

CONTRACT DOCUMENTS AND SPECIFICATIONS
31E / ALBERT GALLATIN RETAINING WALL BID

CITY OF GALLATIN

ENGINEERING DIVISION
132 WEST MAIN STREET
GALLATIN, TENNESSEE 37066

DATE: 7-1-2014

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INVITATION TO BID
&
INFORMATION FOR BIDDERS

SECTION A

INVITATION TO BID

Sealed bids will be received by the City of Gallatin in the office of the City Engineer, Room 204, City Hall, 132 West Main Street, Gallatin, Tennessee until 10:30 a.m. local time, 8-12-2014, at which time they will be opened and read aloud for the construction of 31E / ALBERT GALLATIN RETAINING WALL.

Plans, Specifications, Proposal Forms, and Contract Documents may be inspected at, and obtained after 2:00 p.m. local time, 7-24-2014 at the office of the City Engineer, Room 204, City Hall, 132 West Main Street, Gallatin, Tennessee upon payment of \$25.00 per set or by downloading from the City's home page <http://www.gallatintn.us/> under "I Want To – Get-City Bid Information".

All bidders must be licensed contractors and eligible to bid Contracts in the State of Tennessee. The City of Gallatin reserves the right to reject any or all bids.

INFORMATION FOR BIDDERS

All bidders must satisfy themselves by personal examination of the locations of the proposed work, by examination of the specifications and requirements of the work and the accuracy of the estimate of the quantities of the work to be done, and shall not at any time after the submission of a bid dispute or complain of such estimate nor assert that there was any misunderstanding in regard to the nature or amount of work to be done. The City shall not be responsible for bidders' errors and misjudgments, nor any information on local conditions or general laws and regulations.

The Documents and Specifications contain the provisions required for the design and build of 31E / ALBERT GALLATIN RETAINING WALL. No information obtained from any officer, agent, or employee of the City on any such matters shall in any way affect the risk or obligations assumed by the Contractor, or relieve him from fulfilling any of the conditions of the contract.

All bids must be made on the blank form of **Proposal** attached hereto. **Bids must be submitted in a sealed envelope clearly marked "BID – 31E / ALBERT GALLATIN RETAINING WALL."** Bids arriving after the announced opening time or absent of the aforementioned markings will not be accepted.

All bidders must be licensed contractors and eligible to bid Contracts in the State of Tennessee. **No bid will be opened if the following information does not appear on the envelope containing the bid.**

1. Bidder's Name
2. Address
3. Tennessee Contractor's License Number
4. License Classification Applying to Bid
5. License Expiration Date
6. Name of Project for which Bid is submitted
7. Name and License information for all Subcontractors who will perform work.

Proposals which are incomplete, unbalanced, conditional, or obscure or which contain additions not called for, erasures, alterations or irregularities of any kind or which do not comply with the Invitation to Bid and Information for Bidders may be rejected at the option of the City. Bids must be written with typewriter, ink or indelible pencil; otherwise they may not be considered. Faxed bids will not be accepted.

The City of Gallatin reserves the right to disregard all nonconforming, nonresponsive, or conditional bids; to reject any or all bids; to limit quantities; to waive informalities; and to evaluate proposals and accept any proposal or any part of any proposal that is judged, in our opinion, to be of the best quality, value, and service to the City of Gallatin.

A bidder may withdraw any proposal he has submitted at any time prior to the hour set for the closing of the bids, provided the request for withdrawal is signed in a manner identical with the proposal being withdrawn. No withdrawal or modification will be permitted for 60 days after the hour and date designated for opening the bids.

All questions or explanations requested by Bidders shall be submitted in writing to the City in ample time to permit consideration before the bid date. Necessary replies will be issued to all bidders of record as Addenda and receipt thereof shall be acknowledged on the proposal. Bidders shall check with the City prior to bid opening to secure any Addenda that may affect bidding. Oral instructions will not be given and do not form a part of the Bidding Documents.

Contractor will be paid based on quantities of work installed. Payment applications shall be made on a monthly basis.

In case of default of the Contractor, the City may procure the articles of services from other services and hold the Contractor responsible for any excess cost occasioned thereby.

Bids must be executed in the Company name and signed by an officer or individual who has authority to bind the Company.

No bid shall be altered or amended after the specified time for opening bids.

All material and workmanship shall be subject to inspection. In case any articles are found to be defective in material or workmanship, or otherwise not in conformity with the specification requirements, the City shall have the right to reject such articles or require their correction. Final inspection shall be conclusive except as regards latent defects, fraud, or such gross mistakes as amount to fraud.

A change order will be issued only in the event of a change in the scope of work.

All bid proposals must include the following:

1. Sealed envelope with required information on the outside.
2. Bid Proposal Form
3. Bid Surety or Certified check in the amount of 10% of the total bid.
4. Drug-Free Workplace Affidavit.

The successful bidder must provide the following, each of which shall be in accordance with the contract documents:

1. Performance surety covering and including labor and materials in the amount of one hundred percent (100%) of the contract price. The performance bond is to remain in place for a period of one year after project completion.
2. Certificate of Insurance naming the **City of Gallatin** additionally insured with any exclusions listed, including
 - General Liability
 - Worker's Comp
 - Auto Insurance
3. Proof of Worker's Comp for all Subcontractors
4. W-9 Form, if a new vendor

Additional Requirements:

- The successful bidder will also be responsible for payment of all taxes levied under the laws of the State of Tennessee.
- The successful bidder shall have the responsibility to insure that all persons employed under a contract with the City, whether directly or by subcontract, be legal residents and be authorized to work in the United States.
- Affirmative Action compliance is required.

All interested parties, without regard to race, color, or national origin, shall be afforded the opportunity to bid and shall receive equal consideration.

Additional information may be obtained by contacting the City of Gallatin Engineering Division, Zach Wilkinson, Project Engineer, at (615) 451-5965.

<i>EQUAL OPPORTUNITY TITLE VI POLICY STATEMENT</i>

It is the policy of the City of Gallatin to ensure compliance with Title VI of the Civil Rights Act of 1964; 49 CFR, Part 21; related statutes and regulations to the end that no person shall be excluded from participation in or be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance from the U. S. Department of Transportation on the grounds of race, color, sex, age, disability or national origin.

**BID PROPOSAL
INCLUDING DRUG FREE AFFIDAVIT**

SECTION B

PROPOSAL

ENGINEERING DIVISION
GALLATIN, TENNESSEE 37066

In response to the Invitation to Bid, the undersigned Bidder submits the following proposal for construction of 31E / ALBERT GALLATIN RETAINING WALL within the City of Gallatin as described and specified in the contract documents and conditions.

The Bidder declares that he has examined the site of the work and informed himself fully in regard to all conditions pertaining to the scope; that he has examined the Plans, Specifications, and Contract Documents for the work, and has read all the Special Provisions furnished prior to the opening of bids; and that he has satisfied himself relative to the work to be performed.

The Bidder agrees that this bid shall be good and may not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving bids.

The Bidder hereby agrees that if he is awarded the Contract for this Work, he will commence work before a date to be specified in a written Notice to Proceed of the Owner and to fully complete the work as directed by the City Engineer.

The undersigned Bidder does hereby declare and stipulate that this Proposal is made in good faith, without collusion or connection with any other person or persons bidding for the same work, and that it is made in pursuance of and subject to all the terms and conditions of the Contract, the Specifications, and the Plans pertaining to the Work to be done.

Attached is the required Bid Surety or Certified Check in the amount of 10% of the total bid which the Bidder agrees will be retained by the City as liquidated damages in the event that the Bidder's proposal is accepted and the Bidder fails to execute the contract within the time stated in the proposal.

BID PROPOSAL
31E / ALBERT GALLATIN RETAINING WALL

In compliance with your legal Invitation to Bid for the City of Gallatin 31E / ALBERT GALLATIN RETAINING WALL., the undersigned Bidder, a corporation organized and existing under the laws of the State of _____, or a partnership of _____, or an individual doing business as _____ of the City of _____

State of _____, having examined the Specifications and Contract forms thereto attached, and being fully advised as to the extent and character of the work to be performed, and the equipment to be furnished, hereby proposes to furnish all labor, tools, material and equipment necessary for the Project.

The Bidder shall complete all tables to establish his Bid. The undersigned further proposes to, perform all work, and furnish all equipment and materials in accordance with the Specifications and Contract stipulations thereof, within the time limit specified, for the price so stated below.

BID SCHEDULE:

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	EXTENDED AMOUNT
1	Retaining Wall (1)	497	SF		
2	Underdrain (2)	145	LF		
3	Geogrid (3)	1315	SF		
4	Backfill (4)	1	LS		
5	Seed/Straw Mat (5)	1	LS		

- (1) Item includes all excavation required for construction of wall and trail to match proposed grades shown on plans, construction of wall footing, construction of wall using Keystone Standard Unit 18-Tri Plane Face block in color that matches existing trail walls (or approved equal), and all incidentals required for wall construction. Measurement for payment will be based on actual square footage of block installed (underground and exposed).
- (2) Item includes installation of underdrain for wall as indicate by plans, utilizing pipe meeting specs as identified in the Wall Specifications, including geotextile wrap and aggregate.
- (3) Item includes installation of Geogrid as indicated in plans, utilizing material meeting specs as identified in the Wall Specifications.
- (4) Item includes backfill of wall and grading of subgrade of proposed trail as indicated in plans with materials meeting the standards set forth in the Wall Specifications and project plans.
- (5) Item includes placement of seed and straw mat NAG SC150 BN or approved equal installed per manufacturer's recommendations in all disturbed areas.

TOTAL BID

\$ _____

TOTAL BID: Bidder agrees to perform all work and provide all materials as described in the specifications, plans, and conditions shown on the bid schedule for the sum of

_____ (\$ _____)

(Amount shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

Respectfully submitted:

Contractor

By: _____

Title: _____

Business Address: _____

Contractor's License No: _____

Telephone Number: _____

NOTICE OF AWARD

SECTION C

NOTICE OF AWARD

TO: _____

PROJECT DESCRIPTION: 31E / ALBERT GALLATIN RETAINING WALL

We have considered the Bid submitted by you for the above-described Work in response to our Invitation to Bid and are pleased to award the contract to your company.

You are required to execute the enclosed Agreement and furnish the required Contractor's Performance and Payment Bond within 10 calendar days from the date of this Notice.

If you fail to execute said Agreement and to furnish said bonds within 10 calendar days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your Bid as abandoned and as a forfeiture of your Bid Bond. The OWNER will be entitled to such other rights as may be granted by law.

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

Dated this _____ day of _____, 20__.

City of Gallatin
(Owner)

By: _____

Title: _____ Mayor _____

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged.

Contractor
By: _____

Title: _____

This the _____ day of _____, 20__

CONTRACT AGREEMENT

SECTION I

AGREEMENT BETWEEN
OWNER AND CONTRACTOR

THIS AGREEMENT made as of the ___day of _____, 2014, by and between the OWNER: CITY OF GALLATIN, TENNESSEE, and CONTRACTOR:_____

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

Article 1. WORK. The CONTRACTOR will perform all Work as shown in the Contract Documents for the completion of the Project generally described as follows: 31E / ALBERT GALLATIN RETAINING WALL

Article 2. ENGINEER. The City Engineer will act as the ENGINEER in connection with completion of the Project in accordance with the Contract Documents.

Article 3. CONTRACT TIME. The Work for this Contract shall be completed within 35 days of issuance of the Notice of Award.

Article 4. CONTRACT PRICE. The OWNER will pay the CONTRACTOR for performance of the Work and completion of the Project in accordance with the Contract Documents subject to adjustment by Modifications as provided therein in current funds as follows:

_____ (\$ _____)
(Amount shall be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

Article 5. PAYMENT. The OWNER will pay the CONTRACTOR upon completion and acceptance of Work covered in this Contract.

Article 6. MISCELLANEOUS.

6.1 Neither the OWNER nor the CONTRACTOR shall, without the prior consent of the other, assign or sublet in whole or in part his interest under any of the Contract Documents and, specifically, the CONTRACTOR shall not assign any monies due or to become due without consent of the OWNER.

6.2 The OWNER and the CONTRACTOR each binds himself, his partners, successors, assigns, and legal representatives to the other party hereto in respect to all covenants, agreements, and obligation contained in the Contract Documents.

6.3 The Contract Documents constitute the entire agreement between the OWNER and the CONTRACTOR and may only be altered, amended, or repealed by a duly-executed written instrument.

Article 7. TIME FOR COMPLETION AND LIQUIDATED DAMAGES. It is hereby understood and mutually agreed, by and between the CONTRACTOR and the OWNER, that the time for completion as specified in the Contract is an ESSENTIAL CONDITION of this Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on a date to be specified in the Notice to Proceed, and that said Work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion within the time allotted. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the time for the completion of Work described herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality. If the said CONTRACTOR shall neglect, fail, or refuse to complete the Work within the time herein specified, or any proper extension thereof granted the OWNER, then the CONTRACTOR does hereby agree, as a partial consideration for the awarding of this Contract, to pay to the OWNER, not as a penalty but as liquidated damages for such breach of Contract as hereinafter set forth, \$100 for each and every calendar day that the CONTRACTOR shall be in default after the time stipulated for completing the Work of the total Contract.

The same amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount shall be retained from time to time by the OWNER from current periodical estimates.

It is further agreed that time is of the essence of each and every portion of this Contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever and, where under the Contract, an additional time is allowed for the completion of any Work, the new time limit fixed by such extension shall be of the essence of this Contract. Provided, that the CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the Work is due:

7.1 To any preference, priority, or allocation order duly issued by the Government;

7.2 To unforeseeable cause beyond the control and without the fault or negligence of the CONTRACTOR, including, but not restricted to, acts of God or of the public enemy, acts of the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; and

7.3 To any delays of subcontractors or suppliers occasioned by any of the causes specified in subsections 7.1 and 7.2 of this article;

Provided, further, that the CONTRACTOR shall, within ten days from the beginning of such delay, unless the OWNER shall grant a further period of time prior to the date of final settlement of the Contract, notify the OWNER, in writing, of the causes of the delay, who shall ascertain the facts and extent of the delay and notify the CONTRACTOR within a reasonable time of its decision in the matter.

Article 8. - CONTRACT DOCUMENTS.

- 8.01 The Contract Documents will consist of the following:
- I. This Agreement (3 pages, inclusive).
 - II. General Conditions of the Construction Contract (68 pages)
 - III. Special Conditions (1 page)
 - IV. Project Plans (4 pages)
 - V. Wall Specifications (8 pages)

8.02 There are no Contract Documents other than those listed above in this Article 8. Approved Shop Drawings and Samples, other Contractor's submittals and the reports and drawings of subsurface and physical conditions are not Contract Documents.

8.03 The Contract Documents may only be amended, modified or supplemented in writing and in accordance with Article 9 of the General Conditions.

IN WITNESSETH WHEREOF the parties hereto have executed this Agreement the day and year first above written.

OWNER: CITY OF GALLATIN,
TENNESSEE

CONTRACTOR: _____

BY: _____

BY: _____
JO ANN GRAVES, MAYOR

ATTEST:

CONNIE KITTRELL, CITY RECORDER

STANDARD GENERAL CONDITIONS

SECTION II

Available at:

http://academic.cengage.com/resource_uploads/downloads/1111578710_313206.pdf

SPECIAL CONDITIONS

SECTION III

SPECIAL CONDITIONS

DISPOSAL OF MATERIAL

All debris and related appurtenances removed as part of this contract shall be stored in a manner compliant with all local, state and federal regulations for the storage of such materials. Recycling of materials, where possible, is encouraged.

WORK ZONE SAFETY

Contractor shall at all times maintain work zone safety standards in accordance with latest OSHA and TOSHA standards.

MAINTENANCE OF TRAFFIC

Pedestrian traffic may be detoured, blocked, or shut down if required for the duration of the project. Two way traffic on 31E shall be maintained at all times. Any lane closures, shifts, etc shall be approved by TDOT and signed/coned appropriately per MUTCD standards.

31E/ALBERT GALLATIN RETAINING WALL

Gallatin, Sumner County, Tennessee



ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	EXTENDED AMOUNT
1	Retaining Wall (1)	497	SF		
2	Underdrain (2)	145	LF		
3	Geogrid (3)	1315	SF		
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- (2) Item includes installation of underdrain for wall as indicated by plans, utilizing pipe meeting specs as identified in the Wall Specifications, including geotextile wrap and aggregate.
- (3) Item includes installation of Geogrid as indicated in plans, utilizing material meeting specs as identified in the Wall Specifications.
- (4) Item includes backfill of wall and grading of subgrade of proposed trail as indicated in plans with materials meeting the standards set forth in the Wall Specifications and project plans.
- (5) Item includes placement of seed and straw mat NAG SC150 BN or approved equal installed per manufacturer's recommendations in all disturbed areas.



**Know what's below.
Call before you dig.**

Sheet 1: Plan View
 Sheet 2: Profile and Cross-Section
 Sheet 3: Keystone Standard Detail



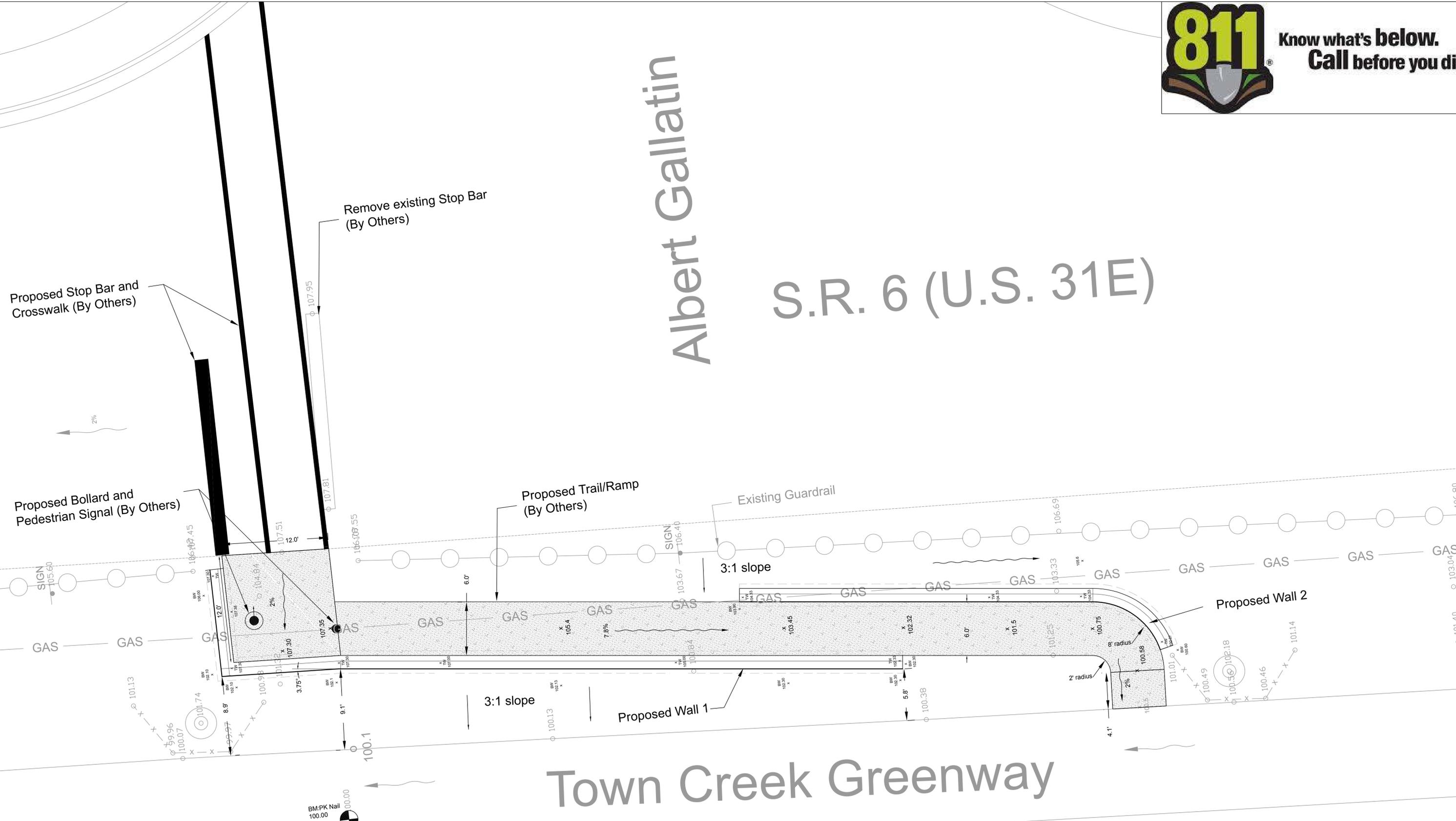
31E/ALBERT GALLATIN RETAINING WALL	
DATE: 7-3-2014	TITLE SHEET
PREPARED BY: ZACH WILKINSON CITY OF GALLATIN ENGINEERING DIVISION	SHEET 0



Know what's below.
Call before you dig.

Albert Gallatin

S.R. 6 (U.S. 31E)



Proposed Stop Bar and Crosswalk (By Others)

Remove existing Stop Bar (By Others)

Proposed Bollard and Pedestrian Signal (By Others)

Proposed Trail/Ramp (By Others)

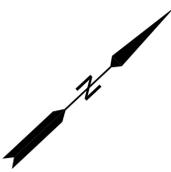
Existing Guardrail

Proposed Wall 2

Proposed Wall 1

Town Creek Greenway

*Handrail to be installed by others per ADA standards.



SCALE: 1"=5'
o: Existing Elevation
x: Proposed Elevation

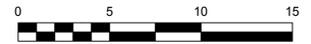
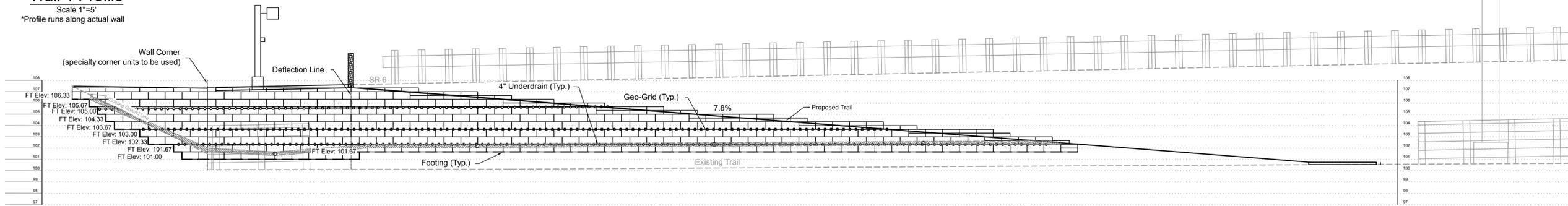


31E/ALBERT GALLATIN RETAINING WALL	
DATE: 7-3-2014	PLAN VIEW
PREPARED BY: ZACH WILKINSON CITY OF GALLATIN ENGINEERING DIVISION	SHEET 1

Wall 1 Profile

Scale 1"=5'

*Profile runs along actual wall

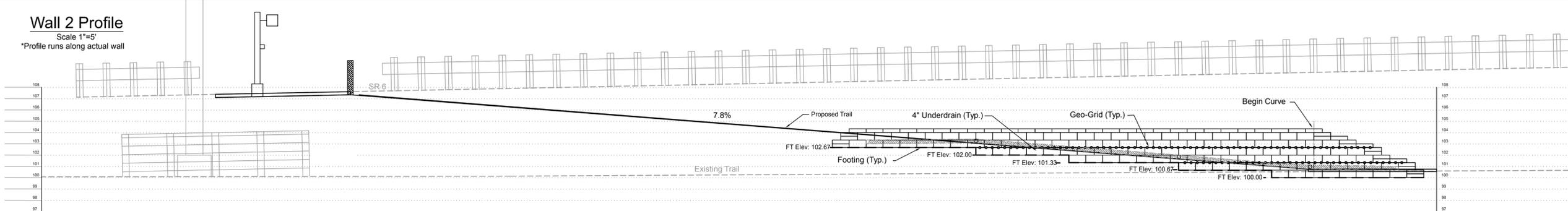


SCALE: 1"=5'

Wall 2 Profile

Scale 1"=5'

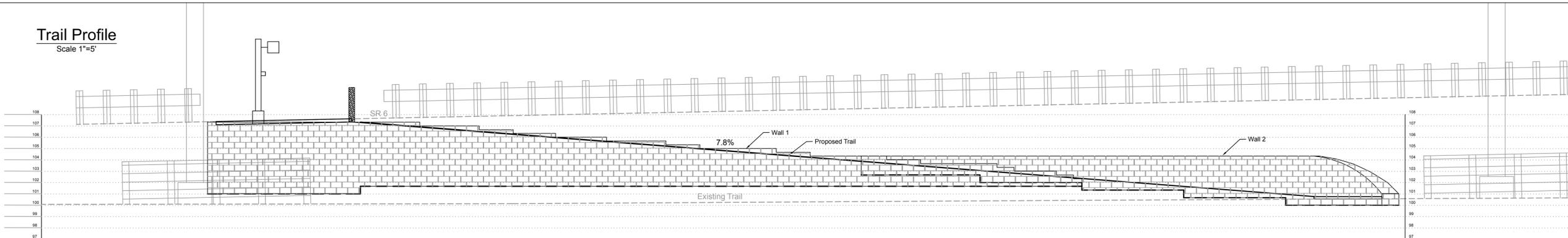
*Profile runs along actual wall



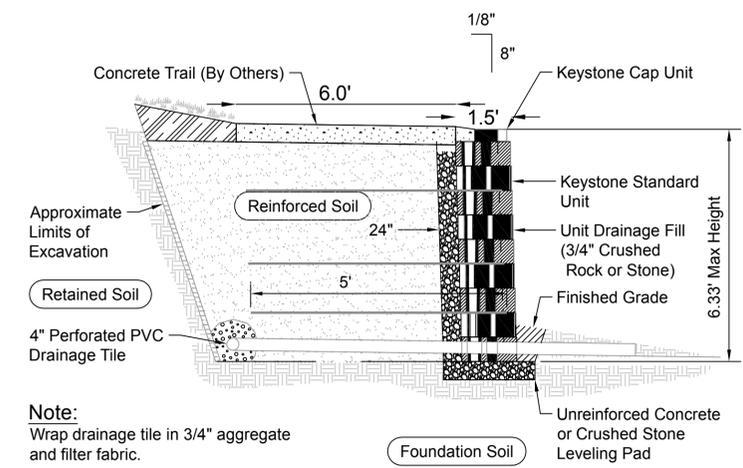
SCALE: 1"=5'

Trail Profile

Scale 1"=5'



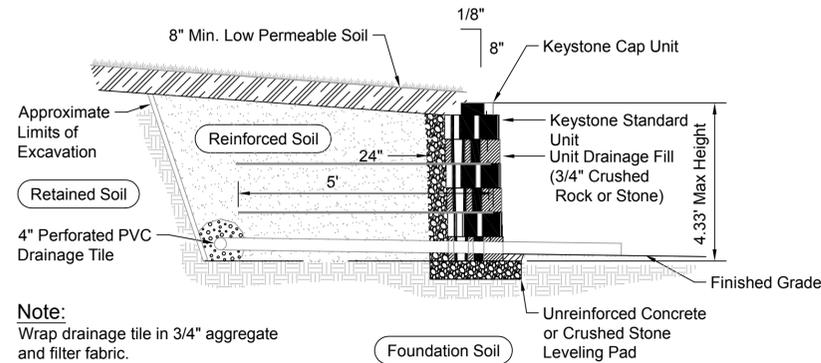
SCALE: 1"=5'



Note:
Wrap drainage tile in 3/4\"/>

Wall 1

Standard Unit - Near Vertical Setback
N.T.S.



Note:
Wrap drainage tile in 3/4\"/>

Wall 2

Standard Unit - Near Vertical Setback
N.T.S.

General Notes:

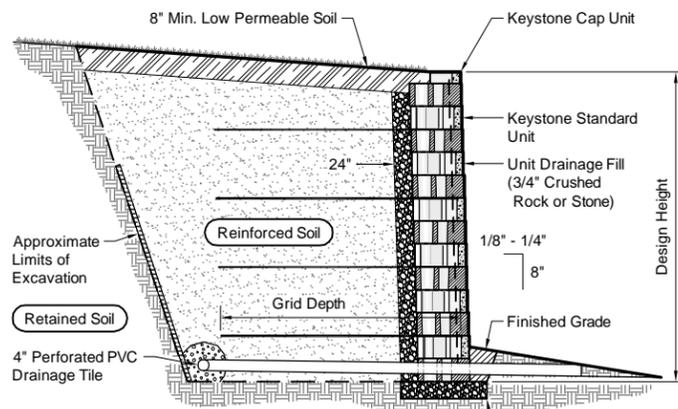
- All signal components will be provided and installed by the City of Gallatin. Some coordination with wall contractor may be required.
- Ramp trail surface will be completed by City of Gallatin. Contractor shall backfill wall up to 10\"/>



31E/ALBERT GALLATIN RETAINING WALL

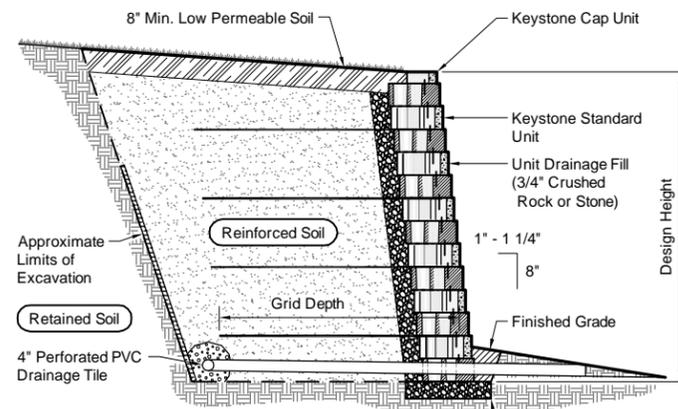
DATE: 7-3-2014 PROFILE AND CROSS-SECTION

PREPARED BY: ZACH WILKINSON CITY OF GALLATIN ENGINEERING DIVISION SHEET 2



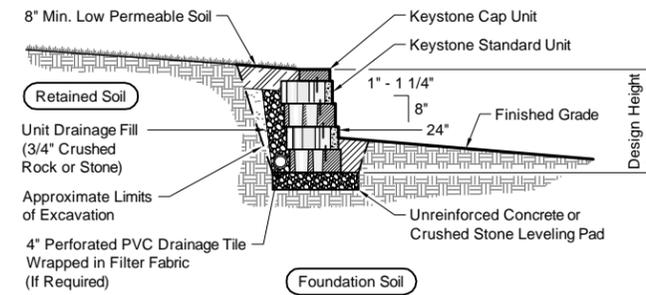
Note:
When site conditions require, wrap drainage tile in 3/4\"/>

Typical Reinforced Wall Section
Standard Unit - Near Vertical Setback



Note:
When site conditions require, wrap drainage tile in 3/4\"/>

Typical Reinforced Wall Section
Standard Unit - 1\"/>

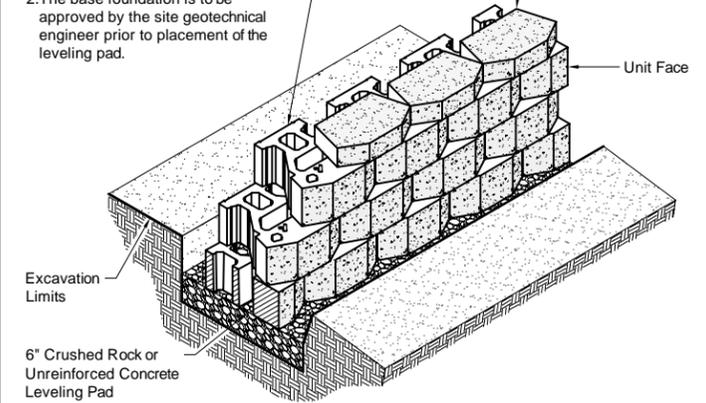


Typical Gravity Wall Section
Standard Unit - 1\"/>

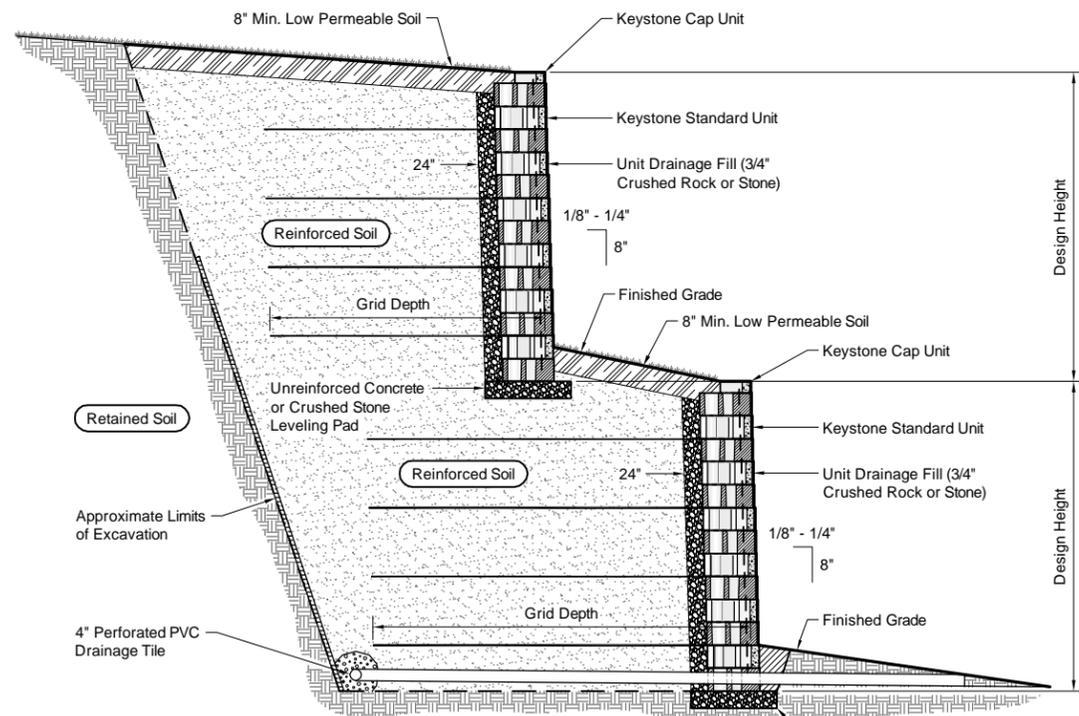
Base Leveling Pad Notes:

- The leveling pad is to be constructed of crushed stone or 2,000 psi± unreinforced concrete.
- The base foundation is to be approved by the site geotechnical engineer prior to placement of the leveling pad.

Standard Unit		Cap Unit	
Width:	18"	Width:	18"
*Depth:	18"	*Depth:	10 1/2"
Height:	8"	Height:	4"
*Weight:	102 lbs	*Weight:	45 lbs

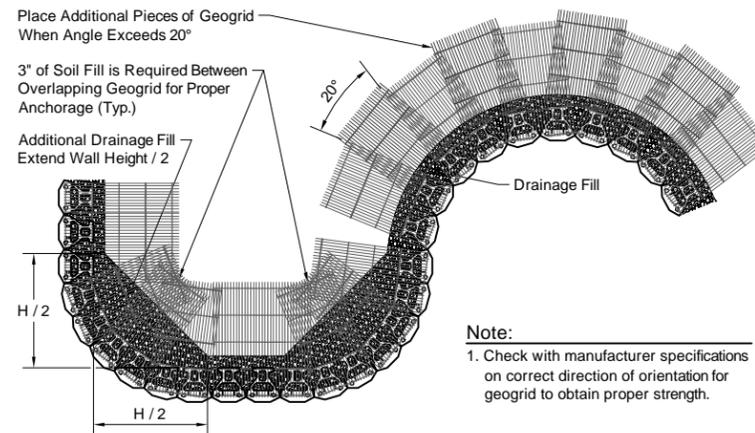


Standard Unit/Base Pad Isometric Section View
* Dimensions & Weight May Vary by Region



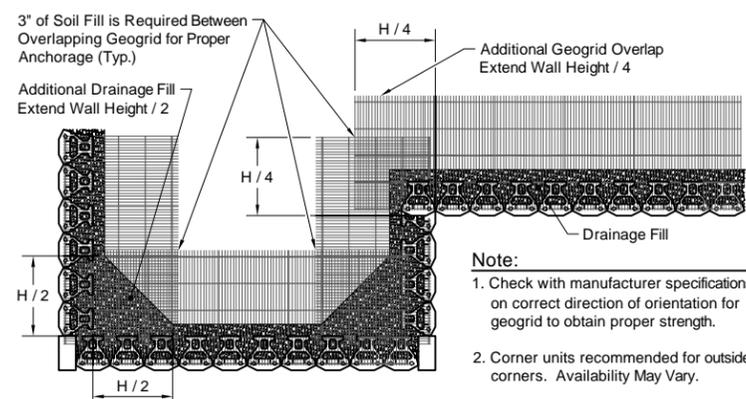
Note:
When site conditions require, wrap drainage tile in 3/4\"/>

Typical Reinforced Tiered Wall Section
Standard Unit - Near Vertical Setback



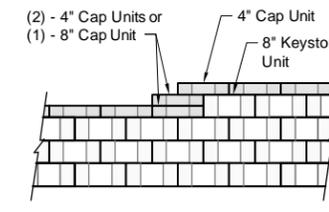
Note:
1. Check with manufacturer specifications on correct direction of orientation for geogrid to obtain proper strength.

Geogrid Installation on Curves



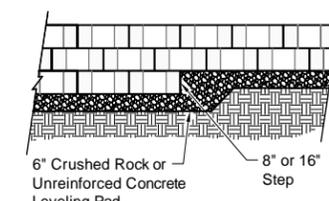
Note:
1. Check with manufacturer specifications on correct direction of orientation for geogrid to obtain proper strength.
2. Corner units recommended for outside corners. Availability May Vary.

Geogrid Installation at Corners



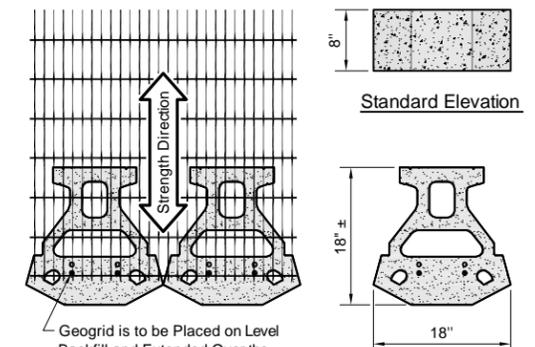
Note:
1. Secure all cap units with Keystone Kapseal or equal.

Top of Wall Steps



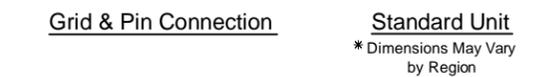
Note:
1. The leveling pad is to be constructed of crushed stone or 2000 psi± unreinforced concrete.

Leveling Pad Detail



Standard Elevation

Standard Plan



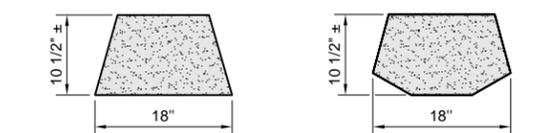
Grid & Pin Connection

Standard Unit
* Dimensions May Vary by Region



Cap Unit Elevation

Cap Unit Elevation



Cap Unit Plan

Cap Unit Plan



Universal Cap Unit Option
* Dimensions & Availability Will Vary by Region

3-Plane Split Cap Unit Option
* Dimensions & Availability Will Vary by Region

Copyright 2003 Keystone Retaining Wall Systems

Design is for internal stability of the KEYSTONE wall structure only. External stability, including but not limited to foundation and slope stability is the responsibility of the Owner. The design is based on the assumption that the materials within the retained mass, methods of construction, and quality of materials conform to KEYSTONE's specification for this project.

This drawing is being furnished for this specific project only. Any party accepting this document 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 Keystone Retaining Wall Systems, Inc.

No.	Date	Revision	By



Designed By: RKM	Title: Standard Unit 18 - Tri Plane Face Details	Date:
Checked By: CDM	Project: Keystone Retaining Wall Systems Typical Wall Details	Project No:
Scale: No Scale		Drawing No:

Section 02834 (32 32 23)

MODULAR CONCRETE RETAINING WALL

PART 1: GENERAL

1.01 Description

- A. Work shall consist of furnishing and construction of a KEYSTONE Standard Unit Retaining Wall System or equal in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.
- B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.

1.02 Related Sections

- A. Section 02300 (31 00 00) - Earthwork

1.03 Reference Documents

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C140 Sampling and Testing Concrete Masonry Units
 - 2. ASTM C1372 Specification for Dry-Cast Segmental Retaining Wall Units
 - 3. ASTM D422 Particle-Size Analysis of Soils
 - 4. ASTM D698 Laboratory Compaction Characteristics of Soil -Standard Effort
 - 5. ASTM D1557 Laboratory Compaction Characteristics of Soil -Modified Effort
 - 6. ASTM D3034 Polyvinyl Chloride Pipe (PVC)
 - 7. ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
 - 8. ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
 - 9. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
 - 10. ASTM D4595 Tensile Properties of Geotextiles - Wide Width Strip
 - 11. ASTM D5262 Unconfined Tension Creep Behavior of Geosynthetics
 - 12. ASTM D5818 Evaluate Installation Damage of Geosynthetics
 - 13. ASTM D6637 Tensile Properties of Geogrids – Single or Multi-Rib
 - 14. ASTM D6638 Connection Strength - Reinforcement/Segmental Units
 - 15. ASTM D6706 Geosynthetic Pullout Resistance in Soil
 - 16. ASTM D6916 Shear Strength Between Segmental Concrete Units
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M 252 Corrugated Polyethylene Drainage Pipe
- C. Geosynthetic Research Institute (GRI)
 - 1. GRI-GG4 Determination of Long Term Design Strength of Geogrids
 - 2. GRI-GG5 Determination of Geogrid (soil) Pullout
- D. National Concrete Masonry Association (NCMA)

1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

1.04 Submittals/Certification

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.
- B. Contractor shall submit a test report documenting strength of specific modular concrete unit and geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety factor of 1.5. The connection strength evaluation shall be performed in accordance with ASTM D6638 (NCMA SRWU-1).

1.05 Quality Assurance

- A. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units and specific geogrid):
 - 1) Has been successfully utilized on a minimum of five (5) similar projects, i.e., height, soil fill types, erection tolerances, etc.; and
 - 2) Has been successfully installed on a minimum of 1 million (1,000,000) square feet of retaining walls.
- B. Contractor shall submit a list of one (1) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.
- C. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.06 Delivery, Storage and Handling

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification has been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 Definitions

- A. Modular Unit - a concrete retaining wall element machine made from Portland cement, water, and aggregates.

- B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.
- C. Unit Drainage Fill - drainage aggregate, which is placed within and immediately behind the modular concrete units.
- D. Reinforced Backfill - compacted soil, which is placed within the reinforced soil volume as outlined on the plans.

2.02 Modular Concrete Retaining Wall Units

- A. Modular concrete units shall conform to the following architectural requirements:
 - 1. Face color - concrete gray, unless otherwise specified. The Owner may specify standard manufacturers' color.
 - 2. Face finish - sculptured rock face in angular tri-planer configuration. Other face finishes will not be allowed without written approval of Owner.
 - 3. Bond configuration - running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
 - 4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused lighting.
- B. Modular concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.
- C. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:
 - 1. Compressive strength: ≥ 3000 psi (21 MPa);
 - 2. Absorption: 8 % (6% in northern states) for standard weight aggregates;
 - 3. Dimensional tolerances: $\pm 1/8$ " (3 mm) from nominal unit dimensions not including rough split face, $\pm 1/16$ " (1.5 mm) unit height - top and bottom planes;
 - 4. Unit size: 8" (203 mm) (H) x 18" (457 mm)(W) x 18" (457 mm)(D) minimum;
 - 5. Unit weight: 100 lbs/unit (45 kg) minimum for standard weight aggregates.
- D. Modular concrete units shall conform to the following performance testing:
 - 1. Inter -unit shear strength in accordance with ASTM D6916 (NCMA SRWU-2): 1500 plf (21 kN/m) minimum at 2 psi (13 MPa) normal pressure;
 - 2. Geogrid/unit peak connection strength in accordance with ASTM D6638 (NCMA SRWU-1): 900 plf (13 kN/m) minimum at 2-psi (13 MPa) normal force.
- E. Modular concrete units shall conform to the following constructability requirements:
 - 1. Vertical setback: $1/8$ " (3 mm) \pm per course (near vertical) or 1" (25 mm) + per course per the design;
 - 2. Alignment and grid positioning mechanism - fiberglass pins, two per unit minimum;
 - 3. Maximum horizontal gap between erected units shall be $\leq 1/2$ inch (13 mm).

2.03 Shear Connectors

- A. Shear connectors shall be 1/2-inch (12 mm) diameter thermoset isophthalic polyester resin-pultruded fiberglass reinforcement rods or equivalent to provide connection between vertically and horizontally adjacent units with the following requirements:
1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum;
 2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.
- B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.04 Base Leveling Pad Material

- A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

2.05 Unit Drainage Fill

- A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch (25 mm)	100
3/4-inch (19 mm)	75-100
No. 4	0 - 10
No. 50	0 - 5

- B. One cubic foot (0.028 m³), minimum, of drainage fill shall be used for each square foot (0.093 m²) of wall face. Drainage fill shall be placed within cores of, between, and behind units to meet this requirement.

2.06 Reinforced Backfill

- A. Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
2-inch (50 mm)	100
3/4-inch (19 mm)	100-75
No. 40	0-60
No. 200	0-35

Plasticity Index (PI) <15 and Liquid Limit <40 per ASTM D-4318.

- B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.
- C. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

2.07 Geogrid Soil Reinforcement

- A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high-density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 Meg/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.
- B. T_a , Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:

$$T_a = T_{ult} / (RF_{cr} * RF_d * RF_{id} * FS)$$

T_a shall be evaluated based on a 75-year design life.

1. T_{ult} , Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637.
 T_{ult} is based on the minimum average roll values (MARV).
 2. RF_{cr} , Reduction Factor for Long Term Tension Creep
 RF_{cr} shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.45 minimum.
 3. RF_d , Reduction Factor for Durability
 RF_d shall be determined from polymer specific durability testing covering the range of expected soil environments. $RF_d = 1.10$ minimum.
 4. RF_{id} , Reduction Factor for Installation Damage
 RF_{id} shall be determined from product specific construction damage testing performed in accordance with ASTM D5818 (GRI-GG4). Test results shall be provided for each product to be used with project specific or more severe soil type. $RF_{id} = 1.05$ minimum.
 5. FS , Overall Design Factor of Safety
 FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.
- C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the "Hinge Height" divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units (NCMA SRWU-1).
 - D. Soil Interaction Coefficient, C_i
 C_i values shall be determined per ASTM D6706 (GRI:GG5) at a maximum 0.75-inch (19 mm) displacement.

- E. Manufacturing Quality Control
The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.
The QC testing shall include:
 - Tensile Strength Testing
 - Melt Flow Index (HDPE)
 - Molecular Weight (Polyester)

2.08 Drainage Pipe

- A. The drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.09 Geotextile Filter Fabric

- A. When required, Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needlepunched nonwoven fabric.

PART 3: EXECUTION

3.01 Excavation

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required.
- B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 Base Leveling Pad

- A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the modular wall unit.
- B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557.
- C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 Modular Unit Installation

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.

- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.
- C. Install shear/connecting devices per manufacturer's recommendations.
- D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.
- E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.
- C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.
- D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.
- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand compaction is used, or 8 - 10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.
- C. Reinforced backfill shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, - 3%.
- D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1m) from the tail of the modular concrete unit.
- E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

- F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.
- G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

- A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.07 As-built Construction Tolerances

- A. Vertical alignment: ± 1.5 " (40 mm) over any 10' (3 m) distance.
- B. Wall Batter: within 2 degrees of design batter.
- C. Horizontal alignment: ± 1.5 " (40 mm) over any 10' (3 m) distance.
Corners, bends & curves: ± 1 ft (300 mm) to theoretical location.
- D. Maximum horizontal gap between erected units shall be $\leq 1/2$ inch (13 mm).

3.08 Field Quality Control

- A. Quality Assurance - The Owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction control testing.
- B. Quality assurance should include foundation soil inspection. Verification of geotechnical design parameters, and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications. Quality assurance is best performed by the site geotechnical engineer.
- C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.
- D. Quality control testing shall include soil and backfill testing to verify soil types and compaction and verification that the retaining wall is being constructed in accordance with the design plans and project specifications.