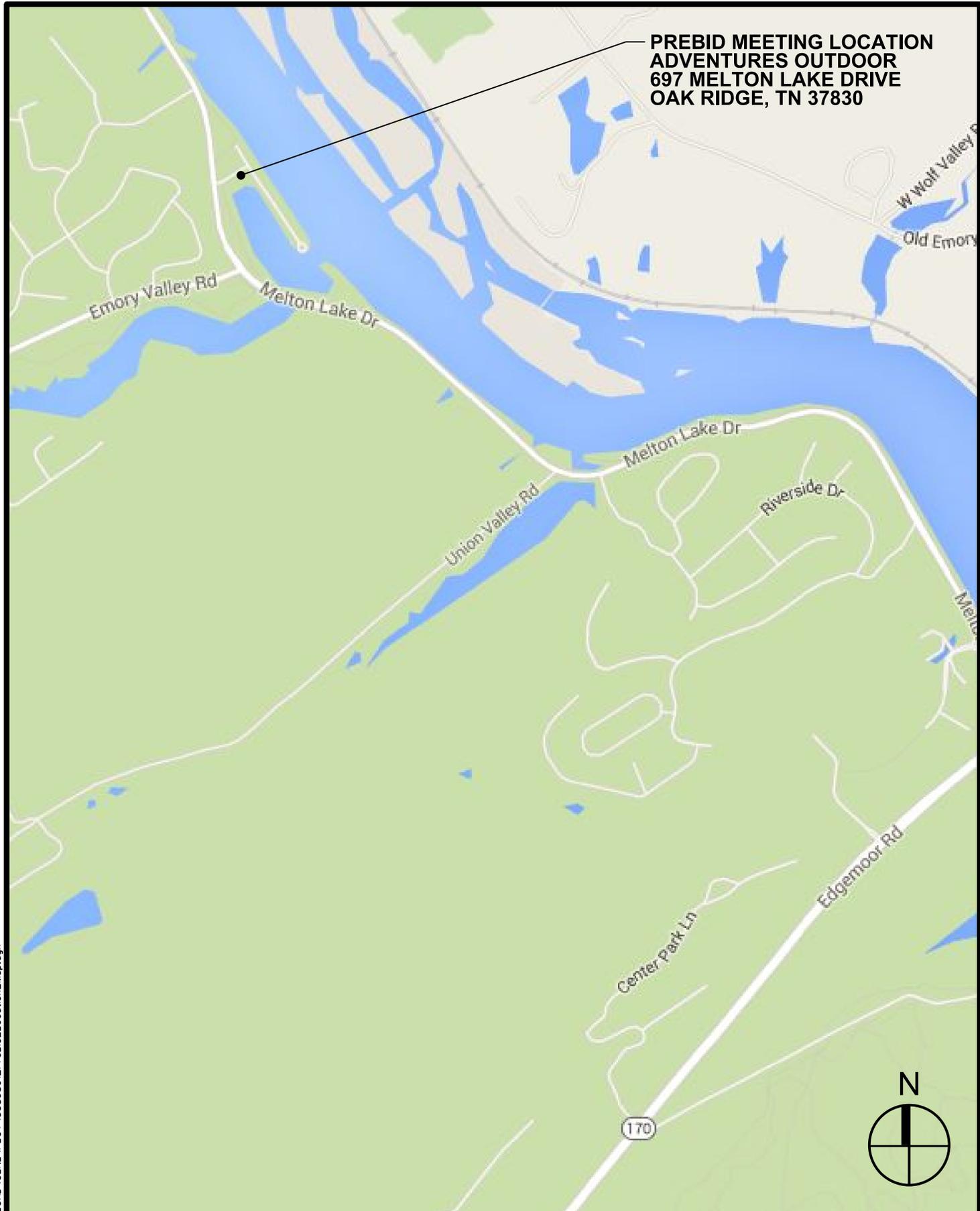
Background Checks

The selected Bidder shall only furnish employees who are competent and skilled for work under this contract. If, in the opinion of the City, an employee of the selected contractor is incompetent or disorderly, refuses to perform in accordance with the terms and conditions of the contract, threatens or uses abusive language while on City property, or is otherwise unsatisfactory, that employee shall be removed from all work under this contract. The selected contractor's employees working on this project may be subject to police background checks at the sole discretion of the City.

Retainage

For all contracts for the improvement of real property where the contract amount equals or exceeds \$500,000.00 and the City of Oak Ridge, Tennessee has determined to retain a certain amount or percentage of the contract price, said retained amount will be deposited in a separate escrow account with TNBank, 401 South Illinois Avenue, Oak Ridge, Tennessee 37830.

All funds accumulated in said escrow account (together with any interest thereon) shall be paid to the contractor to whom such funds and interest are owed only upon satisfactory completion of the contract as evidenced by a written release by the City in accordance with Tennessee Code Annotated § 66-11-144.



**PREBID MEETING LOCATION
ADVENTURES OUTDOOR
697 MELTON LAKE DRIVE
OAK RIDGE, TN 37830**

5/6/2016 F:\35\35898\3589801\04_CAD\GENL\LOT\3589801_Prebld_Location_Map.dgn

BWSC

**BARGE
WAGGONER
SUMNER &
CANNON, INC.**

1033 Sherrill Blvd., Suite 200, Knoxville, Tennessee 37932
PHONE 8651 637-2800 FAX 8651 673-8554

PRE-BID LOCATION MAP

**OAK RIDGE ROWING COURSE
OAK RIDGE, TENNESSEE**

DRAWN BY: BSP	CHECKED BY: BCN
DRAWING NO.: SK-1	
PROJECT NO.: 35898-01	DATE: 05/06/2016

Bid Submittal Instructions

Pursuant to Tennessee Code Annotated § 62-6-119, each bid must be submitted in an opaque sealed envelope marked and addressed on the outside as follows:

From: Bidder's Name
Bidder's Address
*General Contractor's State of Tennessee License Number
*Bidder's License Date of Registration
*Bidder's License Category or Classification
*Bidder's License Expiration Date

*If bid equals or exceeds \$25,000, include this information if a contractor's license is required for this project per the State of Tennessee's Contractors Licensing Board. (The same information must also be provided for major subcontractors.)

To:	<u>In Person or By Overnight Delivery</u>	<u>Regular Mail</u>
	Attn: Lyn Majeski Finance Department City of Oak Ridge 100 Woodbury Lane Oak Ridge, TN 37830	Attn: Lyn Majeski Finance Department City of Oak Ridge P.O. Box 1 Oak Ridge, TN 37831-0001

If the bid is submitted by mail rather than hand-delivery, the sealed envelope containing the bid must be enclosed in another envelope addressed as stated above. Bids submitted by mail should indicate on the outside envelope, lower left corner, the following: "Sealed bid for FY2016-180: Oak Ridge Rowing Course Site Improvements to be opened June 1, 2016 at 3:00 p.m. local time" to ensure the bid is delivered to the appropriate person at the City in a timely fashion. Late bids are not accepted and will not be opened.

FY2016-180 BID FORM

Project: Oak Ridge Rowing Course Site Improvements

In compliance with the Invitation for Bids, dated May 10, 2016, the undersigned Bidder:

* a corporation organized and existing under the laws of the State of: _____

* a partnership consisting of: _____

*an individual trading as: _____

(*fill in as appropriate)

of the City of _____ in the State of _____ agrees that if this bid is accepted as hereinafter provided, it will furnish all labor, materials, supplies, tools, and equipment necessary to perform all work and services described in the Invitation for Bid and Instructions to Bidders, in strict accordance with the terms and provisions of the Contract attached thereto.

If written Notice of Award is received, the Bidder agrees to furnish to the City of Oak Ridge, within ten (10) working days after receipt of said Notice of Award, the Completion and Performance Bond; Labor and Material Bond or other suitable securities; and required insurance certificates naming the City of Oak Ridge as an additional insured.

Bidder acknowledges receipt the following addenda:

Bidder understands that the City reserves the right to reject any or all bids and to waive any informality in the bidding.

Bidder agrees that this bid shall be good for a period of ninety (90) days from the date of opening. The successful bidder shall sign and return the contract for this project within ten (10) days of receipt from the City at which time this Bid Form will be incorporated by reference and said unit prices will be the unit prices used for payment under the contract.

**FY2016-180 BID FORM
(continued)**

Item No.	Description	Unit	Est. # of Units	Unit Price	Item Total
BID SCHEDULE					
Oak Ridge Rowing Course – Site Improvements					
1	Mobilization/Demobilization. Total cost to travel, set-up job trailer (if required), commence construction activities, and close-out constructions activities.	LS	1	\$	\$
2	Earthwork. Total cost to furnish all labor, materials, equipment, and services to excavate, backfill, and compact soil for sheet pile wall.	LS	1	\$	\$
3	Erosion Control. Total cost to furnish all labor, materials, equipment, and services to install the erosion control measures as shown on the plans and specified herein, for both the project location and the project spoil location.	LS	1	\$	\$
4	Topsoil & Seeding. Total cost to furnish all labor, materials, equipment, and services to provide the topsoil and seeding as shown on the plans and specified herein.	LS	1	\$	\$
5	Dredging. Total cost to furnish all labor, materials, equipment, and services to dredge the required materials as shown on the plans and specified herein.	LS	1	\$	\$
Unit Price Items, As Directed by the Engineer					
6	Sheet Pile Wall. Includes all labor, materials, and equipment, etc., to install sheet pile wall to refusal depth, as shown on the plans and specified herein. Units are SF of wall face.	SF	17,300	\$	\$
7	Sheet Pile Wall – Tie Back Anchoring. Includes all labor, materials, and equipment, etc., to install tie back anchoring system for sheet pile wall, as shown on the plans and specified herein.	LF	2,950	\$	\$
8	Rip-Rap. Includes all labor, materials, and equipment, etc., to install rip-rap for slope stabilization, as shown on the plans and specified herein.	Ton	10	\$	\$
9	Greenway Pavement. Includes all labor, materials, and equipment, etc., to replace the greenway trail that was removed or damaged by construction activities. Typical sections, details, and alignment of greenway pavement is shown on the plans, and specified herein.	LF	600	\$	\$
10	Mineral Aggregate Base. Includes all labor, materials, and equipment, etc., to replace any damage to the gravel vehicular pull-off area between Melton Hill Drive and the Greenway Trail due to construction activities.	Ton	165	\$	\$
11	Safety Railing. Includes all labor, materials, and equipment, etc., to install safety railing along the top of new sheet pile wall.	LF	575	\$	\$
12	Concrete Cap. Includes all labor, materials, and equipment, etc., to install concrete cap along the top of new sheet pile wall.	LF	571	\$	\$
Total of Bid				\$	

Total Bid Price (from previous page)

Oak Ridge Rowing Course – Site Improvements

\$ _____

_____ Dollars and _____ Cents

Bidder acknowledges receipt of the following addenda:

Addendum No. _____ Date: _____
Addendum No. _____ Date: _____
Addendum No. _____ Date: _____

Addendum No. _____ Date: _____
Addendum No. _____ Date: _____
Addendum No. _____ Date: _____

Bidder attests that no officers or employees of the City of Oak Ridge are members of, or have financial interest in, the business submitting this bid.

By: _____
Signature

Telephone #: _____

Name: _____

Fax # _____

Title: _____

Email: _____

Business
Name: _____

Date: _____

Mailing
Address: _____

Physical
Address: _____

Tax ID Number: _____

NOTE: In accordance with the Invitation to Bid, the following attachments are required: a Bid Bond in the amount of ten percent (10%) of the total bid price and at least three (3) references.

BID BOND

FY2016-180

KNOW ALL MEN BY THESE PRESENTS,

That we, _____,
(hereinafter called the "Principal"), as Principal, and the _____, of
_____ a

corporation duly organized under the laws of the State of _____

(hereinafter called the "Surety"), as Surety, are held and firmly bound unto the City of Oak Ridge, Tennessee, (hereinafter called the "Obligee"), as Obligee, in the sum of ten percent (10%) of the bid price for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for:

_____.

NOW THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the Invitation to Bid and Instructions to Bidders with good and sufficient surety for the faithful performance of such contract, or in the event of the failure of the Principal to enter such contract and give such bond, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____ A.D. 2016.

IN THE PRESENCE OF:

_____(Seal)
Principal

Witness

Title

Witness

_____(Seal)
Surety

Title

DRUG-FREE WORKPLACE AFFIDAVIT

STATE OF _____)
)
COUNTY OF _____)

The undersigned principal officer of _____, an employer of five (5) or more employees, contracting with the City of Oak Ridge, Tennessee, to provide construction services, hereby states under oath as follows:

1. That the undersigned is a principal officer of _____ (hereinafter referred to as the "Company") and is duly authorized to execute this Affidavit on behalf of the Company.
2. The Company submits this Affidavit pursuant to Tennessee Code Annotated § 50-9-113, which requires each employer with no less than five (5) employees receiving pay who contracts with the state or any local government to provide construction services or who is awarded a contract to provide construction services to the state or local government to submit an affidavit stating that such employer has a drug-free workplace program that complies with Title 50, Chapter 9 of the Tennessee Code.
3. The Company is in compliance with Tennessee Code Annotated § 50-9-113.

Further affiant saith not.

Principal Officer

State of _____)
)ss.
County of _____)

Before me personally appeared _____ with whom I am personally acquainted (or proved to me on the basis of satisfactory evidence) and who acknowledged that such person executed the foregoing affidavit for the purposes therein contained.

Witness my hand and official seal this _____ day of _____, 2016.

Notary Public

My Commission Expires: _____.

CONTRACT

FY2016-180

THIS CONTRACT entered into this _____ day of _____, 2016, by and between the CITY OF OAK RIDGE, TENNESSEE, a municipal corporation, hereinafter called the "City," and _____, a _____, hereinafter called the "Contractor."

WITNESSETH

In consideration of the mutual promises of the parties hereto, the parties do hereby agree as follows:

ARTICLE 1 – Scope of This Contract

The work to be done consists of furnishing all labor, materials, supplies, tools, equipment and other incidentals necessary to perform all work and services required for the Oak Ridge Rowing Course Site Improvements in accordance with the attached Project Manual which is incorporated herein by reference as if fully set forth verbatim. All work performed under this Contract shall be in strict accordance with the terms and provisions of this Contract, the Project Manual, and the bid of the Contractor, all attached hereto and incorporated herein by reference.

In performance of this Contract, the Contractor binds himself to the City to comply fully with all provisions, undertakings, and obligations hereinafter set forth.

ARTICLE 2 – Term

This Contract shall become effective upon its execution and shall continue in full force and effect through June 30, 2017. Work shall commence within ten (10) calendar days after the City's issuance of a written Notice to Proceed and by shall be completed within one hundred and ten (110) calendar days of commencement, unless an alternate schedule is approved by the parties in writing.

ARTICLE 3 – Changes

- A. City may, by written order, and without notice to the Sureties, make changes in the specifications of this Contract within the general scope thereof. If any such changes cause an increase or decrease in the scope of this Contract or in the time required for its performance, an equitable adjustment shall be made and this Contract shall be modified in writing accordingly.
- B. Should the Contractor encounter conditions materially different from those shown in the specifications, the City shall be notified in writing immediately of such conditions before they are disturbed. The City shall thereupon promptly investigate the conditions and if it finds that they do so materially differ from those specified, this Contract shall be modified to provide for any increase or decrease of cost and difference in time resulting from the conditions so found.
- C. Except as otherwise herein provided, no charge for any extra work or material will be allotted unless the same has been approved in writing by the City, and the price stated.

ARTICLE 4 – Inspections and Defective Work

All workmanship and services shall be subject to inspections, examinations and tests by the City at any and all times during the performance of this Contract. The City shall have the right to reject defective workmanship and to require correction. Rejected workmanship shall be satisfactorily corrected without charge therefore. If the Contractor fails to proceed at once to correct such defective workmanship, the City may proceed with such corrective work and the Contractor shall be liable for all direct cost occasioned in the performance therefore.

This provision does not negate, modify or replace any warranties contained elsewhere in this Contract. This provision shall survive the termination or suspension of this Contract.

Neither payment nor any provisions in the Contract document shall relieve the Contractor of responsibility for faulty materials or defective workmanship. The City shall give notice of observed defects with reasonable promptness. The deterioration due to ordinary use and normal wear is excepted from this guarantee.

The Contractor shall reimburse the City for the cost of damage, if any, as well as the cost of replacing defective materials or workmanship. If replacements are not made within ten (10) days after notice is given of such defect in workmanship, or thirty (30) days in case of materials, then the City shall have the right to make replacements and charge the cost of same to Contractor or the Contractor's surety.

ARTICLE 5 – Site Investigation

The Contractor represents that it has visited the site and determined the nature of the work and the difficulties and facilities attending execution of the work, and all other matters, which can in any way affect the work under this Contract.

ARTICLE 6 – Delays, Damages

If the Contractor refuses or fails to prosecute the work with such diligence as will ensure its completion within the time specified in Article 2, or fails to complete the work within such time, the City may terminate this Contract. In such event, the City may take over the work and prosecute the same to completion by contract or otherwise, and the Contractor shall be liable to the City for any excess cost occasioned thereby. If this Contract is so terminated, the City may take possession of and utilize in completing the work such materials, appliances, tools and equipment as may be on the site of the work and necessary therefore.

ARTICLE 7 – Payment

As consideration for performing all work and services set forth in this Contract, and as full consideration thereof, the City agrees to pay the Contractor \$_____ in accordance with the bid sheet of the Contractor which is incorporated by reference into this Contract. The Contractor shall submit monthly invoices detailing the services provided for the prior month. The City shall pay such invoices within thirty (30) calendar days of receipt for work satisfactorily performed. The City will withhold five percent (5%) retainage on this project until final payment.

ARTICLE 8 – Final Payment

Upon completion of the work and services covered by this Contract and before final payment, the Contractor must furnish evidence to satisfy the City that all suppliers of materials used and all labor and other employees working for the Contractor pursuant to this Contract have been fully paid. Upon final payment, the City is to be released from all liability whatsoever growing out of this Contract.

ARTICLE 9 – Indemnification by Contractor

To the fullest extent permitted by all applicable laws and regulations, the Contractor hereby agrees to protect, indemnify and hold harmless the City and their consultants, agents and employees from and against any and all claims, loss, expense, damage, charges and costs direct, indirect or consequential (including but not limited to fees and charges of engineers, architects, attorneys and other professional and court costs), collectively referred to as “claims,” for injury to or death of persons and injury to or destruction of property suffered or alleged to have been suffered as a result of any act or omission on the part of the Contractor, any of the Contractor’s subcontractors, anyone for whose acts any of them may be liable, or others whose services are engaged by the Contractor or anyone directly or indirectly employed or controlled by either of them in the course of the performance of the work provided for in the Contract, except such injury, destruction or death as may be caused by the sole negligence or fault of the City.

When the City submits notice, the Contractor shall promptly defend any aforementioned action. In any and all claims against the City or any of their consultants, agents or employees by any employee of the Contractor, any of the Contractor’s subcontractors, anyone for whose acts any of them may be liable, or others whose services are engaged by the Contractor or anyone directly or indirectly employed or controlled by either of them in the course of the performance of the work provided for in the Contract, the indemnification obligation described herein shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any subcontractor under workers’ compensation acts, disability benefit acts or other employee benefit acts. The limits of insurance required in this Contract shall not limit the Contractor’s obligations under this article.

The terms of this article shall survive the termination or suspension of this Contract.

ARTICLE 10 – Completion and Performance Bond and Labor and Material Bond

A. Completion and Performance Bond

Prior to commencing work under this Contract, the Contractor agrees to furnish and to maintain during the term of this Contract a Completion and Performance Bond in the amount of one hundred percent (100%) of the Contract price with good and sufficient surety or sureties acceptable to the City in connection with the performance of the work under this Contract, including any amendments or extensions hereof. The form and conditions of said Performance Bond shall be as prescribed by the City. The bond will be required at the beginning of each contract term and will be in an amount equal to the contract price for that year.

In lieu of a Performance Bond, the City will accept other suitable Securities agreed upon by both parties. At all times during the term of this Contract, the Contractor shall provide the City with evidence that the Contractor has obtained such Performance Bond or Securities. A certificate from the surety showing that the bond premiums have been paid by the Contractor shall accompany the bond.

B. Labor and Material Bond

Prior to commencing work under this Contract, the Contractor agrees to furnish and to maintain during the term of this Contract a Labor and Material Bond in the amount of one hundred percent (100%) of the Contract price with good and sufficient surety or sureties acceptable to the City, conditioned that the Contractor shall promptly make payments to the persons supplying labor, material, or supplies to the Contractor or subcontractors in the performance of the work under this Contract and any amendment or extension thereof. The form and conditions of this bond shall be as prescribed by the City. The bond will be required at the beginning of each contract term and will be in an amount equal to the contract price for that year.

In lieu of a Labor and Material Bond, the City will accept other suitable Securities agreed upon by both parties. At all times during the term of this Contract, the Contractor shall provide the City with evidence that the Contractor has obtained such Labor and Material Bond or Securities. A certificate from the surety showing that the bond premiums have been paid by the Contractor shall accompany the bond.

ARTICLE 11 – Rate of Progress

Notwithstanding any other provisions in this Contract, the Contractor shall furnish sufficient labor, materials, supplies, tools, and equipment, and shall work such hours, including overtime, Sundays, and/or Holidays, as may be necessary to carry out the work in accordance with the approved schedules for its completion not later than the respective times allowed for completion set forth in these Contract Documents. Should the Contractor refuse or fail to comply with its obligations set forth in the preceding sentence after receipt of any written directive or request by the City that the Contractor furnish additional labor, materials, supplies, tools, and equipment, and/or work additional hours, including overtime, Sundays, and/or Holidays, the City may terminate the Contractor's right to proceed with the whole or any part of the work under this Contract.

ARTICLE 12 – Compliance with All Laws, Ordinances, Statutes, and Regulations

The Contractor shall comply with all federal, state, county and local laws, ordinances, statutes, and regulations.

ARTICLE 13 – Insurance

The Contractor shall at all times during the Contract maintain in full force and effect Comprehensive General Liability, Workers' Compensation and Property Damage Insurance in the amounts set forth below and naming the City of Oak Ridge, Tennessee as an *additional insured*.

The Contractor shall maintain policies providing the following insurance protection, each policy containing a requirement that, in the event of change or cancellation, thirty (30) days' prior written notice be sent by mail to the City. Certificates of Insurance describing the coverage shall be furnished by the Contractor and shall contain the following express obligation:

"This is to certify that the policies of insurance described herein have been issued to the insured for whom this certificate is issued and are in force at this time. In the event of cancellation or material change in a policy affecting the certificate holder, thirty (30) days' prior written notice will be given the certificate holder."

1. Comprehensive General Liability:

Bodily Injury	\$300,000	each occurrence
	\$700,000	aggregate
Property Damage	\$100,000	each occurrence
Or Combined Single Limit of	\$1,000,000	
2. Workers' Compensation and Employer's Liability as provided for in applicable statutes.
3. Comprehensive Automobile Liability (Including all owned, non-owned and hired vehicles)

Bodily Injury	\$300,000	each person
	\$700,000	each occurrence
Property Damage	\$100,000	each occurrence
Or Combined Single Limit of	\$1,000,000	

The Contractor may purchase at its own expense such additional or other insurance protection as it may deem necessary. Maintenance of the required minimum insurance protection does not relieve the Contractor of responsibility for any losses not covered by the above-required policies.

Before commencement of work hereunder, the Contractor agrees to furnish to the City of Oak Ridge (Legal Department, P.O. Box 1, Oak Ridge, Tennessee 37831-0001) a Certificate of Insurance or other evidence satisfactory to the City to the effect that such insurance has been procured and is in force.

ARTICLE 14 – Permits and Licenses

The Contractor shall obtain, at the Contractor's expense, all permits, licenses and bonds required by law or ordinance and maintain the same in full force and effect.

ARTICLE 15 – Subcontracting and Assignment

- A. The Contractor may utilize the services of specialty subcontractors on those parts of the work which, under normal contracting practices, are performed by specialty subcontractors.
- B. The Contractor shall not award, assign, transfer or pledge any work to any subcontractor without prior written approval of the City, which approval will not be given until the Contractor submits to the city a written statement concerning the proposed award to the subcontractor, which statement shall contain such information as the City may require.
- C. The Contractor shall be as fully responsible to the City for the acts and omissions of subcontractors, and of persons either directly or indirectly employed by said subcontractors, as the Contractor is for the acts and omissions of persons directly employed by the Contractor.
- D. The Contractor shall make a condition of all subcontracts and/or cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and other Contract Documents insofar as applicable to the work of subcontractors and to give the Contractor the same power as regards terminating any subcontract that the City may exercise over the Contractor under any provision of the Contract Documents.
- E. Nothing contained in this Contract shall create any contractual relation between any subcontractor and the City.

ARTICLE 16 – Superintendence by the Contractor

The Contractor shall give its personal superintendence to the work or have a competent foreman or superintendent satisfactory to the City on the site at all times during the progress of the work, with authority to act on behalf of the Contractor.

ARTICLE 17 – Termination

Notwithstanding any other provisions in this Contract, the Contractor shall furnish all labor, materials, supplies, tools and equipment necessary to perform the work and services within allowed times for completion as set forth in these Contract Documents. Should the Contractor refuse or fail to comply with its obligations, or in the event the Contractor shall violate any of the provisions of this Contract, or the quality or quantity of the work performed is, in the judgment of the City, below standard and therefore unsatisfactory, the City shall have the right to cancel this Contract upon thirty (30) days written notice to the Contractor and to complete the work undertaken by the Contractor without incurring any liability to the Contractor except to pay the Contractor the fair value to the City of the work satisfactorily performed by the Contractor.

ARTICLE 18 – Termination of Contract for Cause

If, through any cause, the Contractor shall fail to fulfill in timely and proper manner the obligations under this Contract, or if the Contractor shall violate any of the covenants, agreements, or stipulations of this Contract, the City shall thereupon have the right to terminate this Contract by giving written notice to the Contractor of such termination and specifying the effective date thereof, at least five (5) days before the effective date of such termination. In such event, all finished or unfinished documents, data, studies, surveys, drawings, maps, models, photographs, and reports prepared by the Contractor under this Contract shall, at the option of the City, become the City's property and the Contractor shall be entitled to receive just and equitable compensation for any work satisfactorily completed hereunder.

Notwithstanding the above, the Contractor shall not be relieved of liability to the City for damages sustained by the City by virtue of any breach of the Contract by the Contractor, and the City may withhold any payments to the Contractor for the purpose of set-off until such time as the exact amount of damages due the City from the Contractor is determined.

ARTICLE 19 – Anti-Discrimination

The Contractor, in performing the work or furnishing the services covered by this Contract, shall not discriminate against any person because of race, creed, color, national origin, age, sex, sexual orientation, disability, religion or other legally protected status. The City of Oak Ridge encourages the utilization of minority and women-owned businesses in its contracting and subcontracting projects and the Contractor is encouraged to actively solicit the participation of these businesses. The Contractor shall inform all of its subcontractors and vendors providing work or services under this Contract of this requirement and shall ensure compliance therewith.

ARTICLE 20 – Personnel

- A. The Contractor represents that it has, or will, secure at the Contractor's expense, all personnel required to perform the work and services outlined in this Contract. Such personnel shall not be employees of or have any contractual relationship with the City.
- B. All of the services required hereunder will be performed by the Contractor or under the Contractor's supervision, and all personnel engaged in the work shall be fully qualified and shall be authorized or permitted under state and local laws to perform such services.

ARTICLE 21 – Reports and Information

At such times and in such forms as the City may require, the Contractor shall furnish to the City such periodic reports as are requested by the City pertaining to the work and services covered by this Contract, the costs and obligations incurred or to be incurred in connection herewith, and any other matters covered by this Contract. The City can audit the Contractor's and the Contractor's subcontractors' financial records pertaining to this project.

ARTICLE 22 – Liquidated Damages

The City and the Contractor hereby agree that any actual damage amount for delay in the completion of the work under this Contract is unknown and would be difficult if not impossible to estimate; therefore, the parties agree that the City may assess as liquidated damages and not as penalty the amount of two hundred dollars (\$200.00) for each and every day of delay of the work under the Contract beyond the term specified for completion of the work. The City is entitled to deduct the amount of liquidated damages from the Contractor's compensation.

ARTICLE 23 – Governing Law

This Contract is governed by the laws of the State of Tennessee.

IN WITNESS WHEREOF, the parties hereto have executed this Contract as of the day and year first above written, the City of Oak Ridge, by its Mayor, by authority duly given.

APPROVED AS TO FORM AND LEGALITY:

CITY OF OAK RIDGE, TENNESSEE

City Attorney

Mayor

(CONTRACTOR)

Signature

(Printed or Typed Name and Title)

Attachments: Specifications
Bid Documents
Contractor's Bid

Approved by Resolution _____

LABOR AND MATERIAL BOND

FY2016-180

Know all men by these presents

That We _____

AS PRINCIPAL, and

AS SURETY are held firmly bound unto the

hereinafter called the Obligee, in the penal sum of

Dollars (\$ _____)

lawful money of the United States, for payment of which sum well and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS: Said Principal has entered into a certain Contract with said Obligee dated _____ 20 _____ (hereinafter called the Contract) for the full and complete performance of

which Contract and the specifications for said work shall be deemed a part hereof as fully as if set out herein.

NOW, THEREFORE, the condition of this obligation is such that if said Principal and all contractors to whom any portion of the work provided for in said Contract is sublet and all assignees of said Principal and of such contractors shall promptly make payments to the persons supplying him, or them, with labor, material, fuel or supplies, for or in the prosecution of the work provided for in said Contract, or in any amendment or extension of or addition to said Contract, and for payment of reasonable attorney's fees, incurred by the Claimant or Claimants in suits on said Bond, then the above obligation shall be void; otherwise to remain in full force and effect. Provided, however, that this Bond is subject to the following conditions and limitations:

- (a) Any person, firm or corporation that has furnished labor, materials, fuel or supplies for or in the prosecution of the work provided for in said Contract shall have a direct right of action against the Principal and Surety of this Bond which right of action shall be asserted in a proceeding, instituted in the county in which the Principal does business. Such right of action shall be asserted in a proceeding instituted in the name of the Claimant or Claimants for his or their use and benefit against said Principal and Surety or either of them, (but not later than one year after the final

Labor and Material Bond
(continued)

settlement of 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 City Manager of the City of Oak Ridge, Tennessee, as the agent of each of 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 Principal and/or Surety.
- (c) The Surety shall not be liable hereunder for any damages or compensation recoverable under any worker's compensation or employers' liability statute.
- (d) This bond is furnished in compliance with Tennessee Code Annotated Section 12-4-201 et seq.

In Witness whereof the parties hereto have executed this agreement on the day and date first above written in two counterparts, each of which shall without proof or accounting for the other counterpart, be deemed an original contract.

SIGNED, SEALED AND DELIVERED this _____ day of _____, 20_____.

Attest: _____

By: _____ (Seal)
Principal

Attest: _____

By: _____ (Seal)

COMPLETION AND PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

FY2016-180

THAT _____
(Name and address of legal title of Contractor)

as Principal, hereinafter called Contractor, and _____
SURETY, hereinafter called Surety, and held and firmly bound unto the City of Oak Ridge, as Obligee, in
the amount of _____ Dollars (\$ _____)

for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators,
successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 20_____
entered into a Contract with the City of Oak Ridge for

_____ in accordance with the specifications and
approved amendments, which Contract is by reference made a part hereof, including all the obligations
thereunder, and is hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of this obligation is such that, if Contractor shall promptly and faithfully
perform said Contract, including all the obligations thereunder, then this obligation shall be null and void,
otherwise it shall remain in full force and effect.

Whenever Contractor shall be, and declared by City to be, in default under the Contract or any part
thereof, the City having performed the City's obligation thereunder, the Surety may promptly remedy the
default, or shall promptly at the City's option:

- (1) Complete the Contract in accordance with its terms and conditions; OR
- (2) Obtain a bid or bids for submission to the City for completing the Contract in accordance with
the terms and conditions, and upon determination by Owner and Surety of lowest responsible
bidder, arrange for a contract between such bidder and the City and make available as work
progresses (even though there shall be a default or a succession of defaults under the
Contract or contracts of completion arranged under this paragraph) sufficient funds to pay the
cost of completion or any obligations thereunder.

Any suit under this bond must be instituted before the expiration of two years from the date on which final
payment under the Contract falls due.

SIGNED AND SEALED THIS _____ DAY OF _____ A.D., 20_____
IN THE PRESENCE OF:

Witness

By _____
Principal (Seal)

Witness

By _____
Surety (Seal)

PROJECT MANUAL

The Project Manual, as prepared by Barge Waggoner Sumner & Cannon, Inc., is attached and incorporated herein by reference into this bid package. It is a multi-page attachment that includes, but is not limited to, Documents and Specifications, Geotechnical Report, and Site Improvement Drawings.

PROJECT MANUAL

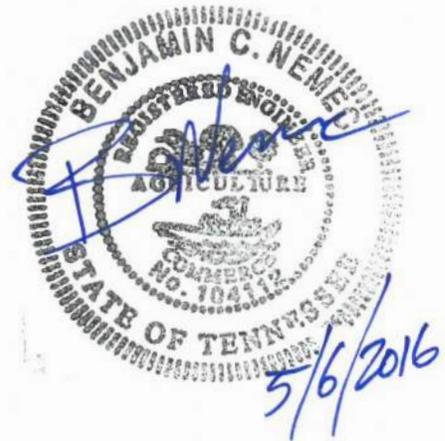
DOCUMENTS AND SPECIFICATIONS

OAK RIDGE ROWING COURSE SITE IMPROVEMENTS

ANDERSON COUNTY, TENNESSEE

Prepared for:

City of Oak Ridge, TN



Issued: May 2016

File No. 35898-01

Set No.

BWSC | BARGE
WAGGONER
SUMNER &
CANNON, INC.

Engineers, Architects, Planners,
Landscape Architects and Surveyors

1110 Market Street, Suite 200, Tennessee 37402 Voice (423) 725-3025 FAX (423) 756-8477

GENERAL

This Project Manual follows the CSI Master Format Document Identifying System and Cost Accounting Numbers.

Non-applicable division and section references have been omitted.

Recipients of Bidding Documents must consult the Table of Contents to determine the full scope of the work involved and to ensure that all pages of the Project Manual and Drawings have been included.

Neither the Owner nor the Designer will be responsible for bids submitted that are based on incomplete Bidding Documents.

DIVISION 00: PROCUREMENT AND CONTRACTING

00 01 10 Table of Contents

DIVISION 01: GENERAL REQUIREMENTS

01 22 00 Measurement and Payment

01 57 23 Erosion and Sediment Control

DIVISION 03: CONCRETE

03 30 00 Cast-In-Place Concrete

DIVISION 31: EARTHWORK

31 20 00 Earth Moving

31 22 19 Spread and Grade Topsoil

31 25 26 Turbidity Curtain

DIVISION 32: EXTERIOR IMPROVEMENTS

32 92 19 Seeding

DIVISION 35: WATERWAY AND MARINE CONSTRUCTION

35 20 23 Dredging

ATTACHMENT A

Report of Geotechnical Exploration dated 11/30/2015 (GEOServices)

END OF SECTION

PART 1 - GENERAL

SCHEDULE 0 -

Measurement for payment on a unit price basis shall be as described below. Payment for each unit installed shall be made according to the unit price bid, as listed in the Bid Form. Only those items appearing in the Bid Form will be considered for payment on a unit price basis.

SCHEDULE 1 -

Even though an item of work is included in the technical Specifications, if it is not both covered herein and specifically itemized in the Bid Form, payment for it shall not be separately made. Such work shall be considered a necessary part of or incidental to its related work.

The quantities set forth in the Bid Form are approximate and are given to establish a uniform basis for the comparison of Bids. The Owner reserves the right to increase or decrease the quantity of any class or portion of the work during the progress of construction in accordance with the terms of the Contract. Unit prices are used as a means of computing the final figures for Bid and Contract purposes, for periodic payments for work performed, for determining value of additions or deletions, and wherever else as is reasonable.

Payment will be made on the basis of work actually performed, completing each item in the Contract, such work including, but not limited to, the furnishing of all necessary labor, materials, equipment, transportation, clean up, and all other appurtenances to complete the construction, installation, testing, and start-up of the work to the configuration and extent as shown on the Project Plans and as described in the Specifications.

Notwithstanding any other Sections, paragraphs, sentences, or words in the Contract Documents, payments shall not be made for work not performed, materials not supplied and/or any other item/items for which the Owner does not receive the benefit described or intended.

1.01 BID FORM ITEM NO. 1, MOBILIZATION & DEMOBILIZATION

- A. Payment for full mobilization of manpower and equipment to the site along with construction of all temporary facilities – 60% of Lump sum price; Full demobilization of manpower and equipment and removal of temporary facilities, waste materials, debris, and restoration of the site – 40% of lump sum price.

The Contractor will be responsible for obtaining City of Oak Ridge permits. Cost of permits shall be included in the lump sum unit price for mobilization. A City of Oak Ridge Land Disturbance Permit will be required. The Contractor will only be paid for a single mobilization for this Project.

1.02 BID FORM ITEM NO. 2, EARTHWORK

- A. General excavation for the sheet pile wall shall be paid for as a Lump Sum item. Stripping topsoil within the project limits and stockpiling topsoil at the proposed site is included in this Bid Form Item. Topsoil stockpiles shall be neatly dressed. This price shall be full compensation for the removal and satisfactory disposal of any excavated material from behind the wall site in accordance with the Drawings and Specifications and for all work incidental thereto, including the furnishing of all labor, materials, and equipment required to complete the item. Rip rock and blast rock are also considered part of this of Bid Form Item and are considered unclassified excavation.

1.03 BID FORM ITEM NO. 3, EROSION CONTROL

- A. Payment will be made at the contract lump sum price as shown in the Bid Form for providing of all erosion control measures for the wall site and spoil area as shown in the plans, and required by TDEC or the City of Oak Ridge. The erosion control measures shall remain in place for as long as necessary to stabilize the site and the contractor shall return to remove the measures at the appropriate time as approved by the Owner or Engineer.

1.04 BID FORM ITEM NO. 4, TOPSOIL AND SEEDING

- A. Payment will be made at the contract lump sum price as shown in the Bid Form for placing and spreading topsoil as shown on the Plans, and in the Specifications.

1.05 BID FORM ITEM NO. 5, DREDGING AND SPOIL

- A. Payment will be made at the contract lump sum price as shown in the Bid Form for dredging. The price shall include dredging, hauling, spoil placement, and all equipment and material costs, and all other incidental operations. The spoil stockpile shall be located at the proposed spoil site, or other approved spoil location, and is included in this Bid Form Item. This price shall be full compensation for the removal and satisfactory disposal of the dredged material in accordance with the Plans and Specifications. Such payment shall constitute full reimbursement for all work necessary to complete the Work.

1.06 BID FORM ITEM NO. 6, SHEET PILE WALL

- A. Payment will be made at the contract unit price per square foot (sf) of wall as shown in the Bid Form for providing installation of sheet piling to refusal depth, and concrete cap as shown on the Plans, and in the Specifications. The cost of earthwork behind the sheet pile wall is excluded from this line item since it is included in Bid Form Item No.2.

1.07 BID FORM ITEM NO. 7, SHEET PILE WALL – TIE BACK ANCHORING

- A. Payment will be made at the contract unit price per linear foot (lf) of anchoring as

shown in the Bid Form for providing installation of drilled anchors to bedrock for the sheet pile wall as shown on the Plans, and in the Specifications.

1.08 BID FORM ITEM NO. 8, RIP-RAP

- A. Payment will be made at the contract unit price per ton as shown in the Bid Form for providing of stone material and placement of rip rap as required to provide stabilization for channels as shown on the Plans, and Specifications. Maintenance of installed rip rap shall be incidental to the work and included in the unit price bid for this item.

1.09 BID FORM ITEM NO. 9, GREENWAY PAVEMENT

- A. Payment will be made at the contract unit price per linear foot (lf) as shown in the Bid Form for providing the replacement of the greenway pavement section to original conditions as shown on the Plans. This price includes any required stone base for the pavement section. Greenway pavement replacement shall be limited to only the areas that are damaged by construction activities.

1.10 BID FORM ITEM NO. 10, MINERAL AGGREGATE BASE

- A. Payment will be made at the contract unit price per ton as shown in the Bid Form for providing mineral aggregate base stone and placement of mineral aggregate base stone as required to restore the roadway shoulder to original conditions. Maintenance of installed mineral aggregate base stone shall be incidental to the work and included in the unit price bid for this item.

1.11 BID FORM ITEM NO. 11, SAFETY RAILING

- A. Payment will be made at the contract unit price per linear foot (lf) as shown in the Bid Form for providing the safety railing behind the sheet pile wall as shown on the Plans.

1.12 BID FORM ITEM NO. 12, CONCRETE CAP

- A. Payment will be made at the contract unit price per linear foot (lf) as shown in the Bid Form for providing the concrete cap on top of the sheet pile wall as shown on the Plans.

END OF SECTION

PART 1 – GENERAL

1.01 SCOPE

- A. The Contractor shall provide temporary control measures as shown in the Plans and these Specifications, or as necessary during the life of the Contract to control erosion and water pollution, through the use of berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.
- B. The temporary pollution control provisions contained herein shall be coordinated with any permanent erosion control features to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

1.02 DEFINITIONS

- A. BMP – Best Management Practices.
- B. CGP – Construction General Permit (Tennessee General Permit No. TNR 100000)
- C. NOC – Notice of Coverage from TDEC authorizing construction activities in accordance with the Construction General Permit
- D. NOI & NOT – Notice of Intent and Notice of Termination for TPDES permits.
- E. SWPPP – Storm Water Pollution Prevention Plan
- F. TDEC – Tennessee Department of Environment and Conservation
- G. MS4 – Municipal Separate Storm Sewer Systems
- H. NPDES – National Pollutant Discharge Elimination System
- I. Large Construction Activities – Construction activities including clearing, grading and excavating that result in land disturbance of equal to or greater than five (5) acres
- J. Small Construction Activities - Construction activities including clearing, grading and excavating that result in land disturbance of equal to or greater than one (1) acre and less than five (5) acres of land.
- K. SWQMP – Storm Water Quality Management Plan

1.03 RELATED DOCUMENTS AND APPLICABLE WORK

- A. The Work described in this Section is applicable to any and all Sections of the Contract Documents. Any and all Work that would disturb the existing Site conditions or present the potential for site run-off shall adhere fully to this Specification Section.
- B. Unless specifically notified to the contrary by the Owner, in writing, all aspects of this specification shall apply to this Project.

1.04 SUBMITTALS

- A. At the pre-construction conference the Contractor shall submit for acceptance his schedule for installment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, bridges and other structures at water-courses, construction, and paving. He shall also submit for acceptance his proposed method of erosion control on haul roads and borrow pits and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Engineer. Acceptance by the Engineer does not relieve Contractor of responsibility for any erosion damage that may occur.

1.05 QUALITY ASSURANCE

- A. In order to minimize the discharge of pollutants to storm water, the Contractor shall implement all permanent and temporary Site controls according to the Plans and City of Oak Ridge.
- B. Implementation of site controls shall be performed by a qualified contractor experienced in the proper installation of such devices in accordance with manufacturers' specifications, and in keeping with recognized Best Management Practices (BMP's).

PART 2 - PRODUCTS

2.04 TEMPORARY SEEDING AND MULCHING

- A. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion.

2.05 TEMPORARY SILT FENCES

- A. Silt fences are temporary measures utilizing filter fabric and woven wire fence, mulch filled socks, or other approved material. For silt fences, a filter cloth, composed of burlap, plastic filter fabric, etc., is attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

2.06 TEMPORARY TURBIDITY CURTAINS

- A. An in-stream sediment control measure designed to trap or filter sediment without halting the movement of the water itself. This device consists of a filter fabric curtain suspended from floats and held vertically in the water by means of a bottom ballast chain.

PART 3 - EXECUTION

3.01 PROJECT REVIEW

- A. Prior to the pre-construction conference the Contractor shall meet with the Engineer and go over in detail the expected problem areas in regard to the erosion control work. It is the basic responsibility of the Contractor to review the erosion control plan and to prevent erosion damage to the project or to adjacent property. Any damage is the responsibility of the Contractor.

3.02 GENERAL

- A. The Contractor shall provide a complete installation of all site control devices and measures (BMPs). Indicated in the Site Erosion and Sedimentation Control Drawing and as specified herein. These BMPs must be confirmed as fully operational with the Owner before any Work that disturbs the Site can begin.

3.03 CONSTRUCTION REQUIREMENTS

- A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other water impoundment. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds.
- B. The Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in his accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit, otherwise erosion control measures may be required between successive construction stages.
- D. The Engineer will limit the area of excavation, borrow, and embankment operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

- E. Under no condition shall the amount of surface area or erodible earth material exposed at one time be excavation or fill within the project area exceed 750,000 square feet without prior approval by the Engineer.
- F. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions.
- G. In the event of conflict between these requirements and pollution control laws, rules, or regulations or other Federal, State, or Local agencies, the more restrictive laws, rules, or regulations shall apply.

3.04 CONSTRUCTION OF STRUCTURES

- A. Temporary Seeding and Mulching
 - 1. Seeding and mulching shall be performed in accordance with the section entitled "Seeding."
- B. Brush Barriers
 - 1. Brush barriers shall consist of brush, tree trimmings, shrubs, plants and other approved refuse from the clearing and grubbing operation. The brush barriers shall be constructed approximately parallel to original ground contour. The brush barrier shall be compressed to an approximate height of 3 to 5 feet and approximate width of 5 to 10 feet. The embankment shall not be supported by the construction of brush barriers.
- C. Temporary Silt Fences
 - 1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem. Silt fences are constructed of wire mesh fence with a covering of burlap or some other suitable material on the upper side of the fence and anchored into the soil.
 - 2. The Contractor shall be required to maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by the Engineer. The silt accumulation at the fence shall be leveled and seeded upon removal of the fence. The silt fence becomes the property of the Contractor whenever the fence is removed.
- D. Temporary Turbidity Curtain
 - 1. Install per manufacturers' specifications and remove upon completion of work.

3.05 MAINTENANCE

- A. The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Contractor.

- B. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled such work shall be performed by the Contractor at his own expense.
- C. Where the work to be performed is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls and falls within the Specifications for a work item that has a contract price, the units of work shall be paid for at the proper contract prices.

3.06 EROSION CONTROL OUTSIDE PROJECT AREA

- A. Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads and equipment storage sites. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed.

END OF SECTION

Part 1 General

1.01 Extent of the Work

- A. The extent of concrete work is shown on the Drawings.

1.02 Quality Assurance

- A. Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301, Specifications for Structural Concrete for Buildings.
 - 2. ACI 302, Guide for Concrete Floor and Slab Placement.
 - 3. ACI 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
 - 4. ACI 305, Hot Weather Concreting.
 - 5. ACI 306, Cold Weather Concreting.
 - 6. ACI 308, Standard Practice for Curing Concrete.
 - 7. ACI 315, Detailing Manual.
 - 8. ACI 318, Building Code Requirements for Reinforced Concrete.
 - 9. ACI 347, Recommended Practice for Concrete Formwork.
 - 10. ACI 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 11. CRSI Manual of Standard Practice.
- B. The Contractor is responsible for correcting concrete work that does not conform to the specified requirements, including requirements for strength, tolerances, and finishes. Correct deficient concrete as directed by the Engineer.
- C. Materials and installed work may require testing and retesting, as directed by the Engineer and paid for by the Soils and Concrete Testing Cash Allowance. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.

1.03 Submittals

- A. Submit manufacturer/supplier certifications for aggregate and cement. Provide the project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, materials manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results.
- B. Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, water stops, joint systems, curing and sealing compounds, and others requested by the Engineer.
- C. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315, Detailing Manual, showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Show on the shop drawings special reinforcement required and openings through concrete structures.
- D. Submit mix design in accordance with ACI requirements. Provide for each mix design, the project name, city, general contractor, concrete strength, and its intended use.
- E. Submit 2 copies of laboratory test reports with standard deviation analysis or trial batch data. All concrete materials shall be listed.
- F. Submittals shall be approved by the Engineer prior to procurement or fabrication of materials.

Part 2 Products

2.01 Form Materials

- A. Forms for Exposed Finish Concrete: Unless otherwise specified or shown on the Drawings, construct formwork for exposed concrete surfaces with plywood, metal, metal framed plywood, or other panel type materials acceptable to the Engineer in order to provide exposed surfaces that are continuous, straight, and smooth. To minimize the number of joints and to conform to the joint system shown on the Drawings, furnish panels in the largest practicable sizes. Provide form material that is thick enough to withstand pressure of newly placed concrete without bowing or deflection.
- B. Forms for Unexposed Finish Concrete: For surfaces that will be unexposed in the finished structure, form concrete with plywood, lumber, metal, or other material acceptable to the Engineer. If lumber is used, it shall be dressed on at least two edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form coating compounds that will not bond with, stain, or adversely affect concrete surface and that will not impair

subsequent treatments of concrete surfaces to be cured with water or curing compound.

2.02 Reinforcing Materials

- A. Reinforcing Bar: ASTM A615, Grade 60.
- B. Supports for Reinforcement: Provide supports for reinforcement, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Unless otherwise indicated on the Drawings, use wire type bar supports complying with CRSI recommendations. Wood, brick, and other devices will not be acceptable. Comply with the following:
 - 1. For slabs on grade, where wetted base material will not support chair legs, use supports with sand plates or horizontal runners.
 - 2. For concrete surfaces exposed to view, where leg supports are in contact with forms, provide supports with legs that are hot dip galvanized or protected by either plastic or stainless steel.

2.03 Concrete Materials

- A. Portland Cement: ASTM C150, Type I or I/II. Use only one brand of cement throughout the project, unless otherwise acceptable to the Engineer.
- B. Fine and Coarse Aggregates: ASTM C33.
- C. Water: Clean, fresh, drinkable.
- D. Admixtures
 - 1. Water Reducing Admixture: Eucon WR 75, WR-91 or MR by the Euclid Chemical Company, Pozzoloth 220-N by Master Builders, or WRDA 15 by W.R. Grace. The admixture shall conform to ASTM C494, Type A, and not contain more chloride ions than are present in municipal drinking water.
 - 2. Water Reducing, Retarding Admixture: Eucon Retarder 75 by the Euclid Chemical Company or Pozzoloth 100 XR by Master Builders. The admixture shall conform to ASTM C494, Type D, and not contain more chloride ions than are present in municipal drinking water.
 - 3. Mid-range Water Reducing Admixture: Eucon MR or Plastol 341 by the Euclid Chemical Company, Polyheed 997 by Master Builders or Daracem SD by W.R. Grace. The admixture shall conform to ASTM C494 Type A.
 - 4. Nonchloride Accelerator: Accelguard 80, Accelguard 90 or NCA by the Euclid Chemical Company or Darex Set Accelerator by W. R. Grace. The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water.

5. Air Entraining Admixture: AEA-92 by Euclid Chemical Corporation, MB AE-90 by Master Builders, or Darex AEA by W.R. Grace. The admixture shall conform to ASTM C260.
6. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
7. Certification: Written conformance to the aforementioned requirements and the chloride ion content will be required from the admixture manufacturer prior to mix design review by the Engineer.

2.04 Related Materials

- A. Contraction/Construction Joint Filler: The joint filler shall be a two (2) component 100% solids compound, with a minimum shore A hardness of 80. Products: Subject to compliance with requirements, provide "Euco 700 or QWIK Joint" by the Euclid Chemical Company, "Sikadur 51 SL" by Sika Chemical Corporation, or MM-80 by Metzer/McGuire.
- B. Moisture Retaining Covering: One of the following, complying with ASTM C171:
 1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene coated burlap.
 4. Waterborne, Membrane Forming Compound: ASTM C309, Type 1, Class B.
- C. Curing and Sealing Compound: Kurez DR VOX or Kurez W VOX by the Euclid Chemical Company, Master Kure 200W by Master Builders or Kure-n-Seal by Sonneborn. The compound shall conform to FS TT C 800A, 30 percent solids content minimum, and have test data from an independent laboratory indicating a maximum moisture loss of 0.030 gram per square centimeter when applied at a coverage rate of 300 square feet per gallon. Manufacturer's certification is required.
- D. Bonding Compound: Euco Weld by Euclid Chemical Company or Weldcrete by the Larsen Company. The compound shall be a polyvinyl acetate, rewettable type.
- E. Epoxy Adhesive: Euco Epoxy No. 452 or No. 620 by Euclid Chemical Company, Sikadur Hi Mod by Sika Chemical Corporation, or Epcon Ceramic 6 by ITW Ramset. The compound shall conform to ASTM C881, be a 2 component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces.
- F. Nonshrink Grout: Euco NS by the Euclid Chemical Company or Masterflow 713 by Master Builders. The grout shall conform to CRD C 621 80, "Corps of Engineers Specification for Nonshrink Grout."

2.05 Mix Design

- A. Preparation

1. Prepare design mixes for each type and strength of concrete in accordance with applicable provisions of ACI-318 and ASTM C94. Use an independent testing facility acceptable to the Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same one used for field quality control testing unless this is acceptable to the Engineer. Submit to the Engineer written reports of each proposed mix in accordance with Section 01 33 23.
 2. The design mix shall provide normal weight concrete with compressive strength as indicated on the Drawings.
- B. Water/Cementitious Ratio:
1. All concrete subject to freezing and thawing shall have a maximum water/cement ratio of 0.45 (4000 psi at 28 days or more). All trowel finished interior slabs, subjected to vehicular traffic, shall have a maximum water/cement ratio of 0.45.
- C. Admixtures
1. All concrete slabs placed at air temperatures below 50 degrees F shall contain the specified nonchloride accelerator. All concrete required to be air entrained shall contain an approved air entraining admixture. All pumped concrete, fiber concrete, concrete for floor slabs, and concrete with a water/cement ratio below 0.50 shall contain the specified high range water reducing admixture (superplasticizer) or mid-range water reducing admixture.
 - a. Use an air entraining admixture in all concrete structures and slabs exposed to freezing and thawing or subjected to hydraulic pressure:
 - 1) 2.5 percent to 5.5 percent for maximum 2 inches aggregate.
 - 2) 4.5 percent to 7.5 percent for maximum 3/4 inch aggregate.
 - 3) 5.5 percent to 8.5 percent for maximum 1/2 inch aggregate.
 2. Use the amounts of admixtures recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities and types of admixtures as required to maintain quality control.
- D. Slump Limits
1. All concrete containing the high range water reducing admixture (superplasticizer) shall have a maximum slump of 8 inches unless otherwise approved by the Engineer. The concrete shall arrive at the job site at a slump of 2 inches to 3 inches and be verified; then the high range water reducing admixture shall be added to increase the slump to the approved level.
 2. All other concrete shall have a maximum slump of 3 inches for slabs and 4 inches for other members.

2.06 Proportioning

A. Ready Mix Concrete

1. Comply with the requirements of ASTM C94 and of these specifications.
2. During hot weather or under conditions that contribute to rapid setting of concrete, a shorter mixing time than that specified in ASTM C94 may be required. When the air temperature is between 85 degrees and 90 degrees F, reduce the mixing and delivery time from 1 1/2 hours to 75 minutes; when the air temperature is above 90 degrees F, reduce the mixing time to 60 minutes.
3. Each load of concrete arriving at the job shall be accompanied by a delivery ticket that shall be collected by the Contractor and submitted to the Owner's representative and shall contain the following information:
 - a. The design mix and strength of mix of concrete being delivered.
 - b. The exact time the cement, aggregate, and water were discharged into the delivery truck.

Part 3 Execution

3.01 Forms

- A. Design, erect, support, brace, and maintain formwork to support any vertical and lateral loads that may be applied until such loads can be supported by the concrete structure. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position. Design and construction of form work shall be the responsibility of the Contractor.
- B. Design formwork so that it can be readily removed without impact, shock, or damage to cast in place concrete surfaces and adjacent materials.
- C. Construct forms complying with ACI 347 and ACI SP-4 to the sizes, shapes, lines, and dimensions shown on the Drawings so that in the finished structures the work will be level and plumb and have accurate alignment, location, and grade within the tolerance limits of ACI 301. Provide for openings, offsets, linkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features that the work requires. Use selected materials to obtain the required finishes. Butt joints solidly, and provide backup at joints to prevent leakage of cement paste.
- D. Fabricate forms so that they can be easily removed without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep for the concrete to be placed with bottom forms only. To form keyways, reglets, recesses, and the like, kerf wood inserts to prevent swelling and to permit easy removal.

- E. Where the interior area of formwork is not accessible for cleanout, provide temporary openings to permit concrete placement and inspection before the concrete is placed. Brace temporary openings securely and set them tightly to forms to prevent the loss of concrete mortar. Position temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as shown on the Drawings, using wood, metal, PVC, or rubber chamfer strips fabricated to produce smooth, uniform lines and tight edge joints.
- G. Use metal form ties that are factory made, adjustable in length, designed to prevent form deflection, and either removable or snap off and that will prevent the concrete surface's being spalled when the ties are removed. If snap off ties are used, the portion remaining within the concrete after removal must be at least 1 1/2 inches inside the concrete and be provided with a waterproofing washer unless the Drawings indicate otherwise.
- H. Unless the Drawings indicate otherwise, provide form ties that will not leave holes larger than 1 1/2 inches in diameter in the concrete surface.
- I. Provide openings in concrete formwork to accommodate the work of other trades. Determine the size and location of openings, recesses, and chases from the trades providing such work. Accurately place and securely support items built into forms.
- J. Clean thoroughly forms and adjacent surfaces that are to receive concrete. Remove chips, wood, sawdust, dirt, sediment, and any other debris just before the concrete is placed. After concrete placement, retighten forms if necessary to eliminate mortar leaks.

3.02 Placing Reinforcement

- A. For details and methods of placing reinforcement and supports, comply with the specified codes and standards, the recommended practice of the CRSI as outlined in "Placing Reinforcing Bars," and these specifications.
- B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials that reduce or destroy the bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement with metal chairs, runners, bolsters, spacers, and hangers as required for security.
- D. Place reinforcement to obtain at least the minimum coverage for concrete protection as required by ACI 318 and ACI 350 as applicable. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so that ends are directed into the concrete, not toward exposed concrete surfaces.

- E. Do not place reinforcing bars more than 2 inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment or similar construction loads.
- F. Install welded wire fabric in lengths that are as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.03 Joints

- A. Locate and install construction joints, as shown on the Drawings, or specified herein, so that the strength and appearance of the structure will not be impaired.
- B. Provide keyways at least 1 1/2 inches deep in construction joints that are in walls and slabs or between walls and footings. Bulkheads designed for this purpose may be used if accepted by the Engineer. Omit keyway where steel waterstops are shown between walls and footings.
- C. Construct isolation joints in slabs on the ground wherever there is contact between slabs on the ground and vertical surfaces and wherever else indicated on the Drawings.
- D. Install joint filler and sealant materials as specified by the manufacturer.
- E. Construct contraction (control) joints in slabs on ground to form panels of patterns as shown. The soff-cut saw system shall be used immediately after final finishing and to a depth of 1/3 slab thickness. A conventional saw shall be used as soon as possible without dislodging aggregate and to a depth of 1/3 slab thickness, if the initial soff-cut did not achieve the 1/3 depth.
- F. Install semi-rigid joint filler or joint sealant in accordance with the direction of the manufacturer.
- G. The maximum joint spacing (in feet) of slabs on grade shall be 30 times the slab thickness (in inches) unless otherwise shown on the Drawings.

3.04 Installation of Embedded Items

- A. Set and build into the work anchoring devices and other embedded items required for other work that are to be attached to or supported by cast in place concrete. Use setting drawings, diagrams, instructions, and directions provided by the suppliers of the items to be attached thereto.
- B. Set edge forms or bulkheads and intermediate screed strips for slabs in order to provide the elevations and contours in the finished slab surface required by the Drawings. Provide units strong enough to support the types of screed strips used, and secure with strike off templates or compacting screeds accepted by the Engineer.

3.05 Preparation of Form Surfaces

- A. Before placing reinforcement, coat the contact surfaces of forms with a form coating compound.
- B. Thin the form coating compound only with the amount and type of thinning agent and only under the conditions recommended by the compound manufacturer. Do not allow excess form coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply the form coating compound in compliance with the manufacturer's instructions.
- C. Coat steel forms with a non-staining, rust preventive form oil, or otherwise protect against rusting. Rust stained steel formwork is not acceptable.

3.06 Concrete Placement

- A. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades that the formwork is complete so that they may then install their work; cooperate with other trades in setting such work. Wherever form coatings are not used, wet wood thoroughly just before placing concrete.
- B. Coordinate the installation of joint materials and moisture barriers with the placement of forms and reinforcing steel.
- C. Deposit concrete either continuously or in layers thick enough to prevent its being placed on concrete that has hardened enough to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as close to its final location as practicable in order to avoid segregation due to rehandling or flowing.
- D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner that avoids inclined construction joints. Where placement consists of several layers, avoid cold joints by placing each layer while the preceding one is still plastic.
- E. Use mechanical vibrating equipment supplemented by hand spading, rodding, or tamping to consolidate placed concrete. The equipment and procedures used to consolidate the concrete shall comply with the recommended practices of ACI 309 and suit both the type of concrete and project conditions.
- F. Do not use vibrators to transport concrete once it is inside the forms. Insert and withdraw vibrators vertically at uniformly spaced locations no further apart than the visible horizontal effectiveness of the machine. Limit layer heights so that the vibrator is effective into 6 inches of the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete, and complete embedment of reinforcement and other embedded items without causing segregation of the mix. Lower frequency vibrators may be used with "flowing" concrete.

- G. Until the placing of a panel or section is completed, deposit and consolidate concrete slabs in a continuous operation within construction joints.
- H. Consolidate concrete during placing operations so that it is thoroughly worked around reinforcement and other embedded items and into corners.
- I. Bring slab surfaces to the correct level with a straightedge and strike off. Use highway bull floats or darbies to smooth the surface, leaving it free from humps and hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces before starting finishing operations.
- J. Maintain reinforcement in the proper position during placement operations.
- K. Cold Weather Placement
 - 1. Comply with ACI 306 and the requirements herein specified to protect concrete work from physical damage or reduced strength due to frost, freezing, or low temperatures.
 - 2. When the air temperature has fallen or is expected to fall below 40 degrees F, heat all water and aggregates uniformly before mixing so that the concrete, at point of placement, will have a temperature of not less than 50 degrees nor more than 80 degrees F.
 - 3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 4. Use only the specified nonchloride accelerator. Do not use calcium chloride or admixtures containing more than 0.05 percent chloride ions.
- L. Hot Weather Placement
 - 1. When the weather is hot enough to impair the concrete's quality and strength, place the concrete as specified herein and in ACI 305.
 - 2. Cool ingredients before mixing so that when the concrete is placed, its temperature is below 90 degrees F. Mixing water may be chilled, or else a portion of the water may be in the form of chopped ice.
 - 3. If reinforcing steel becomes hotter than the ambient air temperature, cool it with water soaked burlap so that its temperature will not exceed the ambient air temperature.
 - 4. When high temperatures and/or placing or humidity conditions dictate, the mix may be initially retarded by use of the water reducing, retarding formulation (Type D) of the specified water reducing admixture (Type A).

3.07 Finish of Formed Surfaces

- A. Rough Form Finishes: For formed concrete surfaces not exposed to view in the finished work or covered by other construction, use a rough form finish unless other-

wise indicated by the Drawings. Repair and patch tie holes and defective areas, and rub down or chip off fins and other projections more than 1/4 inch high.

- B. Smooth Form Finish: For formed concrete surfaces that are exposed to view or to be covered with a coating or covering material applied directly to the concrete or a covering material bonded to the concrete (e.g., waterproofing, dampproofing, painting, etc.), use a smooth form finish. This is the as cast finish obtained on the concrete surface when the selected form facing material is regularly and symmetrically arranged with a minimum of seams. Repair and patch defective areas so that all fins and other projections are completely removed and smoothed.
- C. Rubbed Finish: At all formed surfaces exposed inside and outside the structure, apply rubbed finish as follows:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Uniform Finishes:
 - 1. At the tops of walls, horizontal offsets, and similar unformed surfaces that are next to formed surfaces, strike off smooth and finish with a texture that matches the adjacent formed surfaces. Unless otherwise shown on the Drawings, continue the final surface treatment of formed surfaces uniformly across adjacent unformed finishes.
- E. Float Finish
 - 1. Apply float finish to monolithic slab surfaces that are to receive a trowel finish or other finishes specified hereinafter; to slab surfaces that are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand bed terrazzo; and as otherwise indicated by the Drawings or schedules.
 - 2. After screening, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened enough to permit the operation of power driven floats or by hand floating if the area is small or inaccessible to power units. Check and level the surface plane so that the surface conforms to the specified FF/FL17 tolerance.
- F. Trowel Finish
 - 1. Apply a trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise indicated by the Drawings, and to slab surfaces that are to be covered with resilient flooring, paint, or other thinfilm finish coating.
 - 2. After the slab has received a floated finish, begin first trowel finish operation using a power driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over it. Surface shall be troweled until it is free of trowel marks, is uniform in texture and has a smooth dense ap-

pearance, and achieves an FF30/FL25 tolerance. Grind smooth any surface defects that would telegraph through the applied floor covering.

G. Nonslip Broom Finish

1. Apply nonslip broom finish to exterior concrete platforms, steps, and ramps and elsewhere as indicated by the Drawings or schedules.
2. Immediately after float finishing, roughen the concrete surface slightly by brooming perpendicular to the main traffic route with a fiber bristle broom. Texture shall be as approval by the Engineer from sample panels.

H. Nonslip Finish: Where the contract documents require a nonslip finish, give the surface a "dry shake" application of crushed ceramically bonded aluminum oxide or other specified selected abrasive particles. The rate of application of such material shall be not less the 25 pounds per 100 SF.

3.08 Curing

- A. After placing and finishing the concrete, start initial curing of concrete as soon as free water has disappeared from concrete surface. Keep continuously moist for not less than 7 days.
- B. Begin final curing immediately after final finishing. Continue final curing for at least 7 days in accordance with ACI 301 and ACI 308. Avoid rapid drying at the end of the final curing period.
- C. Cure concrete by moist curing, moisture retaining cover curing, membrane curing, or combinations of these methods, as specified herein and ACI 308.
- D. Provide moisture curing by one of the following methods:
 1. Keep concrete surface continuously wet by covering with water.
 2. Spray it continuously with a water fog.
 3. Cover the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water and keeping it wet; position the absorptive cover so that it covers the concrete surface and edges and laps adjacent absorptive covers by 4 inches.
- E. Provide moisture cover curing by covering concrete surfaces with a moisture retaining cover designed for curing concrete. Place the cover in the widest practicable width of material with sides and ends of the material lapped at least 3 inches and sealed by waterproof tape or adhesive. Repair immediately any holes or tears that occur during the curing period with identical cover material and waterproof tape.
- F. Provide membrane curing to slabs as follows: All interior slabs that have resilient tile or carpet or are left exposed and all exterior slabs, sidewalks, curbs, etc., shall be cured with the specified clear curing and sealing compound. The compound shall be applied immediately after final finishing operations are completed. Apply

uniformly in a continuous operation by power spray or roller in accordance with the manufacturer's directions. Areas that are subjected to heavy rainfall within 3 hours after initial application shall be recoated. Maintain continuity of coating, and repair damage during the curing period.

- G. Cure formed concrete surfaces (including undersides of beams, supported slabs, and other similar surfaces) by moist curing with forms in place for the full curing period or until the forms are removed. If forms are removed, continue curing by the methods specified above, as applicable.
- H. Cure unformed surfaces such as slabs, floor topping, and other flat surfaces by the application of the specified curing and sealing compound, strippable curing compound or by a moist curing method approved by the Engineer.

3.09 Removal and Reuse of Forms

- A. Formwork not supporting weight of concrete (e.g., sides of beams, walls, columns, and similar parts of the work) may be removed after curing at a temperature of not less than 50 degrees F 24 hours after the concrete is placed, provided the concrete is hard enough not to be damaged by form removal operations and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete (e.g., beam soffits, joints, slabs, and other structural elements) may not be removed for at least 14 days nor until the concrete has attained a design minimum compressive strength of 28 days. Determine the potential compressive strength of in place concrete by testing the field cured specimens representative of the concrete location or members.
- C. Form facing material may be removed 4 days after concrete placement only if shores and other vertical supports have been arranged to permit it to be removed without loosening or disturbing shores and supports.
- D. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact form surfaces as specified above for new formwork.
- E. When forms are extended for successive concrete placement, clean surfaces thoroughly, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces.

3.10 Miscellaneous Concrete Items

- A. Filling In: Unless the Drawings show otherwise or the Engineer directs, fill in holes and openings left in concrete structures for the work of other trades once that work is in place. Mix, place, and cure concrete as specified herein to blend with in place construction. Provide other miscellaneous concrete filling shown on the Drawings or necessary to complete the work.

- B. Nonshrink Grout: All column base plates, equipment bases, and other locations noted on the structural drawings shall be grouted with the specified nonshrink grout. All exposed grout shall be of the specified nonmetallic type.
- C. Reinforced Masonry: Provide concrete grout for reinforced masonry lintels and bond beams where indicated on the Drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.11 Concrete Surface Repairs

- A. Repair and patch defective areas with cement mortar immediately after removing forms.
- B. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete, but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water, and apply the specified bonding compound. The cement mortar shall be placed after the bonding compound has dried.
- C. Remove and replace concrete with defective surfaces if these effects cannot be repaired to the satisfaction of the Owner and Engineer. Such surface defects include irregularities of color and texture, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, and fill with dry pack mortar or with precast cement cone plugs secured in place with bonding agent.
- D. Where possible, repair concealed formed surfaces that contain defects which adversely affect the durability of the concrete. If such defects cannot be repaired, remove and replace the concrete.
- E. Test unformed surfaces such as monolithic slabs for smoothness and to verify that the surface plane meets the tolerances specified for each surface and finish. Correct low and high areas as specified herein. Test unformed surfaces sloped to provide drainage for both trueness of slope and smoothness with a template of the slope specified on the Drawings.
- F. Repair finished unformed surfaces that contain defects which adversely affect durability of the concrete. Such surface defects include crazing, spalling, pop outs, honeycomb, rock pockets, cracks that are more than 0.01 inch wide or that, regardless of width, penetrate either to reinforcement or completely through unreinforced sections, and other objectionable conditions.
- G. After the concrete has cured at least 14 days, correct high areas in unformed surfaces by grinding.
- H. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting them out and refilling with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.

- I. Repair defective areas (except for random cracks and single holes not more than 1 inch in diameter) by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete, and apply the specified bonding compound. Place patching concrete after the bonding compound has dried. Mix patching concrete of the same materials to provide concrete of the same type or class as the original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
- J. Repair isolated random cracks and single holes not over 1 inch in diameter by the dry pack method. Groove top of cracks, cut out holes until sound concrete is reached, and clean to remove dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply the specified bonding compound. Place dry pack after the bonding compound has dried. Dry pack shall consist of 1 part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve. Mix with no more water than is necessary for handling and placing. Compact dry pack mixture in place, and finish to match adjacent concrete. Keep patched area continuously moist for no less than 72 hours.
- K. All structural repairs shall be made, with prior approval of the Engineer as to the method and procedure, using the specified epoxy adhesive and/or epoxy mortar.
- L. Repair methods not specified above may be used, subject to acceptance by the Engineer.

3.12 Quality Control Testing During Construction

- A. The Contractor will employ a testing laboratory to perform any or all of the tests specified below and to submit reports on these tests. The testing laboratory shall be approved by the Owner and shall be paid for by the Soils and Concrete Testing Cash Allowance. Sampling and testing for quality control during the placement of concrete may include the following, as directed by the Engineer:
 - 1. Sampling Fresh Concrete: ASTM C172, but modified for slump to comply with ASTM C94.
 - 2. Slump: ASTM C143; one test for each concrete load at point of discharge and one test of each set of compressive strength test specimens.
 - 3. Air Content: ASTM C173 volumetric method for lightweight concrete; ASTM C231 pressure method for normal weight concrete; one test for each set of compressive strength test specimens.
 - 4. Water Content: The water content of freshly mixed concrete will be tested each time cylinders are made and as directed by the Engineer in accordance with AASHTO TP 23, Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

5. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below or when 80 degrees F and above and each time a set of compression test specimens is made.
 6. Compression Test Specimen: ASTM C31; one set of 6 standard cylinders for each compressive strength test, unless otherwise directed by the Engineer. Mold and store cylinders of laboratory cured test specimens except when the Engineer requires field cured test specimens.
 7. Compressive Strength Tests: ASTM C39; one set for each 100 cubic yards or fraction thereof of each concrete class placed in any one day or one set for each 5,000 square feet of surface area placed; 2 specimens tested at 7 days, 2 specimens tested at 28 days, and 1 specimen retained in reserve for later testing, if needed.
- B. When the frequency of testing provides less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or, if fewer than 5 are used, from each batch.
 - C. The strength level shall be considered satisfactory as long as the averages of all sets of 3 consecutive strength test results equal or exceed the specified strength f'_c , and no individual test result falls below the specified strength f'_c by more than 500 psi.
 - D. When the strength of field cured cylinders is less than 85 percent of companion laboratory cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in place concrete.
 - E. Test results will be reported to the Engineer and Contractor in writing on the same day that the test is made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, and compressive breaking strength and type of break for both 7 day tests and 28 day tests.
 - F. Non-Compliant Test Reports: All test reports indicating non-compliance should be provided immediately to all parties on the test report distribution list.
 - G. The testing service will make additional tests of in place concrete when the test results indicate that the required strength level has not been achieved and other characteristics have not been attained in the structure, as directed by the Engineer. The testing service may conduct tests to determine the adequacy of concrete by cored cylinders that comply with ASTM C42 or by such other methods as are directed by the Engineer. The Contractor shall pay for such tests and any additional testing that may be required when concrete is verified to be unacceptable.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Excavating and filling for rough grading the Site.
 - 2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
 - 3. Excavating and backfilling for buildings and structures.
 - 4. Subbase course for concrete walks and pavements.
 - 5. Subbase course and base course for asphalt paving.
 - 6. Subsurface drainage backfill for walls and trenches.
 - 7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.03 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subgrade course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated. All excavation to design depth is unclassified.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits,

and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering or ripping.

- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.04 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct pre-excavation conference at Project site.
 - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Dewatering.
 - e. Field quality control.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Warning tapes.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.

1.07 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.08 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify "811 Call Before You Dig" for area where Project is located before beginning earth-moving operations.
- C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.
- D. Do not commence earth-moving operations until plant-protection measures specified in Section 01 56 39 "Temporary Tree and Plant Protection" are in place.
- E. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

Part 2 PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
 - 1. Liquid Limit: Less than 50.

2. Plasticity Index: Less than 25.
- C. Unsatisfactory Materials: Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches.
 - D. Cohesionless and Cohesive Materials: Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.
 - E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
 - F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
 - G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
 - H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.
 - I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.
 - J. Sand: ASTM C 33/C 33M; fine aggregate.
 - K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
 - a. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
 - b. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
 - c. Tear Strength: 56 lbf (250 N); ASTM D 4533.
 - d. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
3. Apparent Opening Size: **No. 70 (0.212-mm)** sieve, maximum; ASTM D 4751.
4. Permittivity: 0.1 per second, minimum; ASTM D 4491.
5. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.

2.03 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
 1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

Part 3 EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.03 EXCAVATION, GENERAL

- A. Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches (600 mm) outside of concrete forms other than at footings.
 - b. 12 inches (300 mm) outside of concrete forms at footings.
 - c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
 - f. 6 inches (150 mm) beneath pipe in trenches and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.04 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
1. Excavate by hand or with an air spade to indicated lines, cross sections,

elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.05 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.06 EXCAVATION FOR UTILITY TRENCHES

- A. Coordinate this article with utility Sections in other Divisions.
- B. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- C. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: As indicated.
- D. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
- E. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
- F. Trenches in Tree- and Plant-Protection Zones:
 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 3. Cut and protect roots according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

3.07 SUBGRADE INSPECTION

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.

- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavement with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Geotechnical Engineer.

3.08 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.09 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- C. Backfill voids with satisfactory soil while removing shoring and bracing.
- D. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 - 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.
- E. Final Backfill:
 - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
 - 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- F. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.11 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 3 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under structures and building slabs, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 98 percent.
 2. Under pavements scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 3. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 90 percent.
 4. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 5. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
 2. Walks: Plus or minus 1 inch (25 mm).
 3. Pavements: Plus or minus 1/2 inch (13 mm).

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.15 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 2-inch (50-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.

3.16 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 1. Shape base course to required crown elevations and cross-slope grades.
 2. Place base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 3. Place base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 4. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Geotechnical Engineer.

- D. Testing agency will test compaction of soils in place according to ASTM D 1556 and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Geotechnical Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, to the approved spoil site location. Alternate spoil pile location may be used if prior approval is obtained from the Owner and Engineer. Remove trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

PART 1 – GENERAL

1.01 SCOPE

- A. The work covered by this Section consists of furnishing all labor, equipment, and material required to provide and place topsoil on the site, including compacting, fine grading, raking, and other placement operations on graded earthen areas to receive topsoil as described herein and/or as shown on the Drawings. In general, topsoil operations shall be conducted on all newly graded earthen turf areas not covered by structures, pavement, or sidewalks; all cleared or grubbed areas which are to remain as finished grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be topsoiled according to these Specifications.

PART 2 – PRODUCTS

2.01 TOPSOIL

- A. Topsoil shall be natural or amended topsoil found on the site which is pushed back or stockpiled during construction of the project. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than ½ inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips, or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and perennial weed seeds, and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements or vegetable debris undesirable or harmful to plant life.
- B. Offsite topsoil shall be provided as necessary to meet these specifications and/or as shown on the drawings.

PART 3 – EXECUTION

3.01 STRIPPING TOPSOIL

- A. Strip any available topsoil to its full depth at all areas to be regraded, resurfaced, or paved within contract limit work area.
- B. Stockpile topsoil in locations acceptable to the Owner, for use in finish grading.
1. Stockpiled topsoil shall be free from trash, brush, stones, and other extraneous matter.
 2. Grade and slope stockpiles for proper drainage and to prevent erosion.
 3. **No topsoil shall be removed from the site.** It is the property of the Owner.

- C. Protect all areas which are not to be resurfaced or regraded, and adjacent areas outside of the contract limits from damage due to site preparation and performance of the Work.

3.02 PLACING TOPSOIL

- A. Contractor shall spread topsoil, or re-grade existing topsoil, to a thickness of at least 4 inches over all surrounding site finished contours, except areas required to be finished with material other than topsoil in accordance with the Drawings. Use loose, dry topsoil. Do not use frozen or muddy topsoil. Place during dry weather.
- B. On-site sources of topsoil shall be approved by the Engineer prior to disturbance.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles, and contours of subgrades.
- D. Remove stones, roots, weeds, and debris while spreading topsoil materials. Rake surface clean of stones 1" or larger in any dimension and all debris. Provide surfaces suitable for seedbed preparation.

3.03 MAINTENANCE

- A. Protect finish graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and damaged areas.
- B. Where completed areas are disturbed by construction operations or adverse weather, scarify, reshape, and compact to required density.

END OF SECTION

PART 1 – GENERAL

- 1.01 This work shall consist of installing, repairing, maintaining, and removing Type II or III turbidity curtains in accordance with the manufacturer's recommendations and as directed by the Engineer.

PART 2 – PRODUCTS

- 2.01 The turbidity curtain shall be a commercially available, preassembled system, including a Geotextile, flotation system, bottom weight, and anchoring and securing mechanism. If assembled in panels, it shall include a secure mechanism for joining panels together.

Hemmed pockets shall be sewn or heat bonded to contain flotation material, bottom weights, and for anchor lines. The flotation material shall maintain buoyancy if punctured or cut. The bottom weight shall be sufficient to hold the curtain in a vertical position. The curtain shall be capable of molding to conform to bottom contours so that suspended sediment is prevented from escaping underneath the curtain.

Anchorage lines shall be provided of sufficient strength and number to support the curtain and maintain it in position under normally expected conditions. End anchors shall be provided, with intermediate anchor points (for stakes or anchors) such that unanchored spans do not exceed 100 feet, sufficient to maintain the turbidity curtain in place. Where the turbidity curtain is constructed in panels, anchor-line and shackle connections securing the panels together shall be sufficient for normally expected current, wind, or wave conditions.

PART 3 – EXECUTION

3.01 SYSTEM REQUIREMENTS

- A. Perform all work in accordance with manufacturer's recommendations.
- B. The curtain height shall provide sufficient slack to allow the top of the curtain to rise to the Maximum expected highwater level (including waves) while the bottom maintains continuous contact with the bottom of the water body. The bottom edge of the curtain shall have a weight system capable of holding the bottom of the curtain down and conforming to the bottom of the water body, so as to prohibit escape of turbid water under the curtain.
- C. If constructed in panels, panels shall be connected in such a manner as to prevent suspended particles passing through joints. Load lines shall be connected so as to develop the full strength of the line across the joint. Use a minimum continuous span of 50 feet between joints, maximum span of 100 feet between joint anchors.
- D. Flotation material shall be arranged so as to be flexible and to provide continuous support.

- E. The flotation and curtain top shall be such as to provide a minimum of 4 inches of freeboard along the entire length of the curtain, to prohibit escape of turbid water over the top.

3.02 INSTALLATION

- A. The turbidity curtain shall be installed in accordance with the manufacturer's instructions. It shall be placed close to the site of disturbance as possible without interfering with construction activity.
- B. Turbidity curtain shall be installed and maintained in a manner that precludes entry of equipment, other than hand-held equipment or boats, to the water body outside the protected area.
- C. The fully assembled turbidity curtain shall be prepared for installation by being furled and tied at intervals of 5 foot for the length of the curtain. It shall be placed and secured in the furled condition, then released to allow the bottom edge to sink.
- D. At sites subject to tidal or heavy wave action, adjustment lines may be used to achieve the required height of the curtain.
- E. At sites not subject to tidal or heavy wave action, excess curtain material shall lay on the bottom, away from construction activity.
- F. The ends of the installation shall be anchored securely well up the bank. Intermediate anchors of a type and number sufficient to hold the curtain in place under expected conditions shall be placed, and firmly fastened to the top of the curtain assembly.

Maximum spacing between anchorage points shall not exceed 100 feet.

3.03 MAINTENANCE

- A. The turbidity curtain shall be inspected daily, with additional monitoring of performance during storms or significant flow events.
- B. Any visible plume of cloudy water passing beyond the curtain from the enclosed construction area shall constitute inadequate performance of the turbidity curtain. The
- C. Contractor shall immediately modify, adjust, or repair any portion of the turbidity curtain to correct inadequate performance.
- D. The turbidity curtain shall remain in place until the protected construction activities have ceased and the turbidity of the water enclosed is reduced to acceptable levels.

The curtain shall be removed within 72 hours of this condition being met.

3.04 REMOVAL

- A. The turbidity curtain shall be removed in such a way as to minimize release of sediment.
- B. Sediment behind the curtain shall be removed before removal of the curtain, if directed by the Engineer. If so, any resulting turbidity shall be allowed to settle before removal proceeds.

END OF SECTION

PART 1 - GENERAL

1.01 SCOPE

- A. This specification section consists of furnishing all materials, labor, and equipment required to place riprap for slope protection as shown on the Drawings.

PART 2 - PRODUCTS

2.01 CRUSHED ROCK RIPRAP

- A. The crushed rock used for riprap shall meet the requirements TDOT Specifications Section 709 for Machined Riprap, and shall meet the sizes indicated on the Drawings.

Machined Riprap Class A-1: 2" to 15" in size, 1.5' thick, machine placed

Machined Riprap Class A-2: 2" to 15" in size, 1' thick, hand placed

Machined Riprap Class A-3: 2" to 6" in size, machine placed; thickness per Drawings

2.02 SURGE STONE

- A. The crushed rock Surge Stone used for subgrade stabilization shall be well-graded 2" to 4" stone.
- B. The crushed rock used for construction entrances, etc. shall be 2" to 4" clean stone.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to placement of the riprap for slope protection, the slopes or ground surface shall be smoothed and trimmed to reasonable conformance with the lines and grades indicated on the Drawings. Excavation for key trenches beyond the specified lines shall be filled with riprap.

3.02 PLACEMENT OF RIPRAP

- A. The rock shall be delivered and placed to the depth specified on the Drawings and in a manner that prevents segregation of the larger stones from the smaller stones. The placed riprap shall be reasonably homogeneous, with the larger rock uniformly distributed and firmly in contact one to another and the smaller rocks filling in the voids between larger rocks. All finished rock slopes shall be tamped or raked by ap-

appropriate equipment to insure that all rocks are locked and remain in a stable position.

END OF SECTION

PART 1 – GENERAL

1.01 SCOPE

- A. The work covered by this Section consists of furnishing all labor, equipment, and material required to prepare seedbed, to place topsoil, seed, commercial fertilizer, agricultural limestone, and mulch material, including seedbed preparation, harrowing, compacting, and other placement operations on graded earthen areas as described herein and/or shown on the Drawings. In general, seeding operations shall be conducted on all newly graded earthen turf areas not covered by structures, pavement, or sidewalks; all cleared or grubbed areas which are to remain as finished grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- B. The work shall include temporary seeding operations to stabilize earthen surfaces during construction or inclement weather and to minimize stream siltation and erosion.

1.02 QUALITY ASSURANCE

- A. Prior to seeding operations, the Contractor shall furnish to the Engineer labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirement of this section.
- B. Prior to topsoil operations, the Contractor shall obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Services or other certified testing laboratory.
- C. All existing lawns encountered shall be replaced with topsoil and seeding of the same type and quality as that existing prior to construction and shall be restored to original condition or better.

PART 2 – PRODUCTS

2.01 TOPSOIL

- A. The Contractor shall place and prepare topsoil according to Section 31 22 19: SPREADING & GRADING TOPSOIL of these specifications, or as shown on the Drawings.

2.02 SEED

- A. Seed shall be delivered in new bags or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- B. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- C. Seed shall bear the growers analysis testing to 98 percent for purity and 90 percent for germination. At the discretion of the Engineer samples of seed may be taken for check against the growers analysis.
- D. Species, rate of seeding, fertilization, and other requirements are shown in the Seeding Requirements Table.

2.03 FERTILIZER AND LIMING MATERIALS

- A. Fertilizer and liming materials shall comply with applicable State, Local, and Federal laws concerned with their production and use.
- B. Commercial fertilizer shall be a ready mixed material and shall be equivalent to the grade or grades specified in the Seeding Requirements Table. Container bags shall have the name and address of the manufacturer, the brand name, net weight, and chemical composition.
- C. Agricultural limestone shall be a pulverized limestone having a calcium carbonate content of not less than 85 percent by weight. Agricultural limestone shall be crushed so that at least 85 percent of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

2.04 MULCH MATERIAL

- A. All mulch materials shall be air dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
- B. Mulch shall be composed of wood cellulose fiber, straw, or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch blowing equipment.
- C. Wood-cellulose fiber mulch shall be as manufactured by Weyerhaeuser Company, Conway Corporation, or equal.
- D. Straw mulch shall be partially decomposed stalks of wheat, rye, oats, or other approved grain crops.
- E. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum, or other approved standing field crops.

2.05 MULCH BINDER

- A. Mulch on slopes exceeding 3 to 1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be non-toxic to plant life and shall be acceptable to the Engineer.
- B. Emulsified asphalt binder shall be Grade SS-1, ASTM D 977. Cutback asphalt binder shall be Grade RC 70 or RC 250.

2.06 INNOCULANTS FOR LEGUMES

- A. All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.07 WATER

- A. Water shall be clean, clear water free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

PART 3 - EXECUTION

3.01 SECURING AND PLACING TOPSOIL

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Engineer.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage, and other characteristics as to offer assurance that, when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.
- C. All areas from which topsoil is to be secured, shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen, or its residue, and any other refuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such materials shall be removed from the topsoil, or if required by the Engineer, the pit shall be abandoned.
- E. Before placing or depositing topsoil upon any areas, all improvements within the area shall be completed, unless otherwise approved by the Engineer.

3.02 SEEDBED PREPARATION

- A. Before fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line free from unsightly variation, bumps, ridges and depressions, and all detrimental material, roots, and stones larger than 1/2 inch in any dimension shall be removed from the soil.
- B. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 2 inches with a

Seeding

- weighted disc, tiller, pulvimixer, or other equipment, until the surface is smooth and in a condition acceptable to the Engineer.
- C. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be placed in a condition suitable for seeding.
 - D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition.

3.03 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown in the Seeding Requirements Table. Copies of all weight tickets shall be furnished to the Engineer.
- B. Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1/2 inch.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.
- D. Agricultural limestone shall be thoroughly mixed into the soil according to the rates in the Seeding Requirements Table. The specified rate of application of limestone may be reduced by the Engineer if the pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.
- E. It is the responsibility of the Contractor to make one application of maintenance fertilizer according to the recommendations listed in the Seeding Requirements Table.

3.04 SEEDING

- A. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates shown in the Seeding Requirements table unless otherwise approved by the Engineer. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation. Copies of all weight tickets shall be furnished to the Engineer.
- B. Seeds shall be uniformly sown by any approved mechanical method to suit the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder, or approved mechanical power drawn seed drills. Hydro-seeding and hydro-mulching may be used on steep embankments, provided full coverage is obtained. Hard packing and ruts shall be prevented or repaired when hydro-seeding and hydro-mulching. Care shall be taken to adjust the seeder for seedings at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

- C. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- D. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen-fixing inoculant in accordance with the manufacturer's mixing instruction.

3.05 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and the air to circulate and at the same time shade the ground, reduce erosion, and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:
 - 1. Wood Cellulose Fiber 1,400 lbs/acre
 - 2. Straw 4,000 lbs/acre
 - 3. Stalks 4,000 lbs/acre

These rates may be adjusted at the discretion of the Engineer at no additional cost to the Owner depending on the texture and condition of the mulch material and the characteristics of the seeded area.

- C. Mulch on slopes greater than 3 to 1 ratio shall be held in place by the use of an approved mulch binder. Binder shall be thoroughly mixed and applied in accordance with manufacture's specifications.
- D. The Contractor shall cover structure, poles, fence, and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.
- E. Mulch and binder shall be applied in accordance with manufacture's specifications.

3.06 WATERING

- A. Contractor shall be responsible for maintaining the proper moisture content of the soil to insure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain an adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank trucks, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.07 MAINTENANCE

- A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris, and excess material and the premises shall be left in a neat and orderly condition.

Seeding

- B. The Contractor shall maintain all seeded areas without additional payment until a uniform stand is accomplished and until final acceptance of the seeding work by the Owner. Seeding work shall be repeated on defective areas until a uniform stand is accomplished at the Contractor's expense. Damage resulting from erosion, gulleys, washouts, or other causes shall be repaired by filling with topsoil, compacting, and repeating the seeding work at Contractor's expense.
- C. If sowing season is missed, the Contractor shall stabilize, maintain, and prevent erosion and stormwater pollution in the areas to be seeded until the appropriate sowing season, at which time appropriate seedbed preparation shall be performed and seeding operations shall resume immediately.

END OF SECTION

PART 1 – GENERAL

1.01 SCOPE

- A. The work covered by this section consists of furnishing all labor, materials, and equipment, and performing all excavation and disposal of all material as specified herein or indicated on the drawings. This scope also includes all necessary measures for protection of the environment. Environmental protection requirements under this contract are as important to overall completion of the work as other technical aspects. Failure to meet the requirements of these specifications for environmental protection may result in work stoppages or termination for default. No part of the time lost due to any such work stoppages shall be made the subject of claims for extensions of time or for excess costs or damages by the Contractor. If the Contractor fails or refuses to promptly repair any damage caused by violation of the provisions of these specifications, the Owner may have the necessary work performed and charge the cost thereof to the Contractor.

1.02 SUBMITTALS

- A. Surveys

Hydrographic surveys will be used to determine conformance to the plans. The Contractor will provide a final after-dredging (AD) survey to ensure adequate dredging to the required lines and grades. The Contractor shall submit the after-dredging survey to the Engineer for final acceptance.

1.03 UTILITY CROSSINGS

- A. General - It is the Contractor's responsibility to investigate the location of all utility crossings. The Contractor shall take precautions against damages which might result from his operations in the vicinity of the utility crossings. If any damage occurs as a result of his operations, the Contractor will be required to suspend dredging until the damage is repaired and approved by the Engineer and the Owner. Costs of such repairs and downtime of the dredge and attendant plant shall be at the Contractor's expense.

1.04 FINAL CLEANUP

- A. Final cleanup shall include the removal of all the Contractor's materials and equipment either for disposal or reuse. Equipment and/or materials to be disposed of shall only be disposed in a manner and at locations approved by the Engineer. Unless otherwise approved by the Engineer, the Contractor will not be permitted to abandon any equipment in the disposal area or other areas adjacent to the worksite.
- B. Failure to promptly remove all plant, pipeline, equipment, and materials upon

completion of the dredging shall be considered a delay in the completion of the final cleanup and demobilization work. In such case, the Owner will exercise its right, as stated in Contract Conditions, to remove any plant and/or equipment and/or materials at the Contractor's expense.

1.05 WORK VIOLATIONS

- A. Work done in violation of these specifications, associated permits, or a verbal or written stop order of the Owner/Engineer will be considered as unsatisfactory progress for purposes of progress payments (in accordance with Contract Conditions).

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.01 WORK AREA

- A. The Contractor will be permitted to exclude the public from the work areas in the immediate vicinity of his dredging, transporting, and disposal operations. The Contractor shall prevent public access to the discharge end of any pipelines. The Contractor shall erect, maintain, and move as necessary, a restrictive barrier around the Work Area and/or discharge of the hydraulic pipeline, if used. The barrier shall be constructed so as to prevent the public from approaching the discharge from any direction closer than 40 feet. The Contractor shall post signs in a conspicuous location with the wording "DANGER - HIGH PRESSURE DISCHARGE FROM DREDGE". Enforcement shall be the Contractor's responsibility at no additional cost to the Owner. The enforcement shall be coordinated with local enforcement agencies and will be subject to approval of the Owner. Additionally, the Contractor shall place a safety person at the discharge end of any disposal pipeline. The safety person shall be present at all times during discharge operations and will maintain radio communication between the dredge and the disposal operation.
- B. Protection of Existing Waterways
The Contractor shall conduct his operations in such a manner that material or other debris are not pushed outside of dredging limits or otherwise deposited in existing side channels, basins, docking areas, or other areas being utilized by vessels. The Contractor will be required to change his method of operations as may be required to comply with the above requirements. Should any bottom material or other debris be pushed into areas described above, as a result of the Contractor's operations, the same must be promptly removed by and at the expense of the Contractor to the satisfaction of the Engineer and the Owner.
- C. Adjacent Property and Structures
No dredging will be permitted within 25 feet of any structure. Any damage to private or public property or structures resulting from the disposal or dredging operations shall be repaired promptly by the Contractor at his expense. Any damage to structures as a result of Contractor's negligence will result in suspension of dredging and require prompt repair at the Contractor's expense as a prerequisite to the resumption of dredging.

D. Subaqueous Cable Crossings

The Contractor shall be responsible for verifying the locations and depths of all utility crossings and take precautions against damages which might result from his operations, especially the sinking of dredge spuds and/or anchors into the channel bottom, in the vicinity of utility crossings. If any damage occurs as a result of his operations, the Contractor will be required to suspend dredging until the damage is repaired and approved by the Owner and the Engineer. Costs of such repairs and downtime of the dredge and attendant plant shall be at the Contractor's expense.

3.02 DISPOSAL OF EXCAVATED MATERIAL

A. General

Material excavated shall be transported to and deposited in the disposal area designated on the drawings.

B. Sediment Disposal

Dredged material from the Work Area shall be placed in Disposal Area (D/A) as shown on the contract drawings. The dredged material shall be placed to the sections and limits as shown on the drawings to the extent of the dredged material.

C. Debris Removal

The Contractor shall clean and remove from the de-watering and disposal areas all debris that has been placed as a result of the disposal operation. The debris will be disposed of in a location provided by the Contractor and accepted by the Owner/Engineer. The Contractor shall continuously monitor the material as it is placed. Any dredged material that is obviously not compatible with the placement (such as significant amounts of unsuitable fill materials or debris) shall be immediately removed and reported to the Owner/Engineer.

D. Transport

Water and dredged materials shall not be permitted to overflow or spill out while transporting to the disposal site(s). Failure to repair change the method of operation which is resulting in overflow or spillage will result in suspension of dredging operations and require prompt repair or change of operation to prevent overflow or spillage as a prerequisite to the resumption of dredging..

E. Misplaced Materials

Materials deposited above the maximum indicated elevation or outside of the disposal area shown will require the re-grading or removal of such materials at the Contractor's expense. Excess material above this tolerance may be left in place or be required to be removed at the discretion of the Owner/Engineer.

3.03 ALLOWABLE OVERDEPTH AND SIDE SLOPES

A. Allowable Over-depth

To cover the inaccuracies of the dredging process, material actually removed from

Dredging

the designated areas to be dredged, to a depth below the required depth of not more than the allowable overdepth of 0.5 foot.

B. Side Slopes

Although dredging of side slope material may be necessary to provide the required project channel dimensions (depth and width), the side slopes shown on the drawings are provided for payment purposes only. Side slopes may be formed by box cutting, step cutting, or dredging along the side slope. Material actually removed, within the limits approved by the Owner/Engineer, to provide for final side slopes not flatter than that shown on the contract drawings, but not in excess of the amount originally lying above this limiting side slope.

C. Areas to be Dredged

Based on information currently available to the Engineer, areas known to require dredging are depicted on the drawings as hatched areas. The actual areas to be dredged may vary from the hatched areas shown in the drawings. In order to provide the required project dimensions within and throughout the project limits shown on the drawings, the Contractor shall remove material located within the project limits as directed by the Owner/Engineer, regardless of whether the material is located in a hatched area or not.

3.04 SURVEYS

A. General

1. The Owner/Engineer shall use the post-dredging hydrographic survey, which has been performed by a licensed surveyor, and paid for by the Contractor, as a basis for determining Final Approval and conformance to the Plans.
2. All hydrographic surveys conducted shall follow the guidelines as referenced in the Corps of Engineers Hydrographic Survey Manual EM 1110-2-1003, dated 01 January 2002, for navigation and Dredging Support Surveys, for soft bottom material. Electronic single beam cross sections, on 25-foot station intervals, will be utilized to compute the volume of material removed. All electronic echo sounders will operate nominally at 200 kHz.

B. Contractor Representative

The Owner/Engineer or his authorized representative will be notified when surveys are to be made. All in-place measurement surveys and final acceptance surveys may be performed with a representative of the Owner or Engineer present during the full execution of the survey. The Owner/Engineer shall indicate to the Contractor per each survey if they will accompany the survey crew(s). If the Owner/Engineer chooses to accompany the survey crew(s), the Owner/Engineer's representative shall be knowledgeable in surveying procedures, techniques, equipment, and horizontal and vertical calibration methods, and state-of-the-art horizontal and vertical accuracy limitations. The Owner/Engineer's representative shall observe and review, in progress, the adequacy and accuracy of the survey for in-place payment purposes, and for the potential existence of collusion, fraud, or obvious error in the data.

3.05 INSPECTION

- A. The Owner/Engineer shall be notified prior to the establishment of horizontal control work (baseline layout, ranges, station flags, etc.) and vertical control work (tide staff(s), upland cross sections, construction elevations top/invert, maximum/minimum elevations of dredged materials within disposal area(s), etc.), but the presence or absence of the Owner/Engineer shall not relieve the Contractor of his responsibility for proper execution of the work in accordance with the specifications. The Contractor will be required:

To furnish, on the request of the Owner or Engineer, the use of such boats, boatmen, laborers, and material forming a part of the ordinary and usual equipment and crew of the dredging plant as may be reasonably necessary in inspecting and supervising the work. However, the Contractor will not be required to furnish such facilities for the surveys prescribed in the paragraph FINAL EXAMINATION AND ACCEPTANCE of this Section. To furnish, on the request of the Owner or Engineer suitable transportation from all points on shore designated by the Owner/Engineer to and from the various pieces of plant, and to and from the disposal area.

- B. Failure to Comply

Should the Contractor refuse, neglect, or delay compliance with these requirements, the specific facilities may be furnished and maintained by the Owner and the cost thereof will be deducted from any amounts due or to become due the Contractor.

3.06 FINAL EXAMINATION AND ACCEPTANCE

- A. Final Examination of Work

As soon as practicable and no later than 7 days after the completion of the entire work or any section thereof (if the work is divided into sections) as in the opinion of the Owner/Engineer will not be subject to damage by further operations under the contract, such work will be thoroughly examined at the cost and expense of the Owner by sounding or by sweeping, or both, as determined by the Owner/Engineer. Should any shoals, lumps, or other lack of contract depth be disclosed by this examination, the Contractor will be required to remove same by dredging at the contract rate of dredging.

The Contractor or his authorized representative will be notified when soundings and/or sweepings are to be made and will be permitted to accompany the survey party. When the area is found to be in a satisfactory condition, it will be accepted finally. Should more than two sounding or sweeping operations by the Owner over an area be necessary by reason of work for the removal of shoals disclosed at a prior sounding or sweeping, the cost of such third and any subsequent soundings or sweeping operations will be charged against the Contractor at the rate of \$2,500 per day for each day in which the Owner's plant is engaged in sounding or sweeping and/or is enroute to or from the site or held at or near the said site for such operation.

- B. Final Acceptance

Final acceptance of the whole or a part of the work and the deductions or corrections of deductions made thereon will not be reopened after having once been made, except on evidence of collusion, fraud or obvious error, and the acceptance of a completed section shall not change the time of payment of the retained

percentages of the whole or any part of the work.

3.07 SHOALING

- A. If, before the contract is completed, shoaling occurs in any section previously accepted, including shoaling in the finished channel because of the natural lowering of the side slopes, re-dredging at contract price, within the limits of available funds may be done if agreeable to both the Contractor and the Owner/Engineer.

3.08 NOISE CONTROL

- A. All hauling and excavating equipment and dredge/barges, boats, and trucks, etc. used on this work shall be equipped with satisfactory mufflers or other noise abatement devices. The Contractor shall conduct his operations so as to comply with all Federal, State and local laws pertaining to noise. The use of horns and whistle signals shall be held to the minimum necessary in order to ensure as quiet an operation as possible.

END OF SECTION

ATTACHMENT A

Report of Geotechnical Exploration



November 30, 2015

Barge Wagoner Sumner & Cannon, Inc.
10133 Sherrill Boulevard
Suite 200
Knoxville, Tennessee 37932

ATTENTION: Mr. Keith Craft – *Project Manager*
keith.craft@bwsc.net

Subject: **REPORT OF GEOTECHNICAL EXPLORATION**
Oak Ridge Rowing Association Retaining Wall
Oak Ridge, Anderson County, Tennessee
GEOS Project No. 21-15635

Dear Mr. Craft:

We are submitting the results of the geotechnical exploration performed for the subject project. The geotechnical exploration was performed in accordance with our Proposal No. 11-15139R1, dated May 11, 2015, and as authorized by you.

The following report presents our findings and recommendations for the proposed construction. Should you have any questions regarding this report, or if we can be of any further assistance, please contact us at your convenience.

Sincerely,

GEOServices, LLC

Dennis A. Huckaba, P.E.
Principal

ACA/DAH/mtb



Adam C. Alexander, P.E.
Geotechnical Manager
TN 114,515

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this geotechnical exploration was to evaluate the subsurface conditions for the design and construction of the proposed retaining wall system to be located in Oak Ridge, Tennessee.

1.2 PROJECT AND SITE DESCRIPTION

The project site is located on the western bank of the Clinch River (Melton Hill Lake) near the Oak Ridge Rowing Association located at 697 Melton Lake Drive in Oak Ridge, Tennessee. Project information was provided in the form of a conceptual wall design and layout. It is our understanding that the proposed construction will consist of a new retaining wall approximately 500 feet in length and a maximum height of about 15 feet to accommodate the addition of a new rowing course ‘lane.’ A review of the topographic information provided revealed top of wall elevations ranging from 796 feet mean sea-level (MSL) to 800 feet MSL in the middle portion of the wall. To facilitate the expansion, we have assumed that the proposed bottom of wall elevation will be at, or very near, 785 feet MSL for the majority of the alignment.

Detailed information about the type and geometry of the proposed retaining wall has not been provided as the type of wall selected will be dependent on the subsurface conditions surrounding the area of the wall, site constraints, and the project budget. However, for purposes of this proposal we have assumed that the proposed retaining wall will likely consist of a gabion basket or mechanically stabilized earth (MSE) retaining wall.

1.3 SCOPE OF STUDY

This geotechnical exploration involved a site reconnaissance, field drilling, laboratory testing, and engineering analysis. The following sections of this report present discussions of the field

exploration, laboratory testing programs, site conditions, and conclusions and recommendations. Following the text of this report, figures, test boring records, and laboratory test results are provided in the appendix. Appendix A provides figures and test boring records. Appendix B provides laboratory tests performed and the results of these tests.

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air, on, or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2.0 EXPLORATION AND TESTING PROGRAMS

2.1 FIELD EXPLORATION

The site subsurface conditions were explored with five (5) soil test borings spaced along the proposed retaining wall alignment. The boring locations and depths were selected and staked in the field prior to initiation of our services. Drilling was performed from October 12 to 13, 2015. The borings were advanced using a 3.25-inch inside diameter hollow stem augers (HSA) and a CME 55 ATV mounted drill rig. The drill crew worked in general accordance with ASTM D 6151 (HSA Drilling). Sampling of overburden soils was accomplished using the standard penetration test procedure (ASTM D 1586). The approximate locations of the test borings performed on site are referenced in Figure 2. Detailed logs for soil test borings can be found in Appendix A of this report.

Within each soil test boring, SPT and split-spoon sampling were performed continuously. In split-spoon sampling, a standard 2-inch O.D. split-spoon sampler is driven into the bottom of the boring with a 140 pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler the last 12 inches of the standard 18 inches of total penetration is

recorded as the Standard Penetration Resistance (N-value). These N-values are indicated on the boring logs at the testing depth, and provide an indication of strength of cohesive materials.

2.2 LABORATORY TEST PROGRAM

After completion of the field drilling and sampling phase, the soil samples were returned to our laboratory where they were visually classified by a geotechnical professional. Selected soil samples were then tested for natural moisture determinations (ASTM D 2216), organic content determinations, and Atterberg limits determinations (ASTM D 4318). Selected undisturbed Shelby tube samples were tested for consolidated undrained triaxial shear testing (ASTM D 4767). The results of the laboratory testing are discussed in the following sections. A summary of these results is presented in Appendix B.

3.0 SUBSURFACE CONDITIONS

3.1 GEOLOGIC CONDITIONS

The project site lies within the Appalachian Valley and Ridge Physiographic Province. The Province is characterized by elongated, northeasterly-trending ridges formed on highly resistant sandstone and shale. Between ridges, broad valleys and rolling hills are formed primarily on less resistant limestone, dolomite, and shale.

Published geologic information indicates that the site is underlain by bedrock of the Rockwood Formation. The upper portion of the Rockwood Formation consists of medium-gray and yellowish-brown argillaceous shale with thin layers of siltstone and hematite. The middle portion of the formation is predominately reddish-brown, light green and gray, very fine to fine-grained, thin to medium-bedded, calcareous sandstone with interbedded siltstone and limestone. The lower portion of the formation consists of yellow and gray, fine-grained to cryptocrystalline, silty limestone with interbedded siltstone.

Since the bedrock underlying this site contains carbonate rock (i.e. limestone/dolomite), the site is susceptible to the typical carbonate hazards of irregular weathering, cave and cavern conditions, and overburden sinkholes. Carbonate rock, while appearing very hard and resistant, is soluble in slightly acidic water. This characteristic, plus differential weathering of the bedrock mass is responsible for the hazards. Of these hazards, the occurrence of sinkholes is potentially the most damaging to overlying soil-supported structures. Sinkholes occur primarily due to differential weathering of the bedrock and flushing or raveling of overburden soils into the cavities in the bedrock. The loss of solids creates a cavity or dome in the overburden. Growth of the dome over time or excavation over the dome can create a condition in which rapid, local subsidence or collapse of the roof of the dome occurs.

A certain degree of risk with respect to sinkhole formation and subsidence should be considered at any site located within geologic areas underlain by potentially soluble rock units. While a rigorous effort to assess the sinkhole potential at this site was beyond the scope of services, we did not observe obvious signs of surficial sinkhole activity at this site. However, we observed closed depressions, which are indicative of past sinkhole activity, on the published United States Geologic Survey (USGS – Clinton Quadrangle) topographic map approximately 2,000 feet north of the site.

3.2 SOIL STRATIGRAPHY

The following subsurface description is of a generalized nature to highlight the subsurface stratification features and material characteristics at the boring locations. The boring logs included in Appendix A of this report should be reviewed for specific information at each boring location. Information on actual subsurface conditions exists only at the specific boring locations and is relevant only to the time that this exploration was performed. Variations may occur and should be expected at the site.

Surface

A surficial layer of topsoil approximately 3 to 6 inches in thickness was encountered in each of the borings conducted on site.

Fill Soils

Beneath surficial layers, fill soils were encountered in each of the five borings conducted on site to depths ranging from approximately 8 to 15 feet beneath the existing ground surface. Fill soils are soils that are placed by man. The fill soils generally consisted of dark brown and grayish brown fat clay (CH) with varying amounts of rock fragments and organics. The SPT N-values used to evaluate the consistency of the fill soil encountered ranged 4 blows per foot (bpf) of penetration to 50 blows with three inches of penetration, indicating a relative soil consistency ranging from firm to very hard. It should be noted that the very stiff, or greater, consistency soil (SPT N-values exceeding 15 bpf) was generally encountered in the presence of abundant rock fragments that likely inflated the SPT N-values. Therefore, the consistency of the fill soils encountered was generally soft to stiff.

The natural moisture content of the existing fill soil samples tested ranged from about 10 to 19 percent. Organic content testing of the fill material encountered in boring B-4 (3.5-5.0 feet and 6.0-7.5 feet) indicated organic contents of 3.1 and 3.2 percent, respectively, by weight. Consolidated undrained (CU) triaxial shear testing of undisturbed samples obtained from boring B-2 (6.0-8.0 feet) revealed an effective friction angle of 37 degrees and an effective cohesion of 30 psf.

Residual Soil

Beneath the fills soil encountered in boring B-1, residual soils were encountered to a depth of 22.3 feet beneath the existing ground surface. Residual soils are formed from the in-place weathering of the underlying parent bedrock. The residual soils generally consisted of brown fat clay (CH) with varying amounts of chert fragments. The SPT N-values used to evaluate the consistency of the residual soil ranged from 13 to 16 bpf, indicating a relative soil consistency ranging from stiff to very stiff.

Alluvial

Beneath the existing fill soils encountered in four borings (B-2 to B-5), alluvial soils were encountered to depths ranging from 22.0 to 31.4 feet beneath the existing ground surface. Alluvial soils are defined as any material that has been transported and placed by water. The alluvial soil generally consisted of dark brown, gray, and grayish brown lean clays (CL) with varying amounts of sand, shale fragments, and organics. The SPT N-values used to evaluate the consistency of the alluvial soil ranged from 4 to 28 bpf, indicating a relative soil consistency ranging from soft to very stiff. It should be noted that the very stiff, or greater, consistency soil (SPT N-values greater than 15 bpf) were generally encountered in the presence of shale fragments and were likely inflated due to the presence rock. Therefore, the alluvial soil encountered was generally firm to very stiff in consistency.

The natural moisture content of the alluvial soil samples tested ranged from about 22 to 27 percent. Organic content testing of the alluvial material encountered in borings B-2 (18.5-20.0 feet and 23.5-25.0 feet) and B-4 (23.5-25.0 feet and 28.5-30.0 feet) indicated organic contents of 2.8, 1.8, 3.0, and 2.6 percent, respectively, by weight. Consolidated undrained (CU) triaxial shear testing of undisturbed samples obtained from boring B-5 (13.5-15.0 feet) revealed an effective friction angle of 35.2 degrees and an effective cohesion of 90 psf.

Auger Refusal

Auger refusal conditions were encountered in each of the five (5) borings conducted on site, at depths ranging from 22 to 31.4 feet beneath the existing ground surface. Auger refusal depths are provide in a table below. Auger refusal is a designation applied to any material that cannot be penetrated by the power auger. Auger refusal may indicate dense gravel or cobble layers, boulders, rock ledges or pinnacles, or the top of continuous bedrock. Based on our experience in this geology, auger refusal in these borings likely corresponds to rock ledges, pinnacles, and/or the top of continuous bedrock.

Table 1: Auger Refusal Depths

Boring	Refusal Depth (ft)	Refusal Elevation (feet MSL)
B-1	22.3	778.7
B-2	27.6	772.4
B-3	23.1	774.9
B-4	31.4	766.6
B-5	22	775.0

Subsurface Water

Subsurface water was observed in two borings (B-1 and B-3) conducted on site at depths ranging from 12 to 12.8 feet beneath the existing ground surface. However, subsurface water levels may fluctuate due to seasonal changes in precipitation amounts or due to construction activities in the area. Additionally, discontinuous zones of perched water may exist within the overburden and/or at the contact with bedrock. The groundwater information presented in this report is the information that was collected at the time of our field activities. The contractor should determine the actual groundwater level at the site at the time of the construction activities.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 SITE ASSESSMENT AND SHORING

The results of the field exploration indicate that the site is generally underlain by fill soils compromised of fat clay with varying amounts of shale fragments overlying alluvial soils generally composed of lean clays with varying amounts of sand and shale fragments.

As previously mentioned, the proposed retaining wall type has yet to be determined as our services were performed to obtain information about the subsurface soils and determine the feasibility of various retaining structures. The overall project goal is to add a rowing lane to the existing rowing course AND maintain a minimum water height (depth) below all lanes of at least 9 feet. Given these geometric constraints and the existing site conditions (roadway, soils, etc.) it is our opinion that a mechanically stabilize earth (MSE) wall system likely the most cost efficient

option for constructing the wall specifically. Utilizing a rip-rap buttress at an inclination of 2:1 will likely shorten the geogrid embedment lengths to a length that will allow safe and stable construction for both temporary and permanent conditions. However, in order to construct a MSE wall, a significant amount of dewatering will likely be required. The cost to de-water the construction area may likely control the project cost. Therefore, in the event that the dewatering system (i.e. sheet pile wall) cost controls, we recommend the owner evaluate a second option for the proposed retaining wall consisting of a pile and lagging OR a sheet pile wall. Both of these options are typically more expensive than a MSE wall. However, the added cost of dewatering may make the alternate wall options more viable.

Shoring

Shoring and/or sloping may be utilized in relatively shallow sections of the proposed construction. In the event that excavations will be less than 10 feet beneath the existing ground surface elevation, we recommend the use of maximum allowable slope of 1.5:1 (H:V) in accordance with OSHA Code of Federal Regulations (Part 1926, Title 29, Chapter XVIII) for Type B soils. In excavations exceeding 10 feet, in which case freely-seeping water will likely be encountered, we recommend the use of maximum allowable slope of 2:1 (H:V) in accordance with OSHA Code of Federal Regulations (Part 1926, Title 29, Chapter XVIII) for Type C soils. In all cases, forces from any expected surcharge loading including sloping backfill should be added to the equivalent fluid pressures used in the shoring design. The walls should be properly drained to remove water or hydrostatic pressure should be added to the design pressure.

Excavation Safety

Excavations should be sloped or shored in accordance with local, state, and federal regulations, including OSHA (29 CFR Part 1926) excavation trench safety standards. The contractor is usually solely responsible for site safety. This information is provided only as a service and under no circumstances should GEOS be assumed to be responsible for construction site safety.

5.0 LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. This report is for our geotechnical work only, and no environmental assessment efforts have been performed. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, express or implied, is made.

The analyses and recommendations submitted herein are based, in part, upon the data obtained from the exploration. The nature and extent of variations between the borings will not become evident until construction. We recommend that GEOServices be retained to observe the project construction in the field. GEOServices cannot accept responsibility for conditions which deviate from those described in this report if not retained to perform construction observation and testing. If variations appear evident, then we will re-evaluate the recommendations of this report. In the event that any changes in the nature, design, or location of the structures are planned, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed and conclusions modified or verified in writing. Also, if the scope of the project should change significantly from that described herein, these recommendations may need to be re-evaluated.

APPENDIX A

Figures and Test Boring Records

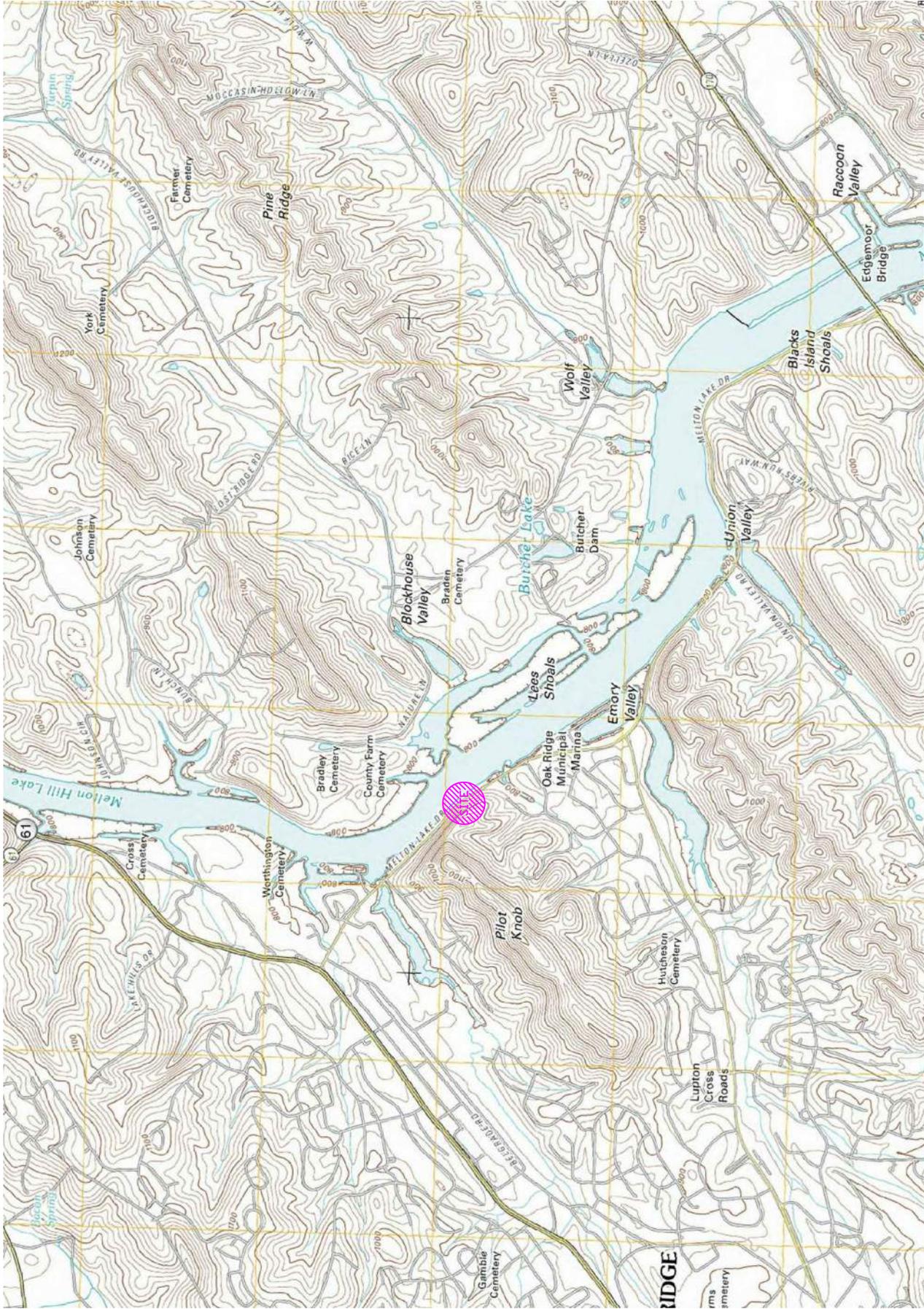


FIGURE	1
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DRAWN BY:	MTB
APPROVED BY:	ACA
SCALE:	N.T.S.
JOB NO.:	21-15635
DATE:	10-28-2015

SITE VICINITY MAP

OAK RIDGE ROWING ASSOCIATION
 RETAINING WALL
 OAK RIDGE, TN

GEOS
 Geotechnical and Materials Engineers
 2561 Willow Point Way
 Knoxville, Tennessee 37931
 Office: 865-539-9242
 Fax: 865-539-9252

NOTES:
 1.) BASE MAP: USGS QUADRANGLE (CLINTON, TENNESSEE)

GENERAL NOTES

FINE AND COARSE GRAINED SOIL PROPERTIES

PARTICLE SIZE

BOULDERS:	GREATER THAN 300 mm
COBBLES:	75 mm to 300 mm
GRAVEL:	4.74 mm to 75 mm
COARSE SAND:	2 mm to 4.74 mm
MEDIUM SAND:	0.425 mm to 2 mm
FINE SAND:	0.075 mm to 0.425 mm
SILTS & CLAYS:	LESS THAN 0.075 mm

COARSE GRAINED SOILS (SANDS & GRAVELS)

N-VALUE	RELATIVE DENSITY
0 - 4	VERY LOOSE
5 - 10	LOOSE
11 - 30	MEDIUM DENSE
31 - 50	DENSE
OVER 50	VERY DENSE

FINE GRAINED SOILS (SILTS & CLAYS)

N-VALUE	CONSISTENCY	Qu, PSF
0 - 2	VERY SOFT	0 - 500
3 - 4	SOFT	500 - 1000
5 - 8	FIRM	1000 - 2000
9 - 15	STIFF	2000 - 4000
16 - 30	VERY STIFF	4000 - 8000
OVER 31	HARD	8000 +

STANDARD PENETRATION TEST (ASTM D1586)

THE STANDARD PENETRATION TEST AS DEFINED BY ASTM D1586 IS A METHOD TO OBTAIN A DISTURBED SOIL SAMPLE FOR EXAMINATION AND TESTING AND TO OBTAIN RELATIVE DENSITY AND CONSISTENCY INFORMATION. THE 1.4 INCH I.D./2.0 INCH O.D. SAMPLER IS DRIVEN 3-SIX INCH INCREMENTS WITH A 140 LB. HAMMER FALLING 30 INCHES. THE BLOW COUNTS REQUIRED TO DRIVE THE SAMPLER THE FINAL 2 INCREMENTS ARE ADDED TOGETHER AND DESIGNATED THE N-VALUE. AT TIMES, THE SAMPLER CAN NOT BE DRIVEN THE FULL 18 INCHES. THE FOLLOWING REPRESENTS OUR INTERPRETATION OF THE STANDARD PENETRATION TEST WITH VARIATIONS.

BLOWS/FOOT (N-VALUE)

DESCRIPTION

25.....25 BLOWS DROVE SAMPLER 12" AFTER INITIAL 6" SEATING
75/10".....75 BLOWS DROVE SAMPLER 10" AFTER INITIAL 6" SEATING
50/PR.....PENETRATION REFUSAL OF SAMPLER AFTER INITIAL 6" SEATING

SAMPLING SYMBOLS

ST:	UNDISTURBED SAMPLE
SS:	SPLIT SPOON SAMPLE
CORE:	ROCK CORE SAMPLE
AU:	AUGER OR BAG SAMPLE

SOIL PROPERTY SYMBOLS

N:	STANDARD PENETRATION, BPF
M:	MOISTURE CONTENT %
LL:	LIQUID LIMIT %
PI:	PLASTICITY INDEX %
Qp:	POCKET PENETROMETER VALUE, TSF
Qu:	UNCONFINED COMPRESSIVE STRENGTH, TSF
DUW:	DRY UNIT WEIGHT, PCF

ROCK PROPERTIES

ROCK HARDNESS

ROCK QUALITY DESIGNATION (RQD)

PERCENT	QUALITY
90 TO 100	EXCELLENT
75 TO 90	GOOD
50 TO 75	FAIR
25 TO 50	POOR
0 TO 25	VERY POOR

VERY SOFT:	ROCK DISINTEGRATES OR EASILY COMPRESSES TO TOUCH: CAN BE HARD TO VERY HARD SOIL.
SOFT:	ROCK IS COHERANT BUT BREAKS EASILY TO THUMB PRESSURE AT SHARP EDGES AND CRUMBLES WITH FIRM HAND PRESSURE.
MODERATELY HARD:	SMALL PIECES CAN BE BROKEN OFF ALONG SHARP EDGES BY CONSIDERABLE HARD THUMB PRESSURE: CAN BE BROKEN BY LIGHT HAMMER BLOWS.
HARD:	ROCK CAN NOT BE BROKEN BY THUMB PRESSURE, BUT CAN BE BROKEN BY MODERATE HAMMER BLOWS.
VERY HARD:	ROCK CAN BE BROKEN BY HEAVY HAMMER BLOWS.



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
 GEOServices Project # 21-15635

LOG OF BORING **B-1**
 SHEET 1 OF 1

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-1 DRY ON COMPLETION ? no

DATE October 12, 2015 SURFACE ELEV. 801.0 FT.
 REFUSAL: Yes DEPTH 22.3 FT. ELEV. 778.7 FT.
 SAMPLED 22.3 FT. 6.8 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 22.3 FT. ELEV. 778.7 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH 12.8 FT.
 ELEV. 788.2 FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL	
0.0 - 0.3										Topsoil (3 inches)
2.5 - 2.8	798.5		1.0 - 2.5	1	SS	11				Fat CLAY (CH) - with shale fragments - dark brown and grayish brown - very moist to wet (FILL)
5.0 - 5.3	796.0		3.5 - 5.0	2	SS	9				
7.5 - 7.8	793.5		6.0 - 7.5	3	SS	6				
10.0 - 10.3	791.0		8.5 - 10.0	4	SS	11				
12.5 - 12.8	788.5									
15.0 - 15.3	786.0		13.5 - 15.0	5	SS	13				
17.5 - 17.8	783.5									
20.0 - 20.3	781.0		18.5 - 20.0	6	SS	16				

Auger Refusal at 22.3 feet

REMARKS: _____



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
 GEOServices Project # 21-15635

LOG OF BORING **B-2**
 SHEET 1 OF 2

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-2 DRY ON COMPLETION ? Yes

DATE October 12, 2015 SURFACE ELEV. 800.0 FT.
 REFUSAL: Yes DEPTH 27.6 FT. ELEV. 772.4 FT.
 SAMPLED 27.6 FT. 8.4 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 27.6 FT. ELEV. 772.4 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH Dry FT.
 ELEV. _____ FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL	
0.0 - 0.3										Topsoil (3 inches)
2.5 - 797.5			1	SS	13					10.2
5.0 - 795.0			2	SS	10					11.9
7.5 - 792.5			3	SS	6					13.2
10.0 - 790.0			4	SS	7					15.3
12.5 - 787.5			5	SS	4					26.2
15.0 - 785.0			6	SS	4					
17.5 - 782.5										
20.0 - 780.0										

Fat CLAY (CH) - with shale fragments - dark brown and grayish brown - very moist to wet (FILL)

Lean CLAY (CL) - with sand and trace organics - dark grayish brown and grayish brown - wet (ALLUVIUM)

(continued)

REMARKS: Organic content testing of SS samples 6 and 7 indicated organic contents of 2.8 and 1.8 percent, respectively, by weight



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
 GEOServices Project # 21-15635

LOG OF BORING **B-2**
 SHEET 2 OF 2

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-2 DRY ON COMPLETION ? Yes

DATE October 12, 2015 SURFACE ELEV. 800.0 FT.
 REFUSAL: Yes DEPTH 27.6 FT. ELEV. 772.4 FT.
 SAMPLED 27.6 FT. 8.4 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 27.6 FT. ELEV. 772.4 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH Dry FT.
 ELEV. _____ FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION	
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL		PI
22.5	777.5									(continued) Lean CLAY (CL) - with sand and trace organics - dark grayish brown and grayish brown - wet (ALLUVIUM) Auger Refusal at 27.6 feet	
25.0	775.0	23.5	25.0	7	SS	4					23.3
27.5	772.5										
30.0	770.0										
32.5	767.5										
35.0	765.0										
37.5	762.5										
40.0	760.0										

REMARKS: Organic content testing of SS samples 6 and 7 indicated organic contents of 2.8 and 1.8 percent, respectively, by weight



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
 GEOServices Project # 21-15635

LOG OF BORING **B-3**
 SHEET 1 OF 2

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-3 DRY ON COMPLETION ? No

DATE October 12, 2015 SURFACE ELEV. 798.0 FT.
 REFUSAL: Yes DEPTH 23.1 FT. ELEV. 774.9 FT.
 SAMPLED 23.1 FT. 7.0 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 23.1 FT. ELEV. 774.9 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH 12.0 FT.
 ELEV. 786.0 FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL	
0.0 - 0.3										Topsoil (3 Inches)
2.5 - 2.8	795.5		1	SS	9					Fat CLAY (CH) - with shale fragments - dark brown - moist to very moist increasing with depth (FILL)
5.0 - 5.3	793.0		2	SS	50/3"					
7.5 - 7.8	790.5		3	SS	7					
10.0 - 10.3	788.0		4	SS	7					
15.0 - 15.3	783.0		5	SS	28					Lean CLAY (CL) - with shale fragments, trace organics, and an organic odor - dark brown and gray - very moist to wet - stiff to very stiff (ALLUVIUM)
17.5 - 17.8	780.5		6	SS	11					
20.0 - 20.3	778.0									

(continued)

REMARKS: _____



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
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LOG OF BORING **B-3**
 SHEET 2 OF 2

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-3 DRY ON COMPLETION ? No

DATE October 12, 2015 SURFACE ELEV. 798.0 FT.
 REFUSAL: Yes DEPTH 23.1 FT. ELEV. 774.9 FT.
 SAMPLED 23.1 FT. 7.0 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 23.1 FT. ELEV. 774.9 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH 12.0 FT.
 ELEV. 786.0 FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL	
-	-	-								(continued)
22.5	775.5									Lean CLAY (CL) - with shale fragments, trace organics, and an organic odor - dark brown and gray - very moist to wet - stiff to very stiff (ALLUVIUM)
25.0	773.0									Auger Refusal at 23.1 Feet
27.5	770.5									
30.0	768.0									
32.5	765.5									
35.0	763.0									
37.5	760.5									
40.0	758.0									

REMARKS: _____



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
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LOG OF BORING **B-4**
 SHEET 1 OF 2

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-4 DRY ON COMPLETION ? Yes

DATE October 12, 2015 SURFACE ELEV. 798.0 FT.
 REFUSAL: Yes DEPTH 31.4 FT. ELEV. 766.6 FT.
 SAMPLED 31.4 FT. 9.6 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 31.4 FT. ELEV. 766.6 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH Dry FT.
 ELEV. _____ FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL	
0.0 - 0.5										Topsoil (6 inches)
2.5 - 795.5			1	SS	9					Fat CLAY (CH) - with shale fragments throughout and organics from 3 to 8 feet - dark brown and grayish brown - moist to wet increasing with depth (FILL)
5.0 - 793.0			2	SS	50/3"					
7.5 - 790.5			3	SS	11					
10.0 - 788.0			4	SS	50/7"					
12.5 - 785.5										
15.0 - 783.0			5	SS	13					
17.5 - 780.5										Lean CLAY (CL) - with sand, trace shale fragments, and organics - gray, grayish brown, and dark brown - wet - firm to stiff (ALLUVIUM)
20.0 - 778.0			6	SS	6		31	12	27.1	

(continued)

REMARKS: Organic content testing of SS samples 2, 3, 7, and 8 indicated organic contents of 3.1, 3.2, 3.0, and 2.6 percent, respectively, by weight



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
 GEOServices Project # 21-15635

LOG OF BORING **B-4**
 SHEET 2 OF 2

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-4 DRY ON COMPLETION ? Yes

DATE October 12, 2015 SURFACE ELEV. 798.0 FT.
 REFUSAL: Yes DEPTH 31.4 FT. ELEV. 766.6 FT.
 SAMPLED 31.4 FT. 9.6 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 31.4 FT. ELEV. 766.6 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH Dry FT.
 ELEV. _____ FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION	
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL		PI
22.5	775.5									(continued) Lean CLAY (CL) - with sand, trace shale fragments, and organics - gray, grayish brown, and dark brown - wet - firm to stiff (ALLUVIUM)	
25.0	773.0	23.5	25.0	7	SS	10					24.3
27.5	770.5										
30.0	768.0	28.5	30.0	8	SS	15					22.2
32.5	765.5										
35.0	763.0										
37.5	760.5										
40.0	758.0										
Auger Refusal at 31.4 Feet											

REMARKS: Organic content testing of SS samples 2, 3, 7, and 8 indicated organic contents of 3.1, 3.2, 3.0, and 2.6 percent, respectively, by weight



Oak Ridge Rowing Association Retaining Wall
Oak Ridge, TN
 GEOServices Project # 21-15635

LOG OF BORING **B-5**
 SHEET 1 OF 1

DRILLER M.Bowers
 ON-SITE REP. _____

BORING NO. / LOCATION B-5 DRY ON COMPLETION ? Yes

DATE October 13, 2015 SURFACE ELEV. 797.0 FT.
 REFUSAL: Yes DEPTH 22.0 FT. ELEV. 775.0 FT.
 SAMPLED 22.0 FT. 6.7 M
 TOP OF ROCK DEPTH _____ FT. ELEV. _____ FT.
 BEGAN CORING DEPTH _____ FT. ELEV. _____ FT.
 FOOTAGE CORED (LF) _____ FT.
 BOTTOM OF HOLE DEPTH 22.0 FT. ELEV. 775.0 FT.

WATER LEVEL DATA (IF APPLICABLE)
 COMPLETION: DEPTH Dry FT.
 ELEV. _____ FT.
 AFTER 1 HRS: DEPTH TNP FT.
 ELEV. _____ FT.
 AFTER 24 HRS: DEPTH TNP FT.
 ELEV. _____ FT.

BORING ADVANCED BY: _____ POWER AUGERING X PROPOSED BOW: 785 FT.

STRATUM DEPTH	SAMPLE DEPTH		SAMPLE OR RUN NO.	SAMPLE TYPE	FIELD RESULTS		LABORATORY RESULTS			STRATUM DESCRIPTION
	FT.	ELEV.			FROM FT.	TO FT.	N-Value	Qu	LL	
0.0 - 0.5										Topsoil (4 inches)
2.5 - 794.5			1	SS	30					Fat CLAY (CH) - with rock fragments - dark brown and brown - slightly moist to moist (FILL)
5.0 - 792.0			2	SS	47					
7.5 - 789.5			3	SS	18					
10.0 - 787.0			4	SS	8					Lean CLAY (CL) - with abundant shale fragments - gray and brown - very moist - firm to stiff (ALLUVIUM)
12.5 - 784.5										
15.0 - 782.0			ST-2	ST						
17.5 - 779.5										
20.0 - 777.0			5	SS	12					

Auger Refusal at 22.0 Feet

REMARKS: _____

APPENDIX B

Laboratory Testing Results



Moisture Content and Organic Content

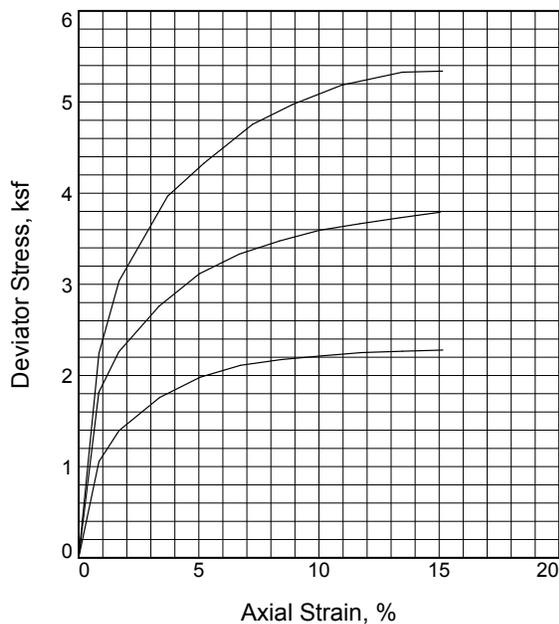
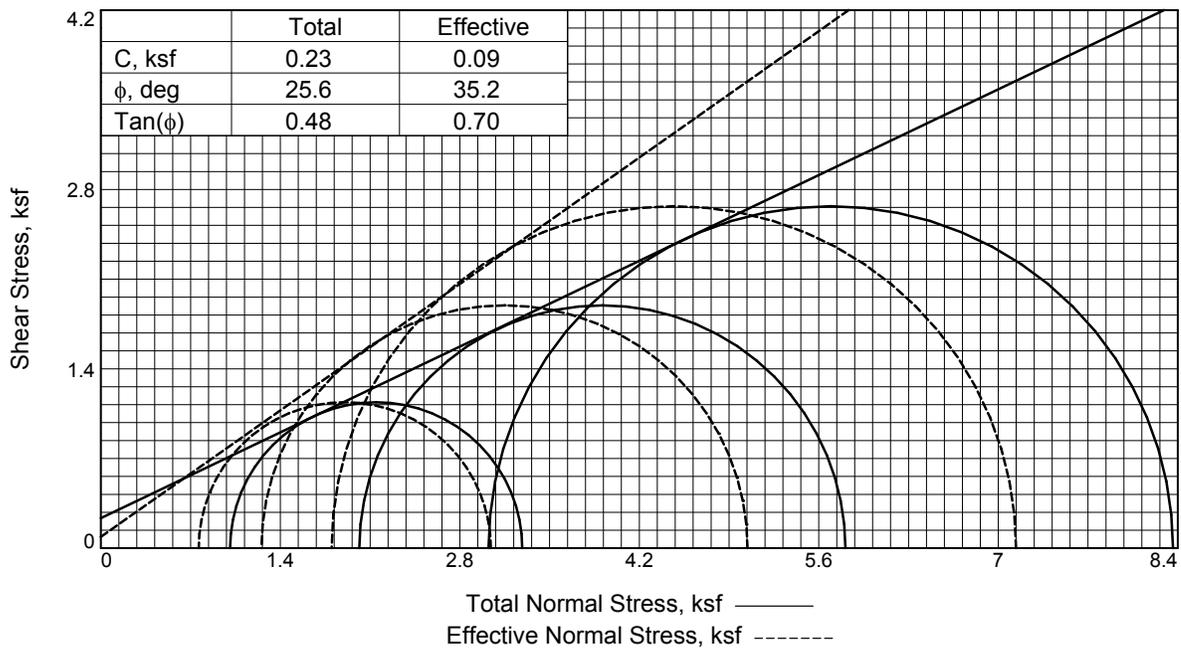
Project Name: Oak Ridge Rowing Association Retaining Wall

Date Received: 10/20/2015

Project Number: 21-15635

Report Date: 10/28/2015

Lab ID	Sample ID	Sample Type	Depth	Moisture Content (%)	Organic Content (%)
1	B-2/S-6	Bag	18.5-20.0'	26.2	2.8
2	B-2/S-7	Bag	23.5-25.0'	23.3	1.8
3	B-4/S-2	Bag	3.5-5.0'	14.9	3.1
4	B-4/S-3	Bag	6.0-7.5'	11.8	3.2
5	B-4/S-7	Bag	23.5-25.0'	24.3	3.0
6	B-4/S-8	Bag	28.5-30.0'	22.2	2.6



Sample No.	1	2	3	
Initial	Water Content, %	14.8	15.5	15.1
	Dry Density, pcf	120.9	120.0	120.9
	Saturation, %	97.0	99.4	99.0
	Void Ratio	0.4201	0.4304	0.4198
	Diameter, in.	2.880	2.880	2.880
	Height, in.	5.950	6.010	5.980
At Test	Water Content, %	15.0	14.9	14.3
	Dry Density, pcf	121.6	121.7	123.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.4115	0.4104	0.3928
	Diameter, in.	2.874	2.867	2.862
	Height, in.	5.938	5.982	5.942
Strain rate, in./min.	0.003	0.003	0.003	
Back Pressure, psi	30.00	30.00	30.00	
Cell Pressure, psi	37.00	44.00	51.00	
Fail. Stress, ksf	2.28	3.79	5.34	
Total Pore Pr., ksf	4.56	5.08	5.54	
Ult. Stress, ksf				
Total Pore Pr., ksf				
$\bar{\sigma}_1$ Failure, ksf	3.04	5.04	7.14	
$\bar{\sigma}_3$ Failure, ksf	0.76	1.25	1.80	

Type of Test:

CU with Pore Pressures

Sample Type: Shelby Tube Specimens

Description: Clay, silty, grayish brown w/shale

LL= 29

PL= 19

PI= 10

Assumed Specific Gravity= 2.75

Remarks:

Client: GEOservices, LLC

Project: Oak Ridge Retaining Wall

Sample Number: B5

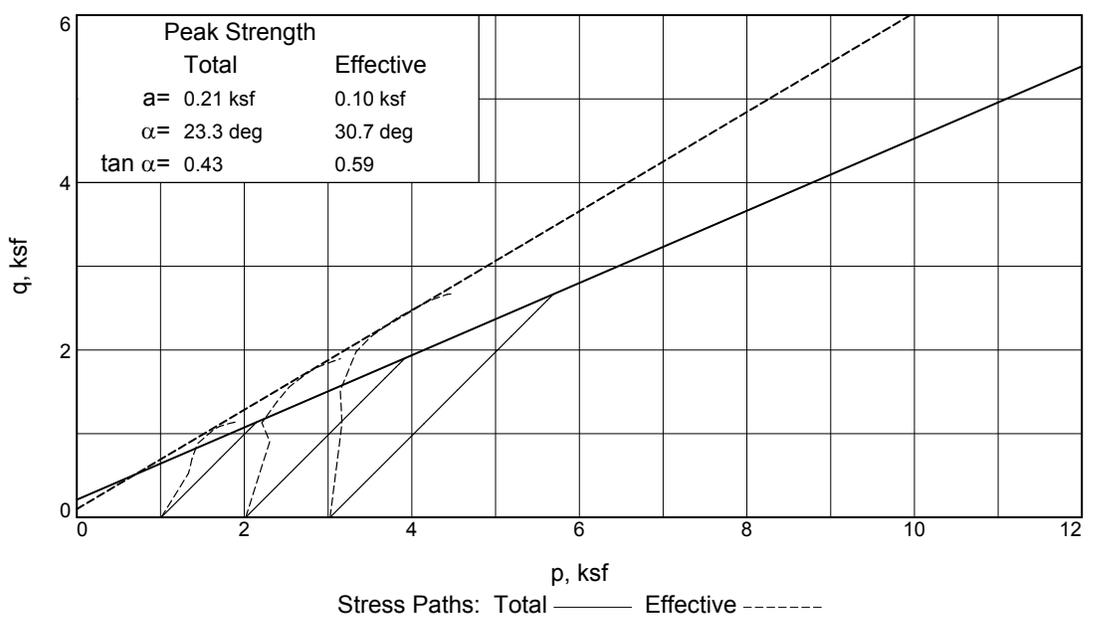
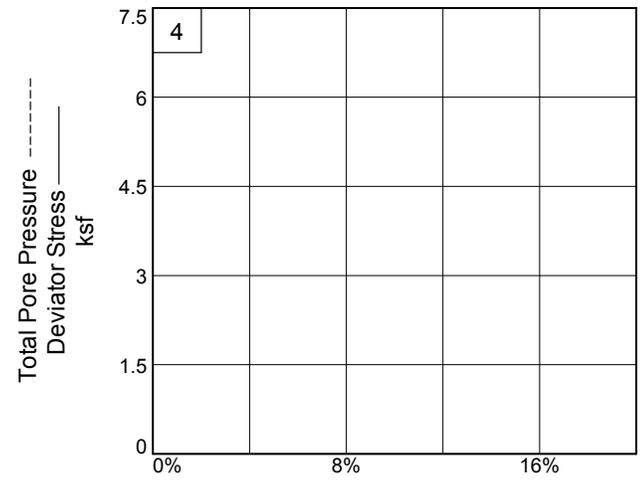
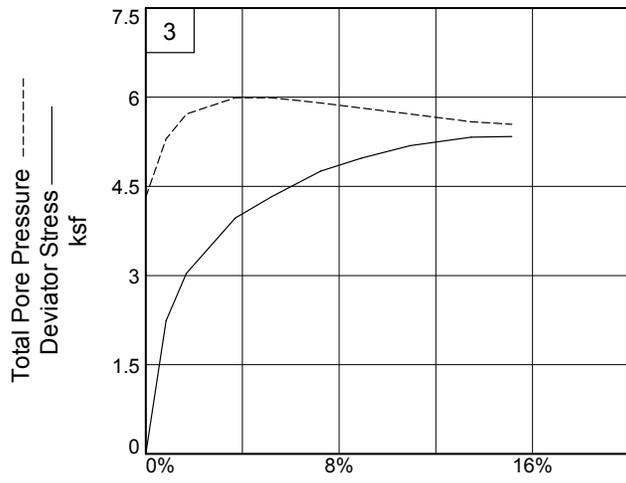
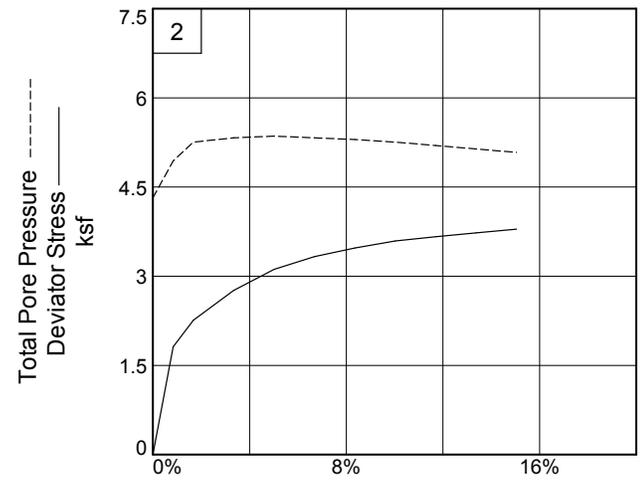
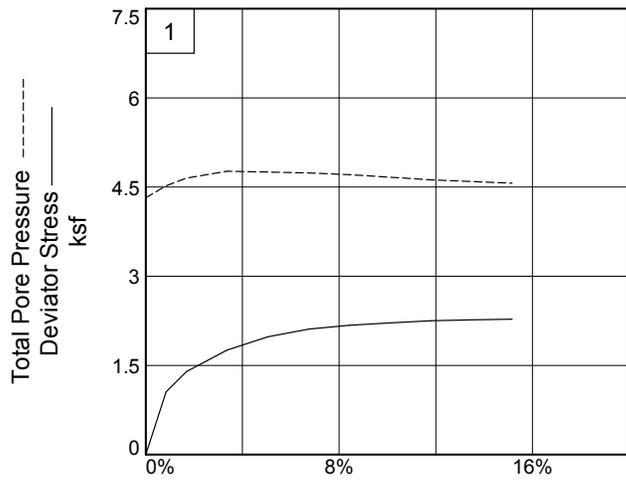
Depth: 13.5'-15.5'

Proj. No.: 21-15634

Date Sampled: 10/22/15

TRIAXIAL SHEAR TEST REPORT
Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Figure 1



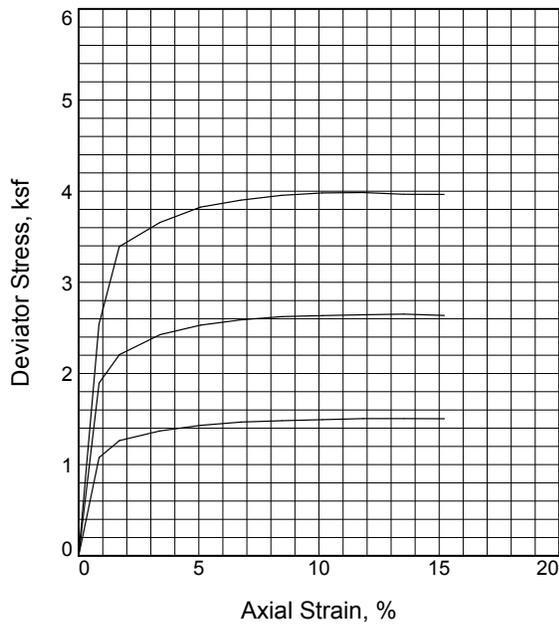
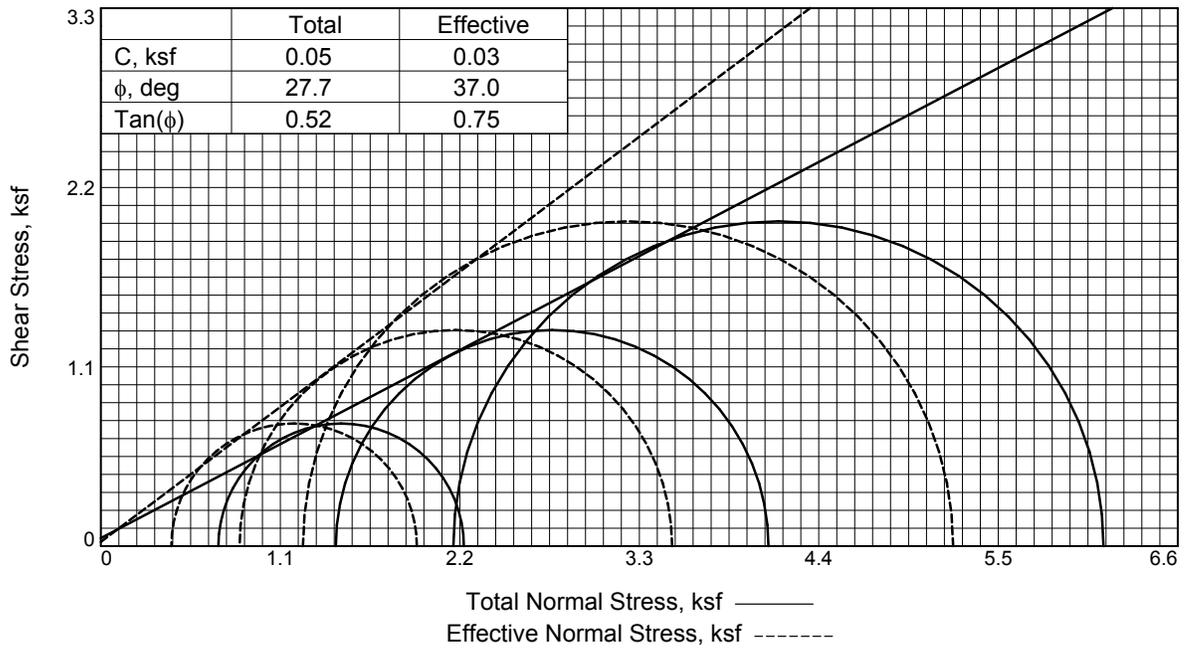
Client: GEOservices, LLC

Project: Oak Ridge Retaining Wall

Depth: 13.5'-15.5' **Sample Number:** B5

Project No.: 21-15634

Figure 2



Sample No.	1	2	3	
Initial	Water Content, %	12.1	11.4	12.4
	Dry Density, pcf	123.6	124.4	123.9
	Saturation, %	85.4	82.7	88.8
	Void Ratio	0.3889	0.3800	0.3852
	Diameter, in.	2.880	2.880	2.880
At Test	Height, in.	5.920	5.930	5.940
	Water Content, %	13.9	13.4	13.5
	Dry Density, pcf	124.1	125.4	125.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.3833	0.3695	0.3705
At Test	Diameter, in.	2.876	2.873	2.870
	Height, in.	5.912	5.915	5.919
	Strain rate, in./min.	0.003	0.003	0.003
	Back Pressure, psi	30.00	30.00	30.00
	Cell Pressure, psi	35.00	40.00	45.00
Fail. Stress, ksf	Fail. Stress, ksf	1.50	2.65	3.98
	Total Pore Pr., ksf	4.61	4.91	5.24
Ult. Stress, ksf	Ult. Stress, ksf			
	Total Pore Pr., ksf			
$\bar{\sigma}_1$ Failure, ksf	$\bar{\sigma}_1$ Failure, ksf	1.94	3.50	5.22
	$\bar{\sigma}_3$ Failure, ksf	0.43	0.85	1.24

Type of Test:

CU with Pore Pressures

Sample Type: Shelby Tube Specimens

Description: Shale, clay, silty, grayish brown

LL= 25 PL= 16 PI= 9

Assumed Specific Gravity= 2.75

Remarks:

Client: GEOservices, LLC

Project: Oak Ridge Retaining Wall

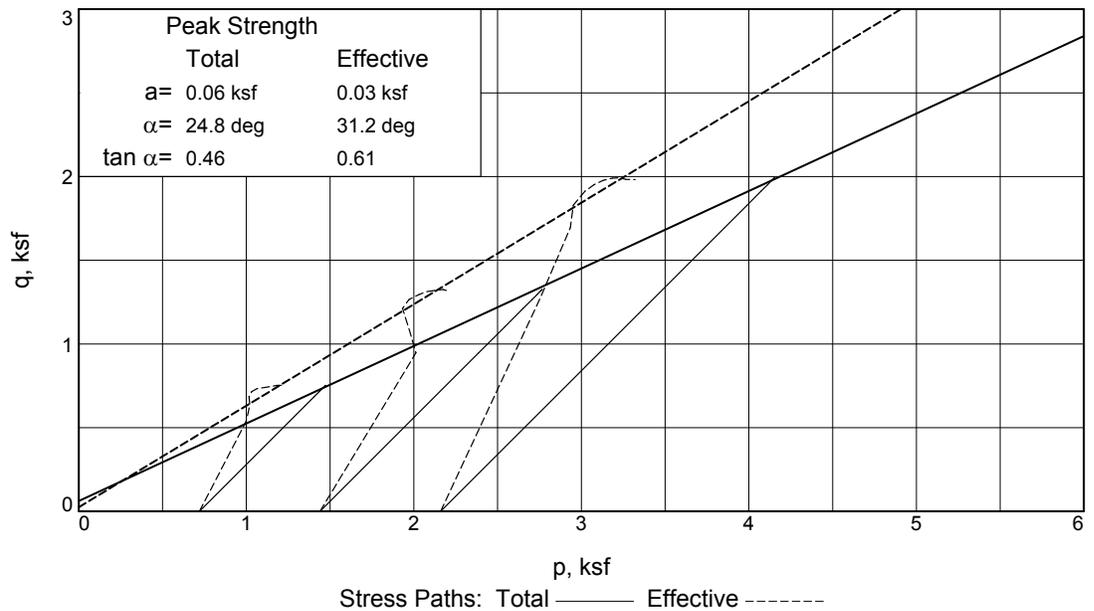
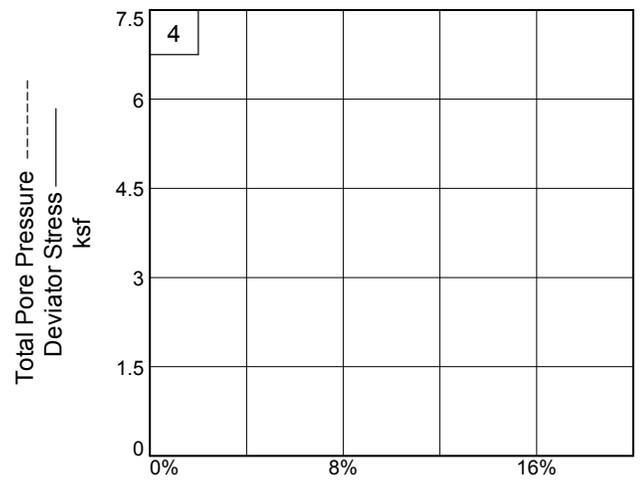
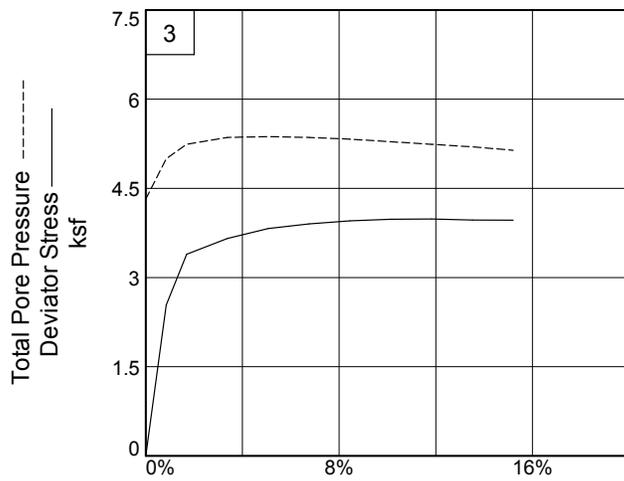
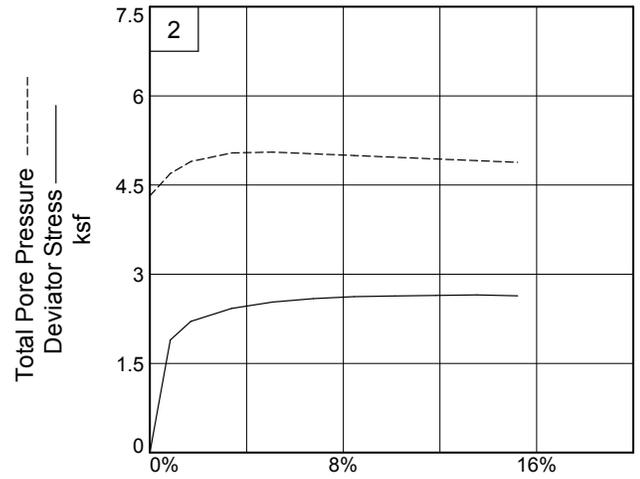
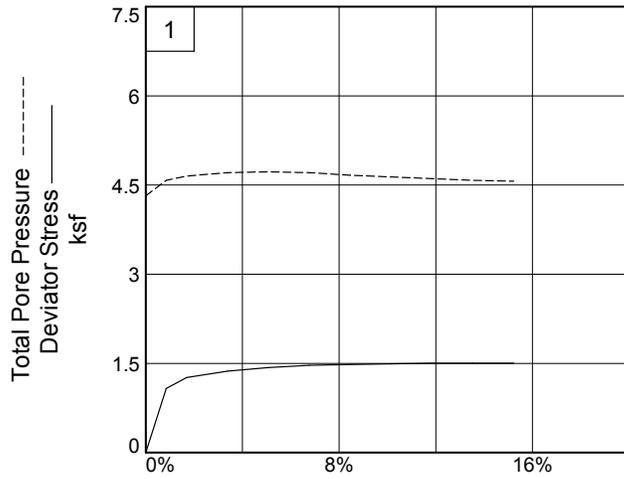
Sample Number: B2 **Depth:** 6'-8'

Proj. No.: 21-15634

Date Sampled: 10/23/15

TRIAXIAL SHEAR TEST REPORT
Geo/Environmental Associates, Inc.
Knoxville, Tennessee

Figure 1



Client: GEOservices, LLC
Project: Oak Ridge Retaining Wall
Depth: 6'-8' **Sample Number:** B2
Project No.: 21-15634

Figure 2

SITE IMPROVEMENTS FOR THE OAK RIDGE ROWING COURSE OAK RIDGE, TENNESSEE

BWSC

MAY 6, 2016

PROJECT No.
3589801

ISSUED FOR
BID

INDEX OF DRAWINGS

CIVIL

Sheet No.	Description	Revision	Date
C0.00	COVER SHEET	0	05/06/2016
C0.02	GENERAL NOTES	0	05/06/2016
C2.01	SITE LAYOUT & GRADING PLAN	0	05/06/2016
C2.31	INITIAL & FINAL EROSION & SEDIMENT CONTROL PLAN	0	05/06/2016
C2.32	SPOIL AREA EROSION & SEDIMENT CONTROL PLAN	0	05/06/2016
C5.01	SHEET PILE WALL SECTIONS	0	05/06/2016
C7.01	SITE DETAILS	0	05/06/2016
C7.31	EROSION & SEDIMENT CONTROL DETAILS	0	05/06/2016

SHEET PILE WALL

Sheet No.	Description	Revision	Date
RW-1	SHEET PILE WALL NOTES	0	05/06/2016
RW-2	SHEET PILE WALL DETAILS	0	05/06/2016
RW-3	SHEET PILE WALL DETAILS	0	05/06/2016
RW-1.0	SHEET PILE WALL PLAN & PROFILE	0	05/06/2016

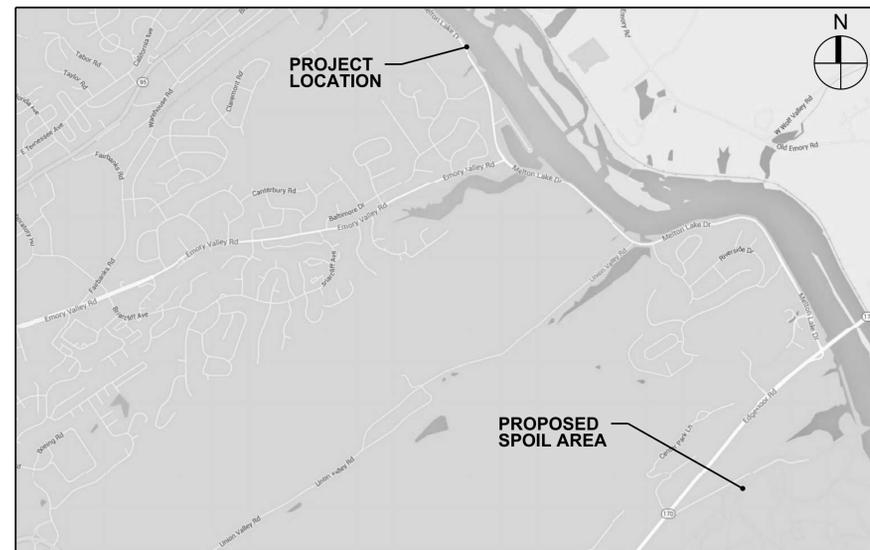
DEVELOPED FOR:

CITY OF OAK RIDGE, TN

CITY MAYOR
Warren L Gooch

CITY MANAGER
Mark S. Watson

CITY COUNCIL
Ellen Smith (Mayor Pro Tem)
Trina Baughn
Kelly Callison
Rick Chinn, Jr.
Charlie Hensley
Chuck Hope



LOCATION MAP

NOT TO SCALE

**SITE IMPROVEMENTS
FOR THE
OAK RIDGE ROWING COURSE
OAK RIDGE, TENNESSEE**



5558 North Lee Highway
Cleveland, Tennessee 37312
Office: 423-614-6471
Fax: 423-614-6479



520 West Summit Hill Drive, Suite 1202, Knoxville, Tennessee 37902
PHONE (865) 637-2810 FAX (865) 673-8554



G0.01

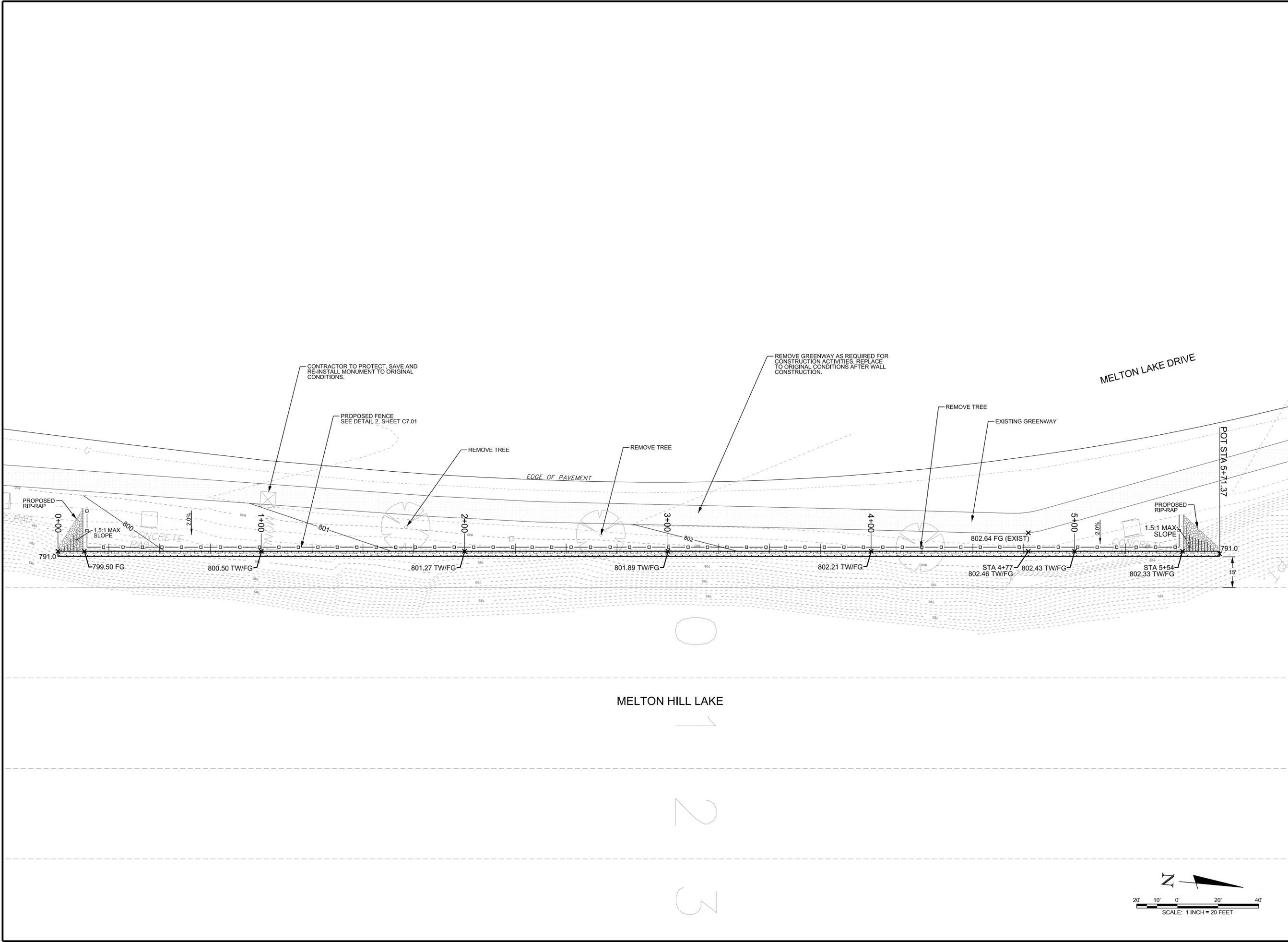


SITE LAYOUT AND GRADING PLAN

**OAK RIDGE ROWING COURSE
 SITE IMPROVEMENTS**
 OAK RIDGE, TENNESSEE

REV.	CHK.	DATE	DESCRIPTION
0	BSP	05/06/2016	ISSUED FOR BID

C2.01
 FILE NO. 35898-01



SEEDING SCHEDULE & NOTES:

PERMANENT SEED MIXTURE					
GROUP	SEEDING DATES	GRASS SEED	PERCENTAGES	RATE/SF	RATE/AC
A	FEBRUARY 1 TO JULY 1	KENTUCKY 31 FESCUE	85%	2.5LBS/ 1,000SF	110LBS/ ACRE
		WHITE CLOVER	10%		
		ENGLISH RYE	5%		
B	JUNE 1 TO AUGUST 15	KENTUCKY 31 FESCUE	60%	2.5LBS/ 1,000SF	110LBS/ ACRE
		ENGLISH RYE	2%		
		WHITE CLOVER	10%		
		GERMAN MILLET	10%		
C	AUGUST 1 TO DECEMBER 1	KENTUCKY 31 FESCUE	70%	2.5LBS/ 1,000SF	110LBS/ ACRE
		ENGLISH RYE	20%		
		WHITE CLOVER	10%		
TEMPORARY SEED MIXTURE					
	AUGUST 15 TO OCTOBER 31	ANNUAL RYE GRASS	100%	0.9LBS/ 1,000SF	40LBS/ ACRE
	APRIL 15 TO JUNE 15	BROWN TOP MILLET	100%	0.9LBS/ 1,000SF	40LBS/ ACRE
	SEPTEMBER 15 TO NOVEMBER 30	WINTER WHEAT	100%	4.1LBS/ 1,000SF	3BU/ ACRE

- A. MAY TO SEPTEMBER 20 LB/AC OF STARR MILLET SHALL BE ADDED WITH SPECIFIED SEED GROUPING LISTED ABOVE.
- B. WHEN SEEDING NATIVE GRASSES FROM OCTOBER TO APRIL 32 LB/AC OF OATS SHALL BE ADDED WITH SPECIFIED SEED GROUPS LISTED ABOVE.
- C. WHEN SEEDING FESCUE OR BERMUDA GRASSES MIXES FROM OCTOBER TO APRIL 32 LB/AC OF OATS SHALL BE ADDED WITH SPECIFIED SEED GROUPS LISTED ABOVE.
- D. OCTOBER TO APRIL ADD 3 LB/1000 SF OF ANNUAL RYE GRASS WITH SPECIFIED SEED GROUPS LISTED.

OVERALL DREDGING INFO

TOTAL AREA = 1,347± SY
 TOTAL DREDGED VOLUME = 1,855± CY
 POOL ELEVATION = 795.0'
 PROPOSED DREDGING ELEV = 785.0'

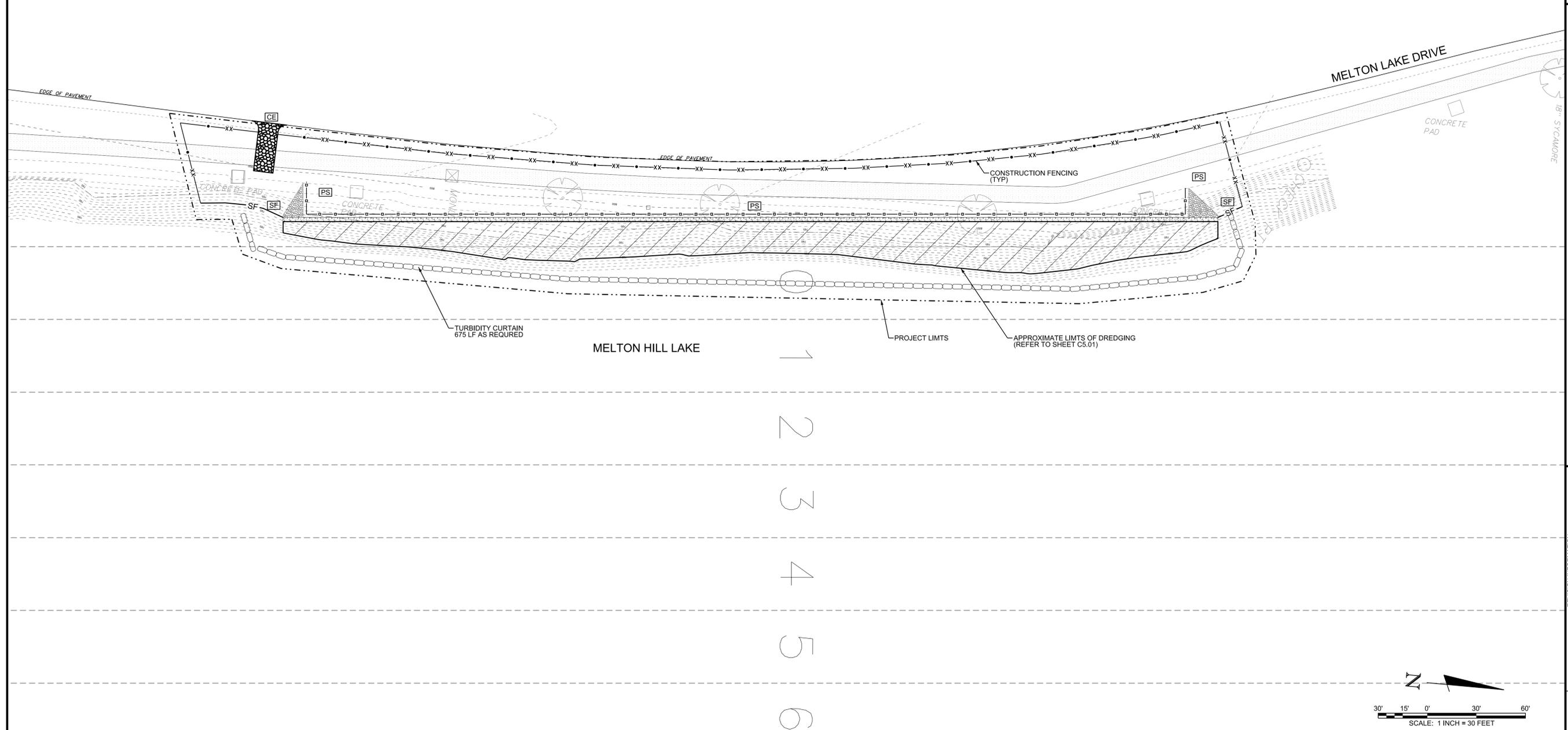
NOTES

- FOR GENERAL NOTES, SEE SHEET C0.02.
- CONTRACTOR SHALL ENSURE THAT NO SEDIMENT FROM DREDGED MATERIAL SHALL POLLUTE ANY ROADWAY. CONTRACTOR IS RESPONSIBLE FOR INSTALLING ANY E&SC MEASURES REQUIRED TO ADEQUATELY DRY DREDGED MATERIAL OR LINE DUMP BEDS BEFORE MATERIAL IS TRANSPORTED OFF-SITE.

LEGEND

- SF SILT FENCE
- TURBIDITY CURTAIN
- CONSTRUCTION FENCING
- PS PERMANENT SEEDING
- LIMIT OF DISTURBED AREA
- CE CONSTRUCTION EXIT

1 SEEDING SCHEDULE
 C2.31 NOT TO SCALE



INITIAL & FINAL EROSION & SEDIMENT CONTROL PLAN

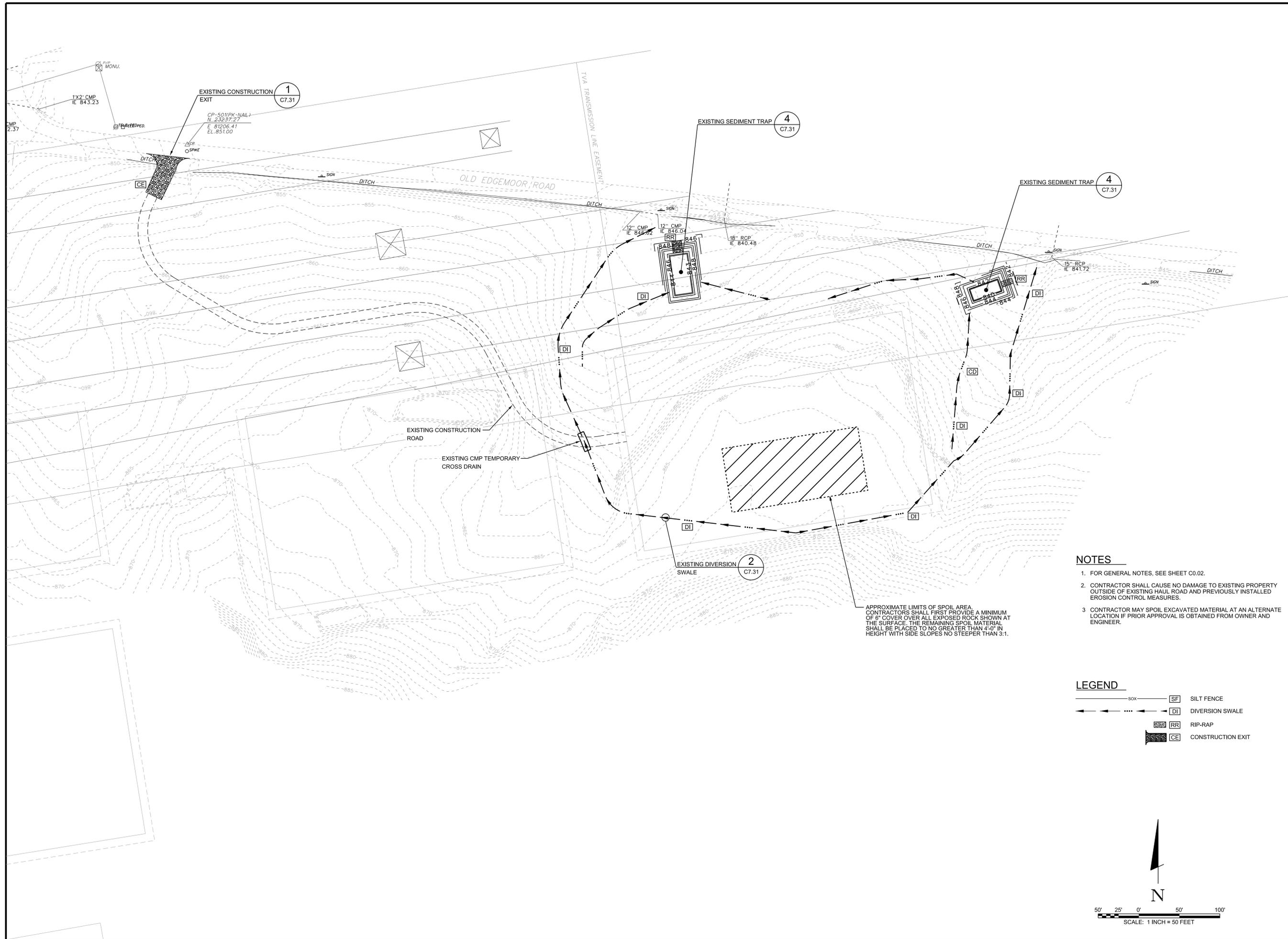
OAK RIDGE ROWING COURSE
 SITE IMPROVEMENTS
 OAK RIDGE, TENNESSEE



BWSC
 BARGE WAGGONER SUMNER & CANNON, INC.
 520 West Summit Hill Drive, Suite 1202, Knoxville, Tennessee 37902
 PHONE (865) 637-2810 FAX (865) 673-8554

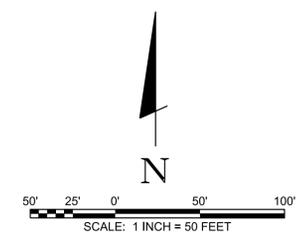
REV.	DR.	CHK.	DATE	DESCRIPTION
0	BSP	BCN	05/06/2016	ISSUED FOR BID

C2.31
 FILE NO. 35898-01



- NOTES**
- FOR GENERAL NOTES, SEE SHEET C0.02.
 - CONTRACTOR SHALL CAUSE NO DAMAGE TO EXISTING PROPERTY OUTSIDE OF EXISTING HAUL ROAD AND PREVIOUSLY INSTALLED EROSION CONTROL MEASURES.
 - CONTRACTOR MAY SPOIL EXCAVATED MATERIAL AT AN ALTERNATE LOCATION IF PRIOR APPROVAL IS OBTAINED FROM OWNER AND ENGINEER.

- LEGEND**
- SF SILT FENCE
 - DI DIVERSION SWALE
 - RR RIP-RAP
 - CE CONSTRUCTION EXIT

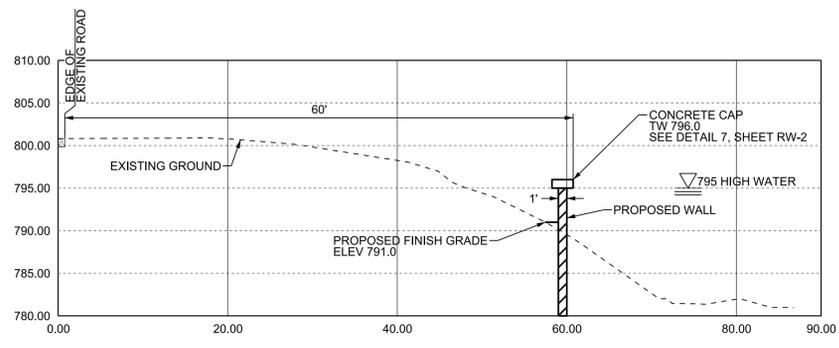


APPROXIMATE LIMITS OF SPOIL AREA.
CONTRACTORS SHALL FIRST PROVIDE A MINIMUM OF 6" COVER OVER ALL EXPOSED ROCK SHOWN AT THE SURFACE. THE REMAINING SPOIL MATERIAL SHALL BE PLACED TO NO GREATER THAN 4'-0" IN HEIGHT WITH SIDE SLOPES NO STEEPER THAN 3:1.

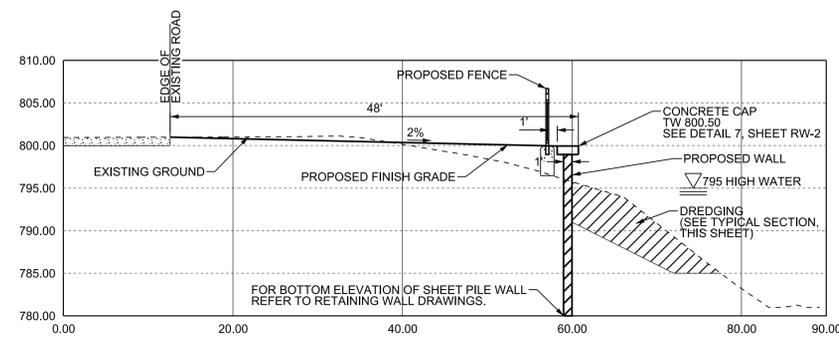


SPOIL AREA EROSION & SEDIMENT CONTROL PLAN
OAK RIDGE ROWING COURSE
SITE IMPROVEMENTS
 OAK RIDGE, TENNESSEE

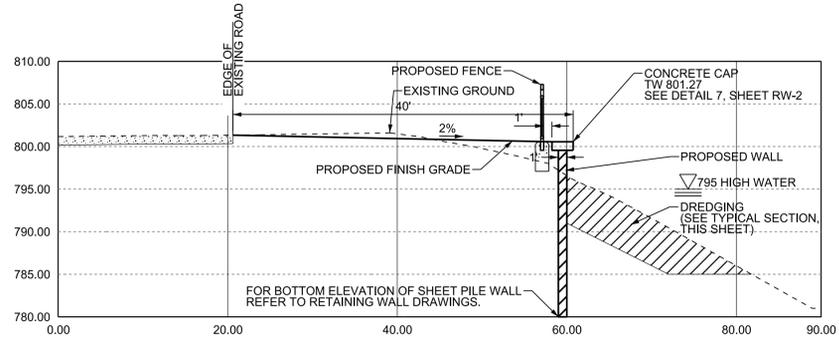
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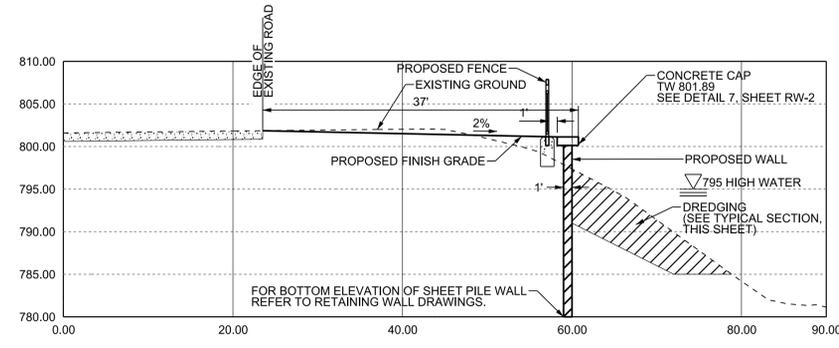
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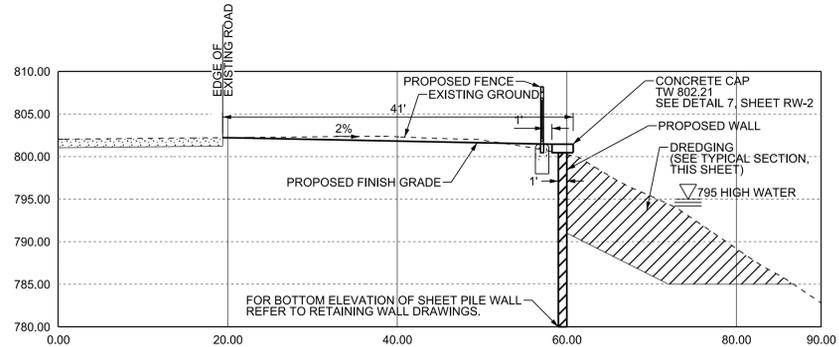
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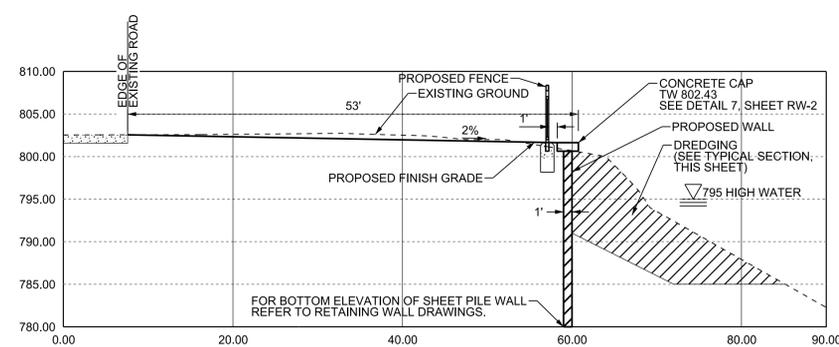
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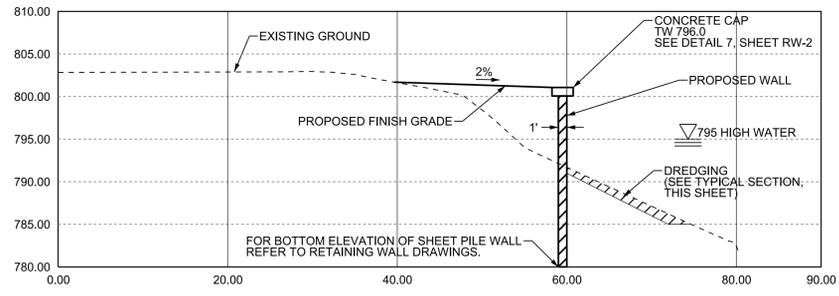
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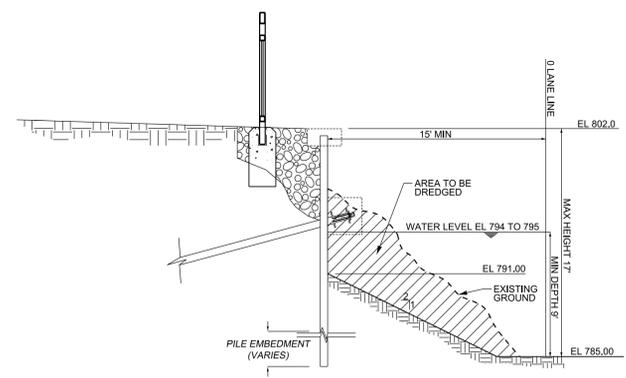
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SECTION @ STA 5+00



SECTION @ STA 5+71.37



TYPICAL DREDGING SECTION

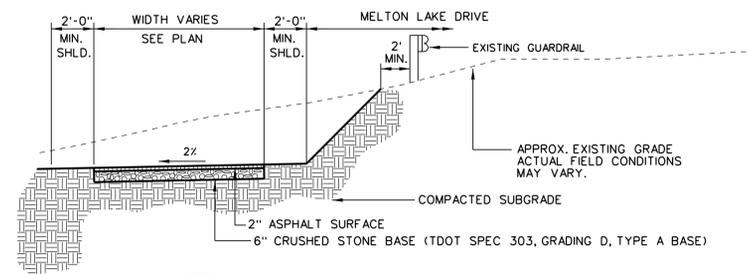
SCALE: NTS

SCALE:
HORIZ: 1" = 10'
VERT: 1" = 10'



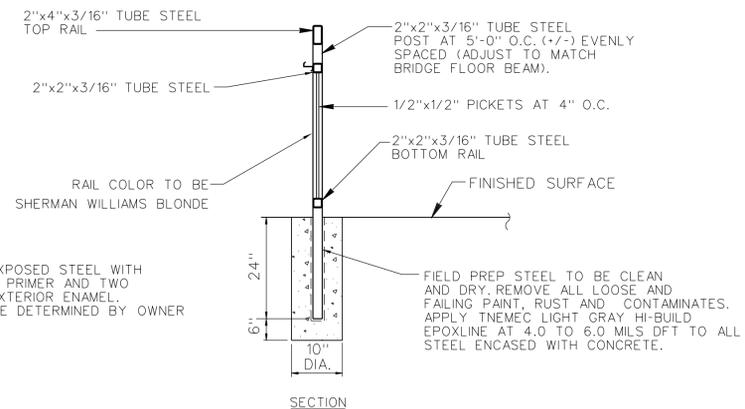
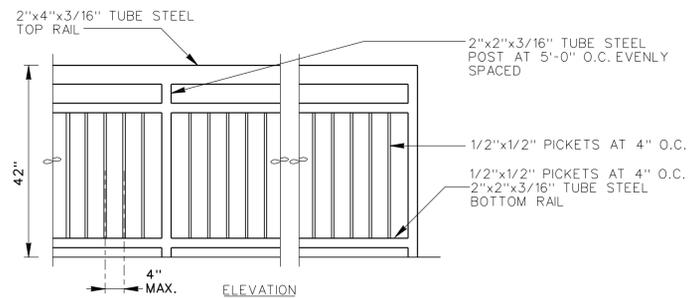
SHEET PILE WALL SECTIONS
OAK RIDGE ROWING COURSE
SITE IMPROVEMENTS
OAK RIDGE, TENNESSEE

REVISION INFORMATION	
REV.	DESCRIPTION
0	ISSUED FOR BID



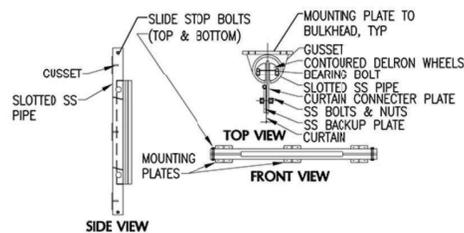
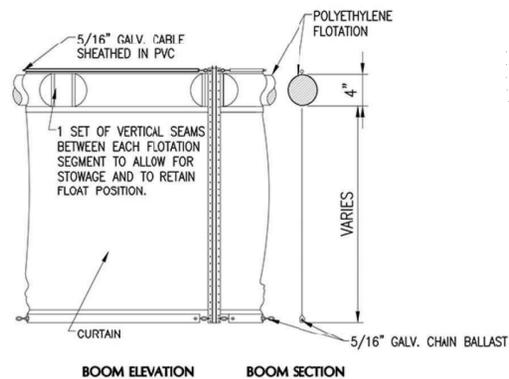
NOTE:
ON 1:1 CUT SLOPES, AND FILL SLOPES THAT EXCEED 3:1, INSTALL:
FABRIC CONTECH BRAND "C-JUTE" FABRIC (OR EQUIVALENT) ACCORDING TO MANUFACTURERS RECOMMENDATIONS
SEED MIX CROWNVETCH AND KY. 31 FESCUE, PLANT ACCORDING TO KNOX COUNTY EROSION AND SEDIMENT CONTROL STANDARD NO. 2

1 TRAIL SECTION ALONG MELTON LAKE DRIVE
C7.01 SCALE: NTS



NOTE:
PAINT ALL EXPOSED STEEL WITH RUST PROOF PRIMER AND TWO COATS OF EXTERIOR ENAMEL. COLOR TO BE DETERMINED BY OWNER

2 SAFETY RAIL DETAIL FOR RETAINING WALL
C7.01 SCALE: NTS



3 TURBIDITY CURTAIN DETAILS
C7.01 SCALE: NTS



REV.	DR.	CHK.	DATE	DESCRIPTION
0	BSP	BCN	05/06/2016	ISSUED FOR BID

1. GENERAL NOTES:

- a. Pre-Construction Meeting: A pre-construction meeting shall be conducted by the General Contractor prior to beginning construction. Owner's Construction Manager shall be notified of the date, time, and location of the meeting. Mandatory attendees include the General Contractor, the Engineer of record, the project geotechnical engineer, the Contractor's testing agency, Owner's independent testing laboratory, and representatives of all sub-contractors involved with the proposed construction. Meeting topics shall include, but are not limited to; schedule and phasing of construction; coordination with other on-site construction activities; responsibilities of parties; and sources, quality, and acceptance of materials.
- b. Construct retaining wall and anchors in accordance with these drawings or as directed by the Engineer (GEOservices) during the course of construction.
- c. The Contractor shall provide all labor, equipment, and materials to construct the project in accordance with the lines, elevations, and requirements of these plans and specifications or as directed by the Engineer during the course of the construction. Alternatives to, or changes in, the plans and specifications must be approved by the Engineer prior to commencement of work.
- d. The field locations of existing utilities, foundations and other structures identified to the Engineer are shown on these drawings. The Engineer is not responsible for field verifying these locations or any damage to identified and unidentified utilities and foundations. The Contractor shall field verify locations and elevations of all utilities within 50 feet behind and in front of retaining wall. If any conflicts are found to exist with the proposed construction and the existing utility locations, the Engineer shall be notified to determine the modifications required.
- e. The Contractor shall be responsible for acquiring permission and all permits for the wall construction areas.
- f. Wall heights shown are based on information available at the time of design. If the actual wall heights are more than one foot greater than the wall heights shown on the drawings, the Contractor shall immediately inform the Engineer, who will determine if any modifications are required.
- g. The Contractor shall field verify all conditions, grades and dimensions at the site prior to wall construction. If the Contractor discovers any errors, omissions or discrepancies, he shall contact the Engineer prior to commencing retaining wall remediation.
- h. All grade information shown shall be field verified at the time of construction.
- i. Contractor shall implement measures to meet local, state and federal requirements for fall protection, traffic barriers, and all other safety conditions at the retaining wall location both during and after construction. Safety measures and conditions shall be the responsibility of the Contractor. Under no circumstances shall the Engineer be responsible for performance or implementation of the safety measures or any other safety conditions at the site both during and after construction.
- j. The Contractor is solely responsible for site safety and under no circumstances shall the Engineer be responsible for construction site safety.
- k. The Contractor shall assume full responsibility for compliance with the contract documents, for dimensions to be confirmed at the job site, for fabrication processes, for safe conditions at the job site, and for the means, methods, techniques, sequences, and procedures of construction.
- l. These drawings are furnished for application to this specific project only. Any party accepting these documents does so in confidence and agrees that it shall not be duplicated in whole or in part, nor disclosed to others without the consent of GEOservices, LLC.

2. DESIGN CRITERIA:

- a. The design reflected on these drawings is intended for the construction of a permanent anchored sheet pile retaining wall. Some limited lateral and vertical movement may occur above and behind the wall.
- b. Water is expected within the construction limits of the retaining wall. Differential hydrostatic pressure is not considered in the design.
- c. Surcharge load: The retaining wall was designed with a 250 psf surcharge. The wall shall not have any additional surcharges including but not limited to heavy equipment, construction traffic, and material stockpiles above the wall at any time during or after construction.

3. GEOTECHNICAL DATA

- a. The Engineer shall verify the suitability of the following parameters for the onsite materials used in the design of the retaining wall at the time of construction:
 Retained Soils: Alluvium
 Internal Friction Angle = 32 Degrees
 $\phi_p = 120$ psf
 $\phi_s = 62.6$ psf
 Active Earth Pressure Coefficient = $K_a = 0.31$
 Passive Earth Pressure Coefficient = $K_p = 3.26$
- b. If the materials vary from the parameters listed above, the Engineer shall be retained to determine if adjustments to the design are required.

4. MATERIALS:

- a. Sheet Piles: NZ19, Skyline Steel or equivalent. Minimum sizes shall be in accordance with the schedules. All piles shall have standard coal tar epoxy (16 mil. min.) protection on exposed surfaces or equivalent corrosion protection.
- b. Steel Plate: ASTM A572 or ASTM A709 grade 50 structural steel.
- c. Welds: All welds shall use E70xx electrodes (min.). All exposed welds shall be covered with zinc rich paint or approved equal.
- d. Tieback Anchor drill hole diameter: 6 inches (minimum).
- e. Tieback Anchors: All-Thread bar, Grade 75 (ASTM A722), Multiple Corrosion Protection II, Class I Protection Prefabricated Anchor - Williams Form or approved equal size #11 minimum.
- f. Trumpets: ASTM A53-86 - 2" diameter Schedule 40 steel pipe 18" long and fully welded to bearing plate. All trumpets shall have galvanized or epoxy coating corrosion protection on exposed surfaces or equivalent corrosion protection.
- g. Bar Nuts and Washers: Size and type compatible with tieback bars per manufacturer's specifications.
- h. Centralizers: Plastic material that is non-detrimental to the prestressing steel. The centralizer shall position the anchor in the center of the drill hole.
- i. Grout - Type I, II, or III portland cement conforming to AASHTO T106 / ASTM C-150 specifications shall be used for grout. Cement should be fresh and should not contain any lumps or other indications of hydration. 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 4,000 psi. Grout shall be tested once per day, 1 set of 3 cubes per day, or every 20 cubic yards of grout placement per day, whichever is greater. One specimen broken at 3 days and the other two broken at 28 days.
- j. Water for Grout: Clean, potable water
- k. Granular Backfill: Granular backfill shall be #2 size crushed limestone aggregate (or approved equal).

5. CONSTRUCTION:

- a. SHEET PILE INSTALLATION: Sheet piles shall be installed as shown on the drawings. The piles shall be plumb within 2 percent of the total-length alignment. The top elevation of the piles shall be plus/minus 1 inch from the top of wall elevations shown on the drawings. Sheets shall be installed to bedrock and shall maintain a minimum embedment as shown on the profiles (sheet RW-3).
- b. GROUND HEAVE OR SUBSIDENCE: During construction, the Contractor shall observe the conditions in the vicinity of the wall construction on a daily basis for signs of ground heave or subsidence. Immediately notify the Engineer if signs of movements are observed. The Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the wall is adversely affected, or if adjacent structures are damaged from the drilling or grouting.

If the Engineer determines that the movements require corrective action, the Contractor shall take the corrective actions necessary to stop the movement and/or perform repairs. When due to the Contractor's methods, operations, or failure to follow the approved construction sequence, as determined by the Engineer, the costs of providing corrective actions shall be borne by the Contractor.

- c. DRILLING FOR TIEBACKS: Core drilling, rotary drilling or percussion drilling can be used in hard geomaterials. Auger drilling, rotary drilling, and percussion driven casing can be used in medium or soft geomaterials. The Contractor shall submit the drilling method to the Engineer for approval prior to installing tiebacks. Care shall be taken in drilling the tiebacks to prevent drilling into previously installed tiebacks.

The Anchor Lengths listed are the minimum lengths that the tiebacks shall extend into competent material using a 6 inch diameter drilled hole. The location of competent material at each tieback location shall be determined during construction by the Engineer. The unbonded length of each tieback will vary based on actual site conditions.

- d. TIEBACK INSTALLATION: The Contractor shall install the tiebacks as shown on the drawings. Each tieback location shall be placed within 1 inch of the location shown and the angle of entry shall be within 3 degrees of that shown on the drawings. With approval by the Engineer, the Contractor shall adjust the tieback angle of entry to avoid damaging existing utilities and structures.
- e. TIEBACK GROUTING: The Contractor shall use a stable neat cement grout or sand cement grout without lumps and undispersed cement. The Contractor shall have the means and methods of measuring the grout quantity and pumping pressure during the grouting process. The grout shall be kept in agitation prior to mixing. Grout shall be placed within one hour of mixing. The grout shall have a minimum 28-day strength of 4,000 psi.

The Contractor shall inject the tieback grout beginning from the lowest point of the tieback. The grout may be placed using grout tubes, casing or drill rods. The grout can be placed before or after insertion of the tieback bar. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled by the Contractor to prevent excessive heave in cohesive soils or fractured rock.

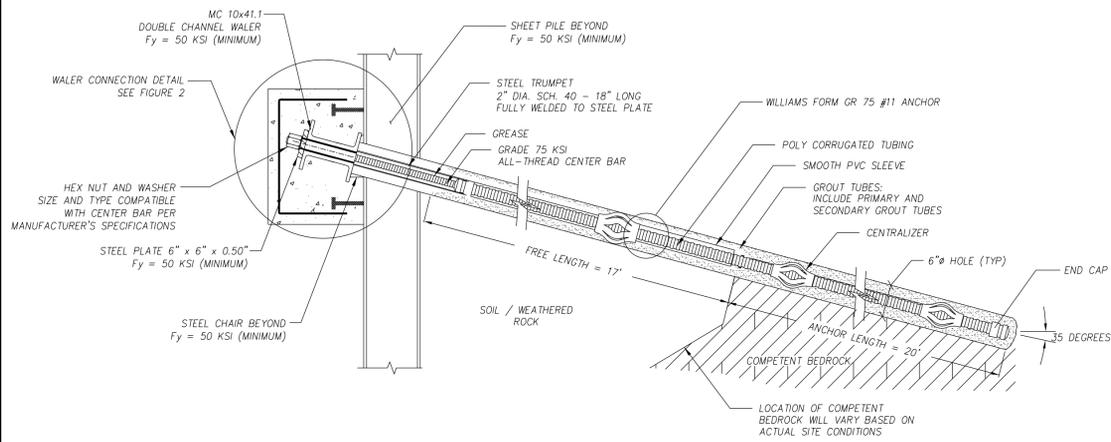
- f. TIEBACK LOADING: All tiebacks shall be loaded in accordance with the testing procedures outlined in sections 6 and 7 of these notes.
- g. WALL BACKFILL AND FILL PLACEMENT: Areas behind the retaining wall shall be backfilled with materials described in Section 4 to meet the lines and grades for the proposed top of wall elevations. All backfill materials shall be placed in a manner that will minimize voids, pockets, and bridging. Only lightweight hand-operated equipment shall be allowed within 3 feet from the face of the wall.

h. The Contractor shall be responsible for protecting tiebacks and all other constructed portions of the retaining wall during fill placement. Any portions of the retaining wall damaged during construction shall be replaced at the Contractor's expense.

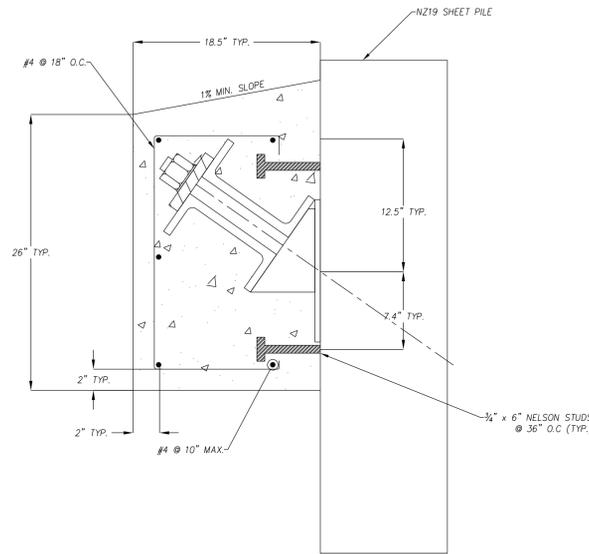
6. ANCHOR PERFORMANCE TEST PROCEDURES

- a. Performance testing shall be performed on the first three anchors installed. The location of the first three anchors installed shall be at multiple representative locations along the wall alignment as approved by the Engineer. If any modifications to the design are required based on the results of the performance tests, the Engineer will issue revisions. Any anchor installations performed prior to approval of the first three anchor performance tests by the Engineer shall be at the risk of the Contractor.
- b. Following Performance Testing of the first three anchors, a minimum of 10% of the remaining anchors shall be Performance Tested.
- c. Anchor performance testing shall comply with the recommendations of the Post Tensioning Institute (PTI).
- d. The test load increment shall be maintained at each interval until movement stabilizes or for the minimum time shown, whichever is greater. Test load shall be evenly distributed on the wall face and no closer than 18 inches to the tieback anchor being tested.
- e. At each load increment, the total movement of the pulling head (Anchor Elongation) shall be recorded to the nearest 0.001 in with respect to an independent fixed reference point.
- f. Each performance test shall be performed as follows:

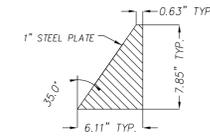
CYCLE	LOAD	HOLD	CYCLE	LOAD	HOLD
1	AL	1 MINUTE	5	AL	1 MINUTE
	0.25 P			0.25 P	
	0.50 P			0.50 P	
2	0.25 P	1 MINUTE	6	0.25 P	1 MINUTE
	0.50 P			0.50 P	
	0.75 P			0.75 P	
3	AL	1 MINUTE	7	AL	1 MINUTE
	0.25 P			0.25 P	
	0.50 P			0.50 P	
4	AL	1 MINUTE	8	AL	1 MINUTE
	0.25 P			0.25 P	
	0.50 P			0.50 P	
5	0.25 P	1 MINUTE	9	0.25 P	1 MINUTE
	0.50 P			0.50 P	
	0.75 P			0.75 P	
6	0.25 P	1 MINUTE	10	0.25 P	1 MINUTE
	0.50 P			0.50 P	
	0.75 P			0.75 P	
7	0.25 P	1 MINUTE	11	0.25 P	1 MINUTE
	0.50 P			0.50 P	
	0.75 P			0.75 P	
8	0.25 P	1 MINUTE	12	0.25 P	1 MINUTE
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	0.75 P			0.75 P	
9	0.25 P	1 MINUTE	13	0.25 P	1 MINUTE
	0.50 P			0.50 P	
	0.75 P			0.75 P	
10	0.25 P	1 MINUTE	14	0.25 P	1 MINUTE
	0.50 P			0.50 P	
	0.75 P			0.75 P	
11	0.25 P	1 MINUTE	15	0.25 P	1 MINUTE
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12	0.25 P	1 MINUTE	16	0.25 P	1 MINUTE
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14	0.25 P	1 MINUTE	18	0.25 P	1 MINUTE
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22	0.25 P	1 MINUTE	26	0.25 P	1 MINUTE
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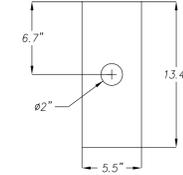
1 TYPICAL TIEBACK ANCHOR DETAIL
RW-2 SCALE: NTS



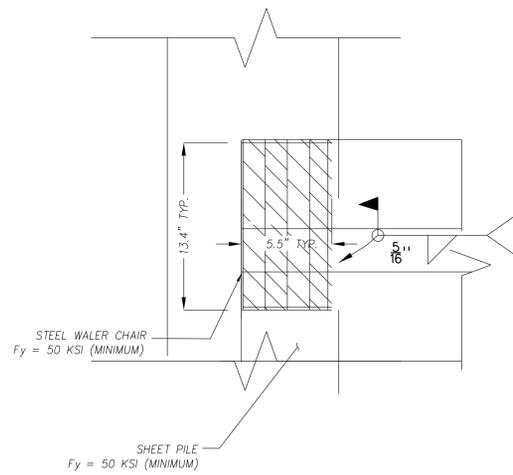
2 WALER CONNECTION DETAIL - SECTION
RW-2 SCALE: 1-1/2\"/>



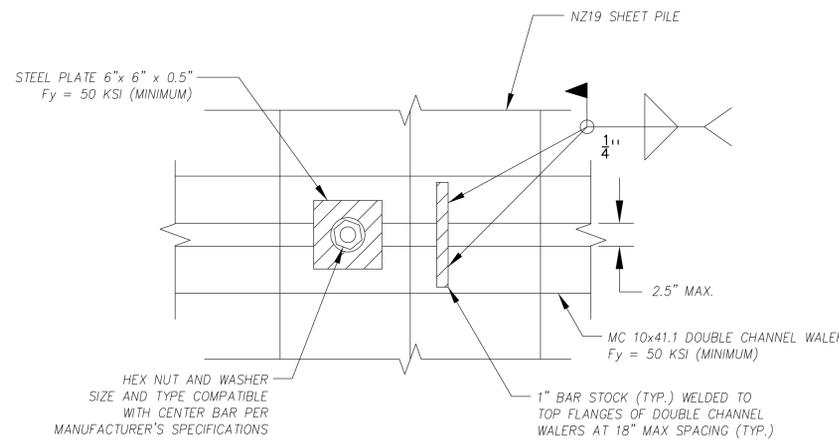
3 WALER CHAIR DETAIL - SECTION
RW-2 SCALE: 1-1/2\"/>



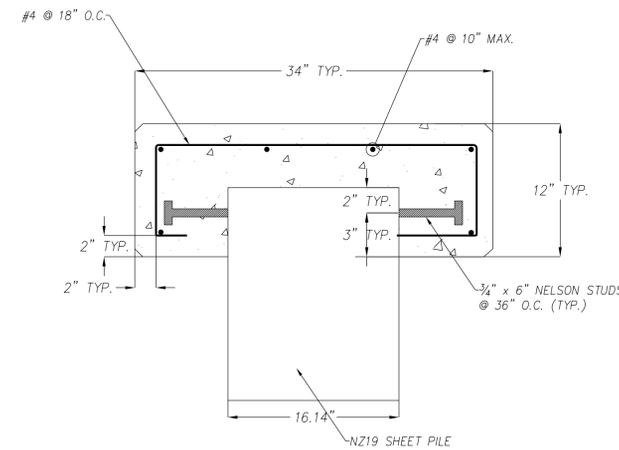
4 STEEL PLATE DETAIL
RW-2 SCALE: 1-1/2\"/>



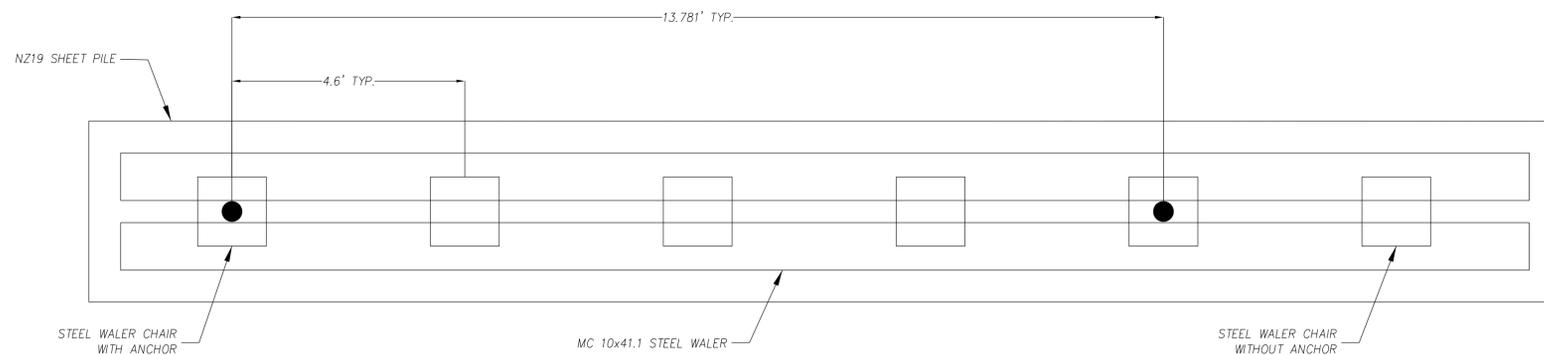
5 WALER CHAIR DETAIL - ELEVATION
RW-2 SCALE: NTS



6 WALER CONNECTION DETAIL - ELEVATION
RW-2 SCALE: NTS



7 CAP BEAM DETAIL
RW-2 SCALE: 1-1/2\"/>



8 CHAIR SPACING DETAIL
RW-2 SCALE: 1-1/2\"/>



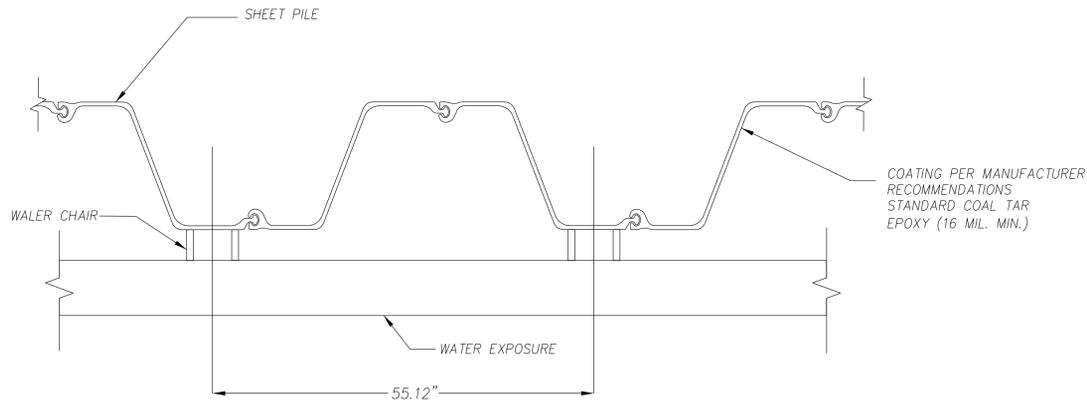
SHEET PILE WALL CONSTRUCTION DETAILS

OAK RIDGE ROWING COURSE
SITE IMPROVEMENTS
OAK RIDGE, TENNESSEE

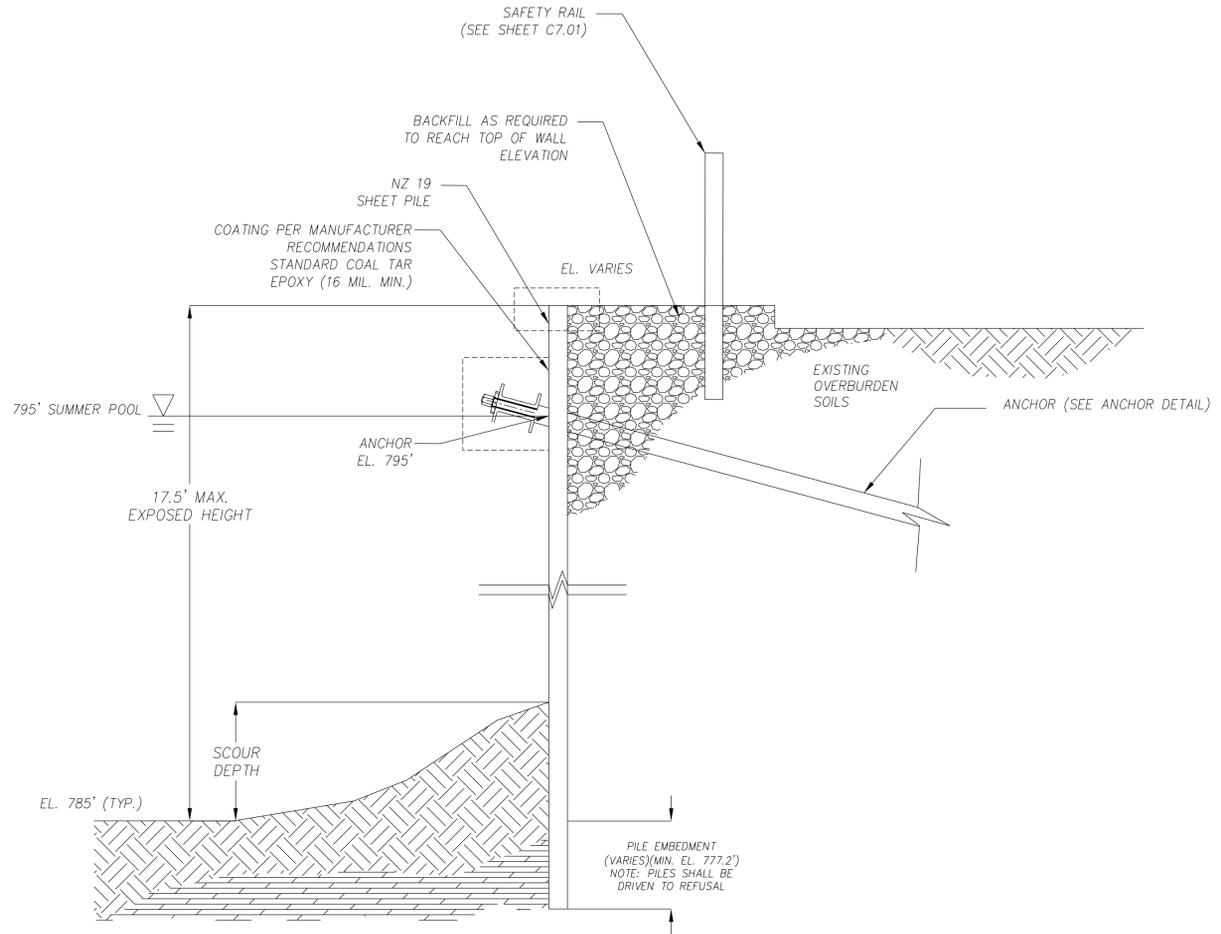
REV.	DR.	CHK.	DATE	DESCRIPTION
0			05/06/2016	ISSUED FOR BID

RW-2

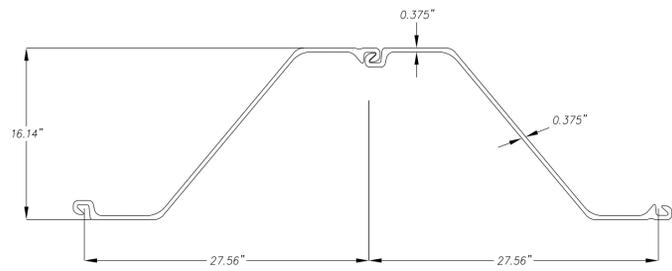
FILE NO. 35898-01



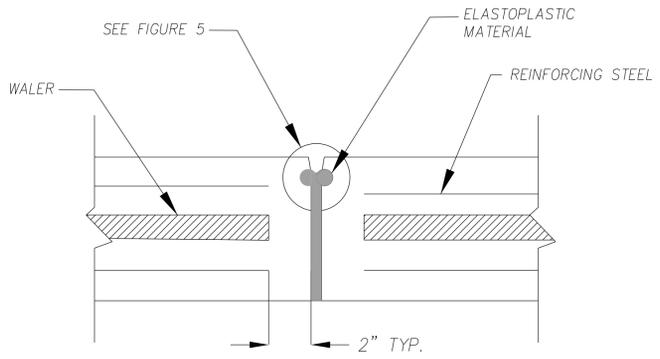
1 WALER SUPPORT DETAIL
RW-3 SCALE: NTS



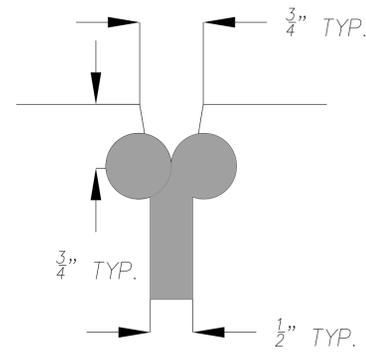
1 TYPICAL WALL CROSS SECTION DETAIL
RW-3 SCALE: NTS



2 NZ 19 SHEET PILE DETAIL
RW-3 SCALE: NTS



4 EXPANSION JOINT DETAIL
RW-3 SCALE: NTS



5 EXPANSION JOINT DETAIL - DIMENSIONS
RW-3 SCALE: NTS

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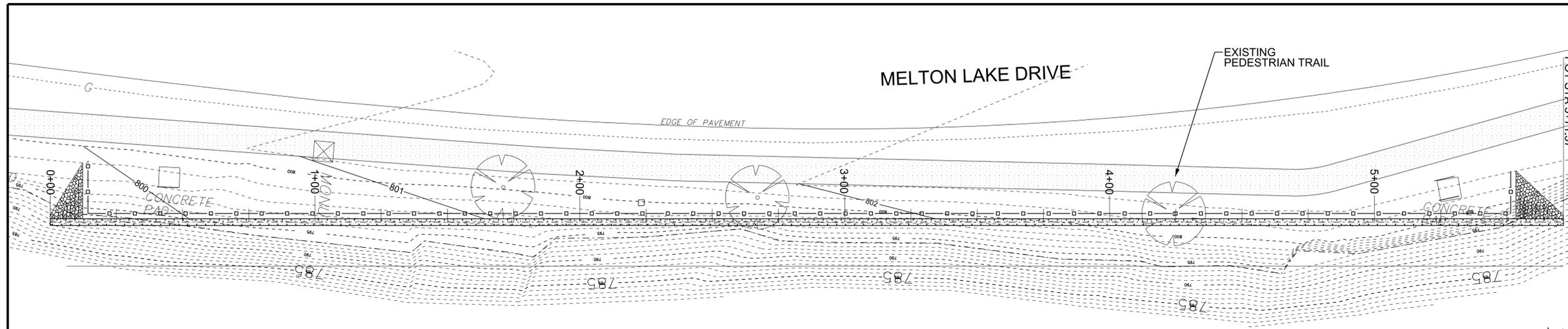
SHEET PILE WALL CONSTRUCTION DETAILS

OAK RIDGE ROWING COURSE
SITE IMPROVEMENTS
OAK RIDGE, TENNESSEE

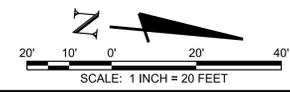
REV.	CHK.	DATE	DESCRIPTION
0		05/06/2016	ISSUED FOR BID

RW-3

FILE NO. 35898-01

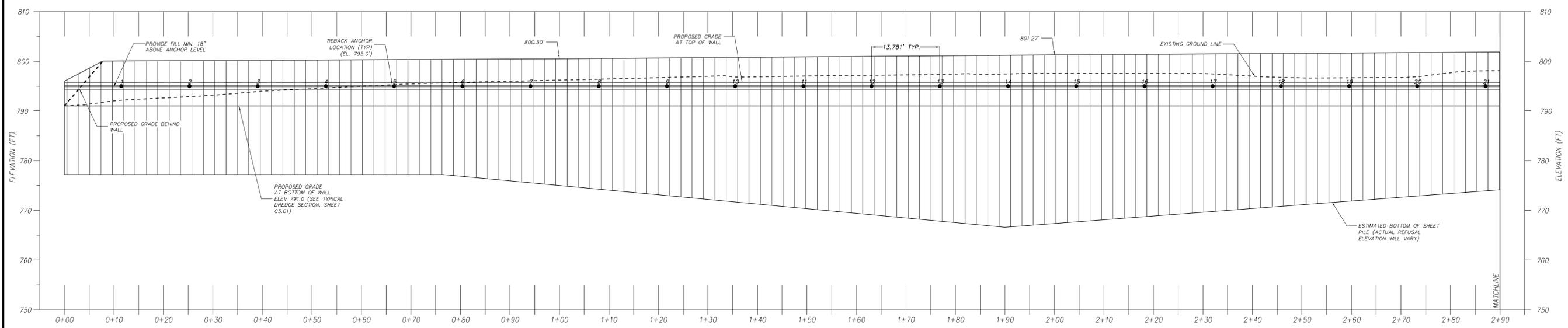


1 WALL LOCATION PLAN
RW-1.0 SCALE: 1" = 20'

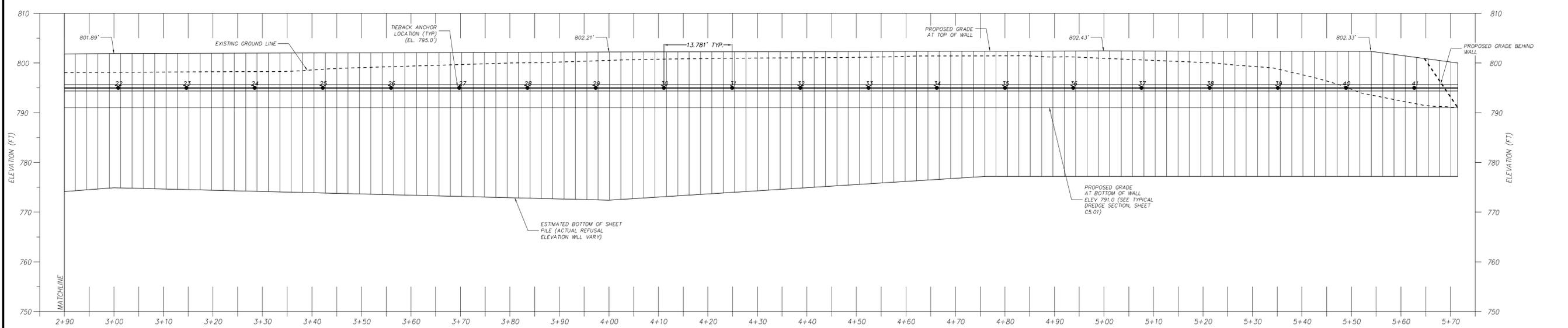


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2 SHEET PILE WALL PROFILE
RW-1.0 SCALE: 1" = 10'



3 SHEET PILE WALL PROFILE
RW-1.0 SCALE: 1" = 10'

RETAINING WALL PLAN & PROFILE
OAK RIDGE ROWING COURSE
SITE IMPROVEMENTS
OAK RIDGE, TENNESSEE

REV.	DR.	CHK.	DATE	DESCRIPTION
0			05/06/2016	ISSUED FOR BID

RW-1.0
FILE NO. 35898-01

5/9/2016
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