

Project No. 927CM3002
June 10, 2016
Final Construction Documents



Specifications

DEPARTMENT OF VETERANS AFFAIRS ALABAMA NATIONAL CEMETERY MONTEVALLO, ALABAMA

INSTALL 5,000 PRE-PLACED CRYPTS AND 1,499 IN-GROUND CREMAINS

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**DEPARTMENT OF VETERANS AFFAIRS
 NCA MASTER SPECIFICATIONS**

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SECTION 01 00 02
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)

1.1 GENERAL INTENTION

- A. Contractor shall completely prepare site for building operations, including demolition and removal of existing structures, and furnish labor, materials, equipment and services and perform and complete all work for crypt and in ground cremains installation at Alabama National Cemetery as required by drawings and specifications.
- B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.
- C. All Testing Laboratory services will be retained and paid for by the Contractor (see Spec Section 01 45 29, Testing Laboratory Services). However, the Department of Veterans Affairs may elect to retain its own Testing Laboratory for any purpose. Before placement and installation of work subject to tests by testing laboratory retained by Department of Veterans Affairs, the Contractor shall notify the COR in sufficient time to enable testing laboratory personnel to be present at the site in time for proper taking and testing of specimens and field inspection. Such prior notice shall be not less than three work days unless otherwise designated by the COR.
- D. All employees of general contractor and subcontractors shall comply with security requirements as established by the COR, be identified by name and employer. They shall be restricted from unauthorized access.
- E. Prior to commencing work, general contractor shall provide proof that a OSHA certified "competent person" (CP) (29 CFR 1926.20(b)(2)) will maintain a presence at the work site whenever the general or subcontractors are present.
- F. Training:
 - 1. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course and/or other relevant competency training, as determined by VA CP.
 - 2. Submit OSHA training records of all employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

- A. ITEM I, GENERAL CONSTRUCTION: Installation of all work shown on the plans and described in the specifications including but not limited to:
PROJECT DESCRIPTION

Installation of the crypt field and in-ground cremains section. This work includes erosion and sediment control, minor demolition, earthwork, storm drainage, and irrigation and landscaping, among other tasks.

- B. ITEM II, PRE-PLACED CRYPTS: Purchase and deliver 5,000 pre-placed crypts (PPC) to the project site. This shall include all associated extra parts and devices as noted in the pre-placed crypt specification section.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, 1 bond paper set(s) of specifications and drawings will be furnished.
- B. Additional sets of drawings may be made by the Contractor, at Contractor's expense, from digital files furnished by the Issuing Office.

1.4 CONSTRUCTION SECURITY REQUIREMENTS

- A. Security Plan:
 - 1. The security plan defines both physical and administrative security procedures that will remain effective for the entire duration of the project.
 - 2. The General Contractor is responsible for assuring that all sub-contractors working on the project and their employees also comply with these regulations.
- B. Security Procedures:
 - 1. General Contractor's employees shall not enter the site without following the procedures approved by the COR. They may also be subject to inspection of their personal effects when entering or leaving the project site.
 - 2. For working outside the "regular hours" as defined in the contract, The General Contractor shall give 3 days notice to the COR so that appropriate arrangements can be provided for the Cemetery employees. This notice is separate from any notices required for utility shutdown described later in this section.
 - 3. No photography of VA premises is allowed without written permission of the COR.
 - 4. VA reserves the right to close down or shut down the project site and order General Contractor's employees off the premises in the event of a national emergency. The General Contractor may return to the site only with the written approval of the COR.

C. Key Control:

1. The General Contractor shall provide duplicate keys and lock combinations to the COR for the purpose of security inspections of every area of project including tool boxes and parked machines, and to take any necessary emergency action.

D. Document Control:

1. Before starting any work, the General Contractor/Sub Contractors shall submit an electronic security memorandum describing the approach to following goals and maintaining confidentiality of "sensitive information".
2. The General Contractor is responsible for safekeeping of all drawings, project manual and other project information. This information shall be shared only with those with a specific need to accomplish the project.
3. Certain documents, sketches, videos or photographs and drawings may be marked "Law Enforcement Sensitive" or "Sensitive Unclassified". Secure such information in separate containers and limit the access to only those who will need it for the project. Return the information to the COR upon request.
4. These security documents shall not be removed or transmitted from the project site without the written approval of COR.
5. All paper waste or electronic media such as CD's and diskettes shall be shredded and destroyed in a manner acceptable to the VA.
6. Notify COR immediately when there is a loss or compromise of "sensitive information".
7. All electronic information shall be stored in a specified location following VA standards and procedures using an Engineering Document Management Software (EDMS).
 - a. Security, access and maintenance of all project drawings, both scanned and electronic shall be performed and tracked through the EDMS system.
 - b. "Sensitive information" including drawings and other documents may be attached to e-mail provided all VA encryption procedures are followed.

E. Motor Vehicle Restrictions

1. Vehicle authorization request shall be required for any vehicle entering the site and such request shall be submitted 24 hours

- E. Dispose of waste and debris in accordance with NFPA 241. Remove from site weekly.
- F. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

1.6 OPERATIONS AND STORAGE AREAS

- A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the COR. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.
- B. Temporary buildings (e.g., storage trailers, office trailers) and utilities may be erected by the Contractor only with the approval of the COR and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work.
- C. The Contractor shall, under regulations prescribed by the COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the COR. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- D. Working space and space available for storing materials shall be as shown on the drawings. Contractor parking will be only in areas and on roadways designated and agreed to by the COR in agreement of the Cemetery.
- E. Workmen are subject to rules of the Cemetery applicable to their conduct.
- F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.
 - 1. Do not store materials and equipment in other than assigned areas.
- G. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, 2.1m (seven

feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 375mm (15 inches). Bottom of fences shall extend to 25mm (one inch) above grade. The temporary fencing shall encompass the construction work area(s) to serve as a pedestrian barrier to alert cemetery patrons of the construction site. Remove the fence when directed by COR.

- H. Utilities Services: Maintain existing utility services for the Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, sewer or air pipes, or conduits, wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by COR. All such actions shall be coordinated with the Utility Company involved.
1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of COR. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the COR, and Cemetery Director's prior knowledge and written approval.
 2. The Contractor shall submit a request to interrupt any such services to both COR and the Cemetery Director in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
 3. The Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations of the Cemetery. Interruption time approved by the Cemetery and COR may occur at other than Contractor's normal working hours.
 4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the COR.

5. In case of a contract construction emergency, service will be interrupted on approval of COR. Such approval will be confirmed in writing as soon as practical.
 6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.
- I. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.
- J. To minimize interference of construction activities with flow of Cemetery traffic, comply with the following:
1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.
 2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the COR.
- K. Coordinate the work for this contract with other construction operations as directed by COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- L. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the COR, in arranging construction schedule to cause the least possible interference with Cemetery activities in actual burial areas. Construction noise during the committal services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period.
1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all

areas of operation adjacent to existing burial plots before these dates.

2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.7 ALTERATIONS

- A. Survey: Before any work is started, the Contractor shall make a thorough survey with the COR of areas in which alterations occur, areas which are anticipated routes of access, and furnish a signed report, to the Contracting Officer. This report shall list:
 1. Existing condition and types of surfaces not required to be altered throughout affected areas.
 2. Existence and conditions of items required by drawings to be either reused or relocated, or both.
 3. Shall note any discrepancies between drawings and existing conditions at site.
 4. Shall designate areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and COR.
- B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of COR, to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by the Contractor with new items in accordance with specifications which will be furnished by the Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88).
- C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and COR together shall make a thorough re-survey of the areas of buildings involved. They shall furnish a report on conditions then existing of surfaces as compared with conditions of same as noted in first condition survey report.
 1. Re-survey report shall also list any damage caused by the Contractor to such flooring and other surfaces, despite protection measures; and, will form the basis for determining extent of repair work required of the Contractor to restore damage caused by the Contractor's workmen in executing work of this contract.

1.8 ENVIRONMENTAL CONTROLS

A. In general, following preventive measures shall be adopted during construction to keep down dust and prevent mold.

1. Dampen debris to keep down dust.

1.10 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the COR.

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the COR may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

C. Refer to Section 01 5719, TEMPORARY ENVIRONMENTAL CONTROLS, for additional requirements on protecting vegetation, soils and the environment. Refer to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

D. Refer to FAR clause 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate NCA

Central/Cemetery) office. The contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:

1. Designating areas for equipment maintenance and repair;
2. Providing waste receptacles at convenient locations and provide regular collection of wastes;
3. Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
4. Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
5. Providing adequately maintained sanitary facilities.

1.11 RESTORATION

- A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any electric work without approval of the COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the COR before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
- B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, landscape stone, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired, reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.
- C. At the Contractor's own expense, the Contractor shall immediately restore to service and repair any damage caused by the Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services communications systems (including telephone), irrigation system control and power which are indicated on drawings and which are not scheduled for discontinuance or abandonment.

- D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2).

1.12 PHYSICAL DATA

- A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

1. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by FourFront Design, Inc.

(FAR 52.236-4)

- B. Subsurface conditions have been developed by core borings and test pits. Logs of subsurface exploration conducted by Terracon are shown diagrammatically on drawings.
- C. A copy of the geotechnical investigation report is an Appendix to these specifications and shall be considered part of the contract documents.
- D. The Government does not guarantee that other materials will not be encountered nor that proportions, conditions or character of several materials will not vary from those indicated by explorations. Bidders are expected to examine the site of work and logs of borings and, after investigation, decide for themselves the character of materials and make their bids accordingly. Upon proper application to the Department of Veterans Affairs, including approved scheduling bidders will be permitted to make subsurface explorations of their own at site.

1.13 PROFESSIONAL SURVEYING SERVICES

- A. A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.14 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at the Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the COR until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the COR may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

- B. Establish and plainly mark lines for each gravesite control monument, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each addition, road, and gravesite control monuments to confirm they are in accordance with lines and elevations shown on contract drawings.
- C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. The Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of columns in both directions, major utilities and elevations of floor slabs:
1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the COR before any work (such as footings, floor slabs, columns, walls, utilities and other major controlling features) is placed.
- D. During progress of work, the Contractor shall have lines, grades, locations and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the

COR before any major items of concrete work are placed. In addition, furnish to the COR certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.

1. Lines and elevations of sewers and of all outside distribution systems.
 2. Lines of grave plot documentation.
 3. Lines of elevations of all swales and interment areas.
 4. Lines and elevations of roads, streets and parking lots.
 5. Lines and elevations and location of top of pre-placed crypts within their respective plots.
 6. Lines and elevations of grade over pre-placed crypts.
 7. Northing/Easting coordinate locations and elevation depth below finished grade of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines.
 8. Northing/Easting coordinate locations and elevation for each gravesite grid monument.
- E. Upon completion of the work, the Contractor shall furnish the COR with reproducible drawings, in AutoCAD form, at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.
- F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.15 AS-BUILT DRAWINGS

- A. The Contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, which will include all contract changes, modifications and clarifications.
- B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the COR's review, as often as requested.
- C. The Contractor shall deliver two approved completed sets of as-built drawings to the COR within 15 calendar days after acceptance of the project by the COR.
- D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.16 USE OF ROADWAYS

- A. For hauling, use only established public roads and designated permanent roads on Cemetery property or authorized by the COR, such Contractor constructed and/or modified temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at the Contractor's expense following approved plans that include: construction, operation, maintenance and restoration. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.17 TEMPORARY TOILETS

- A. Provide where directed, (for use of all Contractor's workers) ample temporary sanitary toilet accommodations with suitable sewer and water connections, or when approved by COR provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.18 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to the Government. The Contractor shall carefully conserve any utilities furnished without charge.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the COR, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.
- C. The Contractor shall install meters at the Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.
- D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and

damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

- E. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Where not available or not convenient to connect to the Cemetery distribution system, the contractor shall supply power via portable generators at own expense. Generators shall be acoustically screened so as not to disturb committal services and/or visitation to the adjacent columbarium.
- F. Water (for Construction and Testing): Furnish temporary water service.
 - 1. Obtain water by connecting to the Cemetery irrigation distribution system. Backflow preventer may not be required at connections to the irrigation system. Water is available at no cost to the Contractor.
 - 2. If potable water is required and convenient connection is available the contractor may connect to the Cemetery potable water distribution system. The contractor shall install reduced pressure backflow preventer at each connection at own expense.
 - 3. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at COR's discretion) of use of water from the Cemetery's system.
 - 4. Where not available or not convenient to connect to the Cemetery distribution system, the Contractor shall supply water via portable/temporary means at his own expense.
- G. Fuel: Natural and LP gas required for burner cleaning, normal initial burner-burner setup and adjusting, and for performing the specified burner tests will be furnished by the Government. Fuel required for prolonged burner setup, adjustments, or modifications due to improper design or operation of burner, or control devices shall be furnished by the Contractor at Contractor's expense.

1.19 TESTS

- B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the COTR. Contractor shall

furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

- D. All related components as defined above shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.
- E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.20 INSTRUCTIONS

- A. The Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.
- B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the COR coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.
- C. Instructions: the Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different

items of equipment that are component parts of a complete system; shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the COR and shall be considered concluded only when the COR is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.21 CONSTRUCTION SIGN

- A. Provide a Construction Sign where directed by the COR. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Signface shall be 4 feet x 5 feet and 6 inches. Provide two 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 900 mm (three feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50mm x 100 mm (two by four inch) material as directed.
- B. Paint all surfaces of sign and posts two coats of white semi-gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.
- C. Maintain sign and remove it when directed by the COR.
- D. Detail Drawing of construction sign showing required legend and other characteristics of sign is a part of this specification.

1.22 SAFETY SIGN

- A. Provide a Safety Sign where directed by COR. Signboard shall be shall be three feet x four feet, 19 mm (3/4-inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.
- B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
- C. Maintain sign and remove it when directed by COR.

- D. Detail Drawing of safety sign showing required legend and other characteristics of sign is included in this specification.
- E. Post the number of accident free days on a daily basis.

Estimated Cost		No. of Photographs
Up to	\$250,000	50 to 100
" "	\$500,000	100 to 150
" "	\$1,000,000	150 to 200
" "	\$2,000,000	200 to 250
" "	\$5,000,000	250 to 300
" "	\$10,000,000	300 to 400

1.23 CONSTRUCTION DIGITAL IMAGES

- A. During construction period through completion, furnish Department of Veterans Affairs weekly color digital photographs of construction progress (8 to 10 images per week with a minimum of 250 photographs throughout the project duration). Photographs of the reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways. Photographs must show distinctly, at as large a scale as possible, all parts of work embraced in picture.
- B. Photographs are to be taken with a high-resolution digital camera, minimum 6 megapixels, with good wide-angle capability. The images shall be recorded in JPEG format with a minimum of 24-bit color and no reduction in actual picture size.
 - 1. Compressed size of the file shall be no less than 80% of the original with no loss of information.
 - 2. File names shall contain the Project number, the date the image was taken, and a unique sequential identifier, for example:
101CM3202_10-01-2013_0001. Use underscore, not spaces in digital file names.
- C. The digital photo files shall become property of Government and will be both e-mailed and submitted on CD-ROM.
 - 1. The images shall be forwarded electronically to the COR via email to philip.obianwu@va.gov within 2 days of when the photo was taken.

Identify the content of each picture by a caption incorporated in the photo.

2. The digital photo files shall also be submitted on CD-ROM to the COR at the conclusion of the project. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.

1.24 HISTORIC PRESERVATION

- A. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the COR verbally, and then with a written follow up.

1.25 PROJECT HEALTH AND SAFETY PLAN

- A. Prior to commencing any construction, the Contractor shall submit a site specific Project Health and Safety Plan (PHSP). At a minimum, the PHSP shall cover the following topics:
 1. Organizational structure (including Responsible Persons)
 2. Site Characterization and Job Hazard Identification
 3. Site Control and Security
 4. Training
 5. PPE
 6. Heat Stress
 7. Spill Containment
 8. Decontamination
 9. Emergency Response
 10. Trench Safety

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SECTION 00 01 15
LIST OF DRAWING SHEETS

The drawings listed below accompanying this specification form a part of
the contract.

<u>Drawing No.</u>	<u>Title</u>
X-100	COVER SHEET
G-001	GENERAL NOTES
B-100	TOPOGRAPHIC SURVEY
B-101	SUBSURFACE INVESTIGATION - BORING LOGS B-2 TO B-7
B-102	SUBSURFACE INVESTIGATION - BORING LOGS B-8 TO B-14A
B-103	SUBSURFACE INVESTIGATION - BORING LOGS B-15 TO B-17
D-100	DEMOLITION PLAN
C-100	STAGING PLAN
C-101	EROSION AND SEDIMENT CONTROL - PRE-CONSTRUCTION
C-102	EROSION AND SEDIMENT CONTROL - POST CONSTRUCTION
C-103	OVERALL SITE PLAN
C-104	SITE LAYOUT #1
C-105	SITE LAYOUT #2
C-106	SITE LAYOUT #3
C-201	PLAN AND PROFILE - WEST MAINTENANCE ROAD
C-202	PLAN AND PROFILE - EAST MAINTENANCE ROAD
C-301	GRADING PLAN - WEST #1
C-302	GRADING PLAN - WEST #2
C-303	GRADING PLAN - EAST
C-501	SITE DETAILS #1
C-502	SITE DETAILS #2
C-503	SITE DETAILS #3
C-504	SITE DETAILS #4
C-505	SITE DETAILS #5
C-506	CRYPT DETAILS #1
C-507	CRYPT DETAILS #2
L-101	OVERALL LAYOUT
L-102	LAYOUT PLAN: SECTION 3
L-103	LAYOUT PLAN: SECTION 6
L-104	LAYOUT PLAN: SECTION 7
L-105	SECTION 3 NUMBERING PLAN

L-106	SECTIONS 6 & 7 NUMBERING PLAN
L-107	SOD & SEED PLAN: SECTION 3
L-108	SOD & SEED PLAN: SECTION 7
L-501	DETAILS
I-101	IRRIGATION NOTES AND LEGEND
I-102	IRRIGATION DEMOLITION PLAN
I-103	IRRIGATION PLAN
I-500	IRRIGATION DETAILS
I-501	IRRIGATION DETAILS
I-502	IRRIGATION DETAILS

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- 1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in GENERAL CONDITIONS.
- 1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.
- 1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
 - A. Satisfactory written evidence is presented to, and approved by Contracting Officer's Representative, that manufacturer cannot make scheduled delivery of approved item or;
 - B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
 - C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.
- 1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.
- 1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by Contracting Officer's Representative (COR) on behalf of the Contracting Officer.
- 1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall

refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

- 1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer's Representative, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.
- 1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer's Representative and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.
- 1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer's Representative assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit samples required, in quadruplicate. Submit other samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.
 - B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail, FAX or e-mail (if acceptable to COR) and shall contain the list of items, name of Cemetery, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.
 1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.

2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Cemetery, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
 3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.
- C. In addition to complying with the applicable requirements specified in preceding Article 1.9, samples which are required to have Laboratory Tests (those preceded by symbol "LT" under the separate sections of the specification shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer's Representative.
1. Laboratory shall furnish Contracting Officer's Representative with a certificate stating that it is fully equipped and qualified to perform intended work, is fully acquainted with specification requirements and intended use of materials and is an independent establishment in no way connected with organization of Contractor or with manufacturer or supplier of materials to be tested.
 2. Certificates shall also set forth a list of comparable projects upon which laboratory has performed similar functions during past five years.
 3. Samples and laboratory tests shall be sent directly to an approved commercial testing laboratory.
 4. Contractor shall send a copy of transmittal letter to both COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Contractor shall forward a copy of transmittal letter to COR simultaneously with submission to a commercial testing laboratory.
 6. Laboratory test reports shall be sent directly to COR for appropriate action.
 7. Laboratory reports shall list contract specification test requirements and a comparative list of the laboratory test results. When tests show that the material meets specification requirements, the laboratory shall so certify on test report.
 8. Laboratory test reports shall also include a recommendation for approval or disapproval of tested item.

- D. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.
- E. Approved samples will be kept on file by the COR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.
- F. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.
1. For each drawing required, submit one legible photographic paper or vellum reproducible.
 2. Reproducible shall be full size.
 3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
 4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
 5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
 6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
 7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1-10. Samples, shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval directly to the COR, in care of COR, VA Medical Center,

ATTN: Philip Obianwu
425 I Street NW, Suite 5E.425
Washington, DC 20001

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

- A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to - GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.
- B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARTMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
425 Eye Street N.W, (sixth floor)
Washington, DC 20001
Telephone Numbers: (202) 632-5249 or (202) 632-5178
Between 9:00 AM - 3:00 PM

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

- AA Aluminum Association Inc.
<http://www.aluminum.org>
- AAN American Nursery and Landscape Association
<http://www.anla.org>
- AASHTO American Association of State Highway and Transportation Officials
<http://www.aashto.org>
- ACI American Concrete Institute
<http://www.aci-int.net>
- ACPA American Concrete Pipe Association
<http://www.concrete-pipe.org>
- ACPPA American Concrete Pressure Pipe Association
<http://www.acppa.org>
- AGC Associated General Contractors of America
<http://www.agc.org>
- AIA American Institute of Architects
<http://www.aia.org>
- AISC American Institute of Steel Construction
<http://www.aisc.org>
- AISI American Iron and Steel Institute
<http://www.steel.org>
- ANLA American Nursery & Landscape Association
<http://www.anla.org>
- ANSI American National Standards Institute, Inc.
<http://www.ansi.org>

APA	The Engineered Wood Association http://www.apawood.org
ASAE	American Society of Agricultural Engineers http://www.asae.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org

CPMB Concrete Plant Manufacturers Bureau
<http://www.cpmc.org>

CRSI Concrete Reinforcing Steel Institute
<http://www.crsi.org>

DHI Door and Hardware Institute
<http://www.dhi.org>

EGSA Electrical Generating Systems Association
<http://www.egsa.org>

EEI Edison Electric Institute
<http://www.eei.org>

EPA Environmental Protection Agency
<http://www.epa.gov>

ETL ETL Testing Laboratories, Inc.
<http://www.etl.com>

FAA Federal Aviation Administration
<http://www.faa.gov>

FCC Federal Communications Commission
<http://www.fcc.gov>

FPS The Forest Products Society
<http://www.forestprod.org>

GANNA Glass Association of North America
<http://www.cssinfo.com/info/ganna.html/>

FM Factory Mutual Insurance
<http://www.fmglobal.com>

GSA General Services Administration
<http://www.gsa.gov>

HI Hydraulic Institute
<http://www.pumps.org>

ICBO International Conference of Building Officials
<http://www.icbo.org>

ICEA	Insulated Cable Engineers Association Inc. http://www.icea.net
IEEE	Institute of Electrical and Electronics Engineers http://www.ieee.org
IMSA	International Municipal Signal Association http://www.imsasafety.org
IPCEA	Insulated Power Cable Engineers Association
NBMA	Metal Buildings Manufacturers Association http://www.mbma.com
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry Inc. http://www.mss-hq.com
NAAMM	National Association of Architectural Metal Manufacturers http://www.naamm.org
NBS	National Bureau of Standards See - NIST
NEC	National Electric Code See - NFPA National Fire Protection Association
NEMA	National Electrical Manufacturers Association http://www.nema.org
NFPA	National Fire Protection Association http://www.nfpa.org
NHLA	National Hardwood Lumber Association http://www.natlhardwood.org
NIH	National Institute of Health http://www.nih.gov
NIST	National Institute of Standards and Technology http://www.nist.gov
NLMA	Northeastern Lumber Manufacturers Association, Inc. http://www.nelma.org

NPA National Particleboard Association
18928 Premiere Court
Gaithersburg, MD 20879
(301) 670-0604

NSF National Sanitation Foundation
<http://www.nsf.org>

NWDA Window and Door Manufacturers Association
<http://www.nwda.org>

OSHA Occupational Safety and Health Administration
Department of Labor
<http://www.osha.gov>

PCA Portland Cement Association
<http://www.portcement.org>

PCI Precast Prestressed Concrete Institute
<http://www.pci.org>

PPI The Plastic Pipe Institute
<http://www.plasticpipe.org>

PEI Porcelain Enamel Institute, Inc.
<http://www.porcelainenamel.com>

PTI Post-Tensioning Institute
<http://www.post-tensioning.org>

RFCI The Resilient Floor Covering Institute
<http://www.rfci.com>

RIS Redwood Inspection Service
See - CRA

RMA Rubber Manufacturers Association, Inc.
<http://www.rma.org>

UBC The Uniform Building Code
See ICBO

UL Underwriters' Laboratories Incorporated
<http://www.ul.com>

ULC Underwriters' Laboratories of Canada
<http://www.ulc.ca>

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained by the Contractor.

1.2 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - T27-11.....Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - T96-02 (R2006).....Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - T99-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
 - T104-99 (R2007).....Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
 - T180-10.....Standard Method of Test for Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
 - T191-02(R2006).....Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
- C. American Concrete Institute (ACI):
 - 506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete
- D. American Society for Testing and Materials (ASTM):
 - A325-10.....Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - A370-12.....Standard Test Methods and Definitions for Mechanical Testing of Steel Products

A416/A416M-10.....Standard Specification for Steel Strand,
Uncoated Seven-Wire for Prestressed Concrete

A490-12.....Standard Specification for Heat Treated Steel
Structural Bolts, 150 ksi Minimum Tensile
Strength

C31/C31M-10.....Standard Practice for Making and Curing
Concrete Test Specimens in the Field

C33/C33M-11a.....Standard Specification for Concrete Aggregates

C39/C39M-12.....Standard Test Method for Compressive Strength
of Cylindrical Concrete Specimens

C109/C109M-11b.....Standard Test Method for Compressive Strength
of Hydraulic Cement Mortars

C136-06.....Standard Test Method for Sieve Analysis of Fine
and Coarse Aggregates

C138/C138M-10b.....Standard Test Method for Density (Unit Weight),
Yield, and Air Content (Gravimetric) of
Concrete

C143/C143M-10a.....Standard Test Method for Slump of Hydraulic
Cement Concrete

C172/C172M-10.....Standard Practice for Sampling Freshly Mixed
Concrete

C173/C173M-10b.....Standard Test Method for Air Content of freshly
Mixed Concrete by the Volumetric Method

C330/C330M-09.....Standard Specification for Lightweight
Aggregates for Structural Concrete

C567/C567M-11.....Standard Test Method for Density Structural
Lightweight Concrete

C1019-11.....Standard Test Method for Sampling and Testing
Grout

C1064/C1064M-11.....Standard Test Method for Temperature of Freshly
Mixed Portland Cement Concrete

C1077-11c.....Standard Practice for Agencies Testing Concrete
and Concrete Aggregates for Use in Construction
and Criteria for Testing Agency Evaluation

C1314-11a.....Standard Test Method for Compressive Strength
of Masonry Prisms

D422-63(2007).....Standard Test Method for Particle-Size Analysis
of Soils

D698-07e1.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Standard Effort

D1140-00(2006).....Standard Test Methods for Amount of Material in
Soils Finer than No. 200 Sieve

D1143/D1143M-07e1.....Standard Test Methods for Deep Foundations
Under Static Axial Compressive Load

D1188-07e1.....Standard Test Method for Bulk Specific Gravity
and Density of Compacted Bituminous Mixtures
Using Coated Samples

D1556-07.....Standard Test Method for Density and Unit
Weight of Soil in Place by the Sand-Cone Method

D1557-09.....Standard Test Methods for Laboratory Compaction
Characteristics of Soil Using Modified Effort
(56,000ft lbf/ft³ (2,700 KNm/m³))

D2166-06.....Standard Test Method for Unconfined Compressive
Strength of Cohesive Soil

D2167-08).....Standard Test Method for Density and Unit
Weight of Soil in Place by the Rubber Balloon
Method

D2216-10.....Standard Test Methods for Laboratory
Determination of Water (Moisture) Content of
Soil and Rock by Mass

D2974-07a.....Standard Test Methods for Moisture, Ash, and
Organic Matter of Peat and Other Organic Soils

D3666-11.....Standard Specification for Minimum Requirements
for Agencies Testing and Inspecting Road and
Paving Materials

D3740-11.....Standard Practice for Minimum Requirements for
Agencies Engaged in Testing and/or Inspection
of Soil and Rock as used in Engineering Design
and Construction

D6938-10.....Standard Test Method for In-Place Density and
Water Content of Soil and Soil-Aggregate by
Nuclear Methods (Shallow Depth)

E94-04(2010).....Standard Guide for Radiographic Examination

E164-08.....Standard Practice for Contact Ultrasonic
Testing of Weldments

- E329-11c.....Standard Specification for Agencies Engaged in
Construction Inspection, Testing, or Special
Inspection
 - E543-09.....Standard Specification for Agencies Performing
Non-Destructive Testing
 - E605-93(R2011).....Standard Test Methods for Thickness and Density
of Sprayed Fire Resistive Material (SFRM)
Applied to Structural Members
 - E709-08.....Standard Guide for Magnetic Particle
Examination
 - E1155-96(R2008).....Determining FF Floor Flatness and FL Floor
Levelness Numbers
- E. American Welding Society (AWS):
- D1.D1.1M-10.....Structural Welding Code-Steel

1.3 REQUIREMENTS:

- A. Accreditation Requirements: Construction materials testing laboratories must be accredited by a laboratory accreditation authority and will be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation. The laboratory's scope of accreditation must include the appropriate ASTM standards (i.e.; E329, C1077, D3666, D3740, A880, E543) listed in the technical sections of the specifications. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."
- B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COR to such failure.
- C. Written Reports: Testing laboratory shall submit test reports to COR, Contractor, unless other arrangements are agreed to in writing by the COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide part time observation of fill placement and compaction and field density testing in building areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with ASTM D698.
2. Make field density tests in accordance with the primary testing method following ASTM D6938 wherever possible. Field density tests utilizing ASTM D1556, AASHTO T191,, or ASTM D2167 shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COR before the tests are conducted.

a. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.

- C. Fill and Backfill Material Gradation: One test per 50 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C136.
- D. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- E. Testing Materials: Test suitability of on-site and off-site borrow as directed by COR.

3.4 LANDSCAPING:

- A. Test topsoil for organic materials, pH, nitrates, phosphate, potash content, sodium, calcium, sulfate, conductivity, lime, and gradation of particles.
 - 1. Test for organic material by using ASTM D2974.
 - 2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.
- B. Submit laboratory test report of topsoil to COR.

3.6 SITE WORK CONCRETE:

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.8 CONCRETE:

- A. Batch Plant Inspection and Materials Testing:
 - 1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COR with concurrence of Contracting Officer's Representative and perform periodic inspections thereafter as determined by COR.
 - 2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COR.
 - 3. Sample and test mix ingredients as necessary to insure compliance with specifications.
 - 4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
 - 5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to

proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:

1. Provide a technician at site of placement at all times to perform concrete sampling and testing.
2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor's expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m³ (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. Label each cylinder with an identification number. COR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day's pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m³ (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m³ (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.

10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:
 - a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
 - b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.
11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
 - a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
 - b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
 - a. Monitor and record amount of water added at project site.
 - b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
 - a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.

- b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
 - c. Provide the Contractor and the COR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
- C. Laboratory Tests of Field Samples:
- 1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
 - 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 - 3. Furnish certified compression test reports (duplicate) to COR. In test report, indicate the following information:
 - a. Cylinder identification number and date cast.
 - b. Specific location at which test samples were taken.
 - c. Type of concrete, slump, and percent air.
 - d. Compressive strength of concrete in MPa (psi).
 - e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
 - f. Weather conditions during placing.
 - g. Temperature of concrete in each test cylinder when test cylinder was molded.
 - h. Maximum and minimum ambient temperature during placing.
 - i. Ambient temperature when concrete sample in test cylinder was taken.
 - j. Date delivered to laboratory and date tested.

3.18 TYPE OF TEST:

Approximate Number of Tests Required

A. Earthwork:

Laboratory Compaction Test, Soils:

(ASTM D698)

10

Field Density, Soils (AASHTO T191, T205, or T238)	4
Penetration Test, Soils	2
B. Landscaping:	
Topsoil Test	3
C. Aggregate Base:	
Laboratory Compaction, (ASTM D1557)	10
Field Density, (AASHTO T191)(ASTM D1556)	5
Aggregate, Base Course Gradation (AASHTO T27)	2
E. Concrete:	
Making and Curing Concrete Test Cylinders (ASTM C31)	4
Compressive Strength, Test Cylinders (ASTM C39)	4
Concrete Slump Test (ASTM C143)	4
Concrete Air Content Test (ASTM C173)	4

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.
- B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
1. Adversely affect human health or welfare,
 2. Unfavorably alter ecological balances of importance to human life,
 3. Effect other species of importance to humankind, or;
 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.
- C. Definitions of Pollutants:
1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
 2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
 3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
 4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
 5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.

6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.
7. Sanitary Wastes:
 - a. Sewage: Domestic sanitary sewage and human and animal waste.
 - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2 QUALITY CONTROL

- A. Establish and maintain quality control for the environmental protection of all items set forth herein.
- B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. U.S. National Archives and Records Administration (NARA):
33 CFR 328.....Definitions

1.4 SUBMITTALS

- A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
 1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the Contracting Officer's Representative to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the Contracting Officer's Representative for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
 - b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
 - c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
 - d. Description of the Contractor's environmental protection personnel training program.

- e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
 - f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.
 - g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.
 - h. Permits, licenses, and the location of the solid waste disposal area.
 - i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the Department of Veterans Affairs.
 - j. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.
- B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

1.5 PROTECTION OF ENVIRONMENTAL RESOURCES

- A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

1. It is the contractor's responsibility to obtain and pay for all required permitting including but not limited to NPDES/SWPP, Army Corps of Engineers, Clean Water Act, etc. prior to the start of construction.

- B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Contracting Officer's Representative. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.
1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.
 2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
 - a. Box and protect from damage existing trees and shrubs to remain on the construction site.
 - b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
 - c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
 3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
 4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.

- a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the first inch of runoff from a storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
 - b. Reuse or conserve the collected topsoil sediment as directed by the Contracting Officer's Representative. Topsoil use and requirements are specified in Section 31 20 11, EARTHWORK (SHORT FORM).
 - c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features shown on the Erosion and Sediment Control Plans. Maintain temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
 6. Manage borrow areas on and off Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
 7. Manage and control spoil areas on and off Government property to limit spoil to areas and prevent erosion of soil or sediment from entering nearby water courses or lakes.
 8. Protect adjacent areas from despoilment by temporary excavations and embankments.
 9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
 10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.

11. Handle discarded materials other than those included in the solid waste category as directed by the Contracting Officer's Representative.
- C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.
1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.
 3. Monitor water areas affected by construction.
- D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.
- E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Alabama Department of Environmental Management and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
 2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the

- project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
 4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.
- F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Contracting Officer's Representative. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 6:00p.m unless otherwise permitted by local ordinance or the Contracting Officer's Representative. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
 - a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

<u>EARTHMOVING</u>		<u>MATERIALS HANDLING</u>	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95

GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

- b. Use shields or other physical barriers to restrict noise transmission.
 - c. Provide soundproof housings or enclosures for noise-producing machinery.
 - d. Use efficient silencers on equipment air intakes.
 - e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - f. Line hoppers and storage bins with sound deadening material.
 - g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the Contracting Officer's Representative noting any problems and the alternatives for mitigating actions.
- G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. **Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.**
- H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the Contracting

Officer's Representative. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

1.2 RELATED WORK:

- A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 11, EARTHWORK (SHORT FORM)
- B. Disconnecting utility services prior to demolition: Section 01 00 02, GENERAL REQUIREMENTS.
- C. Reserved items that are to remain the property of the Government: Section 01 00 02, GENERAL REQUIREMENTS.
- D. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

1.3 PROTECTION:

- A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT and UTILITIES AND IMPROVEMENTS.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

- E. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery Property; any damaged items shall be repaired or replaced as approved by the COR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COR's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- I. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 UTILITY SERVICES:

- A. Demolish and remove outside utility service lines shown to be removed.
- B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION:

- A. Completely demolish and remove indicated site elements and structures, including all appurtenances related or connected thereto, as noted below:
1. As required for installation of new utility service lines.
 2. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.
- B. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding

600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.

- C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.
- E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When Utility lines are encountered that are not indicated on the drawings, the COR shall be notified prior to further work in that area.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COR. Clean-up shall include off the Cemetery Property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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SECTION 03 30 53
(SHORT-FORM) CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies cast-in-place structural concrete and material and mixes for other concrete.

1.2 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TOLERANCES:

- A. ACI 117.
- B. Slab Finishes: ACI 117, F-number method in accordance with ASTM E1155.

1.4 REGULATORY REQUIREMENTS:

- A. ACI SP-66 ACI Detailing Manual
- B. ACI 318 - Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Concrete Mix Design(s).
- C. Shop Drawings:
 - 1. Submit steel reinforcement shop drawings and product data to include all information necessary for fabrication and placement of reinforcement.
 - 2. Indicate grades of reinforcing steel.
 - 3. Clearly indicate the splice length for every size and type of bar used.
- D. Manufacturer's Certificates: Air-entraining admixture, chemical admixtures, curing compounds.

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Concrete Institute (ACI):
 - 117-10.....Specification for Tolerances for Concrete Construction, Materials and Commentary

- 211.1-91(R2009).....Standard Practice for Proportions for Normal,
Heavyweight, and Mass Concrete
- 211.2-98(R2004).....Standard Practice for Selecting Proportions for
Structural Lightweight Concrete
- 301-10.....Specifications for Structural Concrete
- 305.1-06.....Specification for Hot Weather Concreting
- 306.1-90(R2002).....Standard Specification for Cold Weather
Concreting
- SP-66-04ACI Detailing Manual
- 318-11.....Building Code Requirements for Structural
Concrete and Commentary
- 347-04.....Guide to Formwork for Concrete
- C. American Society for Testing And Materials (ASTM):
 - A185/A185M-07.....Standard Specification for Steel Welded Wire
Reinforcement, Plain, for Concrete
Reinforcement
 - A615/A615M-09.....Standard Specification for Deformed and Plain
Carbon Steel Bars for Concrete Reinforcement
 - A996/A996M-09.....Standard Specification for Rail Steel and Axle
Steel Deformed Bars for Concrete Reinforcement
 - C31/C31M-10.....Standard Practice for Making and Curing
Concrete Test Specimens in the Field
 - C33/C33M-11a.....Standard Specification for Concrete Aggregates
 - C39/C39M-12.....Standard Test Method for Compressive Strength
of Cylindrical Concrete Specimens
 - C94/C94M-12.....Standard Specification for Ready Mixed Concrete
 - C143/C143M-10.....Standard Test Method for Slump of Hydraulic
Cement Concrete
 - C150-11.....Standard Specification for Portland Cement
 - C171-07.....Standard Specification for Sheet Material for
Curing Concrete
 - C172-10.....Standard Practice for Sampling Freshly Mixed
Concrete
 - C173-10.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Volumetric Method
 - C192/C192M-07.....Standard Practice for Making and Curing
Concrete Test Specimens in the Laboratory

- C231-10.....Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C260-10.....Standard Specification for Air-Entraining Admixtures for Concrete
- C330-09.....Standard Specification for Lightweight Aggregates for Structural Concrete
- C494/C494M-11.....Standard Specification for Chemical Admixtures for Concrete
- C618-12.....Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- D1751-04(R2008)Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
- D4397-10.....Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
- E1155-96(2008).....Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

Wood, plywood, metal, or other materials, approved by COR, of grade or type suitable to obtain type of finish specified.

2.2 MATERIALS:

- A. Portland Cement: ASTM C150, Type I or II.
- B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalis, and loss on ignition (LOI) not to exceed 5 percent.
- C. Coarse Aggregate: ASTM C33, Size 67. Size 467 may be used for footings and walls over 300 mm (12 inches) thick. Coarse aggregate for applied topping and metal pan stair fill shall be Size 7.
- D. Fine Aggregate: ASTM C33.
- E. Mixing Water: Fresh, clean, and potable.
- F. Air-Entraining Admixture: ASTM C260.
- G. Chemical Admixtures: ASTM C494.
- I. Reinforcing Steel: ASTM A615 or ASTM A996, deformed. See structural drawings for grade.

- J. Welded Wire Fabric: ASTM A185.
- K. Expansion Joint Filler: ASTM D1751.
- L. Sheet Materials for Curing Concrete: ASTM C171.
- M. Abrasive Aggregates: Aluminum oxide grains or emery grits.
- N. Liquid Hardener and Dustproofer: Fluosilicate solution or magnesium fluosilicate or zinc fluosilicate. Magnesium and zinc may be used separately or in combination as recommended by manufacturer.
- O. Liquid Densifier/Sealer: 100 percent active colorless aqueous silicate solution.
- P. Grout, Non-Shrinking: Premixed ferrous or non-ferrous, mixed and applied in accordance with manufacturer's recommendations. Grout shall show no settlement or vertical drying shrinkage at 3 days or thereafter based on initial measurement made at time of placement, and produce a compressive strength of at least 18mpa (2500 psi) at 3 days and 35mpa (5000 psi) at 28 days.

2.3 CONCRETE MIXES:

- A. Design of concrete mixes using materials specified shall be the responsibility of the Contractor as set forth under Option C of ASTM C94.
- B. Compressive strength at 28 days: as indicated.
- C. Establish strength of concrete by testing prior to beginning concreting operation. Test consists of average of three cylinders made and cured in accordance with ASTM C192 and tested in accordance with ASTM C39.
- D. Maximum slump for vibrated concrete is 100 mm (4 inches) tested in accordance with ASTM C143.
- E. Cement and water factor (See Table I):

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete: Strength Min. 28 Day Comp. Str. MPa (psi)	Non-Air-Entrained		Air-Entrained	
	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m ³ (lbs/c. yd)	Max. Water Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,3}	325 (550)	0.55	340 (570)	0.50
25 (3000) ^{1,3}	280 (470)	0.65	290 (490)	0.55
25 (3000) ^{1,2}	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
 2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
 3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.
- F. Air-entrainment is required for all exterior concrete and as required for Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS. Air content shall conform with the requirements of Table 1, previous page.

2.4 BATCHING & MIXING:

- A. Store, batch, and mix materials as specified in ASTM C94.
1. Ready-Mixed: Ready-mixed concrete comply with ASTM C94, except use of non-agitating equipment for transporting concrete to the site will not be permitted. With each load of concrete delivered to project, ready-mixed concrete producer shall furnish, in duplicate, certification as required by ASTM C94.

PART 3 - EXECUTION

3.1 FORMWORK:

- A. Installation conform to ACI 347. Sufficiently tight to hold concrete without leakage, sufficiently braced to withstand vibration of concrete, and to carry, without appreciable deflection, all dead and live loads to which they may be subjected.
- B. Treating and Wetting: Treat or wet contact forms as follows:
1. Coat plywood and board forms with non-staining form sealer. In hot weather cool forms by wetting with cool water just before concrete is placed.
 2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather cool metal forms by thoroughly wetting with water just before placing concrete.
 3. Use sealer on reused plywood forms as specified for new material.
- C. Inserts, sleeves, and similar items: Flashing reglets, masonry ties, anchors, inserts, wires, hangers, sleeves, boxes for floor hinges and other items specified as furnished under this and other sections of specifications and required to be in their final position at time

concrete is placed shall be properly located, accurately positioned and built into construction, and maintained securely in place.

D. Construction Tolerances:

1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials.
2. Cast-in-place concrete elements to have concrete (on or above finished grade) constructed to dimensions indicated on drawings within 6 mm (1/4 inch) of location and elevation.
3. Remedial work necessary for correcting installations that is in excess of allowable tolerances are the responsibility of the contractor.
4. Erected work that exceeds specified tolerance limits must be remedied or removed and replaced, at no additional cost to the government.
5. Any remediation work is subject to approval of the COR in advance of the work.
6. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 REINFORCEMENT:

- A. Details of concrete reinforcement, unless otherwise shown, in accordance with ACI 318 and ACI SP-66. Support and securely tie reinforcing steel to prevent displacement during placing of concrete.

3.4 PLACING CONCRETE:

- A. Remove water from excavations before concrete is placed. Remove hardened concrete, debris and other foreign materials from interior of forms, and from inside of mixing and conveying equipment. Obtain approval of COR before placing concrete. Provide screeds at required elevations for concrete slabs.
- B. Roughen and clean set concrete free from laitance, foreign matter, and loose particles, before placing new concrete on or against concrete which has set.
- C. Convey concrete from mixer to final place of deposit by method which will prevent segregation or loss of ingredients. Do not deposit in work concrete that has attained its initial set or has contained its water

or cement more than 1 1/2 hours. Do not allow concrete to drop freely more than 1500 mm (5 feet) in unexposed work nor more than 900 mm (3 feet) in exposed work. Place and consolidate concrete in horizontal layers not exceeding 300 mm (12 inches) in thickness. Consolidate concrete by spading, rodding, and mechanical vibrator. Do not secure vibrator to forms or reinforcement. Vibration shall be carried on continuously with placing of concrete.

- D. Hot weather placing of concrete: Follow recommendations of ACI 305R to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete.
- E. Cold weather placing of concrete: Follow recommendations of ACI 306R, to prevent freezing of thin sections less than 300 mm (12 inches) and to permit concrete to gain strength properly, except that use of calcium chloride shall not be permitted without written approval from COR.

3.5 PROTECTION AND CURING:

- A. Protect exposed surfaces of concrete from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by COR.

3.6 FORM REMOVAL:

- A. Forms remain in place until concrete has a sufficient strength to carry its own weight and loads supported. Removal of forms at any time is the Contractor's sole responsibility.

3.7 SURFACE PREPARATION:

- A. Immediately after forms have been removed and work has been examined and approved by COR, remove loose materials, and patch all stone pockets, surface honeycomb, or similar deficiencies with cement mortar made with 1 part portland cement and 2 to 3 parts sand.

3.8 FINISHES:

- A. Vertical and Overhead Surface Finishes:
 - 1. Unfinished Areas: Vertical and overhead concrete surfaces exposed in unfinished areas, above suspended ceilings in manholes, and other unfinished areas exposed or concealed will not require additional finishing.
- B. Slab Finishes:
 - 1. Scratch Finish: Slab surfaces to receive a bonded applied cementitious application shall all be thoroughly raked or wire

broomed after partial setting (within 2 hours after placing) to roughen surface to insure a permanent bond between base slab and applied cementitious materials.

2. Floating: Allow water brought to surface by float used for rough finishing to evaporate before surface is again floated or troweled. Do not sprinkle dry cement on surface to absorb water.
3. Float Finish: Ramps, stair treads, and platforms, both interior and exterior, equipment pads, and slabs to receive non-cementitious materials, except as specified, shall be screened and floated to a smooth dense finish. After first floating, while surface is still soft, surfaces shall be checked for alignment using a straightedge or template. Correct high spots by cutting down with a trowel or similar tool and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections on floated finish by rubbing or dry grinding. Refloat the slab to a uniform sandy texture.
4. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
5. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

Slab on grade & Shored suspended slabs	Unshored suspended slabs
Specified overall value F _F 25/F _L 20	Specified overall value F _F 25
Minimum local value F _F 17/F _L 15	Minimum local value F _F 17

3.9 SURFACE TREATMENTS:

- A. Surface treatments shall be mixed and applied in accordance with manufacturer's printed instructions.

3.10 PRECAST CONCRETE ITEMS:

Precast concrete items, not specified elsewhere, shall be cast using 35 MPa (5000 psi) air-entrained concrete to shapes and dimensions shown. Finish surfaces to match corresponding adjacent concrete surfaces. Reinforce with steel as necessary for safe handling and erection.

- - - E N D - - -

SECTION 03 48 21
PRECAST CONCRETE BURIAL CRYPTS
(DOUBLE DEPTH LAWN CRYPT)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this Section is to furnish all labor, materials, manpower, tools and equipment required to complete the manufacturing and installation of the precast concrete burial crypts as specified and/or shown, including but not limited to the work to:
1. Fabricate
 2. Transport and deliver to site
 3. Unload units on dunnage or gravel
 4. Store and/or install precast concrete burial crypts (units or crypts)
 5. Install sub base foundation and drainage
 6. Install units in the prepared crypt fields
 7. Backfill between and around the crypts
 8. Install sand and/or backfill on top of crypts
 9. Compact fill materials
 10. Topsoil
 11. Provide additional Materials:
 - a. Three (3) OSHA -approved crypt lid lifting apparatus
 - b. Five (5) extra concrete crypt lids
 - c. A device to easily retrieve and lower the inside shelf by one man without entering the crypt.
 12. Other Associated Work

1.2 DESIGN OVERVIEW

- A. The design of the units shall be as described in this Section and their installation layout shall be as illustrated on the Drawings. Design requirements shall be as follows:
1. All perimeter crypts shall be structurally designed for overhead and lateral soil pressure plus live loads specified hereafter.
 2. All designs will require that the manufacturer provide fabrication drawings stamped by a Professional Engineer indicating that the design meets or exceeds the structural requirements contained herein.
 3. Alternative crypt component designs may be proposed if all the following requirements are met:

- a. Comply with the design criteria and the functional tests of this specification.
- b. All provisions of this specification shall apply to any proposed alternative design.
- c. The Government may accept or reject part or all of any proposed alternative design. The Contractor will pay for all cost for alternate designs, submittals, and reviews.

1.3 RELATED WORK

- A. Excavation and Backfill: Division 31 "EARTHWORK."
- B. Materials Testing and Inspection during Fabrication and Construction: Division 1 Section TESTING LABORATORY SERVICES.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Bid documents shall include documentation that manufacturer has a minimum of three years of experience with pre-casting units of similar type. Current plant certification for the location(s) that will be producing units for this project from the National Precast Concrete Association (NPCA) shall be provided as a submittal prior to any work being performed.
- B. Provide a written stamped certification from a licensed Structural Engineer that certifies that the units being manufactured conform to the specified design and performance requirements.
- C. Installation Qualifications: Provide written documentation that verifies:
 1. The installer has been regularly engaged, for at least three years, in installation of pre-cast concrete similar to this project.
- D. Fabricate crypts to the interior dimensions described below.
 1. Replace or repair units that do not comply with the individual dimensions and tolerances.
- E. Prior to, or in the initial stage of crypt production, furnish at the site:
 1. Proposed shelf removal tool.
 2. Two (2) perimeter crypts.
 3. One (1) interior crypt.
 - a. The three (3) crypts shall:
 - 1) Demonstrate acceptable quality of construction.
 - 2) Be used to conduct the on-site buried crypt functional load test as described herein below.

F. Functional Load Tests: Functional on-site load tests will be made at the Contractor's expense to insure the units are capable of supporting loads stated. The functional tests will consist of following loading conditions:

1. Confined Loading: An interior unit between two perimeter units shall:
 - a. Be placed in a hole dug in the ground on site and covered with 600 mm (24 inches) of soil or covered to the maximum depth as shown on the plans, whichever is greater.
 - 1) The soil will be compacted to Standard Proctor (AASHTO T-99) density along the sides of 95% and reduced density over the lid, both as shown on the plans.
 - a) Impact type of equipment shall not be used on the sides of the crypts as they can cause conditions that exceed the design parameters.
 - b. An axle load of 5500 kg (12,000 lbs.) shall be passed over the covered crypts for a minimum of 10 times in repetition as follows:
 - 1) In a manner that causes maximum lateral pressure due to wheel load on the sides of the crypts.
 - c. The crypts shall then:
 - 1) Be fully excavated, exposed and the lids removed to allow careful examination inside and outside.
 - a) The crypts must not show any signs of stress or cracking.
2. Shelf Load Testing for the intermediate shelf shall be as follows:
 - a. Apply load to individual support struts. Use one worker with a minimum weight of 90kg (200 lbs.)
 - 1) Worker shall carefully walk on individual supports to confirm structural integrity and load bearing capability.
 - a) Worker shall adhere to all safety regulations while performing test.
 - b. Upon completion of shelf load testing, the inside shelf shall be removed by the removal tool as follows:
 - 1) Without entering the crypt and by one man.
 - 2) Inspected, and lowered back into the crypt in the 2nd interment position.
 - 3) The inside shelf must not show any signs of stress, cracking or deflection.

3. Demonstrate the removal and replacement process for the inside shelf. The functioning of the shelf removal tool shall be approved by the NCA Crypt Specialist.

G. Commence production of crypts only after the written submittal(s) are approved and on-site load testing and demonstration have been scheduled for witnessing by the NCA Crypt Specialist.

1.5 DESIGN CRITERIA

A. Design Criteria (Double Depth Crypt): All design calculations and drawings shall be signed and sealed by qualified licensed Structural Engineer.

1. The units shall be of the following type, style, and size:

a. Type: Precast concrete.

b. Style: One-piece box with separate outer lid and the following:

- 1) A removable one-piece inside shelf
- 2) Four casket risers or two casket support bars
- 3) Drain Holes 100 mm (4-inch) diameter in the floor bottom as follows:

a) Two drain holes at opposite ends when there are casket risers.

b) Three drain holes at opposite ends and in middle, when there are two support bars.

c. Crypt interior size: Interior minimum dimensions are as follows:

- 1) 750 mm (30") minimum width at the inside bottom floor and for the full height of the crypt
- 2) 2.2 m (86") minimum length along the inside bottom floor and for the full height of the crypt
- 3) 640 mm (25") minimum clear height from the highest part of the inside shelf to the underside of the lid
- 4) 640 mm (25") minimum clear height from the lowest part of the inside shelf to the top of the casket risers
- 5) 20 mm (3/4") minimum height casket risers from the crypt floor spaced 500 mm (20") from crypt centerline to eliminate pinching of the lowering straps during removal. Four risers required.

d. Crypt height and wall thickness:

- 1) Exterior maximum height dimension: 1.6 m (60") including the lid.

- 2) Crypt wall thickness: 50 mm minus 12mm (2-inches minus 1/2 inch) for inside shelf bearing.
 - 3) Perimeter crypts are allowed thicker walls where additional reinforcing is included.
 - 4) Crypt wall sections at support slots originated from the top for the inside shelf may be of lesser thickness.
- e. Layout:
- 1) Crypts shall fit in a 920 mm by 2450 mm (3-foot by 8-foot) plot or a lesser plot size as noted on the plans.
 - 2) The lesser plot size shall govern. If the proposed crypts will not fit into the designed/indicated plot size, with adequate room for the between crypt backfill, or if a different plot size is suggested, the Contractor, at no cost to the Owner, shall prepare a revised Layout/Size Plan and submit it for review and approval by the COR.
2. Load Conditions for design of units shall be as follows:
- a. A burial depth with soil cover as indicated on the plans.
 - b. A center point load of 2700 kg (6,000 lbs.) on one square foot, prior to burial.
 - c. Passage of a wheel axle load of 5500 kg (12,000 lbs.) after burial.
 - d. A 900 mm (3-foot) tall pile of excavated material on top of or adjacent to buried crypts.
3. Submit to the Contracting Officer's Representative COR for approval the following:
- a. Five sets of design documentation showing structural design of the units. **In addition, the Contractor shall provide one additional set to NCA Crypt Specialist.**
 - 1) This documentation shall include dimensions, methods of construction, and calculations.
 - b. The Structural Engineer that stamps the design calculations and drawings shall provide:
 - 1) Written recommendations indicating the extent of voids that are allowable in the produced units, without causing any degradation of loading capacity from the design load values.
 - 2) Written recommendations on the conditions where repairs will be allowed, and materials and methods to be used for repairs.

- 3) Written statement that all repairs to the units shall only be allowed if they are performed according to the written recommendations of the Structural Engineer.

B. Design Criteria (Concrete Lids):

1. To be removable and replaceable.
2. Lid lifting shall be from top positioned hot-dipped galvanized anchors (4-required per lid) with removable anchor covers to prevent dirt from entering the anchor bowl and installed in such a manner as to stay in-place when excavating equipment is scraping backfill off the top of the lid.
 - a. Furnish the cemetery with three (3) OSHA approved and tag certified wire rope lifting devices for removing the lid. No chain lifting devices allowed.

C. Design Criteria (Inside shelf):

1. One piece rigid construction
2. Fully conceal the lower casket with a rigid barrier
3. Weigh 18 kg (40 lbs.) or less
4. Allow for easy casket lowering belt removal
5. Capable of holding 180 kg (400 lbs.) indefinitely.
6. The entire inside shelf should be rigid, non-brittle, non-deteriorating, and have a maximum 6 mm (1/4 inch) gap from all shelf edges to the crypt wall to create a visual barrier.
7. Have one lifting hole in the middle about 50 mm (2-inches) from the edge 19 mm (3/4-inch) maximum diameter.

D. Design Criteria (Inside Shelf Removal Tool(s)):

1. Be constructed so one man can easily retrieve and install the shelf from ground level without entering the crypt.
 - a. Demonstrate the use and functionality of said tool at the crypt buried load testing, for the conditions that will occur at the cemetery during the interments at the crypt sections(s).

E. Miscellaneous manufacturing requirements:

1. The concrete lid shall be beveled along the entire top perimeter. Chamfer top edge of lid with a 1:1 chamfer beginning 12 mm (1/2 inch) down from top.
2. The design of casket risers, whether individual spots or bars crossing the bottom, shall allow the casket to rest a minimum of 19 mm (3/4 inch) above the inside floor of the crypt and above the top of the inside shelf in order to aid in casket lowering straps

removal. In addition, rests location shall not exceed 530 mm (21 inches) from crypt centerline.

3. The crypt outside lifting wire shall be designed for transport and installation along with provisions for removal/abandonment of crypt lifting wire once crypt has been installed.

1.6 ALLOWABLE TOLERANCES

- A. Tolerances of individual units shall be as follows:
 1. Variation in overall crypt outside dimensions of unit (height, length and width): 3 mm (1/8") plus or minus. There is zero tolerance for any lesser crypt inside minimum clear dimensions.
 2. Variation in thickness of precast panels and elements: 1.5 mm (1/16") plus or minus.
 3. Maximum height differential in final placement in the ground: 6 mm (1/4") above or below design grade.
 4. Cracks greater than 0.75 mm (0.030 inches) in width are cause for crypt rejection. With evidence of fiber or steel reinforcement, any cracking 0.75 mm (0.030") or lesser width that does **not** extend thru wall is acceptable. Any cracking 0.4 mm (0.016 inch) or lesser that extends thru wall is acceptable. All other cracks are cause for rejecting crypts that shall be repaired or removed and replaced at no cost to VA.

1.7 SUBMITTALS

- A. In accordance with Section 01 33 23, SAMPLES AND SHOP DRAWINGS, within 45 days of the approval of the shop drawings, furnish to the A/E, COR and the NCA Crypt Specialist the following:
 1. Samples: deliver to the site for testing and inspection:
 - a. Two perimeter crypts and one interior crypt.
- B. Submit a detailed concrete Mix Design of Self Consolidating Concrete (SCC) with a **15% minimum requirement** of a cement substitute of fly ash and/or other pozzalons.
- C. Submit Shop Drawings:
 1. Installation Narrative:
 - a. Method of transportation.
 - b. Method of handling and placement.
 2. Production Drawings:
 - a. Elevation view of each unit.
 - b. Plan view of unit.

- c. Sections and details to show quantities, sizes and position of reinforcing steel, inserts, and essential embedded hardware for fabrication, handling, transportation and installation.
 - d. Section, details and location of specialty lid lifting anchors, caps, and lid lifting system.
 - e. Dimensions and finishes.
- D. Submit Product Design Data:
- 1. Structural adequacy calculations of units (crypts), performed by a licensed Structural Engineer.
 - 2. Loadings for Design Calculations:
 - a. Initial handling and erection stresses.
 - b. Dead and live loads specified.
 - c. Other loads specified for units as applicable.
 - d. Deflection of precast members.
 - e. Product test reports:
 - 1) The concrete shall be tested for the compressive strength and beam flexural strength as specified herein. An approved independent, commercial testing laboratory shall perform tests. Certified copies of test reports, including test data and results shall be submitted to the COR immediately after the strength tests have been completed. The tests shall be as specified herein.
 - 2) Prior to backfilling over crypts and at contractor expense, the COR may pick a single crypt for coring another bottom slab drainage hole by an independent lab with said core being analyzed (petrography testing) and results submitted verifying evidence of fly ash or other pozzalons as specified.
 - 3) Based on failed testing, the COR may request more frequent testing to ensure quality of the product and pozzalons content is present, again at contractor expense.
 - 3. Manufacturer's Literature and Data:
 - a. Each type of anchorage, angle, and fastener.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling: Units shall be transported, stored and handled so as to prevent damage to surfaces, edges and corners and to prevent development of stresses and cracks. Provide temporary bracing protection devices and measures as necessary to prevent damage to the units during handling, transportation and storage. Transportation,

C1157/C1157M-11	Standard Performance Specification for Hydraulic Cement
C1399/C1399M-10	Standard Test Methods for Obtaining Residual-Strength of Fiber-Reinforced Concrete.
C1602/C1602M-12	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Precast Concrete: All crypts shall be of concrete with the following:
1. A minimum 28 days compressive strength of 35 MPa (5,000 psi)
 2. Self-Consolidating Concrete (SCC) containing structural fiber with an inverted slump between 550 mm and 700 mm (22" and 28")
 3. A minimum of 15% cement substitute of fly ash and/or other pozzalons. Fiber is not required for crypt lids
 4. Hydraulic Cement: ASTM C150 or ASTM C1157 or ASTM C595
 5. Normal weight Aggregates: ASTM C 33
 6. Water: ASTM C1602
 7. Chemical Admixtures:
 - a. Water reducers, accelerating and retarding: ASTM C 494
 - b. Air Entraining: ASTM C260
 - c. Admixtures for flowing concrete: ASTM C1017
 - d. Admixtures with no standard designation shall be used only with approval of VA.
 8. Prohibited Admixtures: Calcium Chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions.
- B. Reinforcement:
1. Welded Steel Wire Fabric: ASTM A1064.
 2. Steel Wire Reinforcement: ASTM A82, cold drawn.
 3. Steel Reinforcement: ASTM A615 Grade 60, deformed.
 4. Inserts, Anchors, Dowels and Accessories: Steel, ASTM A36, zinc coated ASTM A153 hot-dipped galvanized finish G90.
 5. Fiber: Macrofiber complying with ASTM C1116
- C. Form Coatings:
1. Use commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces.
- D. Paint:

1. Use commercial Concrete & Garage Floor Epoxy Acrylic Paint for crypt concrete lid & inside wall surface numbering. Paint as manufactured by BEHR Deep Base #930 or approved equal. The use of an approved equivalent spray paint product, if approved by the NCA Crypt Specialist, shall only be for use on the interior crypt numbers.

2.2 FABRICATION

A. General:

1. Units shall be fabricated in accordance with the minimum interior dimensions and tolerances indicated herein, with concrete surfaces that are smooth and free of irregularities.

B. Finishes:

1. Surface holes 6 mm (1/4") and smaller caused by air bubbles, normal color variations, normal form joint marks, small chips 6mm (1/4") and smaller and spalling no more than 0.1 square meter (one square foot) total per unit are permitted.
2. Exposed steel reinforcing, honeycomb, bugholes, and cracks not within tolerances are not permitted.
3. The lid lifting system shall be as follows:
 - a. Top mounted and consist of hot dip galvanized steel anchors (four per lid) each in a 65 mm (2-1/2") diameter minimum recessed bowl of depth sufficient to easily connect lifting device as designated compatible by anchor manufacturer.
 - b. Anchors to be installed at locations to ensure maximum lid lifting stability.
 - c. A removable plastic cap secured to the anchor which prevents fill material from entering the anchor bowl. Cap to be flush mounted to ensure the entire assembly is not an obstruction for crypt excavating equipment.
4. Concrete shall have no evidence of segregation of materials.

C. Reinforcement:

1. Provide steel and fiber reinforcing as required for casting, handling, erection loads, lateral and overhead fill, and equipment live loads.
2. Reinforcing steel shall be free of dirt, mill scale, rust, oil, grease, ice, snow, water and placed within approved tolerances in accordance with ACI 318. Careful placement of reinforcing is required to avoid overlapping at thin points of the units.

D. Concrete Placement:

1. Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
2. Units shall be cast in steel forms designed to suit shape and finish required. Each element of the unit shall be cast as an integral piece free of joints and seams.

E. Curing:

1. 75% of specified concrete compressive strength shall be attained before transportation of units to the cemetery or storage site.
2. Units shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally.
3. Units shall be properly cured in accordance with the applicable provisions of the current ACI Manual of Concrete Practice.

F. Surface Treatment and Corrective Work:

1. Units that have minor chipping of edges and corners shall be repaired by a method approved by the COR.
2. Cracked/damaged units exceeding tolerances shall be removed by the contractor at no cost to the government.
3. Any corrective work beyond what the COR determines is minor, shall be handled according to written procedures from the Structural Engineer that stamped the design for the units. Otherwise, the units shall be removed and replaced.

2.3 TESTING AND INSPECTION

A. Contractor's Responsibility for Inspection: The Contractor is responsible for the performance of all inspection requirements including:

1. Removal of lids
2. Number painting inside crypts
3. Replacement of the lids for inspection by the CO/COR.
 - a. The COR reserves the right to perform any of the inspections set forth in the specification when deemed necessary to assure that the units conform to prescribed requirements.

PART 3 - EXECUTION

3.1 CRYPT FIELD QUALITY ASSURANCE

- A. Testing: The contractor shall procure an independent qualified testing agency to perform concrete tests during crypt production and prepare test reports.
 - 1. Concrete Cylinder testing for compressive strength:
 - a. Three cylinders per day of crypt production to be taken in accordance to ASTM C172 as applicable to SCC.
 - b. Strength to exceed 35 MPa (5000 psi) after 28 days curing in accordance to ASTM C31 & C39.
 - c. Test inverted slump when cylinders are made.
 - 2. Beam testing to confirm design flexure strength:
 - a. Once at the beginning of crypt production, a minimum of three beams with fiber shall be taken for testing of Flexural Performance of Fiber-Reinforced Concrete in accordance with ASTM C78 and C1399. All beams' flexural strength shall exceed the crypt design flexural strength requirements and residual strength of fiber reinforced concrete, and shall exceed capacity of conventionally reinforced concrete wall design as submitted by the Structural Engineer and approved by VA. Fiber Manufacturer shall verify type and dosage rate of the test beams are identical in crypt production.
 - 3. A single verification test of fly ash in the crypt concrete mix required at the discretion of the COR.

3.2 GENERAL LAYOUT CONTROL

- A. A professional registered Land Surveyor shall establish sufficient lines, grades and control for the horizontal placement, slope of the base and top, and vertical alignment for the sides of units in accordance with the design drawings.

3.3 PREPARATION

- A. Before beginning installation, inspect work of other trades insofar as it affects the work of this section. Commencing installation of units will be construed as accepting as suitable the work of other trades.
- B. Verify by survey, rough grading of aggregate for first row of crypts to be installed in a field. Provide a certification by the professional surveyor to the COR that the rough grading for the base stone for the first row of crypts to be installed, as well as that the survey control

points for crypt setting have been set according to the plans, prior to the Contractor starting to set crypts in the field. The Surveyor shall indicate to the COR where the control points are located and how they are protected.

- C. Verify by testing, compaction of prepared subgrade and subbase to meet Standard Proctor (AASHTO T-99).
- D. Verify by survey locations and elevations of units relative to control points indicated on plans. Submit new control point layout if a crypt size other than specified is used.

3.4 HANDLING, INSTALLATION AND PAINTING

A. Handling:

- 1. Units shall be handled in a vertical plane at all times and stacked vertically on wood supports of adequate strength, or placed on gravel until erected. Use of approved designed OEM lifting cable system that has been deemed to be safe for handling the units shall be used during the setting process, where workers are nearby.
- 2. Lift units with suitable lifting devices at points provided by manufacturer.
- 3. Provide temporary wood bracing to comply with manufacturer's recommendations to keep crypt bottom off ground during storage.

B. Installation and Painting:

- 1. Install units by competent erector crews trained and certified as competent by units manufacturer.
- 2. Use all means necessary to protect units from being damaged in transport and during and after installation. Lids or other parts of the crypt that show damage from bouncing during transport shall be replaced by the contractor at no cost to the Owner.
- 3. Accurately install by aligning and leveling units in accordance with plans. Assure that crypts are in straight horizontal alignment.
- 4. After crypt installation and prior to backfill, remove lids with the specified lifting apparatus for crypt inspection by the COR inspector and numbering. Numbers furnished by NCA shall be painted on the outside of the crypt lids and on the upper inside crypt short wall (or floor with cremain crypts), both at the headstone end. Numbers shall be permanent paint as specified and approximately twelve inches high. Crypt lid number painting must be applied to a clean, dust-free surface requiring paint application **within 10 seconds** of surface cleaning. After completion of inspection and

marking, the Contractor shall replace the lids. Any damage to lids or crypts will be the responsibility of the contractor.

3.5 PROTECTION OF WORK

- A. Use all means necessary to protect units from being damaged during and after installation.

3.6 REPLACEMENT AND REPAIR

- A. Remove and replace units that the CO/COR has determined are damaged, cracked beyond tolerances, broken, improperly fabricated, or otherwise defective and are structurally unsound and unacceptable.
- B. Units having minor defects not affecting serviceability or appearance may be repaired when approved by NCA Inspector.
- C. Proposed repair work shall be sound, permanent, and flush with adjacent surfaces and submitted for approval by NCA Crypt Specialist.
- D. Replacements and repairs shall be done at no additional cost to the Government.

3.7 BACKFILLING AND CRYPT FIELD PROTECTION

- A. Prior to the backfill being placed between the crypts, a professional registered Land Surveyor shall:
 - 1. Survey the in place crypts and provide a written certification that they are, within allowable tolerances installed:
 - a. At the design locations
 - b. Properly aligned
 - c. At correct elevations and slopes
- B. The following documents shall be provided to the COR:
 - 1. An electronic drawing of the as-built conditions for the installed crypts.
 - 2. A paper copy at appropriate scale so the crypt field is fully shown on a maximum sheet size of 600 mm x 900 mm (24" x 36") with all indications of variances in the placement from the design drawings shown.
 - 3. A written certification that during the manufacturing, handling, setting, and or crypt numbering process that each of the lifting bowls were operated using the designed lifting device, and that any excessive concrete debris has been removed to allow free operation of the lifting bowls. A description of when in the process each of the lifting bowls were used shall also be provided.
- C. When all of the crypts in a specific field are installed as indicated in the design drawings and details, and the surveyor has so certified,

the COR will approve the Contractor proceeding with the backfill between the crypts. The Contractor is responsible for insuring that the crypts do not move during the backfill operations, including but not limited to providing adequate blocking at the base of the units, if deemed necessary, to prevent them from moving during the backfill operations.

- D. Protect installed crypt units during backfill operations.
- E. Install approved backfill against outside walls of all units, insuring no voids are remaining. Approved backfill shall:
 - 1. Contain no materials that will cause a concentrated point load.
 - 2. The perimeter wall backfill shall be compacted to Standard Proctor (AASHTO T-99) to 95% density to the level equal to the top of the crypts.
 - 3. Shall be compacted without using large vibratory equipment near crypts as impact loading may cause damage or failure of the crypt.
- F. Backfill between the crypts where gap is less than 50mm (2-inches) shall be as follows:
 - 1. Install approved (rounded) gravel that meets the specified gradation into gaps between crypts leaving no voids.
 - a. At COR's discretion, a non-rounded stone may be considered as a substitute for the rounded stone. The COR may accept the (non-rounded) stone only following demonstration, through an approved submittal process, that rounded stone is not available for less than 4 times the cost of a cut/crushed angular (non-rounded) aggregate substitute. Largest size for the non-rounded stones shall not exceed the gradation size for the rounded stones. (A smaller gradation size will be required for the non-rounded stones to insure that the stones are not larger than their rounded counterparts.) The non-rounded stone shall only be considered when with the largest size of the stone passing a sieve size does not exceed the allowable stone size for the rounded stone gradations. The non-rounded stone may be approved when the size is as described above, and with a successful demonstration that filling gaps between crypts leaves no voids, because the stones fall into place without bridging as should occur when using rounded stones.
 - 2. Use rodding to assure no bridging occurs and void areas are eliminated.

3. No sand allowed.
4. As a resource saving measure, the use of angular stone of suitable gradation (typically the same stone used as drainage stone for below the crypts) shall be allowed in the space between the head and foot of the crypts only, if the Contractor demonstrates a successful method of placement that prevents the larger angular stone from spreading into the gaps along the long sides of side by side crypts.

Aggregate Size No.	Grading Requirements - Amounts finer than Each Sieve (Square Openings), Mass Percent					
	12.5 mm (1/2")	9.5 mm (3/8")	4.75 mm (No. 4)	8.36 mm (No. 8)	1.18 mm (No. 16)	300 μ (No.50)
8	100	85 to 100	10 to 30	0 to 10	0 to 5	
89	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5

- G. Install backfill on top of units and compact. Backfill shall be as shown on plans. In absence of plan detail, backfill on top of units working from bottom up consists of 50 mm (2 inches) of identification sand, soil to specified level, and 100 mm (4 inches) minimum of topsoil as the final layer. The entire backfill atop units shall be compacted to 85% density (Standard Proctor (AASHTO T-99)).
- H. Install drainage board for pea gravel flow containment located in perimeter crypt gaps in areas shown on Drawings.
 1. Drainage board shall be installed at the perimeter of crypt field in locations where standard or oversize traditional gravesite burial spaces are identified on the drawings and other areas so designated.
 2. Drainage board shall be as appropriate to fill gap and stop pea gravel flow, and provide for drainage rates of 1000 L/hr/m (100 gal/hr/lf) in any direction.
 3. The drainage board shall be made of "non-deteriorating" recycled materials and be able to be compressed and return to its original thickness.
 4. Drainage board shall contain pea gravel between Crypts. Attach board to Crypt wall exterior with fastening method approved during functional load testing. Ensure board material re-expands to original thickness if compressed. Drainage board shall be installed from bottom of Crypt to bottom of lid. Exterior edge of board shall be inset at least 50 mm (2 inches) from edge of crypt and extend 600 mm (2 feet) in between Crypts.

- I. No equipment over the crypts should exceed crypt design loads as specified herein 5500 kg (12,000 lbs axle), which includes compacting equipment. No vibratory compaction equipment over or along side crypts unless impact loads are shown not to exceed crypt design loads.
- J. Immediately during crypts install, mark the crypt field edges with temporary driven 5-foot tall lathes & signage for easy identification by vehicles carrying fill, topsoil, compost, sod, water or other. Signage shall state **"5500-kg axel load maximum. Keep 9 m away"** ("**12,000-lb axle load maximum. Keep 10 yards away**") and placed minimum 15 m (50-ft) apart.
- K. Lathes & signage to be maintained in-place during backfilling thru final acceptance of the crypt field.
- L. Finish grading and prepare topsoil as indicated on plans.
- M. Do not store or stockpile any stone, sand, backfill, crypts or any other material over 1200 mm (4-feet) high within 9 m (10 yards) of ground on top of installed crypts. Affected crypts subject to said loading condition as determined by the COR shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.
- N. Do not allow any vehicle that exceeds a 5500 kg (12,000-lb) axle load, 2700 kg (6000-lb) wheel load or equivalent pressure per square inch to traverse or park within 9 m (10 yards) of or on top of installed crypts. Affected crypts subject to said loading condition as determined by the COR shall be inspected for possible damages with all excavation, lid lifting, fill replacement and all other work as necessary, all at contractor's expense.

3.8 INSPECTION AND ACCEPTANCE

- A. Final inspection and acceptance will be by COR following receipt of:
 - 1. Recommendations from NCA Crypt Specialist and/or A/E team, as applicable.
 - 2. Electronic DWG files of each individual crypt field, with coordinates of the monument markers indicated, and each burial plot being indicated with a closed polygon, and corresponding NCA burial plot identification number, along with the section markers and number for the section.

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SECTION 04 72 00
CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies concrete site elements manufactured and installed to simulate natural cut stone. Cast Stone is made from fine and coarse aggregates, Portland cement, mineral oxide color pigments, chemical admixtures and water to simulate a natural stone.
- B. Unless specifically indicated otherwise, cast stone provided for this project is to be wet-cast type.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Shop Drawings:
 - 1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
- D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification; certification documents must be current within one year of preconstruction meeting.
- E. Submit manufacturers test results of cast stone previously made by manufacturer, indicating compliance with ASTM C1364.
- F. Laboratory Qualifications: Description of testing laboratories facilities and qualifications of its principals and key personnel.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Concrete Institute (ACI):

318/318M-11 Building Code Requirements for Structural
Concrete and Commentary

C. Architectural Precast Association; certification program.

D. American Society for Testing and Materials (ASTM):

A167-99(2009) Stainless and Heat-Resisting Chromium-
Nickel Steel Plate, Sheet, and Strip

A185/A185M-07 Steel, Welded Wire Reinforcement, Plain,
for Concrete

A240/A240M-13a Chromium and Chromium-Nickel Stainless
Steel Plate, Sheet, and Strip for Pressure
Vessels and for General Applications

A276-13 Stainless Steel Bars and Shapes

A615/A615M-12 Deformed and Plain Carbon-Steel Bars for
Concrete Reinforcement

A666 Annealed or Cold-Worked Austenitic
Stainless Steel Sheet, Strip, Plate, and
Flat Bar

C33/C33M-13 Concrete Aggregates

C150/C150M-12 Portland Cement

C260/C260M-10a Air-Entraining Admixtures for Concrete

C426-10 Linear Drying Shrinkage of Concrete Masonry
Units

C494/C494M-13 Chemical Admixtures for Concrete

C618-12a Coal Fly Ash and Raw or Calcined Natural
Pozzolan for Use in Concrete

C979/C979M-10 Pigments for Integrally Colored Concrete

C989/C989M-13 Slag Cement for Use in Concrete and Mortars

C1194-03(2011) Compressive Strength of Architectural Cast
Stone

C1195-03(2011) Absorption of Architectural Cast Stone

C1364-10b Architectural Cast Stone

3. Provide written procedures for removal and replacement of cast stone units that have been damaged on any edges or faces that will be visible in the final installation, including drip slots.
4. Provide procedures for inspection and identification of any exposed damage, with procedures for immediate marking of the units to be removed and replaced prior to grouting or sealing of joints.

1.9 MANUFACTURING TOLERANCES

- A. Cross section dimensions must not deviate by more than + 3 mm (1/8 in.) from approved dimension.
- B. Length of units must not deviate by more than length 3 mm (/360 or + 1/8 in.), whichever is greater, not to exceed 6 mm (+ 1/4 in.) Maximum length of any unit must not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp bow or twist of units must not exceed length 3 mm (/360 or + 1/8 in.), whichever is greater.
- D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features - On formed sides of unit, 3 mm (1/8 in.), on unformed sides of unit, 9 mm (3/8 in.) maximum deviation.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CAST STONE

- A. Comply with ASTM C1364.
- B. Physical Properties: Provide the following:
 1. Compressive Strength - ASTM C1194: 45 Mpa (6,500 psi) minimum for products at 28 days.
 2. Absorption - ASTM C1195: 6 percent maximum by the cold water method, or 10 percent maximum by the boiling method for products as 28 days.
 3. Air Content for Wet Cast Product - ASTM C173 or C231: 4-8 percent for units exposed to freeze-thaw environments.

4. Freeze Thaw - ASTM C1364: The cumulative percent weight loss (CPWL) less than 5 percent after 300 cycles of freezing and thawing.
5. Linear Shrinkage - ASTM C426: Maximum 0.065 percent.

2.2 RAW MATERIALS

- A. Portland Cement: Type I or Type III, white and/or grey, ASTM C150.
- B. Coarse Aggregates: Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
- C. Fine Aggregates: Manufactured or natural sands, ASTM C33, except for gradation.
- D. Admixtures: Comply with the following:
 1. ASTM C260 for air-entraining admixtures.
 2. ASTM C494/C495M Types A-G for water reducing, retarding, accelerating and high range admixtures.
 3. Other Admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, must be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
 - a. Produce units with water repellent accepted by fabricator within mix design; product for mix design and setting mortar to be from same source.
 4. ASTM C618; do not use mineral admixtures of dark and variable colors in surfaces intended to be exposed to view.
 5. ASTM C989; granulated blast furnace slag may be used to improve physical properties, as verified by testing documentation.
- E. Water: Potable.
- F. Reinforcing Bars:
 1. ASTM A615/A615M, Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 37 mm (1.5 in.).

2.3 COLOR AND FINISH

- A. Standard Gray per plans and details.
- B. Provide fine-grained texture similar to natural stone, for surfaces intended to be exposed to view. Air voids are not permitted in excess of 0.8 mm (1/32 in.), and the density of such voids must be less than 3 occurrences per any 25 mm² (1 in²). Air voids are not permitted when obvious under direct daylight illumination at a 1.5 m (5 ft.) distance.
- F. The occurrence of crazing or efflorescence may constitute a cause for rejection, at the sole discretion of the RE/COR.
- G. Remove cement film, if required, from exposed surface prior to packaging for shipment.

2.4 REINFORCING

- A. Reinforce the units as required by the shop drawings, and detail drawings.
- B. Provide non-corrosive reinforcement where faces exposed to weather are covered with less than 38 mm (1.5 in.) of concrete material. Provide reinforcement with minimum concrete coverage of twice the diameter of the bars.

2.6 CURING

- A. Cure units in a warm curing chamber 537.8 C (1000 F) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 371.1 C (700 F) for 16 hours after casting. Provide additional yard curing at 95 percent relative humidity and 350-degree-days (i.e. 7 days at 260.0 C (500 F) or 5 days at 371.1 C (700 F) prior to shipping. Protect form-cured units from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Check cast stone materials for damage, coloration, finish, crazing, efflorescence, fit and finish prior to installation. Do not set unacceptable units.

3.6 REPAIR AND CLEANING

- A. Repair chips with touchup materials furnished by manufacturer.
- B. Saturate units to be cleaned prior to applying an approved masonry cleaner.
- C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

- A. Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute except distance for measuring acceptability to be reduced to 1 m (3 ft.).

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SECTION 10 14 00
EXTERIOR SIGNAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the work required to furnish and install the indicated and specified exterior cemetery site signage systems, including, but not limited to, posts, and mow strips.
- B. Signs shall be products of manufacturers regularly engaged in manufacturing signs of types specified.
- C. Signs included are as follows:
 - 1. Job site/Safety signs
 - 2. Faucet Post with Sign
 - 3. Standard Granite Section Marker

1.2 RELATED WORK

- B. Concrete Bases for posts: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE, 04 72 00 CAST STONE MASONRY.

1.3 MANUFACTURER'S QUALIFICATIONS

- A. Sign manufacturer shall regularly and presently manufacture signs similar to those specified as one of their principal products. Sign manufacturer shall submit qualifications demonstrating a minimum of three years of experience manufacturing the qualifying signs and shall, if possible, demonstrate the successful manufacturing of exterior site signs installed at one or more State or National Veteran Cemeteries.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples: Submit 3 sets. One set to the Contractor, one set to the Contracting Officer's Representative (COR) and one set to the A/E Designer. The Contractor shall provide submittal documents that indicate each of the sign types, mounting types and materials to be used for the various combinations to be used for this project. Submittal materials shall indicate the location(s) for the various sign types including their mounting.
- C. Shop Drawings: All signs showing material, finish, colors, size of members, details of construction, letter spacing, size and type, numbers, symbols or image details, and mounting details. Identify materials, show joints, welds, anchorage, accessory items, mounting and finishes. The details of construction shall clearly show how the sign

is to be disassembled to replace the entire sign or just one side panel, where applicable.

- D. Manufacturer's Literature and Data (mark literature to indicate items proposed to be furnished): Signs, each type. Manufacturer's printed specifications, anchorage details, installation and maintenance instructions. Manufacturer's recommendations for mounting the Sign Panels shall be provided.
- E. Manufacturer's Certificates: Provide certification from the coating installer, indicating exactly what they did to prepared the aluminum as and applied the coating(s) to the specified thickness(es). The certification shall indicate that the coating has been installed according to specific and identified contract specifications and/or approved submittal materials so it is absolutely clear what was done.
- F. Sample(s) shall be submitted of sign(s) of sufficient size to show the full scaled features of each of the sign types, including frame, mounting, panels, panel mounting, sign mounting facilities, lettering, color and texture. All aluminum signs shall have full exterior Powder Coated finish, with color and quality as specified herein.

1.5 DELIVERY AND STORAGE

- A. Package to prevent damage or deterioration during shipment, handling, storage and installation. Maintain protective covering in place and in good repair until removal is necessary.
- B. Deliver signs only when the site, mounting materials, and equipment are ready for installation work to proceed.
- C. Store products in dry condition inside enclosed facilities.

1.6 WARRANTY

- A. Sign Manufacturer shall guarantee the text and symbols applied to the powder coated aluminum for a period of one year following final acceptance of the project acceptance of the exterior signage system work. A warranty inspection shall be performed no later than one year following project final acceptance of the exterior signage system work and the Contractor shall be responsible for removing and replacing any text and/or symbols identified, during the inspection, that have started to fade, chip, peel or otherwise fail. The Contractor shall remove and replace any sign panel faces with new, where the applied lettering, or the paint system itself, is causing damage to, or failure of, the paint system. All work to produce replacement sign panels with

new lettering and/or paint system shall be provided at no cost to the Government, as part of the Warranty work for the signage system.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
- B. Americans with Disabilities Act - 1990, as amended and in effect as of 01-01-2009
- C. Federal Highway Administration:
Manuals on Uniform Traffic Control Devices for Street and Highways -
Single Post Traffic Regulatory Signs.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum, Extruded: Fed. Spec. QQA-200-9, alloy 6063-T5, applicable as material.
- B. Aluminum, Sheet and Plate: ASTM B209
- C. Aluminum, Extrusions and Tubing: ASTM B221
- D. Zinc Chromate Primer: Fed. Spec. TT-P-645.

2.2 SIGNAGE GENERAL

- A. Signs shall be of type, size and design shown on the drawings and as specified.
- B. Signs shall be complete with lettering, framing, and related components for a complete sign installation.
- C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- D. Do not scale drawings for dimensions. Verify all dimensions and conditions shown by the drawings. COR is to be notified of any discrepancy in drawing(s), in field directions or conditions, and/or of any changes required for any such related construction details.
- E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. Warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

2.3 SIGN STANDARDS

A. Typography:

1. Type Style: Helvetica Medium. Initial caps or and lower case as indicated on the drawings, unless otherwise indicated.
2. Letter spacing: See graphic standards on drawings for basis of design.
3. All text, arrows, and symbols to be provided in size, colors, typefaces and letter spacing shown. Text shall be a true, clean, accurate reproduction of typeface(s) shown. Text shown in drawings are for layout purposes only. Text to be installed on specific signs shall be as submitted, reviewed and finally approved in shop drawings processed as submittal materials.

B. Sign Colors and Finishes: As specified in this Specification Section and approved in the Shop Drawing & Submittal process.

1. Aluminum sign system color scheme shall have the background color of sign panels as white and the text/symbols depicted in red.

2.4 SIGNS TYPES

A. General: The exterior sign system shall be comprised of sign type families that are derived from the 10 Types developed in Chapter 12 - National Cemetery Signs, of the VA Signage Design Guide (SDG).

B. Location, layout and construction details for the all of the project exterior signs shall be found in the Construction Drawings. Refer to the signage details for the specific sign panel sizes, text and graphic sizes as well as the layout and content for the text and images for the respective individual signs.

2.5 TEXT AND GRAPHICS

A. All text and graphics for the exterior signage shall be provided in detailed submittal information. Each sign face shall be represented in scaled drawings, with exact font, letter style, font, letter spacing, graphics being shown. Only signs and or sign faces approved in the submittal process shall be manufactured.

2.6 FABRICATION

A. Design components to allow for expansion and contraction for a minimum material temperature range of 56 °C (100 °F), without causing buckling, excessive opening of joints or over stressing of adhesives, welds and fasteners.

- B. Form work to required shapes and sizes, with true curve lines and angles. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners whenever and wherever possible.
- C. Shop fabricate so far as practicable. Joints fastened flush to conceal reinforcement, or welded where thickness or section permits.
- D. Contact surfaces of connected members shall be true. Assemble so joints will be tight and practically unnoticeable, without use of filling compound.
- E. Signs shall have fine, even texture and be flat and sound. Lines and miters sharp, arises unbroken, profiles accurate and ornament true to pattern. Plane surfaces shall be smooth flat and without oil-canning, free of rack and twist. Maximum variation from true plane of surface shall be plus or minus 0.4mm (1/64 inch). Restore texture to filed or cut areas.
- F. Level or straighten wrought work. Members shall have sharp lines and angles and smooth surfaces.
- G. Extruded members to be free from extrusion marks. Members shall have square turns and corners sharp, and curves shall be true.
- H. Drill holes for bolts and screws. Conceal fastenings where possible. Exposed ends and edges mill smooth, with corners slightly rounded. Form joints exposed to weather to exclude water.
- I. All painted surfaces properly primed. Finish coating of paint to have complete coverage with no light or thin applications allowing substrate or primer to show. Finished surface smooth, free of scratches, gouges, drips, bubbles, thickness variations, peeling, foreign matter and other imperfections.
- J. Movable parts, including hardware, are be cleaned and adjusted to operate as designed without binding or deformation of members. All contact surfaces fit tight and even without forcing or warping components.
- K. Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.
- L. Completed sign installations shall not have any exposed openings so insect nesting inside of signs will be prevented.

- M. No signs are to be manufactured until final sign message schedule and location review has been completed by the COR & forwarded to contractor.
- N. Final sign fabrication shall not proceed until samples and shop drawings detailing the sign system as it will be installed, have been submitted and approved during the submittal process.

2.7 PROTECTION OF ALUMINUM

- A. Isolate aluminum in contact with or fastened to dissimilar metals other than stainless steel, white bronze or other metals compatible with aluminum by one of the following:
 - 1. Painting the dissimilar metal with a prime coat of zinc-chromate or other suitable primer, followed by two coats of aluminum paint.
 - 2. Placing an approved caulking compound, or a non-absorptive tape, or gasket between the aluminum and the dissimilar metal.
- B. Paint aluminum in contact with or built into mortar, concrete, or other masonry materials with bituminous paint or zinc chromate primer.

2.8 GRANITE SECTION MARKERS

- A. Details for the Granite Section Markers are to be as indicated on the drawings and associated notes.
- B. Granite Section Markers shall match existing.
- C. Granite Section Markers shall have honed smooth inscription face and all other surfaces shall be smooth saw cut finish. All corners and edges including 50mm (2") below ground shall be rounded to 10mm (3/8") radius. Dimensions and graphics details are as follows:
 - 1. Dimensions:
 - a. Height above finished grade - 600mm (2').
 - b. Width and Depth of the Marker - 150mm (8").
 - c. Beveled sign face - 150mm (6") wide x 200mm (8") high on the angled surface.
 - d. Top edge of beveled sign face from back edge of marker - 50mm (2").
 - e. Bottom edge of beveled sign face from top of marker - 175mm (7").
 - f. Bottom of marker below finished grade - 600mm (2') with concrete setting bed around the granite extending to max frost depth area or 6" below granite minimum, whichever is greater total depth.
 - 2. Graphics:
 - a. "SEC" shall be engraved letters; 38mm (1 1/2") ht., 5mm (3/16") depth, 5mm (3/16") stems & bars, located with bottom edge 57mm (2

1/4") from top of the beveled face; text for section ID numbers shall be as shown on the drawings, approved by the COR & be engraved 50mm (2") ht., 5mm (3/16") depth, 10mm (3/8") stems & bars, and bottom edge 165mm (6 1/2") from top of the beveled face.

- D. Granite Section Markers shall be of materials that match those existing on the site, or are as approved by Memorial Program Services (MPS) for use as niche covers.

2.9 FAUCET POST WITH SIGN

- A. Faucet posts with signs are non-illuminated pylon style with attached message and graphic decals. The decals are mounted directly on the post on a separate metal panel attached to the concrete post.
- B. The posts contain and/or are used to mount the water pipe and the spigot at the Flower Watering Stations.
- C. The posts shall be concrete, with location, materials, color, messages and configuration as indicated on the Drawings and Specifications. Position sign to provide pedestrians with a clear unobstructed view of the sign, or position according to the drawings, if so indicated.

1. Details for the Faucet Posts with Signs are as indicated on the drawings and associated notes.

b. Concrete Faucet Posts

- 1) 190mm x 190mm x 710mm (7 1/2" x 7 1/2" x 2'-4") above finished grade, and depth as indicated on the drawings (minimum depth of concrete holding the sign shall be 600mm (2') 900mm (3')). Drawing details shall take precedence.
- 2) The style for the markers shall have rectangular ends cast into the four sides of the marker. The text panels shall be indented with beveled transition to the text panel mounting surface. The mounting surface for the aluminum text panel for each indent, shall be equal to the dimensions for the aluminum text panels +3mm, -0mm (+1/8", -0") as the gap between the aluminum panel and the flat mounting surface for the panel cast into the concrete.
- 3) The text panel shall be 3mm (1/8") thick powder coated aluminum with two mounting holes, one at the top and bottom of the aluminum panel, drilled and ground smooth before the powder coating. The color and finish shall be as approved in

the submittal process and shall match the other aluminum signs.

- 4) The dimensions for the aluminum text panels shall be 95mm (3 3/4") wide with the symbol being 75mm (3") in height and 30 mm (1 1/4") from top of text panel to the top of the symbol. The text height shall be 19mm (3/4"). The height of the aluminum panel shall be coordinated to fit within the casting for the panel in the concrete markers, with a 3mm (1/8") gap all around between the aluminum and the concrete, as submitted and approved and meeting the standards established in the approved sample for the concrete pylon section markers with the aluminum text panel, as complete. The approximate height for the aluminum text panels is 400mm (1'-3 3/4"). Dimensions shown on detailed construction drawings shall take precedence over the specifications.
 - 5) The aluminum text panels shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors.
 - 6) Cast Stone Faucet Posts shall be manufactured in accordance with Section 04 72 00 Cast Stone Masonry using reinforced wet cast concrete with finish made to emulate stone by the use of acid etching process following casting. Finish, color and texture, as well as dimensional conformance shall be demonstrated by submitting samples of the marker, minimum of 300mm (12") in length, during the submittal process. Submit shop drawings indicating all dimensions and tolerances, as well as reinforcing. The shop drawings and sample shall include the details space for the pipes, appurtenances, and spigot as well as room for assembly and attachment to produce the fully functional FWS spigot assembly as specified. An acceptable sample must be obtained prior to manufacturing the units.
- D. "Do Not Drink" decal shall be as indicated on the drawing details, and as approved during the submittal process.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set work accurately, in alignment and where shown. Signs shall be plumb, level, free of rack and twist and set parallel or perpendicular as required to line and plane the surface.
- B. Protect aluminum in contact with dissimilar metals or mortar as specified in Paragraph "PROTECTION OF ALUMINUM".
- C. Furnish setting drawings and instructions for installation of anchors and for the positioning of items having anchors or sleeves to be built into construction. Provide temporary bracing for such items until permanent anchors are set.
- D. Provide anchoring devices and fasteners as shown and as necessary for securing signs to construction as specified.
- E. Verify that behind or beneath each sign location there are no utility lines, or other buried infrastructure elements, that will be affected by installation of signs. Any damage during installation of signs to utilities, or other buried infrastructure will be the sole responsibility of the Contractor to correct and repair.
- F. Furnish inserts and anchoring devices which must be set in concrete or other material for installation of signs. Provide setting drawings, templates, instructions and directions for installation of anchorage devices which may involve other trades.
- G. Sign message panels shall be mounted using tamper-proof mechanical fasteners that are coated and colored to match the message panels.
- H. Mounting details and materials shall be provided as samples during the submittal process, and complete demonstration of all of the installation features, materials and methods shall be provided during the submittal process.

3.2 CLEANING

- A. After installation, all items shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project.

3.3 PROTECTION

- A. Protect finished surfaces from damage during fabrication, erection and after completion of the work.

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SECTION 31 20 11
EARTHWORK (SHORT FORM)

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies the requirements for furnishing all equipment, materials, labor and techniques for earthwork including excavation, fill, backfill and site restoration utilizing fertilizer, seed and/or sod.

1.2 DEFINITIONS:

A. Unsuitable Materials:

1. Fills: Topsoil, frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic materials, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable.
2. Existing Subgrade (except footings): Same materials as above paragraph, that are not capable of direct support of slabs, pavement, and similar items, with the possible exception of improvement by compaction, proofrolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to COR's approval.

B. Earthwork: Earthwork operations required within the new construction area. It also includes earthwork required for auxiliary structures and buildings and sewer and other trenchwork throughout the job site.

C. Degree of Compaction: Degree of compaction is expressed as a percentage of maximum density obtained by the test procedure presented in ASTM D698.

D. The term fill means fill or backfill as appropriate.

E. Amended Soil Fill Material: Amended soil in place with sand or other inorganic material that provides a percolation rate of 1" per hour. Contractor shall provide material test reports noting that this criteria has been met.

1.3 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

- C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 02, GENERAL REQUIREMENTS.
- D. Subsurface Investigation: Section 01 00 02, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.
- E. Section 32 90 00 PLANTING FOR SODDING, SEEDING AND FINISH GRADING/PREPARATION.
- F. Section 03 48 21 PRECAST CONCRETE BURIAL CRYPTS.
- G. Section 33 46 13 FOUNDATION DRAINAGE.

1.4 CLASSIFICATION OF EXCAVATION:

- A. Unclassified Excavation: Removal and disposal of pavements and other man-made obstructions visible on the surface; utilities, and other items including underground structures indicated to be demolished and removed; together with any type of materials regardless of character of material and obstructions encountered.
- B. It shall be the Contractor's responsibility to determine the subsurface character. Bidders are expected to examine the site and then decide for themselves the character of materials to be encountered. Claims for extra compensation arising from latent subsurface conditions within the area defined will not be considered.

1.5 MEASUREMENT AND PAYMENT FOR EXCAVATION:

- A. Measurement: The unit of measurement for excavation and borrow will be the cubic yard, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. Quantities should be computed by a Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 02, GENERAL REQUIREMENTS. The measurement will include authorized excavation for rock, authorized excavation of satisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to taking of elevations and measurements of the undisturbed grade.

1.6 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Contractor shall submit procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.
- C. Furnish to COR, soil samples, suitable for laboratory tests, of proposed off site or on site fill material.
- D. Qualifications of the commercial testing laboratory or Contractor's Testing facility shall be submitted.
- E. Material certification certificate noting soil percolation rates.

1.7 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Nursery and Landscape Association (ANLA):
2004.....American Standard for Nursery Stock
- C. American Association of State Highway and Transportation Officials (AASHTO):
T99-10.....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
T180-10.....Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg [10 lb] Rammer and a 457 mm (18 inch) Drop
- D. American Society for Testing and Materials (ASTM):
C33-03.....Concrete Aggregate
D698-e1.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1140-00.....Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
D1556-00.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-09.....Laboratory Compaction Characteristics of Soil Using Modified Effort
D2167-94 (2001).....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2487-06.....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)

D6938-10.....Standard Test Methods for Density of Soil and
 Soil-Aggregate in Place by Nuclear Methods
 (Shallow Depth)

E. Standard Specifications of Alabama Department of Transportation (ALDOT),
 latest revision.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Structural Fill Material:

TABLE 1		
Fill Type (1)	USCS Classification	Acceptable Location for Placement
Lean clay	CL (LL<50 and PI<25)	All locations and elevations
Silt	ML (LL<50 and PI<25)	All locations and elevations
Sand	SW, SC, SM	All locations and elevations
Fat clay (2)	CH (LL>50 or PI>25)	Not acceptable for use as engineered fill within the upper 12 inches of areas that may receive paved service paths.
Elastic Silt (2)	MH (LL>50 or PI>25)	Not acceptable for use as engineered fill within the upper 12 inches of areas that may receive paved service paths.
On-Site Soils	Varies	The existing on-site soils may be re-used as fill within all proposed burial plot areas provided they are properly moisture conditioned. We note that silts commonly indicate the possibility of difficulty during earthwork operations when the soils are above their optimum moisture content. All fill material placed within burial plots should have a maximum particle size of 4 inches.
<p>1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.</p> <p>2. Delineation of fat clays and/or elastic silts should be performed in the field by a qualified geotechnical engineer or their representative.</p>		

- C. Fertilizer: (5-10-5) delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- D. Seed: Grass mixture comparable to existing turf delivered to site in unopened containers that clearly display the manufacturer's label, indicating the analysis of the contents.
- E. Sod: Comparable species with existing turf. Use State Certified or State Approved sod when available. Deliver sod to site immediately after cutting and in a moist condition. See 32 90 00 PLANTING. Thickness of cut must be 19 mm to 32 mm (3/4 inch to 1 1/4 inches) excluding top growth. There shall be no broken pads and torn or uneven ends
- F. Requirements For Offsite Soils: Offsite material brought in for use as backfill shall be meet the requirements of Table 1 above. Offsite material shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100parts per million (ppm) of total hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toleune, Ethyl Benzene, and Xylene (BTEX)and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the COR.
- G. Buried Warning and Identification Tape: Polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specific below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, Unaffected by moisture or soil. Warning tape color codes:
- | | |
|---------|------------------------------------|
| Red: | Electric |
| Yellow: | Gas, Oil, Dangerous Materials |
| Orange: | Telephone and Other Communications |
| Blue: | Water Systems |
| Green: | Sewer Systems |
| White: | Steam Systems |

Gray: Compressed Air

- H. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastictape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.102 mm (0.004 inch). Tape shall have a minimum strength of 10.3 MPa (1500 psi) lengthwise and 8.6 MPa (1250 psi) crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 0.9 m(3 feet) deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.
- I. Detection Wire For Non-Metallic Piping: Detection wire shall be Insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

- A. Clearing: Clearing within the limits of earthwork operations as described or designated by the COR. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Cemetery Property.
- B. Grubbing: Remove stumps and roots 75 mm (3 inches) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inches) diameter, and nonperishable solid objects which will be a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left. Cemetery Projects: do not leave material within the burial profile up to 2400 mm (8 feet) below finished grade.
- C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from the areas within 4500 mm (15 feet) of new construction and 2250 mm (7'-6") of utility lines if such removal is approved in advance by the COR. Remove materials from the Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with the latest issue of the, "American Standard for Nursery Stock", of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semi-annually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until the

conclusion of the contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in the construction area. Repair immediately damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including the roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Building materials shall not be stored closer to trees and shrubs that are to remain, than the farthest extension of their limbs.

- D. Stripping Topsoil: Unless otherwise indicated on the drawings, the limits of earthwork operations shall extend anywhere the existing grade is filled or cut or where construction operations have compacted or otherwise disturbed the existing grade or turf. Strip topsoil as defined herein, or as indicated in the geotechnical report, from within the limits of earthwork operations as specified above unless specifically indicated or specified elsewhere in the specifications or shown on the drawings. Topsoil shall be fertile, friable, natural topsoil of loamy character and characteristic of the locality. Topsoil shall be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by the COR. Eliminate foreign material, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials, larger than 0.014 m³ (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on the station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work, shall not, under any circumstances, be carried out when the soil is wet so that the tilth of the soil will be destroyed.
1. Cemetery Projects: Require that the top soil be tested for chemicals, pesticides and fertilizers if topsoil is to be removed from lands formerly utilized as farmland, to verify suitability for use as topsoil in the cemetery where new lawn areas are to be established. See section 01 45 29 TESTING LABORATORY SERVICE
 2. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from the Cemetery Property.

E. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations.

3.2 EXCAVATION:

A. Shoring, Sheeting and Bracing: Shore, brace, or slope to its angle of repose banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities, in compliance with OSHA requirements.

1. Extend shoring and bracing to the bottom of the excavation. Shore excavations that are carried below the elevations of adjacent existing foundations.
2. If the bearing of any foundation is disturbed by excavating, improper shoring or removal of shoring, placing of backfill, and similar operations, provide a concrete fill support under disturbed foundations, as directed by COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COR.

B. Excavation Drainage: Operate pumping equipment as required, to keep excavations free of water and subgrades dry, firm, and undisturbed until approval of permanent work has been received from COR. Approval by the COR is also required before placement of the permanent work on all subgrades. When subgrade for foundations has been disturbed by water, remove the disturbed material to firm undisturbed material after the water is brought under control. Replace disturbed subgrade in trenches by mechanically tamped sand or gravel. When removed disturbed material is located where it is not possible to install and properly compact disturbed subgrade material with mechanically compacted sand or gravel, the COR should be contacted to consider the use of flowable fill.

C. Blasting: **Blasting shall not be permitted.**

D. Building Earthwork:

1. Excavation shall be accomplished as required by drawings and specifications.
2. Excavate foundation excavations to solid undisturbed subgrade.
3. Remove loose or soft material to solid bottom.
4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete, poured separately from the footings.
3. Do not tamp earth for backfilling in footing bottoms, except as specified.

E. Trench Earthwork:

1. Utility trenches (except sanitary and storm sewer):

- a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
- b. Grade bottom of trenches with bell-holes, scooped-out to provide a uniform bearing.
- c. Support piping on suitable undisturbed earth unless a mechanical support is shown. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.
- d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the COR.
- e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
- f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.
- g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:
 - 1) Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional

significance such as coral, slag, cinders, crushed stone, and crushed shells.

- 2) Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

2. Storm sewer trenches:

- a. Trench width below a point 150 mm (6 inches) above top of the pipe shall be 600 mm (24 inches) for up to and including 300 mm (12 inches) diameter and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.
- b. The bottom quadrant of the pipe shall be bedded on suitable undisturbed soil or granular fill. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm (6 inches) loose thickness.
 - 1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
 - 2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one-sixth of pipe diameter below the pipe of 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.
- c. Place and compact as specified the remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.
- d. Use granular fill for bedding where rock or rocky materials are excavated.
- e. Provide buried utility lines with utility identification tape. Bury tape 300 mm (12 inches) below finished grade; under pavements and slabs, bury tape 150 mm (6 inches) below top of subgrade
- f. Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm (12 inches) above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 0.9 m (3 feet) of wire, coiled, remaining accessible in each manhole. The wire shall

remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

- g. Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:

- 1) Class I: Angular, 6 to 40 mm (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.
- 2) Class II: Coarse sands and gravels with maximum particle size of 40 mm (1.5 inches), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.
- 3) See Section 32 84 00 PLANTING IRRIGATION for requirements.

F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials that are determined by the COR as unsuitable, and replace with acceptable material. If there is a question as to whether material is unsuitable or not, the Contractor shall obtain samples of the material, under the direction of the COR, and the materials shall be examined by an independent testing laboratory for soil classification to determine whether it is unsuitable or not. When unsuitable material is encountered and removed, the contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on meters (yardage) in cut section only.

G. Finished elevation of subgrade shall be as follows:

1. Pavement Areas - bottom of the pavement or base course as applicable.
2. Planting and Lawn Areas - 100 mm (4 inches) below the finished grade, unless otherwise specified or indicated on the drawings.

3.3 FILLING AND BACKFILLING:

- A. General: Do not fill or backfill until all debris, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from the excavation. Proof-roll exposed subgrades with a fully loaded dump truck. Use excavated materials or borrow for fill and backfill, as applicable. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, and pipes coming in contact with backfill have been installed, and inspected and approved by COR.
- B. Placing: Place material in horizontal layers not exceeding 200 mm (8 inches) in loose depth and then compacted. Do not place material on surfaces that are muddy, frozen, or contain frost.
- C. Compaction: Use approved equipment (hand or mechanical) well suited to the type of material being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without the prior approval of the COR. Moisten or aerate material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

TABLE 2	
ITEM	DESCRIPTION
Compaction Requirements (1)	<input type="checkbox"/> Burial Plots - Below the crypt bearing elevation: 98% of the materials maximum standard Proctor dry density (ASTM D 698). <input type="checkbox"/> Burial Plots - Above the crypt bearing elevation: 95% of the materials maximum standard Proctor dry density (ASTM D 698). <input type="checkbox"/> Areas that may receive paved service paths: 98% of the materials maximum standard Proctor dry density (ASTM D 698).
Moisture Content Cohesive Soil	Within 2 percentage points of the optimum moisture content value as determined by the standard Proctor test at the time of placement and compaction.
Moisture Content Granular Material (2)	Within 3 percentage points of the optimum moisture content value as determined by the standard Proctor test at the time of placement and compaction.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or

compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

- D. Borrow Material: Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas shown on drawings or from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.
- E. Opening and Drainage of Excavation and Borrow Pits: The Contractor shall notify the COR sufficiently in advance of the opening of any excavation or borrow pit to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.4 GRADING:

- A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.
- B. Cut rough or sloping rock to level beds for foundations. In unfinished areas fill low spots and level off with coarse sand or fine gravel.

- C. Slope backfill outside the building away from the building walls for a minimum distance of 3048 mm (10 feet) at a minimum five percent (5%) slope.
- D. The finished grade shall be 150 mm (6 inches) below bottom line of windows or other building wall openings unless greater depth is shown.
- E. Place crushed stone or gravel fill under concrete slabs on grade tamped and leveled. The thickness of the fill shall be 150 mm (6 inches), unless otherwise indicated.
- F. Finish subgrade in a condition acceptable to the COR at least one day in advance of the paving operations. Maintain finished subgrade in a smooth and compacted condition until the succeeding operation has been accomplished. Scarify, compact, and grade the subgrade prior to further construction when approved compacted subgrade is disturbed by contractor's subsequent operations or adverse weather.
- G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 LAWN AREAS:

- A. General: Harrow and till to a depth of 100 mm (4 inches), new or existing lawn areas to remain, which are disturbed during construction. Establish existing or design grades by dragging or similar operations. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed. Plant bed must be approved by COR before seeding or sodding operation begins.

3.6 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

- A. Disposal: Transport surplus satisfactory soil to designated storage areas on Cemetery property. Stockpile or spread soil as directed by COR.
 - 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.
- B. Place excess excavated materials suitable for fill and/or backfill on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.
- D. Segregate all excavated contaminated soil designated by the COR from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.7 CLEAN-UP:

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of

debris, and suitable for subsequent construction operations. Remove
debris, rubbish, and excess material from the Cemetery Property.

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Geotechnical Engineering Report

Proposed Additions
Alabama National Cemetery
Montevallo, Alabama

November 19, 2015
Terracon Project No.: E1155165

Prepared for:

FourFront Design, Inc.
Rapid City, South Dakota

Prepared by:

Terracon Consultants, Inc.
Birmingham, Alabama



terracon.com

Terracon

Environmental



Facilities



Geotechnical



Materials

November 19, 2015



FourFront Design, Inc.
517 7th Street
Rapid City, South Dakota 57701

Attn: Mr. Chris Brandriet, PLA, LEED BD+C
E: CBrandriet@4FRONT.biz

Re: Geotechnical Engineering Report
Proposed Additions
Alabama National Cemetery
Montevallo, Alabama
Terracon Project No. E1155165

Dear Mr. Brandriet:

Terracon has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal PE1150531, dated July 29, 2015. This report presents the findings of the subsurface exploration and provides site preparation recommendations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Charlie L. Bragg
Field Project Manager

Jerome A. Smith, P.E.
Geotechnical Department Manager
Alabama P.E. No. 20478



Terracon Consultants, Inc. 110 12TH Street North Birmingham, Alabama 35203
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Environmental



Facilities



Geotechnical



Materials

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EXECUTIVE SUMMARY

This geotechnical exploration has been performed for the Alabama National Cemetery located in Montevallo, Alabama. A total of seventeen Standard Penetration Test (SPT) borings and one offset boring were drilled across the site. The borings were extended to a depth of about 15 feet (or auger refusal) below the existing surface grade. Exhibit A-2 shows the approximate location of each boring. Boring Logs are included in Appendix A. The following geotechnical considerations were identified:

- Eleven of the test borings (B-1, B-3, B-4, B-5, B-6, B-10, B-12, B-13, B-15, B-16 and B-17) penetrated near surface soils (within about 3.5 to 6 feet of the existing surface grade) classified as elastic silt (MH) or fat clay (CH). Elastic silts commonly indicate the possibility of difficulty during earthwork operations as well as exhibiting considerable loss in strength when the soils are above their optimum moisture content. Fat clays have a high shrink/swell potential.
- We understand that the project may include the future installation of paved service paths. Elastic silts and fat clays such as those penetrated by the test borings are generally not considered to be suitable for the direct support of pavements. We recommend that elastic silts and fat clays not be used as engineered fill within the upper 12 inches of areas that may receive paved service paths. Also, pavements within cut or at grade areas where elastic silts or fat clays are exposed at finish subgrade elevations should be supported by a minimum of 12 inches of a select engineered fill.
- Boring B-14 and offset boring B-14A encountered rock at depths that may influence grading operations and the installation storm sewer pipes and utilities. If the surface grade is not raised with engineered fill, rock removal would be required for the installation of caskets or crypts in the vicinity of borings B-14 and B-14A. Difficult excavation is discussed in further detail in section **4.3 Difficult Rock Excavation**.
- Onsite soils may be reused as fill provided they are free of topsoil or other deleterious material, are properly moisture conditioned and otherwise meets the requirements for structural fill outlined in section **4.2.2 Structural Fill Material Requirements**.
- Other than the surficial topsoil layer which ranged in thickness from about 1 to 4 inches, no organic debris or obvious deleterious materials were observed. However, we caution that burn pits, burial pits, organic debris, construction debris or other deleterious materials could exist, between or away from our borings. Debris fill may not become evident until construction.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

**PROPOSED ADDITIONS
ALABAMA NATIONAL CEMETERY
MONTEVALLO, ALABAMA
Terracon Project No. E1155165
November 19, 2015**

1.0 INTRODUCTION

This geotechnical exploration has been performed for the Alabama National Cemetery located in Montevallo, Alabama. A total of seventeen Standard Penetration Test (SPT) borings and one offset boring were drilled across the site. Exhibit A-2 shows the approximate location of each boring. Boring Logs are included in Appendix A.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork recommendations

2.0 PROJECT INFORMATION

ITEM	DESCRIPTION
Planned Development	We understand that the planned development will include the construction of 5,000 pre-placed Crypts and 1,000 in-ground Cremains located in five areas of the National Cemetery.
Location	The existing Alabama National Cemetery, located at 3133 Highway 119, in Montevallo, Alabama. Refer to Exhibit A-1 in Appendix A. We understand that five specific areas have been selected for this phase of the development. The site master plan indicates each area's proposed use. Three of these areas are designated for Phase 2, Casket Burial, one area for Phase 2 In-Ground Cremains and one area for Phase 1B Casket Burial. Refer to Exhibit A-2 in Appendix A
Existing improvements	Five specific areas have been identified for development within the existing National Cemetery. Four of these are open and grassed with some previous grading. One area is partially wooded.

ITEM	DESCRIPTION
Existing topography	Provided topographic information indicates the sites to be developed are generally level to gently sloping with existing surface grades ranging from about El. 442' to El. 452'. Specific future grading information was not available at the time of this report.

Should any of the above information or assumptions be inconsistent with the planned construction, please let us know so that we may make any necessary modifications to this report.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

According to the *Geology of the Alabaster 7.5 minute Quadrangle, Shelby County, Alabama*, dated 1998, the site is located in the Alabama Valley and Ridge Physiographic Province and is in the Cahaba Valley district.

The majority of the site is underlain by the Cambrian-Aged Conasauga Formation. The Conasauga consists of medium to dark-gray, thick to massive bedded limestone and dolomite containing interbedded olive-gray shale. Bedrock of the Conasauga can be observed on the surface in several places within the open pastureland along State Hwy 119.

The west side of the site is underlain by the lower Cambrian-Aged Rome Formation. The Rome consists of grayish-red-purple and grayish-olive mudstone, shale, and siltstone containing interbedded sandstone, dolomite, and limestone.

As with any site underlain by carbonate rock formations, there is always a risk of sinkhole development. Carbonate rocks of the Conasauga Formation are susceptible to dissolution as groundwater filters through cracks and fissures in the rock. As dissolution progresses, cavities are formed within the rock mass. Sinkholes are formed as overburden soils filter into the solution cavities. Changes in surface and groundwater drainage patterns, such as those created by mass grading, may accelerate sinkhole development.

While our field observations and geotechnical investigation revealed no visual evidence of sinkholes, it should be noted that this study does not preclude the possibility of future sinkhole development at the site.

3.2 Typical Profile

A total of seventeen borings and one offset boring were drilled across the site. The borings were extended to a depth of about 15 feet (or auger refusal) below the existing surface grade.

Geotechnical Engineering Report

Alabama National Cemetery ■ Montevallo, Alabama
November 19, 2015 ■ Terracon Project No. E1155165



The approximate locations of the test borings are indicated on the attached Exhibit A-2 in Appendix A. Based on the results of the test borings, subsurface conditions on the project site can be generalized as follows:

Test borings B-1 through B-8 were performed in the three areas designated for Phase 2 Casket Burial. The majority of these borings initially penetrated about 1 to 2 inches of topsoil. Below, the topsoil layer, these borings penetrated native soils consisting of lean sandy clay (CL), silty clay (CL) or (CL/ML), elastic silt (MH), clayey silt (ML/MH) and silty fat clay (CH). Borings B-1, B-2 and B-8 penetrated intervals of severely to completely weathered (reduced to strong soils) shale. The consistency of these soils ranged from medium stiff to hard, with recorded N-values ranging from 6 to 50+ blows-per-foot. Test borings B-1 through B-8 were terminated at a depth of 15 feet below the existing surface grade.

Test borings B-9 through B-11 were performed in the area designated for Phase 2 In-Ground Cremains. This area has been previously graded. Underlying approximately 4 inches of topsoil, these borings penetrated approximately 3.5 feet of existing fill material consisting of sandy clay. Recorded N-values within the fill ranged from 8 to 22 blows-per-foot. Underlying the existing fill, these borings penetrated native soils consisting of silty clay (CL), fat clay (CH) and elastic silt (MH). The consistency of these soils ranged from stiff to hard, with recorded N-values ranging from 8 to 40 blows-per-foot. Test borings B-9 through B-11 were terminated at a depth of 15 feet below the existing surface grade.

Test borings B-12 through B-17 were performed in the area designated for Phase 1B Casket Burial. These borings initially penetrated about 2 to 4 inches of topsoil. Below the topsoil layer, borings B-12 through B-16 penetrated native soils consisting of lean sandy clay (CL), silty clay (CL) and elastic silt (MH). The consistency of these native soils ranged from medium stiff to hard, with recorded N-values ranging from 6 to 41 blows-per-foot. Below the topsoil layer, boring B-17 penetrated approximately 3.5 feet of existing fill material consisting of sandy clay. Recorded N-values within the fill were 49 blows-per-foot. Below the existing fill, boring B-17 penetrated native soils consisting of elastic silt (MH). The consistency of these soils ranged from stiff to very stiff, with recorded N-values ranging from 12 to 17 blows-per-foot. Borings B-12 through B-17 encountered auger refusal at depths ranging from 3.5 to 13.5 feet below the existing surface grade. Due to the very shallow refusal depth of 3.5 feet at boring B-14, a boring was offset approximately 20 feet northwest (boring B-14A) and the auger was advanced to refusal at a depth of about 3 feet.

The near-surface soils were of medium to high plasticity, and had the following measured liquid limits, plastic limits, and plasticity indices:

Sample Location, Depth	Liquid Limit	Plastic Limit	Plasticity Index
Boring B-1, 3.5 – 5.0 ft.	73	42	31

Geotechnical Engineering Report

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Natural moistures ranged from about 13 to 37 percent for selected samples. The results of the laboratory tests are shown on the individual boring logs, adjacent to the soil profiles, at their corresponding sample depths in Appendix A.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A.

3.3 Groundwater

The boreholes were observed during drilling and after completion for the presence and level of groundwater. In addition, extended groundwater levels were recorded after approximately 24 hours. The water levels observed are noted on the attached boring logs, and are summarized below.

Boring Number	Depth to Groundwater During Drilling (ft)	Depth to Groundwater Approximately 24 Hours After Drilling (ft)
B-1	Not Encountered	Not Encountered
B-2	Not Encountered	Not Encountered
B-3	Not Encountered	Not Encountered
B-4	Not Encountered	Not Encountered
B-5	Not Encountered	Not Encountered
B-6	Not Encountered	Not Encountered
B-7	Not Encountered	Not Encountered
B-8	Not Encountered	Not Encountered
B-9	Not Encountered	Not Encountered
B-10	Not Encountered	Not Encountered
B-11	Not Encountered	Not Encountered
B-12	Not Encountered	Not Encountered
B-13	Not Encountered	Not Encountered
B-14	Not Encountered	Not Encountered
B-14A	Not Encountered	Not Encountered
B-15	Not Encountered	12.2
B-16	Not Encountered	Not Encountered
B-17	Not Encountered	6.5

Due to the relatively short time frame of the field exploration, the groundwater may not have had sufficient time to stabilize. We note that fluctuations in the level of the groundwater may occur

due to variations in rainfall, temperature, and other factors not evident at the time the measurement was made and reported herein. Perched water should be anticipated within the soil matrix, particularly within the fill. Groundwater levels during construction or at other times in the life of the structure may be higher or lower than the level indicated on the boring log. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

We note that at the time of our field exploration, the Montevallo, Alabama area was under drought conditions with measured precipitation falling below seasonal norms. Specifically, at the time of our field exploration during the month of October, 2015, the National Drought Mitigation Center's U.S. Drought Monitor assigned a D0, Abnormally Dry status for approximately 63% of the state of Alabama, including the Montevallo and Shelby County region. Therefore, surface and groundwater conditions observed at the time of our field exploration are likely not a good representation of the site conditions during periods of normal precipitation.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Eleven of the test borings (B-1, B-3, B-4, B-5, B-6, B-10, B-12, B-13, B-15, B-16 and B-17) penetrated near surface soils (within about 3.5 to 6 feet of the existing surface grade) classified as elastic silt (MH) or fat clay (CH). Elastic silts commonly indicate the possibility of difficulty during earthwork operations as well as exhibiting considerable loss in strength when the soils are above their optimum moisture content. Fat clays have a high shrink/swell potential.

We understand that the project may include the future installation of paved service paths. Elastic silts and fat clays such as those penetrated by the test borings are generally not considered to be suitable for the direct support of pavements. We recommend that elastic silts and fat clays not be used as engineered fill within the upper 12 inches of areas that may receive paved service paths. Also, pavements within cut or at grade areas where elastic silts or fat clays are exposed at finish subgrade elevations should be supported by a minimum of 12 inches of a select engineered fill.

Boring B-14 and offset boring B-14A encountered rock at depths that may influence grading operations and the installation storm sewer pipes and utilities. If the surface grade is not raised with engineered fill, rock removal would be required for the installation of caskets or crypts in the vicinity of borings B-14 and B-14A. We note that the bedrock surface of the Conasauga Formation is highly irregular. Therefore, shallow bedrock could occur at other locations away from or between the test borings. Difficult excavation is discussed in further detail in section **4.3 Difficult Rock Excavation.**

Other than the surficial topsoil layer which ranged in thickness from about 1 to 4 inches, no organic debris or obvious deleterious materials were observed. However, we caution that burn pits, burial pits, organic debris, construction debris or other deleterious materials could exist, between or away from our borings. Debris fill may not become evident until construction.

We recommend that the exposed subgrade be thoroughly evaluated after stripping of any topsoil, pavements, etc. and creation of all cut areas, but prior to the start of fill operations (if any). We recommend that the geotechnical engineer be retained to evaluate the exposed subgrade prior to fill placement. Subsurface conditions, as identified by the field and laboratory testing programs, have been reviewed and evaluated with respect to the proposed construction plans known to us at this time.

4.2 Earthwork

4.2.1 Site Preparation

Prior to placing any fill, all vegetation, topsoil and any soft or otherwise unsuitable material should be removed from the construction areas. Based on the results of our test borings, approximately 1 to 4 inches of topsoil removal should be anticipated. Wet or dry material should either be removed or moisture conditioned and recompacted.

After stripping and grubbing, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a loaded tandem axle dump truck. If soft soils or otherwise unsuitable soils are observed during this process, subgrade improvement will then be necessary to establish a suitable subgrade support condition; especially during wet or cool periods of the year.

Methods of subgrade improvement could include scarification, moisture conditioning, and re-compaction, removal of unstable materials (undercutting) and replacement with engineered fill. Poor subgrade conditions within new pavement areas may be improved with geosynthetics. The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. Terracon can provide more detailed recommendations during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

4.2.2 Structural Fill Material Requirements

Structural fill should meet the following material property requirements:

Fill Type ¹	USCS Classification	Acceptable Location for Placement
Lean clay	CL (LL<50 and PI<25)	All locations and elevations
Silt	ML (LL<50 and PI<25)	All locations and elevations
Sand	SW, SC, SM	All locations and elevations
Fat clay ²	CH (LL>50 or PI>25)	Not acceptable for use as engineered fill within the upper 12 inches of areas that may receive paved service paths.
Elastic Silt ²	MH (LL>50 or PI>25)	Not acceptable for use as engineered fill within the upper 12 inches of areas that may receive paved service paths.
On-Site Soils	Varies	The existing on-site soils may be re-used as fill within all proposed burial plot areas provided they are properly moisture conditioned. We note that silts commonly indicate the possibility of difficulty during earthwork operations when the soils are above their optimum moisture content. All fill material placed within burial plots should have a maximum particle size of 4 inches.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Delineation of fat clays and/or elastic silts should be performed in the field by a qualified geotechnical engineer or their representative.

4.2.3 Structural Fill Placement and Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness	<p>8-inches or less in loose thickness when heavy, self-propelled compaction equipment is used</p> <p>4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.</p> <p>All fill material placed within burial plots should have a maximum particle size of 4 inches.</p>

ITEM	DESCRIPTION
<p>Compaction Requirements ¹</p>	<ul style="list-style-type: none"> ■ Burial Plots – Below the crypt bearing elevation: 98% of the materials maximum standard Proctor dry density (ASTM D 698). ■ Burial Plots – Above the crypt bearing elevation: 95% of the materials maximum standard Proctor dry density (ASTM D 698). ■ Areas that may receive paved service paths: 98% of the materials maximum standard Proctor dry density (ASTM D 698).
<p>Moisture Content Cohesive Soil</p>	<p>Within 2 percentage points of the optimum moisture content value as determined by the standard Proctor test at the time of placement and compaction.</p>
<p>Moisture Content Granular Material ²</p>	<p>Within 3 percentage points of the optimum moisture content value as determined by the standard Proctor test at the time of placement and compaction.</p>

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

4.2.4 Grading and Drainage

Excessive moisture can significantly reduce a soil's support capability and contribute to soft subgrades and settlement. During earthwork operations, exposed subgrades should be properly sloped to provide rapid drainage so that saturation of the subgrades can be minimized.

4.2.5 Slope Design

Provided that no water is observed to be freely seeping from the sides of excavations, the on-site near surface soils can generally be classified as "Type B" according to the Construction Standard for Excavations (29 CFR Part 1926.650-.652, Subpart P) promulgated by the Occupational Safety and Health Administration (**OSHA**). Therefore, temporary slopes in confined areas should typically be cut no steeper than 1.0(H):1.0(V). Slopes excavated in very loose or soft soils or from which water is seeping ("Type C") should be cut no steeper than 1.5(H):1.0(V). However, current **OSHA** regulations should be observed for all temporary slopes.

The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Permanent slopes of less than 10 feet in height composed of engineered FILL should be no steeper than 2.0(H):1.0(V). Furthermore, it is recommended that a minimum distance of 10 feet be provided between the top edge of any slope and any proposed building and 5 feet for curbs. Permanent cut slopes of less than 10 feet in height should be no steeper than 2.5(H):1.0(V).

Soil slopes should be covered for protection from rain, and surface runoff should be diverted away from the slopes. For erosion protection, a protective cover of vegetation should be established on slopes as soon as possible. Positive drainage should be maintained with ditches or channels at the top and bottom of the slope. In the fill slope areas, the pavement curbs at the tops of the slopes can serve as channels to divert water away from the slope face.

4.2.6 Earthwork Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. Should unstable subgrade conditions develop, stabilization measures will need to be employed.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of paved service paths. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations.

If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to construction of paved service paths.

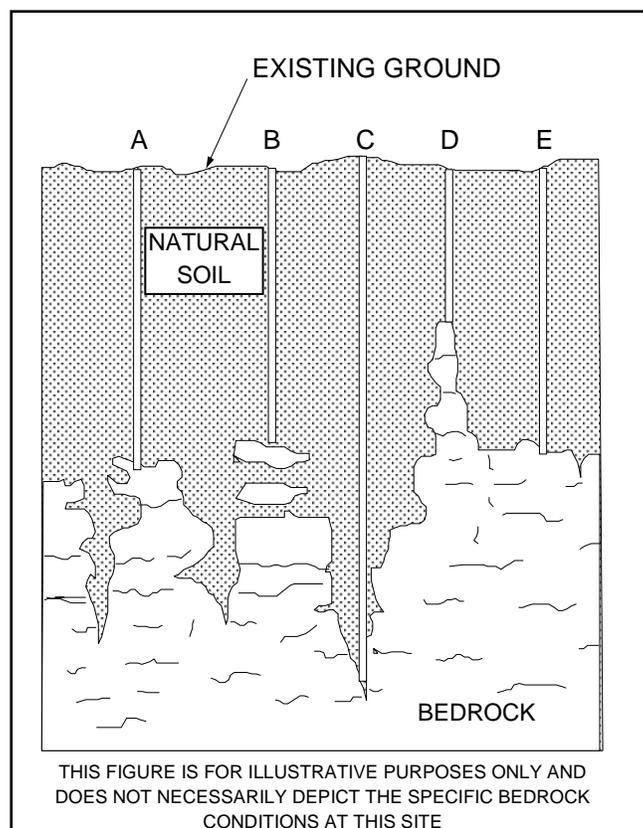
The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of paved service paths.

4.3 Difficult Rock Excavation

Based on our review of the available geologic information, it is likely that test borings B-12 through B-17 refused on limestone of the Conasauga Formation. Limestone of the Conasauga Formation displays a preferential weathering pattern along vertical and horizontal bedding planes/joints. This could result in highly variable depths to auger refusal as well as variable strata of bedrock and voids.

In an area of karst geology, auger refusal can result on paths of unweathered limestone suspended in the residual soil matrix ("floaters"), on rock "pinnacles" rising above the surrounding bedrock surface, in widened joints that may extend well below the surrounding bedrock surface, or on the upper surface of continuous bedrock. Rock coring procedures are required to determine the character and continuity of the auger refusal material and these factors must be considered when evaluating the depth to auger refusal in those test borings that are not cored.

The possible refusal conditions discussed above are illustrated in the figure below.



It is anticipated that it may be possible to rip the limited upper weathered zones of bedrock that could be penetrated with our augers with track-hoes with rock teeth or ripper equipped dozers. However, the majority of bedrock beneath auger refusal depths will likely require the use of other

techniques such as jackhammers, rock splitters, pneumatic breakers, or blasting. It should be noted that the rippability of rock is more dependent on the type and size of the equipment used, the fracturing or quality of the bedrock, and the amount of effort expended, than it is on the type of rock.

5.0 GENERAL COMMENTS

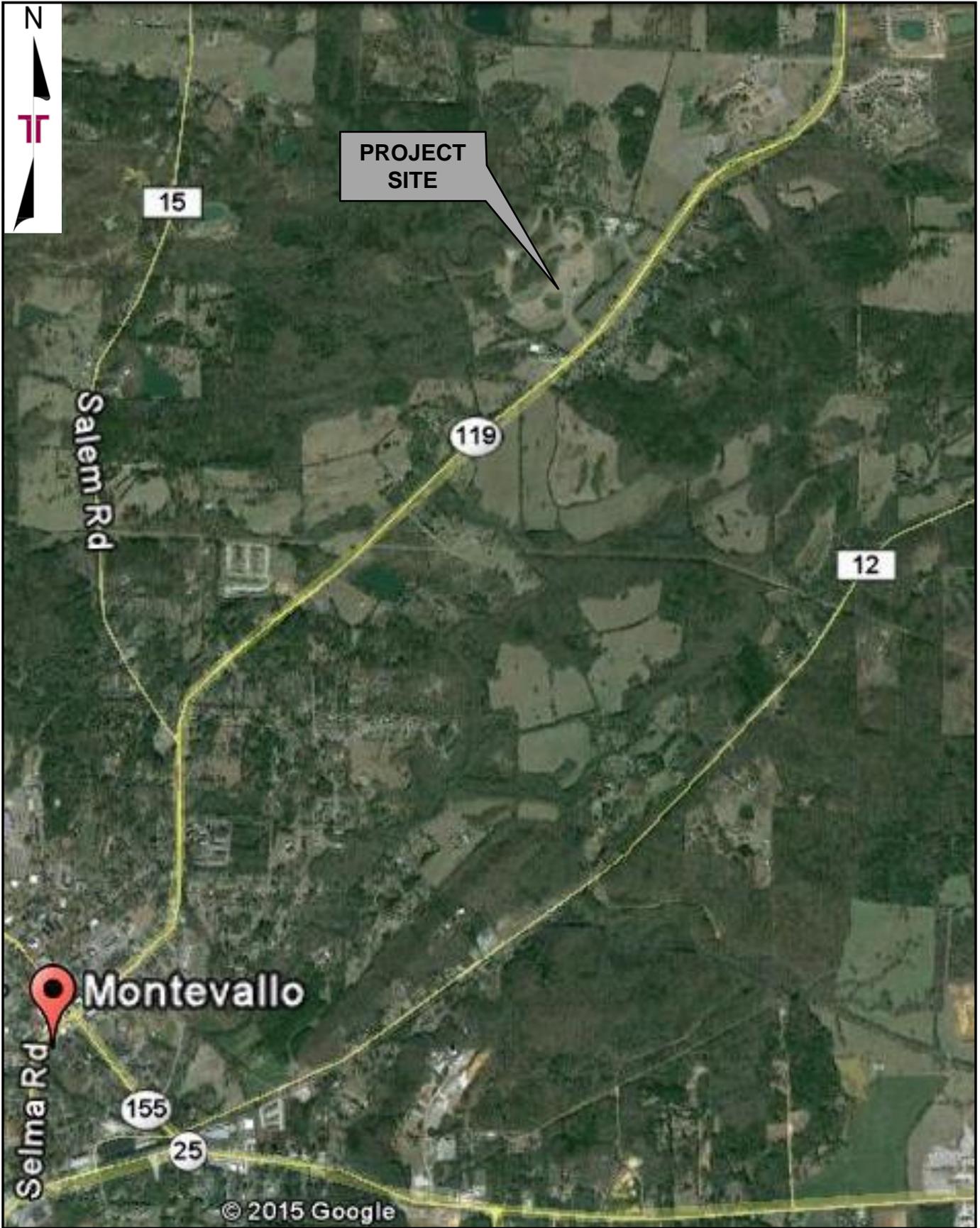
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



Project Manager:	CLB
Drawn By:	CLB
Checked By:	JAS
Approved By:	JAS
Proposal No.	E1155165
Scale:	NTS
File Name:	E1155165.2.pdf
Date:	10-30-2015

Terracon

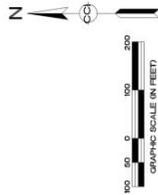
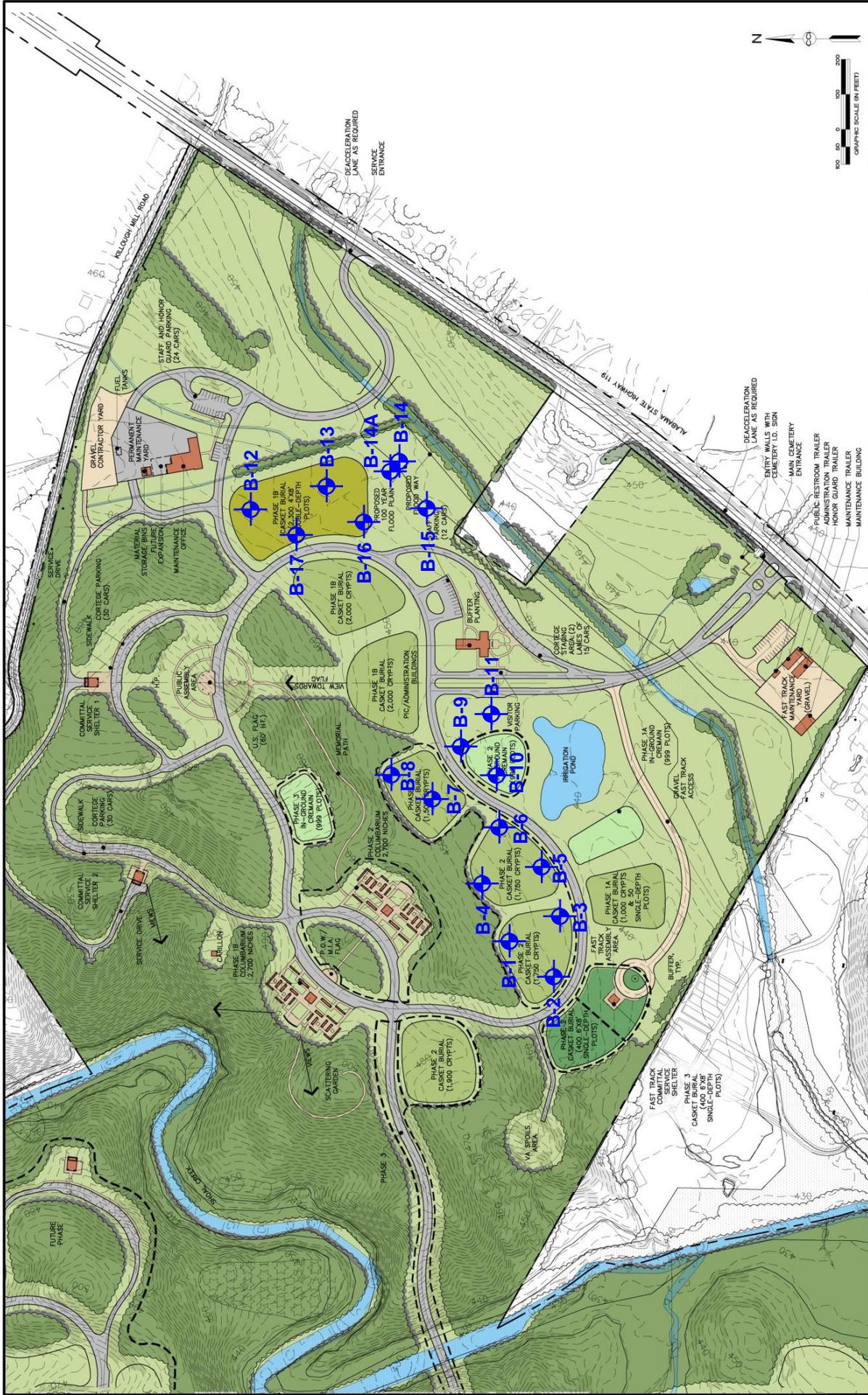
110 12th Street North
Birmingham, Alabama 35203
PH. (205) 942-1289 FAX. (205) 443-5302

SITE LOCATION MAP

PROPOSED ADDITIONS
ALABAMA NATIONAL CEMETERY
MONTEVALLO, ALABAMA

Exhibit

A-1



Exhibit

A-2

BORING LOCATION PLAN

PROPOSED ADDITIONS

ALABAMA NATIONAL CEMETERY

MONTEVALLO, ALABAMA

Terracon
 Consulting Engineers & Scientists

110 12th Street North
 Birmingham, Alabama 35203
 PH: (205) 942-1289 FAX: (205) 445-5302

Project No.	E 1155165
Scale:	1" = 400'
File Name:	E 1155165.2.pdf
Date:	10-30-2015

Project Manager:	CLB
Drawn by:	CLB
Checked by:	JAS
Approved by:	JAS

BORING LOCATIONS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Field Exploration Description

The boring locations were determined utilizing the provided site master plan. The boring locations were located in the field by measuring with a tape and turning approximate right angles from existing property boundary stakes and existing site features. Therefore, the location of these borings should be considered only as accurate as the means and methods by which they were determined. The coordinates of each boring location were determined in the field by using a handheld GPS receiver and are recorded on the individual boring logs in Appendix A. The approximate location of each boring is shown on the attached Exhibit A-2.

The borings were drilled with a trailer-mounted rotary drill rig configured with a rope and cathead using hollow stem augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using the split-barrel sampling procedure.

In the split barrel sampling procedure, the number of blows required to advance a standard 2 inch O.D. split barrel sampler the last 12 inches of the typical total 18 inch penetration by means of a 140 pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled prior to our personnel leaving the site.

A field log of each boring was prepared by Terracon personnel. These logs included visual classifications of the materials encountered during excavation. Final logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples. Individual logs of each boring are included in Appendix A.

BORING LOG NO. B-1

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13158° Longitude: 86.83986°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS	
							LL-PL-PI	
0.1	TOPSOIL CLAY (CL/CH) , trace fine gravel, reddish brown, very stiff				8-10-12 N=22			
3.5	ELASTIC SILT (MH) , yellowish brown, hard	5			12-16-21 N=37	35	73-42-31	
6.0	SILTY CLAY (CL/ML) , light brown, hard, relic bedding				10-15-20 N=35			
8.5	SHALE , light brown, hard, severely to completely weathered	10			15-23-36 N=50+	20		
15.0	becomes very stiff Boring Terminated at 15 Feet	15			11-12-14 N=26			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:						
Abandonment Method: Backfilled with cuttings								
WATER LEVEL OBSERVATIONS No free water observed at time of drilling	<p style="font-size: 0.8em; color: red; margin-top: 5px;">110 12th Street North Birmingham, Alabama</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Boring Started: 10/13/2015</td> <td style="width: 50%;">Boring Completed: 10/13/2015</td> </tr> <tr> <td>Drill Rig: Mobile B47</td> <td>Driller: Chambers</td> </tr> <tr> <td>Project No.: E1155165</td> <td>Exhibit: A-4</td> </tr> </table>	Boring Started: 10/13/2015	Boring Completed: 10/13/2015	Drill Rig: Mobile B47	Driller: Chambers	Project No.: E1155165	Exhibit: A-4
Boring Started: 10/13/2015	Boring Completed: 10/13/2015							
Drill Rig: Mobile B47	Driller: Chambers							
Project No.: E1155165	Exhibit: A-4							

BORING LOG NO. B-2

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13126° Longitude: 86.84003°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
0.2	TOPSOIL						
3.5	LEAN SANDY CLAY (CL) , trace fine gravel, reddish brown, hard			X	13-15-17 N=32		
6.0	SILTY CLAY (CL/ML) , light brown, hard, relic bedding	5		X	15-20-24 N=44	13	
9.0	SHALE , light brown, hard, severely to completely weathered			X	12-33-32 N=50+		
15.0	CLAYEY SILT (ML/MH) , dark brown, very stiff	10		X	10-8-12 N=20		
15.0	Boring Terminated at 15 Feet	15		X	8-9-9 N=18		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Backfilled with cuttings			
WATER LEVEL OBSERVATIONS No free water observed at time of drilling	<p style="font-size: 0.8em; color: #8B0000;">110 12th Street North Birmingham, Alabama</p>	Boring Started: 10/13/2015	Boring Completed: 10/13/2015
		Drill Rig: Mobile B47	Driller: Chambers
		Project No.: E1155165	Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13128° Longitude: 86.8396°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
	DEPTH						
0.2	TOPSOIL						
	LEAN SANDY CLAY (CL) , trace fine gravel, reddish brown, very stiff			X	16-12-12 N=24		
3.5	ELASTIC SILT (MH) , yellowish brown, very stiff	5		X	7-13-16 N=29		
	becomes hard			X	11-16-19 N=35	31	
				X	8-10-14 N=24		
13.5	Auger Refusal at 13.5 Feet			X	50/0" N=50+		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:						
Abandonment Method: Backfilled with cuttings								
WATER LEVEL OBSERVATIONS No free water observed at time of drilling	<p style="font-size: 0.8em; color: red; margin-top: 5px;">110 12th Street North Birmingham, Alabama</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">Boring Started: 10/13/2015</td> <td style="width: 50%; border-bottom: 1px solid black;">Boring Completed: 10/13/2015</td> </tr> <tr> <td style="border-bottom: 1px solid black;">Drill Rig: Mobile B47</td> <td style="border-bottom: 1px solid black;">Driller: Chambers</td> </tr> <tr> <td style="border-bottom: 1px solid black;">Project No.: E1155165</td> <td style="border-bottom: 1px solid black;">Exhibit: A-6</td> </tr> </table>	Boring Started: 10/13/2015	Boring Completed: 10/13/2015	Drill Rig: Mobile B47	Driller: Chambers	Project No.: E1155165	Exhibit: A-6
Boring Started: 10/13/2015	Boring Completed: 10/13/2015							
Drill Rig: Mobile B47	Driller: Chambers							
Project No.: E1155165	Exhibit: A-6							

BORING LOG NO. B-4

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13184° Longitude: 86.83943°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
DEPTH							
0.2	TOPSOIL						
	LEAN SANDY CLAY (CL) , trace fine gravel, reddish brown, stiff			X	4-4-7 N=11		
3.5	ELASTIC SILT (MH) , yellowish brown, hard	5		X	8-12-18 N=30	32	
	becomes very stiff			X	10-14-21 N=35		
		10		X	10-10-14 N=24		
13.5	CLAYEY SILT (ML/MH) , yellowish brown, stiff			X	5-7-7 N=14		
15.0	Boring Terminated at 15 Feet	15					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Backfilled with cuttings		
WATER LEVEL OBSERVATIONS <i>No free water observed at time of drilling</i>	<p style="font-size: 0.8em; color: red;">110 12th Street North Birmingham, Alabama</p>	Boring Started: 10/12/2015 Boring Completed: 10/12/2015 Drill Rig: Mobile B47 Driller: Chambers Project No.: E1155165 Exhibit: A-7

BORING LOG NO. B-5

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13141° Longitude: 86.83923°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	DEPTH						LL-PL-PI
3.5	LEAN SANDY CLAY (CL) , trace fine gravel, reddish brown, stiff			X	11-15-18 N=33		
8.5	ELASTIC SILT (MH) , yellowish brown, very stiff becomes hard	5		X	8-11-14 N=25		
8.5	CLAYEY SILT (ML/MH) , yellowish brown, very stiff, relic bedding			X	8-16-20 N=36	33	
13.5	ELASTIC SILT (MH) , yellowish brown, medium stiff			X	7-11-16 N=27		
15.0	Boring Terminated at 15 Feet	15		X	3-3-3 N=6		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:						
Abandonment Method: Backfilled with cuttings								
WATER LEVEL OBSERVATIONS <i>No free water observed at time of drilling</i>	<p style="font-size: 0.8em; color: red;">110 12th Street North Birmingham, Alabama</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">Boring Started: 10/13/2015</td> <td style="width: 50%; border-bottom: 1px solid black;">Boring Completed: 10/13/2015</td> </tr> <tr> <td style="border-bottom: 1px solid black;">Drill Rig: Mobile B47</td> <td style="border-bottom: 1px solid black;">Driller: Chambers</td> </tr> <tr> <td style="border-bottom: 1px solid black;">Project No.: E1155165</td> <td style="border-bottom: 1px solid black;">Exhibit: A-8</td> </tr> </table>	Boring Started: 10/13/2015	Boring Completed: 10/13/2015	Drill Rig: Mobile B47	Driller: Chambers	Project No.: E1155165	Exhibit: A-8
Boring Started: 10/13/2015	Boring Completed: 10/13/2015							
Drill Rig: Mobile B47	Driller: Chambers							
Project No.: E1155165	Exhibit: A-8							

BORING LOG NO. B-7

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13221° Longitude: 86.83862°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
0.1	TOPSOIL						
	LEAN SANDY CLAY (CL) , trace fine gravel, reddish brown, stiff				11-15-17 N=32		
3.5	SILTY CLAY (CL) , brownish yellow, hard	5			11-20-20 N=40		
					14-1-26 N=27	23	
					14-21-29 N=50		
13.5	SILTY FAT CLAY (CH) , brown and yellowish brown mottled, very stiff				7-10-15 N=25		
15.0	Boring Terminated at 15 Feet	15					

Stratification lines are approximate. In-situ, the transition may be gradual.

<p>Advancement Method: Hollow stem auger</p> <p>Abandonment Method: Backfilled with cuttings</p>	<p>See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.</p>	<p>Notes:</p>						
<p>WATER LEVEL OBSERVATIONS <i>No free water observed at time of drilling</i></p>	<p>110 12th Street North Birmingham, Alabama</p>	<table style="width: 100%; border: none;"> <tr> <td style="border: none;">Boring Started: 10/13/2015</td> <td style="border: none;">Boring Completed: 10/13/2015</td> </tr> <tr> <td style="border: none;">Drill Rig: Mobile B47</td> <td style="border: none;">Driller: Chambers</td> </tr> <tr> <td style="border: none;">Project No.: E1155165</td> <td style="border: none;">Exhibit: A-10</td> </tr> </table>	Boring Started: 10/13/2015	Boring Completed: 10/13/2015	Drill Rig: Mobile B47	Driller: Chambers	Project No.: E1155165	Exhibit: A-10
Boring Started: 10/13/2015	Boring Completed: 10/13/2015							
Drill Rig: Mobile B47	Driller: Chambers							
Project No.: E1155165	Exhibit: A-10							

BORING LOG NO. B-8

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13259° Longitude: 86.83823°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	DEPTH						LL-PL-PI
0.1	TOPSOIL						
6.0	LEAN SANDY CLAY (CL) , trace fine gravel, reddish brown, hard	5		X	7-15-18 N=33		
9.0				X	9-15-18 N=33	19	
12.0	SHALE , brown, hard, severely to completely weathered			X	12-18-30 N=48		
14.0		10		X	14-18-30 N=48		
13.5	ELASTIC SILT (MH) , dark brown, medium stiff			X	3-3-4 N=7		
15.0	Boring Terminated at 15 Feet	15					

Stratification lines are approximate. In-situ, the transition may be gradual.

<p>Advancement Method: Hollow stem auger</p> <p>Abandonment Method: Backfilled with cuttings</p>	<p>See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.</p>	<p>Notes:</p>						
<p>WATER LEVEL OBSERVATIONS <i>No free water observed at time of drilling</i></p>	<p>110 12th Street North Birmingham, Alabama</p>	<table style="width: 100%; border: none;"> <tr> <td style="border: none;">Boring Started: 10/13/2015</td> <td style="border: none;">Boring Completed: 10/13/2015</td> </tr> <tr> <td style="border: none;">Drill Rig: Mobile B47</td> <td style="border: none;">Driller: Chambers</td> </tr> <tr> <td style="border: none;">Project No.: E1155165</td> <td style="border: none;">Exhibit: A-11</td> </tr> </table>	Boring Started: 10/13/2015	Boring Completed: 10/13/2015	Drill Rig: Mobile B47	Driller: Chambers	Project No.: E1155165	Exhibit: A-11
Boring Started: 10/13/2015	Boring Completed: 10/13/2015							
Drill Rig: Mobile B47	Driller: Chambers							
Project No.: E1155165	Exhibit: A-11							

BORING LOG NO. B-9

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13197° Longitude: 86.83807°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	DEPTH						LL-PL-PI
0.3	TOPSOIL						
3.5	FILL, SANDY CLAY , trace fine gravel, reddish brown			X	9-11-11 N=22		
3.5	SILTY CLAY (CL) , trace fine gravel, reddish brown, stiff			X	3-4-4 N=8		
	becomes very stiff	5		X	8-9-12 N=21	24	
				X	10-12-14 N=26		
13.5	FAT CLAY (CH) , yellowish brown, hard			X	14-19-21 N=40		
15.0	Boring Terminated at 15 Feet	15					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:	
Abandonment Method: Backfilled with cuttings	See Appendix C for explanation of symbols and abbreviations.		
WATER LEVEL OBSERVATIONS	110 12th Street North Birmingham, Alabama		
<i>No free water observed at time of drilling</i>			
		Boring Started: 10/12/2015	Boring Completed: 10/12/2015
		Drill Rig: Mobile B47	Driller: Chambers
		Project No.: E1155165	Exhibit: A-12

BORING LOG NO. B-10

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13169° Longitude: 86.83839°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
DEPTH							
0.3	TOPSOIL						
	FILL, SANDY CLAY , trace fine gravel, reddish brown			X	5-4-4 N=8		
3.5	SILTY CLAY (CL) , reddish brown, stiff			X	4-7-8 N=15	24	
6.0	FAT CLAY (CH) , yellowish brown, very stiff			X	8-10-14 N=24		
	becomes hard			X	8-14-18 N=32		
13.5	ELASTIC SILT (MH) , yellowish brown, very stiff			X	8-10-8 N=18		
15.0	Boring Terminated at 15 Feet	15					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Backfilled with cuttings		
WATER LEVEL OBSERVATIONS No free water observed at time of drilling	<p style="font-size: 0.8em; color: red;">110 12th Street North Birmingham, Alabama</p>	Boring Started: 10/12/2015 Boring Completed: 10/12/2015 Drill Rig: Mobile B47 Driller: Chambers Project No.: E1155165 Exhibit: A-13

BORING LOG NO. B-11

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13171° Longitude: 86.83777°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	DEPTH						LL-PL-PI
0.3	TOPSOIL						
	FILL, SANDY CLAY , trace fine gravel, reddish brown			X	3-8-9 N=17		
3.5	SILTY CLAY (CL) , yellowish brown, very stiff			X	5-7-9 N=16	24	
	becomes hard	5		X	11-14-24 N=38		
		10		X	7-14-20 N=34		
13.5	FAT CLAY (CH) , yellowish brown, very stiff			X	7-10-10 N=20		
15.0	Boring Terminated at 15 Feet	15					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Backfilled with cuttings			
WATER LEVEL OBSERVATIONS No free water observed at time of drilling	<p style="font-size: 0.8em; color: #8B0000;">110 12th Street North Birmingham, Alabama</p>	Boring Started: 10/12/2015	Boring Completed: 10/12/2015
		Drill Rig: Mobile B47	Driller: Chambers
		Project No.: E1155165	Exhibit: A-14

BORING LOG NO. B-12

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13353° Longitude: 86.83578°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
	DEPTH						
0.3	TOPSOIL						
	LEAN SANDY CLAY (CL) , reddish brown, very stiff			X	7-10-12 N=22		
3.5	ELASTIC SILT (MH) , yellowish brown, stiff	5		X	5-6-8 N=14	34	
				X	4-5-7 N=12		
8.0	Auger Refusal at 8 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:	
Abandonment Method: Backfilled with cuttings	See Appendix C for explanation of symbols and abbreviations.		
WATER LEVEL OBSERVATIONS	110 12th Street North Birmingham, Alabama	Boring Started: 10/12/2015	Boring Completed: 10/12/2015
<i>No free water observed at time of drilling</i>		Drill Rig: Mobile B47	Driller: Chambers
<i>Dry after 24 hours</i>		Project No.: E1155165	Exhibit: A-15

BORING LOG NO. B-13

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13289° Longitude: 86.83554°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
	DEPTH						
0.2	TOPSOIL						
6.0	LEAN SANDY CLAY (CL) , yellowish brown, very stiff	5		X	9-12-13 N=25		
8.5	ELASTIC SILT (MH) , yellowish brown, stiff			X	9-14-15 N=29		
8.5	Auger Refusal at 8.5 Feet			X	7-8-7 N=15		
8.5	Auger Refusal at 8.5 Feet			X	50/0" N=50+		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:
Abandonment Method: Backfilled with cuttings		
WATER LEVEL OBSERVATIONS <i>No free water observed at time of drilling</i> <i>Dry after 24 hours</i>	<p style="font-size: 0.8em; color: red;">110 12th Street North Birmingham, Alabama</p>	Boring Started: 10/12/2015 Boring Completed: 10/12/2015 Drill Rig: Mobile B47 Driller: Chambers Project No.: E1155165 Exhibit: A-16

BORING LOG NO. B-14

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13229° Longitude: 86.8353°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
DEPTH							
0.3	TOPSOIL LEAN SANDY CLAY (CL) , trace gravel, brown and reddish brown, very stiff			X	10-11-8 N=19		
3.5	Auger Refusal at 3.5 Feet			X	50/0" N=50+		

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:	
Abandonment Method: Backfilled with cuttings	See Appendix C for explanation of symbols and abbreviations.		
WATER LEVEL OBSERVATIONS	110 12th Street North Birmingham, Alabama	Boring Started: 10/12/2015	Boring Completed: 10/12/2015
<i>No free water observed at time of drilling</i>		Drill Rig: Mobile B47	Driller: Chambers
<i>Dry after 24 hours</i>		Project No.: E1155165	Exhibit: A-17

BORING LOG NO. B-14A

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13207° Longitude: 86.83588°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
DEPTH							
0.3	TOPSOIL LEAN SANDY CLAY (CL) , trace gravel, brown and reddish brown						
3.0	Auger Refusal at 3 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Backfilled with cuttings			
WATER LEVEL OBSERVATIONS		Boring Started: 10/12/2015	Boring Completed: 10/12/2015
	110 12th Street North Birmingham, Alabama	Drill Rig: Mobile B47	Driller: Chambers
		Project No.: E1155165	Exhibit: A-18

BORING LOG NO. B-15

PROJECT: Proposed Additions
Alabama National Cemetery

CLIENT: FourFront Design, Inc.

SITE:
Montevallo, Alabama

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13258° Longitude: 86.83593°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.3	TOPSOIL						
	SILTY CLAY (CL) , trace fine gravel, reddish brown, medium stiff			X	2-3-3 N=6		
3.5	SILTY CLAY (CL) , trace fine gravel, reddish brown, very stiff			X	7-11-12 N=23	18	
6.0	ELASTIC SILT (MH) , yellowish brown, very stiff	5		X	9-13-15 N=28		
				X	7-10-14 N=24		
13.0	Auger Refusal at 13 Feet	10	▽				

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Backfilled with cuttings			
WATER LEVEL OBSERVATIONS		Boring Started: 10/12/2015	Boring Completed: 10/12/2015
No free water observed at time of drilling	110 12th Street North Birmingham, Alabama	Drill Rig: Mobile B47	Driller: Chambers
▽ Water observed at 12.2' after 24 hours		Project No.: E1155165	Exhibit: A-19

BORING LOG NO. B-16

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13314° Longitude: 86.83598°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
	DEPTH						
0.2	TOPSOIL						
	LEAN SANDY CLAY (CL) , trace fine gravel, yellowish red and yellowish brown mottled, hard			X	12-20-21 N=41		
3.5	ELASTIC SILT (MH) , yellowish brown, very stiff	5		X	10-11-15 N=26		
	becomes hard			X	9-19-20 N=39		
				X	9-14-21 N=35		
13.5	Auger Refusal at 13.5 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Backfilled with cuttings			
WATER LEVEL OBSERVATIONS			
<i>No free water observed at time of drilling</i>	110 12th Street North Birmingham, Alabama	Boring Started: 10/12/2015	Boring Completed: 10/12/2015
<i>Dry after 24 hours</i>		Drill Rig: Mobile B47	Driller: Chambers
		Project No.: E1155165	Exhibit: A-20

BORING LOG NO. B-17

**PROJECT: Proposed Additions
Alabama National Cemetery**

CLIENT: FourFront Design, Inc.

**SITE:
Montevallo, Alabama**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_E1155165 PROPOSED ADDITIONS ALABAMA NATIONAL CEMETERY.GPJ TERRACON2015.GDT 11/5/15

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.13236° Longitude: 86.83532°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
							LL-PL-PI
DEPTH							
0.3	TOPSOIL						
3.5	FILL, SANDY CLAY , with weathered shale, light brown			X	19-22-27 N=49		
8.5	ELASTIC SILT (MH) , yellowish brown, very stiff, relic bedding becomes stiff	5		X	7-8-9 N=17	36	
			▽	X	4-5-7 N=12		
				X	50/0" N=50+		
	Auger Refusal at 8.5 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Hollow stem auger	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:	
Abandonment Method: Backfilled with cuttings			
WATER LEVEL OBSERVATIONS No free water observed at time of drilling ▽ Water observed at 6.5' after 24 hours		Boring Started: 10/12/2015 Drill Rig: Mobile B47 Project No.: E1155165	Boring Completed: 10/12/2015 Driller: Chambers Exhibit: A-21



APPENDIX B
LABORATORY TESTING

Laboratory Testing

Soil samples were tested in the laboratory to measure their natural moisture content and Atterberg limits. The test results are provided on the individual boring logs included in Appendix A.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. All classification was by visual manual procedures.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING			WATER LEVEL		Water Initially Encountered	FIELD TESTS	(HP) Hand Penetrometer	
	Auger	Split Spoon			Water Level After a Specified Period of Time		(T) Torvane	
					Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)	
	Shelby Tube	Macro Core		Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			(PID) Photo-Ionization Detector	
							(OVA) Organic Vapor Analyzer	
Ring Sampler	Rock Core							
								
Grab Sample	No Recovery							

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 15
With	15 - 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term(s) of other constituents</u>	<u>Percent of Dry Weight</u>
Trace	< 5
With	5 - 12
Modifier	> 12

GRAIN SIZE TERMINOLOGY

<u>Major Component of Sample</u>	<u>Particle Size</u>
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

PLASTICITY DESCRIPTION

<u>Term</u>	<u>Plasticity Index</u>
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GP	Poorly graded gravel ^F
			Fines classify as CL or CH	GM	Silty gravel ^{F,G,H}
		Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	GC
	Sands with Fines: More than 12% fines ^D		Fines classify as ML or MH	SW	Well-graded sand ^I
			Fines classify as CL or CH	SP	Poorly graded sand ^I
	Silts and Clays: Liquid limit less than 50		Inorganic:	$PI > 7$ and plots on or above "A" line ^J	SM
		Organic:	Liquid limit - oven dried < 0.75	SC	Clayey sand ^{G,H,I}
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit 50 or more	Inorganic:	$PI < 4$ or plots below "A" line ^J	CL	Lean clay ^{K,L,M}
		Organic:	Liquid limit - not dried < 0.75	ML	Silt ^{K,L,M}
			PI plots on or above "A" line	OL	Organic clay ^{K,L,M,N}
		Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots below "A" line	OH
	Organic:		Liquid limit - oven dried < 0.75	CH	Fat clay ^{K,L,M}
			Liquid limit - not dried < 0.75	MH	Elastic Silt ^{K,L,M}
	Highly organic soils:		Primarily organic matter, dark in color, and organic odor	Liquid limit - oven dried < 0.75	OH
		Liquid limit - not dried < 0.75		PT	Organic silt ^{K,L,M,Q}
PT				Peat	

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

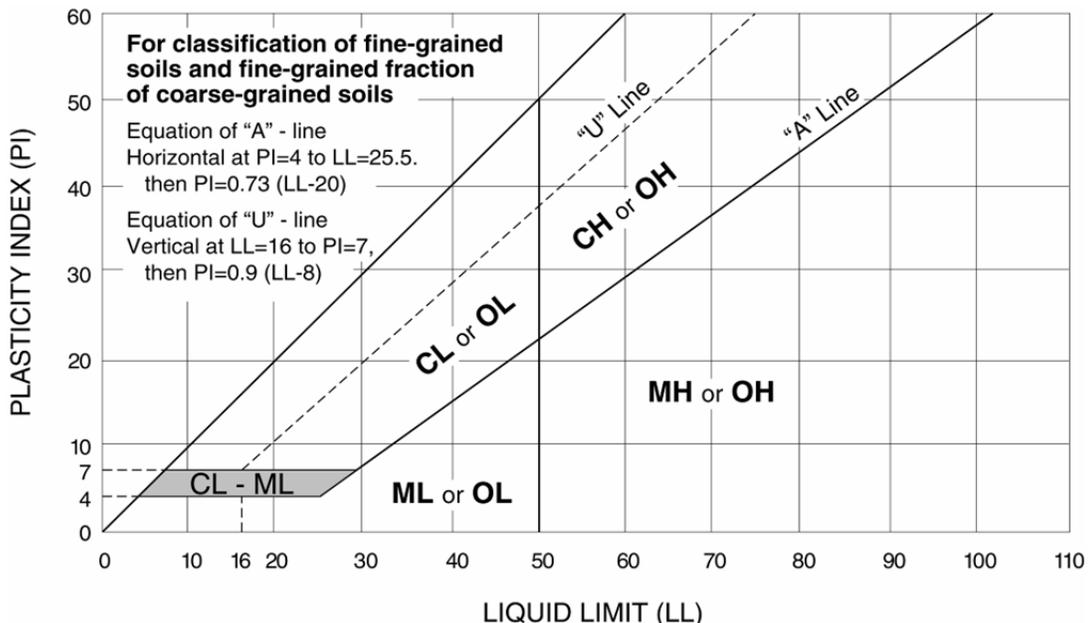
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 SUMMARY:

- A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
 - 1. Implementation of the Erosion and Sedimentation Control Plan.
 - 2. Dewater excavations, including seepage and precipitation.
- B. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 REQUIREMENT:

- A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 600 mm (2 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.
- B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of 300 mm (1 foot) below prevailing excavation surface.
- C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
- D. Maintain stability of sides and bottom of excavation.
- E. Construction operations are performed in the dry.
- F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:

1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
 2. Erosion is controlled.
 3. Flooding of excavations or damage to structures does not occur.
 4. Surface water drains away from excavations.
 5. Excavations are protected from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.
- G. Permitting Requirements: The contractor shall comply with and obtain the required State and County permits where the work is performed.

1.4 RELATED WORK:

- A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Safety Requirements: Section 01 00 02, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.
- C. Submittal requirements as specified in Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 02, GENERAL REQUIREMENTS.
- E. Subsurface Investigation: Section 01 00 02, GENERAL REQUIREMENTS, Article 1.11, PHYSICAL DATA.
- F. Section 02 41 00 DEMOLITION.
- G. Excavation, backfilling, site grade and utilities: Section 31 20 00, EARTH MOVING (SHORT FORM).

1.5 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Drawings and Design Data:
 1. Submit drawings and data showing the method to be employed in dewatering excavated areas 30 days before commencement of excavation.
 2. Material shall include: location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.

3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
4. Capacities of pumps, prime movers, and standby equipment.
5. Design calculations proving adequacy of system and selected equipment. The dewatering system shall be designed using accepted and professional methods of design and engineering consistent with the best modern practice. The dewatering system shall include the deep wells, wellpoints, and other equipment, appurtenances, and related earthwork necessary to perform the function.
6. Detailed description of dewatering procedure and maintenance method.
7. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharge water from the dewatering system are required due to the discharge reaching regulated bodies of water.

C. Inspection Reports.

D. All required permits.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.
- B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of 600 mm (2 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

- A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.
- B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

- A. Dispose of water removed from the excavations in such a manner as:
1. Will not endanger portions of work under construction or completed.
 2. Will cause no inconvenience to Government or to others working near site.
 3. Will comply with the stipulations of required permits for disposal of water.
 4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to: excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.
- B. Excavation Dewatering:
1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
 2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
 3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
 4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.
- C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT:

Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain dewatering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Government.

3.6 DAMAGES:

Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

Insure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

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SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown on the Drawings. Construction shall include the following:
- B. Curb, gutter, and combination curb and gutter.
- C. Vehicular Pavement: Entrance drives.

1.2 RELATED WORK

- A. Section 01 00 02, GENERAL CONDITIONS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Section 01 45 29, TESTING LABORATORY SERVICES.
- D. Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- E. Section 03 48 21, PRECAST CONCRETE BURIAL CRYPTS.
- F. Section 31 20 11, EARTHWORK (SHORT FORM).

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

- A. Hot Weather: Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COR.
- B. Cold Weather: Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COR.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the COR, in writing, for approval. The formula shall include the source of

materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture. Cost of the testing laboratory to be included in the Contractor's cost of project.

1.6 SUBMITTALS

Contractor shall submit the following.

- A. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Hot poured sealing compound
 - 3. Reinforcement
 - 4. Curing materials
- B. Jointing Plan for all concrete areas.
- C. Concrete Mix Design.
- D. Concrete Test Reports
- E. Construction Staking Notes from Surveyor.
- F. Data and Test Reports: Select subbase material.
 - 1. Job-mix formula.
 - 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 2004)
 - M148-05-UL.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309)
 - M171-05-UL.....Sheet Materials for Curing Concrete (ASTM C171)
 - M182-05-UL.....Burlap Cloth Made from Jute or Kenaf and Cotton Mats
- B. American Society for Testing and Materials (ASTM):
 - C31/C31M-10.....Standard Practice for Making and Curing Concrete Test Specimens in the field
 - C33/C33M-11a.....Standard Specification for Concrete Aggregates

- C94/C94M-12.....Standard Specification for Ready Mixed Concrete
- C150/C150M-12.....Standard Specification for Portland Cement
- C171-07.....Standard Specification for Sheet Materials for
Curing Concrete
- C172/C172M-10.....Standard Practice for Sampling Freshly Mixed
Concrete
- C173/C173M-10b.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Volumetric Method
- C192/C192M-07.....Standard Practice for Making and Curing
Concrete Test Specimens in the Laboratory
- C231/C231M-10.....Standard Test Method for Air Content of Freshly
Mixed Concrete by the Pressure Method
- C260/C260M-10a.....Standard Specification for Air Entraining
Admixtures for Concrete
- C309-11.....Standard Specification for Liquid Membrane
Forming Compounds for Curing Concrete
- C494/C494M-12.....Standard Specification for Chemical Admixtures
for Concrete
- C618-12.....Standard Specification for Coal Fly Ash and Raw
or Calcined Natural Pozzolan for Use in
Concrete
- D1751-04(2008).....Standard Specification for Preformed Expansion
Joint Filler for Concrete Paving and Structural
Construction (Non-extruding and Resilient
Bituminous Types)
- D4263-83(2012).....Standard Test Method for Indicating Moisture in
Concrete by the Plastic Sheet Method.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Concrete Type: Concrete shall be as per Table 1 - Concrete Type, air entrained.

TABLE I - CONCRETE TYPE

	Concrete Strength		Non-Air- Entrained	Air-Entrained	
	Min. 28 Day Comp. Str. Psi (MPa)	Min. Cement lbs/c. yd (kg/m ³)	Max. Water Cement Ratio	Min. Cement lbs/c. yd (kg/m ³)	Max. Water Cement Ratio

Type A	5000 (35) ^{1,3}	630 (375)	0.45	650 (385)	0.40
Type B	4000 (30) ^{1,3}	550 (325)	0.55	570 (340)	0.50
Type C	3000 (25) ^{1,3}	470 (280)	0.65	490 (290)	0.55
Type D	3000 (25) ^{1,2}	500 (300)	*	520 (310)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 1200 psi (8.3 MPa) in excess of the compressed strength. For concrete strengths above 5000 psi (35 Mpa), the proposed mix design shall achieve a compressive strength 1400 psi (9.7 MPa) in excess of the compressed strength.
 2. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.
 3. Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.
- B. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP - INCHES (MM)

TYPE	MAXIMUM SLUMP*
Curb & Gutter	3 inches (75 mm)
Pedestrian Pavement	3 inches (75 mm)
Vehicular Pavement	2 inches (50 mm) (Machine Finished) 4 inches (100 mm) (Hand Finished)
Equipment Pad	3 to 4 inches (75 to 100 mm)
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.

2.3 BASE COURSE

- A. Aggregate base course shall be in accordance with ALDOT standard specification.
- B. Subbase material shall produce a compacted, dense graded course, meeting the density requirement specified herein.

2.4 FORMS

- A. Use metal forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 1/8 inch (3 mm) in any ten foot (3000 mm) long section, in either a horizontal or vertical direction.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap having a weight of seven ounces (233 grams) or more per yard (square meter) when dry.
 - 2. Impervious Sheeting conforming to ASTM C171.
 - 3. Liquid Membrane Curing Compound conforming to ASTM C309, Type 1 and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

- A. Material shall conform to ASTM D1751-04.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTHWORK.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 BASE COURSE

- A. Placing:
 - 1. Place the material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 150 mm (6 inches), and that when compacted, will produce a layer of the designated thickness.
 - 2. When the designated compacted thickness exceeds 150 mm (6 inches), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
 - 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
 - 4. If the elevation of the top layer is 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in compacted thickness.

B. Compaction:

1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by ASTM D698.

C. Smoothness Test and Thickness Control:

Test the completed subbase for grade and cross section with a straight edge.

1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.

D. Protection:

1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

3.3 SETTING FORMS

A. Base Support:

1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:

1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.

3. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch (3 mm) when checked with a straightedge and shall not deviate from true line by more than 1/4 inch (6 mm) at any point.
 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
 5. Clean and oil forms each time they are used.
 6. Make necessary corrections to forms immediately before placing concrete.
 7. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.
- C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 02, GENERAL CONDITIONS, shall establish the control, alignment and the grade elevations of the forms or concrete slipforming machine operations. Staking notes shall be submitted for approval to the COR prior to placement of concrete. If discrepancies exist between the field conditions and the Drawings, Contractor shall notify COR immediately. No placement of concrete shall occur if a discrepancy greater than 1 inch (25 mm) is discovered.

3.4 EQUIPMENT

- A. The COR shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING CONCRETE - GENERAL

- A. Obtain approval of the COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.

- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.
- H. Cracked or Chipped Concrete Surfaces and Bird Baths. Cracked or chipped concrete and bird baths will not be allowed. Concrete with cracks or chips and bird baths will be removed and replaced to the nearest joints, and as approved by the COR, by the Contractor with no additional cost to the Government.

3.6 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.7 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.

3.8 CONCRETE FINISHING CURB AND GUTTER

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/4 inch (6 mm) or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.

- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 1/8 inch (3 mm) for gutter and 1/4 (6 mm) for top and face of curb, when tested with a 10 foot (3000 mm) straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain. See Article 3.6, Paragraph H, above.
- H. Visible surfaces and edges of finished curb, gutter, and/or combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.9 CONCRETE FINISHING EQUIPMENT PADS

- A. After the surface has been struck off and screeded to the proper elevation, provide a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 1/8 inch (3 mm) when tested with a 10 foot (3000 mm) straightedge.
- D. Correct irregularities exceeding the above. See Article 3.6, Paragraph H, above.

3.10 JOINTS - GENERAL

- A. Place joints, where shown on the Shop Drawings and Drawings, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.11 CONTRACTION JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.

- B. Construct joints in curbs and gutters by inserting 1/8 inch (3 mm) steel plates conforming to the cross sections of the curb and gutter.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Score pedestrian pavement with a standard grooving tool or jointer.

3.12 EXPANSION JOINTS

- A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool.
- E. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 - 2. Using joint filler of the type, thickness, and width as shown.
 - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.13 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.14 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and

replace the damaged pavement and employ another method of curing as directed by the COR.

- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils (0.1 mm) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 12 inches (300 mm). Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon (5 m²/L) for both coats.
 - 2. Do not allow the concrete to dry before the application of the membrane.
 - 3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
 - 4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.15 CLEANING

- A. After completion of the curing period:
 - 1. Remove the curing material (other than liquid membrane).
 - 2. Sweep the concrete clean.
 - 3. After removal of all foreign matter from the joints, seal joints as specified.
 - 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.16 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the COR, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least

seven days old, or for a longer period of time if so directed by the
COR.

3.17 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Section 03 30 53 CAST IN PLACE CONCRETE (SHORT FORM).
- C. Subgrade Preparation: Paragraph 3.3 and Section 31 20 11, EARTH MOVING (SHORT FORM).
- D. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

- A. The COR shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

- A. The Contractor's Registered Professional Land Surveyor shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Data and Test Reports:
 - 1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by Alabama Department of Transportation Standard Specifications for Highway Construction.

2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by Alabama Department of Transportation Standard Specifications for Highway Construction.
 3. Job-mix formula.
- C. Certifications:
1. Asphalt prime and tack coat material certificate of conformance to Alabama Department of Transportation Standard Specifications for Highway Construction requirements.
 2. Asphalt cement certificate of conformance to Alabama Department of Transportation Standard Specifications for Highway Construction requirements.
 3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.
- D. One copy of Alabama Department of Transportation Standard Specifications for Highway Construction.
- E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Aggregate base, Asphaltic base, and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term "Engineer" is referenced in the State Highway Specifications, it shall mean the VA COR.

2.2 AGGREGATES

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.
- B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").
- C. Base aggregate size shall be as noted in the Alabama Department of Transportation Specifications (latest edition) coarse aggregate gradation table for #610 stone.
- D. Aggregates for asphaltic concrete paving shall be as noted in the Alabama Department of Transportation Specifications (2002 edition) for asphalt mix 429A for wearing surface and 429B for binder. Maximum

aggregate size shall be ½" for wearing surface and 1" for binder. E.

Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions as noted in the Alabama Department of Transportation Specifications (2002 edition) for asphalt mix 429A for wearing surface and 429B for binder.

2.3 ASPHALTS

A. Comply with Section 410 of the Alabama Department of Transportation Standard Specifications for Highway Construction:

1. Asphalt binder: Performance grade 67-22
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for troweling after thorough stirring, and containing no clay or other deleterious substance.

B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the Alabama Department of Transportation Standard Specifications for Highway Construction for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

A. Provide hot plant-mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

A. Shape to line and grade and compact with self-propelled rollers.

B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.

- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA COR. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase (when required)
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.
- B. Aggregate Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).
- E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

- A. Remove all loose materials from the compacted base.
- B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.
- C. Receipt of asphaltic concrete materials:
 - 1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).

2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Contractor is responsible for providing a system with full and complete coverage. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:
1. Procurement of all applicable licenses, permits, and payment of required fees.
 2. Coordination of Utility Locates public and private ("Call Before You Dig").
 3. Maintenance period.
 4. Sleeving for irrigation pipe and wire.

1.2 RELATED WORK

- A. Section 10 14 00 EXTERIOR SIGNAGE
- B. Section 26 ELECTRICAL
- C. Section 32 90 00 PLANTING

1.3 QUALITY ASSURANCE

- A. Contractor:
1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed PVC pipe (3-inch and larger); centralized control systems; electrically operated remote control valves and large radius rotary sprinklers (minimum 1-inch inlet with swing joint).
 2. Contractor and project superintendent must be certified by control system manufacturer as a certified contractor for installation of control system wiring and grounding systems. Provide documentation from control system manufacturer regarding certification.
 3. Key personnel employed by the contractor must provide proof that they are an Irrigation Association Certified Irrigation Contractor and currently in good standing.
 4. Contractor must be licensed in Alabama.

5. Provide documentation of contractor qualifications with equipment submittals.
- B. Equipment Manufacturer:
1. Manufacturer regularly and presently manufactures the item as one of their principal products.
- C. System Requirements:
1. Full and complete coverage as described herein and presented in the drawings is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas.
 2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

1.4 SUBMITTALS

- A. Make submittal and provide number of copies per Specification Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for contractor qualifications, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Contracting Officer/Contracting Officer Representative (CO/COR). Incomplete submittals will be returned without review.
- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water emission components, and control system components and control system communication including radio test if radio is the communication option used. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
- D. Equipment submitted must conform to the Buy American Act. Provide manufacturing location of items submitted.
- E. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative

locations, and critical dimensions. Note modifications to the installation detail.

F. Testing:

1. Document the occurrence of all tests on the Daily Report. Indicate which test was conducted and whether or not it was successful.
2. Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.

G. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.

H. Colored Irrigation Controller Charts: Submit information listed in Part 3 of these specifications.

I. Record Drawings: Submit information listed in Part 3 of these specifications.

1.5 APPLICABLE PUBLICATIONS

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

B. Federal Specifications (Fed. Spec.): RR-F-621E Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole

C. American National Standard Institute (ANSI):

B40.1.....Gauges-Pressure Indicating Dial Type Elastic Element

D. American Society of Agricultural Engineers (ASAE):

S398Sprinkler Testing and Performance Reporting.

E. American Society of Civil Engineers (ASCE):

Manual and Reports on Engineering Practice No. 108, "Pipeline Design for Installation by Horizontal Directional Drilling (2005)

F. American Society for Testing and Materials (ASTM):

B61-02.....Steam or Valve Bronze Castings

B62-15.....Composition Bronze or Ounce Metal Castings

D1785-12.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120

- D2241-15.....Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
- D2287-12.....Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- D2464-15.....Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- D2466-15.....Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- D2564-12.....Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe And Fittings
- D2855-96(2010)....Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D3350-14.....Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- F714-13.....Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- F477-14.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F1962-11.....Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
- F2164-13.....Field Leak Testing of Polyethylene Pressure Piping Systems
- B209-14.....Aluminum and Aluminum-Alloy Sheet and Plate
- G. American Water Works Association (AWWA):
 - C110-12.....Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids
 - C111-12.....Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.
 - C115-11.....Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges
 - C151-09.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
 - C153-11.....Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for Water and Other Liquids.
 - C500-09.....Gate Valves for Water and Sewerage Systems

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- C504-10.....Rubber Sealed Butterfly Valves
- C600-10.....Installation for Ductile-Iron water Mains and Their Appurtenances
- C901-08.....Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service
- H. Irrigation Association (IA): Technical Resources, Irrigation Best Practices & Standards
- I. Manufacturers Standardization Society (MSS):
 - SP70-2011.....Cast Iron gate Valves, Flanged and Thread Ends
- J. National Electrical Manufacturers Association (NEMA):
 - 250-2014.....Enclosures for Electrical Equipment (1000 Volts Maximum); Revision 1, May 1986
- K. National Electric Code: (latest edition 2014)
- L. North American Society for Trenchless Technology (NASTT)
 - Mini-Horizontal Directional Drilling Manual
 - Horizontal Directional Drilling Good Practices Guidelines
- M. Plastics Pipe Institute
 - Chapter 12 Horizontal Directional Drilling
- N. Uniform Plumbing Code: (latest edition 2015)

1.6 RULES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.7 DEMOLITION

- A. Operate existing remote control valves to demonstrate that existing control wiring functions properly. Document that all remote control valves and control wiring associated with the controllers impacted by

this project operate properly. Immediately notify CO/COR if remote control valve and/or control wire does not operate properly. Proceeding with renovation without notifying CO/COR implies that all components are operating properly. It is the responsibility of the Contractor to replace any component not operating properly at the completion of renovation.

- B. Remove/salvage existing irrigation components as indicated on the drawings. Remove items in a manner that minimizes damage to components. Deliver only salvageable components to Cemetery. Properly dispose of other removed items.
- C. Abandon existing irrigation pipe in place. If existing pipe is encountered during installation of new irrigation pipe, cut and remove two (2) feet of existing irrigation pipe on either side of the new irrigation pipe. Properly dispose of removed pipe.
- D. Reuse existing control wiring as indicated on drawings. Cut existing control wiring at remote control valves and permanently label end of wire with existing station number. Protect existing control wiring during construction of new irrigation system.
- E. Demolish existing Flower Water Stations as indicated herein or as described on the drawings. Remove, protect and reinstall existing trash and flower receptacles. Remove existing hydrant and deliver to Cemetery.

1.8 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies. After the contractor has installed the new point of connection, water will be available for flushing and testing of the new irrigation system. The contractor may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.
- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the CO/COR, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.9 TESTING

- A. Notify the CO/COR five working days in advance of testing.

- B. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the CO/COR.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test - Gasketed Mainline Pipe:
 - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 2. Purge all air from the pipeline before test.
 - 3. Subject mainline pipe to 140 PSI for two hours. Maintain constant pressure.
 - 4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
 - 5. Testing pump must provide a continuous 140-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 140-PSI at end of test.
 - 6. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
 - 7. Subject mainline pipe to the anticipated operating pressure of 100 PSI for two hours. Maintain constant pressure. The amount of additional water pumped in during the test will not exceed:
 - a. 0.41 gallons per 100 joints of 3-inch diameter pipe
 - b. 0.54 gallons per 100 joints of 4-inch diameter pipe
 - c. 0.81 gallons per 100 joints of 6-inch diameter pipe
 - d. 1.08 gallons per 100 joints of 8-inch diameter pipe
 - 8. Note: Allowable Leakage calculated using $L = (ND\sqrt{P})/7400$
Where: L = Allowable Leakage (gph)
N = Number of Joints
D = Nominal Diameter of Pipe (inches)
P = Average Test Pressure (psi)
 - 9. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 - 10. Cement or caulking to seal leaks is prohibited.
 - 11. Contractor may sub-contract testing to pipeline testing company approved by CO/COR.

F. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:

1. Subject pipe to a hydrostatic pressure equal to the anticipated operating pressure of 90 PSI for 30 minutes.
2. Cap all sprinkler risers.
3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
5. As an alternative to the visual inspection described in Item 4. above, the CO/COR may request that a pressure drop test be performed:
 - a. Purge air from pipe before test. Attach pressure gauge to a riser in the middle of the lateral. Cap all sprinkler risers.
 - b. Pressurize the lateral via the remote control valve then turn down flow control handle on remote control valve to seal off lateral.
 - c. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
6. Cement or caulking to seal leaks is prohibited.
7. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.

G. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:

1. Activate each remote control valve in sequence from each controller using the remote control valve. Manual operation of the valves is not an acceptable method of activation. The CO/COR will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.

5. Repeat test(s) until each lateral pass all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the CO/COR.

H. Distribution Uniformity (DU):

1. Irrigation Audits
 - a. Performed by an Irrigation Association Certified Landscape Irrigation Auditor.
 - b. Complete an irrigation audit, to include 3 "representative" irrigation zones/test areas.
 - c. Identify the 3 areas to be tested based on cemetery site conditions in consultation with the cemetery foreman and/or irrigation personnel, irrigation auditor, NCA National Irrigation Specialist and CO/COR.
2. Sprinkler Characteristics
 - a. Minimum one audit for each combination of sprinkler model, nozzle type, spacing, and pressure commonly used for the site.
3. Final determination of the areas to be tested will be based on the recommendation of the Contractor and their understanding of the purpose and goals of performing these irrigation audits with final approval by the NCA National Irrigation Specialist. Submit a map indicating the locations of the zones to be tested.
4. Follow the methodology found in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual and Irrigation Audit Guidelines for performing irrigation audits.
 - a. During each audit, a wind anemometer shall be used and wind speed information recorded every 5 minutes, and a graph of this information shall be provided with the summary report and audit information.
 - 1) If at any time during the audit the wind exceeds 5 mph, it shall be noted in the summary report.
 - 2) If at any time the wind exceeds 10 mph, the audit shall be stopped and restarted (cans emptied and started anew) when the wind drops below 5 mph for an extended period of time, at the discretion of the auditor.
 - 3) If a site is being audited that consistently has winds above 10 mph, then the Contractor and National Irrigation Specialist will determine the best course of action to proceed as to the effect of the wind on the audits.

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5. Provide all data called for in the irrigation audit worksheets used in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual.
 - a. Supply all data in a digital (MS Excel format) as well as paper report format to NCA via CO/COR.
 - b. Create similar templates/data sheets as those forms represented in MS Excel if none are readily available to the general public from the Irrigation Association.
 - c. Provide copies of all field notes, drawings, and data collection forms used in the field, to be submitted along with the paper report and digital media versions of the audit information.
6. Do not complete the Pre-Audit Inspection Corrective Actions included in the Irrigation Association Guidelines, as the irrigation system is to be audited in its current condition. However, pressure is to be checked at the pressure regulating device on each valve tested by using a Schrader valve compatible connection and liquid filled pressure gauge. If there is no pressure regulating valve, the closest sprinkler to the RCV will be checked using a pitot tube and liquid filled pressure gauge.
7. Based on the area being audited, the Contractor shall use a number of catch cans that is divisible by 4, with a minimum of 28 catch cans being used for each audit.
8. Catch cans shall be laid out in a grid format per the current edition of Irrigation Association Landscape Irrigation Audit Manual, based on:
 - a. Number of catch cans used
 - b. Size of the area tested
 - c. Number of sprinklers tested
 - d. Site conditions
 - e. Spacing shall be consistent and in a square pattern throughout each testing area.
9. Catch cans shall be as level as possible prior to beginning the audit. Cal Poly ITRC Catch Cans shall be used or approved equal.
10. If water gets into the catch cans prior to the audit beginning, then all catch cans shall be emptied out and the sprinklers test shall start over.

11. Depending on the type of sprinklers being audited, the following general rules shall be followed for determining sprinkler run times:
 - a. Rotor type sprinklers - a minimum of 10 minute run time and a maximum of a 30 minute run time;
 - b. Spray type sprinklers (pop ups) - a minimum of 5 minute run times and a maximum of 10 minute run times;
 - c. Rotary/stream type sprinklers - a minimum of 20 minute run time and a maximum of 60 minute run time.
12. Catch can data collection shall be performed by the same person for all irrigation audits for consistency of data purposes.
13. All worksheets shall be filled out to the fullest extent possible. As much data as can be reasonably determined on each site for each test shall be provided in the worksheets.
 - a. Any missing worksheet data shall be accounted for with a written explanation as to why the data is not present in the worksheets. An example of this would be:
 - 1) No flow meter information provided
 - 2) Reason - no flow meter present on site
 - b. Worksheets shall include all collected catch can data and determination of Low Quarter Distribution Uniformity (DULQ) and Precipitation Rate (PR) along with all of the other pertinent data in the worksheets.
14. On a copy of the irrigation plan accurately (within 1-foot) show the following:
 - a. All sprinklers and associated valves for each test area;
 - b. Any surrounding hardscape, plants, or physical site surroundings (roads, walkways, headstones, benches, water spigots, trees, shrubs, etc.)
 - c. All catch cans (numbered per the worksheets) and associated data collected.
15. A summary report (maximum of one page per audit) shall be provided along with a map and audit data for each location audited along with associated worksheets filled out as specified above.
16. If any conclusions can be drawn based on the area tested, distribution uniformity or precipitation rate, they should be

explained in the summary page, along with any recommendations for improvements of irrigation uniformity for the audit condition.

17. Submit Entire audit report to CO/COR within 10 working days of the completed field work.

I. Control System Grounding:

1. Test for proper grounding of control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's guidelines are met.
3. If the test is acceptable, the individual completing the test must document the results of the grounding test on the inside of each controller pedestal door and via a written report. Documentation should include controller name or number, date of test, and the ohms resistance to ground. The test results should be marked on the inside of each controller pedestal door using a permanent marker.
4. A written report of the test data listing controller name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to ground for each controller must be submitted to the CO/COR.

J. Acceptance Test Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
2. Coordinate start of Acceptance Test with CO/COR.
3. During the Acceptance Test, the irrigation system must be fully operational from the control system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 24 hours of notification from CO/COR. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. If the fault is found to be due to factors outside of the contractor's control (for example, mainline pipe break in area not being renovated) the evaluation period will continue. The

time required to make the repair shall not be included in the evaluation period.

5. When the system has operated for 14 days without fault, contact the CO/COR to schedule Final Inspection. Substantial completion consideration is only given after the 14 day test has been accepted.

1.10 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the CO/COR is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.
 1. Schedule reviews for irrigation system layout or testing with the CO/COR as required by these specifications.
 2. Impromptu reviews may occur at any time during the project.
 3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
 4. All costs, including travel expenses and site visits by the Veterans Administration or Veterans Administration representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.11 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
- B. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for a period of one year from the date of acceptance by COR. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 24 hours of notification from CO/COR.

- C. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- D. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with CO/COR. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.
- B. Install irrigation components in landscaped areas only.
- C. Construction cannot proceed unless staking of irrigation mainline, isolation gate valve locations, quick coupling valve locations, remote control valve locations, sprinkler, and controller locations are reviewed and accepted by the CO/COR.

PART 2 - MATERIALS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. CO/COR must approve equipment prior to construction. The Contactor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's.
- B. Pipe sizes and pressure ratings referenced in the construction documents are a minimum and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeve beneath hardscape for irrigation pipe and wiring. Provide separate sleeve beneath hardscape for wiring.
- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241 for mainline pipe, lateral pipe and wiring sleeves.

- D. Size sleeves are as shown on the drawings. Wiring bundle contained in the sleeve should not exceed 40% of the available area within the sleeve per NEC recommendations.

2.4 PIPE AND FITTINGS

A. Mainline Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.
3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings conforming to ASTM A536 and ASTM F477. Use lubricant approved by the pipe manufacturer. Acceptable manufacturer for ductile iron fittings is Harco or approved equal.
4. Provide joint restraint harness at valves, changes of direction and as recommended by the manufacturer. For joint restraints on PVC pipe applications, use restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536 and ASTM F1674 and meeting the requirements of UNI-B-13-94. Grip ring serrations to be machined. Cast serrations are not permitted. Restraint rods, bolts, and nuts to be low alloy steel meeting AWWA/ANSI C111/A21.11. Acceptable manufacturer and model are EBBA Iron Megalug Series, HARCO 820000 Series, Ford Meter Box Uni-Flange Series or approved equal.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Class 160, SDR-26, rated at 160 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in the case of small nominal diameters not manufactured in Class 160.

3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
2. Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly:

1. As presented in the installation details.
2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure and mechanical joint ends meeting AWWA Standard C509. Acceptable manufacturers are NIBCO, Clow, Kennedy, Mueller or approved equal.
3. Valve Box: Use plastic 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

B. Quick Coupling Valve Assembly:

1. As presented in the installation details.
2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with locking vinyl cover. Acceptable manufacturer and model is Rain Bird 5-LRC to match existing equipment or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Rain Bird to match existing equipment or approved equal.
4. Quick Coupler Anchor: Use pre-manufactured bolt on anchor or swing joint integrated anchor. Acceptable manufacturers are Harco, Lasco, Spears, or approved equal.

5. Valve Box: Use plastic 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

C. Flower Water Station Renovation:

1. As presented in the installation details.
2. Hydrant: Use Haws Model 6252EHLF. Hydrant must have a self closing shut-off handle and be ADA compliant.
3. Curb Stop Valve: Reuse existing valve.
4. Pressure Regulator: Replace existing pressure regulator with Watts Model LF25AUB Z3, size 1-inch, set to 30 PSI or approved equal.
5. Faucet Post with Sign: Use cast stone precast concrete post, 7 ½-inches square with 1-inch chamfer on all exposed edges. Reinforce with four (4) #3 rebar equally spaced. Refer to Specification Section 10 14 00 Exterior Signage for casting and signage construction requirements. Submit shop drawings and sample as required by Specification Section 10 14 00.
6. Copper Pipe: Use Type "M" soft tubing conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details. Use a 95-percent tin and 5-percent antimony solder.
7. Concrete Slab: Use 3500 PSI concrete. Reinforce and finish per installation details.
8. Valve Box: Reuse existing valve box.
9. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

2.6 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. As presented in the installation details.
2. Remote Control Valve: Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating will not be less than 200 PSI. The valve body and bonnet will be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm will be of nylon reinforced nitrile rubber. The valve will have both internal and external manual open/close control (internal and

external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve's internal bleed will prevent flooding of the valve box. The valve will house a fully encapsulated, one-piece solenoid. The solenoid will have a captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. Use 24 VAC 50/60 Hz solenoid that is compatible with a low voltage control wire control system. Valve must have a flow control stem for accurate manual regulation and/or shutoff of outlet flow. The valve must open or close in less than 1 minute at 200 PSI and less than 30 seconds at 20 PSI. The valve will have a self-cleaning stainless steel screen designed for use in dirty water applications. Provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. Valve must have a pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture and model is Rain Bird PESB to match existing equipment or approved equal.

3. Shut-off Valve: Use an angle valve AWWA C135 rated, ductile iron epoxy coated with stainless steel valve mechanism and restraint system. Acceptable manufacturers are Leemco LV212/218 and Harco swivel 90 lateral isolation valve.
 4. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
 5. Valve Box: Use plastic large valve box with black lid or combination of standard and round valve boxes with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
 6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
 7. Install assembly over gravel sump as presented in the installation details.
 8. Wire connectors: Use 3M DBR/Y-6.
 9. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.
- B. Pop-Up Rotor Sprinkler Assembly:
1. As presented in the installation details.
 2. Rotary Sprinkler: Use a gear drive sprinkler capable of covering the radius with the discharge rate at the pressure as presented

on the drawings. Furnish part circle sprinklers with an adjustable arc of 20- to 340-degrees, and full circle sprinklers with a non adjustable arc. Furnish sprinkler with stainless steel pop-down spring. Nozzle must be tested per ASAE S398.1 and be verified to deliver Distribution Uniformity of 80% or more and a Scheduling Coefficient of 1.2 or less at the specified offset spacing. Furnish sprinkler with stainless steel risers, integral check valve in base of the case capable of holding back 10 feet of elevation. Minimum pop-up height is 3 ½-inches. Acceptable manufacturer and models is Rain Bird 5000Plus and 8005 to match existing equipment or approved equal.

3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Rain Bird to match existing or approved equal.

C. Pop-Up Spray Sprinkler Assembly:

1. As presented in the installation details.
2. Spray Sprinkler: Use a spray sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish sprinkler with pressure reducing module in the riser stem and integral check valve in base of the case capable of holding back a minimum of 8 feet of elevation. Minimum pop-up height is 4-inches. Acceptable manufacturer and model is Rain Bird 1800-SAM-PRS to match existing equipment or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint with ½-inch inlet. Acceptable manufacturer is Rain Bird to match existing equipment or approved equal.

2.7 CONTROL SYSTEM COMPONENTS

A. Existing Control System (For Contractor Information): Existing stand-alone, pedestal mounted controllers are Hunter I-Core. Stations on the existing controllers are reused for new irrigation system.

B. Controller:

1. Description: Stand-alone controller, pedestal mounted, compatible with and identical to existing controllers. Acceptable manufacturer and model is Hunter I-Core.
2. Basic Capabilities:
 - a. 100% solid state electrical components with heavy duty, additional, surge protection for input and output circuits.
 - b. Large capacity terminal block.

- c. 24 VAC transformer capable of operating nine solenoids simultaneously.
 - d. Surge protection backed by 3-year lightning warranty.
 - e. Battery backup of at least 14 days.
 - f. Remote activation of each station from hand held radio.
 - g. Minimum number of stations as shown on the drawings.
 - h. AG 2401 surge/lightning protection on power side
 - i. Maximum surge protection by manufacturer on station side
 - j. Stainless steel enclosure
 - k. Compatible with a master valve and flow sensor
3. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1785. Fittings for PVC conduit will be Schedule 40, Type 1, PVC solvent weld fittings, ASTM Standards D2466 and D1784.
 4. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.
 5. Lightning protection: Provide two (2) 5/8"x10 foot copper clad UL listed grounding rods, approximately 30 feet of #6 AWG bare copper grounding wire, two 6-inch plastic round valve boxes, and CADWELD connectors at each controller.

C. Power Wire:

1. Electric wire from the power source to satellite control unit shall be solid or stranded copper, Type TC Round Jacketed multi conductor cable with ground, direct burial, UL listed, rated at 600 volts. Power wires shall be black, white, and green in color. Contractor is responsible for ensuring the power wire sizes are compatible and adequate for the control system being used.
2. Splices: Use 3M #82-A2 Series with Split Bolts or Butt Connectors for inline splices and 82-B1 or 90-B1 Series for wye splices.
3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
4. Warning tape to be installed above all power wire and communication cable, use non-detectable marking tape 4.0 mil

thickness, linear low-density polyethylene, specifically formulated for extended use underground. The legend shall continually repeat a minimum of every three feet. The tape tensile strength shall be in accordance with ASTM D882 and not be less than 4100 MD and 3650 TD. Elongation properties shall be in accordance with ASTM D882 and be greater than 550% at break point. Tape to remain flexible and pliable. Tape composition shall be of virgin LLDPE/LDPE. The tape color shall be red. The legend shall read "Caution Electric Line Buried Below". The tape width shall be 3-inch. Manufacturer T. Christy Enterprises, or approved equal.

D. Controller Wire:

1. Use American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
2. Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of a color different from that of active control wire. Wire color shall be continuous over its entire length.
3. Splices: Use 3M DBR/Y-6 splices as recommended by control system manufacturer.
4. Valve Box: Use plastic standard rectangular valve with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.
5. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations.
6. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be

encountered in soils. Three inches wide colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW", in black lettering.

2.8 OTHER COMPONENTS

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

- A. Site Inspections:
 - 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the CO/COR prior to beginning work.
 - 2. Beginning work of this section implies acceptance of existing conditions.
- B. Utility Locates ("Call Before You Dig"):
 - 1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
 - 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the CO/COR one week in advance of review. The COR will identify modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- B. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with COR.
- C. Sprinklers in Pre-Placed Crypt Sections:
 - 1. After pre-placed crypts are installed by prior to the pre-placed crypts being covered with soil, visually inspect, identify and

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stake sprinkler locations inside the pre-placed crypt section as identified on the drawings.

2. Confirm monumentation offset with Cemetery staff.
3. As presented in the installation details, each sprinkler must be located such that after installation, each sprinkler is centered between the monumentation.
4. Record the location of each sprinkler using a method that cannot be altered during the backfill process for the pre-placed crypts. Use a permanent stake, GPS coordinates or other method so each sprinkler is installed at the proper location, centered between the monumentation.
5. Prior to staking, inform CO/COR of recording method to be used for sprinkler locations.

3.3 EXCAVATION, TRENCHING, BACKFILLING AND HORIZONTAL BORING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Existing Survey Markers:
 1. Protect markers during construction.
 2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it.
- C. Existing Monumentation and Gravesites: At no time shall soil be allowed to pile on or around the existing gravesites and monumentation. Use a tarp when excavation trenches in burial sections. Trenches in burial sections may not be open longer than 24 hours. Backfill material spoils must be removed immediately and not allowed to remain in burial sections after backfill is complete. Sod to be installed over all trenches within 4 days of trench backfill.
- D. Installation Methodology:
 1. Mainline:
 - a. Open trench to install PVC mainline pipe.
 - b. Mainline pipe has been routed to avoid conflicts with existing trees. Do not install mainline pipe within drip line of any existing tree. Immediately contact CO/COR if a conflict between mainline pipe routing and an existing field condition is identified.

2. Lateral Pipe in Burial Sections:
 - a. Open trench to install PVC lateral pipe.
 3. Lateral Pipe in Non-Burial Areas:
 - a. Open trench to install PVC lateral pipe.
 - b. As an alternative to trenching, a vibratory plow device specifically manufactured for pipe pulling may be used to install lateral pipe in non-burial areas. Maintain minimum burial depth. Roll trench after pulling pipe.
- E. Minimum cover:
1. 36-inches over irrigation mainline pipe in landscaped areas. (distance from top of pipe to finish grade)
 2. 22- to 28-inches over irrigation lateral pipe to sprinklers in pre-placed crypt field. Lateral pipe must be installed 4-inches below crypt lid. (distance from top of pipe to finish grade)
 3. 26-inches over irrigation lateral pipe to sprinklers in in-ground cremain burial sections. (distance from top of pipe to finish grade)
 4. 18-inches over irrigation lateral pipe to sprinklers in non-burial areas. (distance from top of pipe to finish grade)
 5. 24-inches over low voltage control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
 6. 6-inches vertical separation between mainline pipe and lateral pipe installed in a common trench.
 7. 4-inch minimum horizontal separation between pipes and wiring in a common trench.
 8. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
- F. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the COR.
- G. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- H. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the COR.
- I. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, and stones larger than 2-

inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.

- J. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
 - 1. Backfill trench using excavated material in 6-inch layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- K. Backfill mainline, lateral pipe and wiring in turf areas in the following manner:
 - 1. Backfill the trench and directional boring excavations by depositing the backfill material equally on both sides of the pipe or wire in 6-inch layers and compacting to the density of surrounding soil.
- L. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the COR.
- M. Resod all trenches and areas disturbed by construction of the irrigation system. See installation details installation procedure description.
- N. Where utilities conflict with irrigation trenching and pipe work, contact the COR for trench depth adjustments.
- O. Horizontal Boring:
 - 1. Use horizontal directional drilling techniques as recommended by NASTT, ASTM F1962, ASCE and in accordance with accepted industry practices.
 - 2. Locate and stake bore pit locations. Contact COR to confirm that bore pit locations are acceptable.
 - 3. Dispose of excess directional boring slurry legally off-site.
 - 4. Backfill bore pits to original grade. Backfill by depositing the backfill material in 6-inch layers and compacting to the density of surrounding soil. Remove excess backfill to on-site location as direction by the COR.
 - 5. Resod bore pit if located in existing turf area.

3.4 SLEEVING

- A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- B. Extend sleeve ends a minimum of 12-inches beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.

C. Verify that sleeve sizing is adequate prior to installation. Note that sleeves required for pipe are a minimum of twice the diameter of the pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

A. General:

1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"
6"	150'	1'-4"
8"	200'	1'-0"

B. Mainline Pipe and Fittings:

1. PVC Rubber-Gasketed Pipe:

- a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Ductile iron fittings will not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.
- c. Install joint restraint harness per the installation details and in the manner recommended by the manufacturer and in accordance with accepted industry standards.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
- c. Snake pipe from side to side within trench.

2. Fittings: The use of cross type fittings is not permitted.

3. Lateral Pipe and swing joints installed in Pre-Placed Crypt sections:

- a. Lateral pipe and fittings may be installed prior to backfill over pre-placed crypts to ensure correct placement and depth.
- b. Contractor responsible for locating the correct tee or el fitting locations in pre-placed crypt areas by using GPS survey grade equipment or installing the pipe and measuring the distance from the crypt ends prior to backfill. All tee locations to be staked and approved by COR.
- c. Cap all swing joint ends prior to backfill.
- d. Mark swing joint locations prior to backfill and final grade using 30-inch length of 1-inch PVC pipe or other approved method. Submit alternate method with submittal review if applicable. Note that grid markers are typically set after the final grade and will typically not be available for reference in location sprinkler locations in pre placed crypt sections.

D. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
2. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
 - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "GV" in 2-inch high by 3/16-inch deep letters on valve box lid.

B. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Flower Water Station Renovation:

1. Locations of existing Flower Water Stations are shown on plans. Confirm locations can coordinate renovation schedule with CO/COR. Only two (2) Flower Water Stations can be renovated simultaneously. Prior to renovation, photograph each flower vase receptacle and trash receptacle to document existing condition. Photograph in the presence of COR. Provide copies of photographs to COR. Any damage to existing flower vase receptacle(s) or trash receptacle(s) is the Contractor's responsibility to correct or replace.
2. As presented in the installation details, per manufacturer's instructions.

3. Sequence of Construction:
 - a. Install and maintain safety fencing around flower water station until renovation is complete.
 - b. Remove existing flower vase receptacle and trash receptacle. Store and protect receptacles during renovation.
 - c. Demolish existing concrete pad. Remove existing hydrant, copper pipe and pressure regulating valve. Turn over hydrant, pressure regulating valve and copper pipe to Cemetery Maintenance staff. Properly dispose of concrete offsite.
 - d. Install new pressure regulating valve to match existing. Reuse existing valve box.
 - e. Install copper pipe, precast concrete post and concrete pad per installation details. Attach "Do Not Drink" sign to hydrant.
 - f. After concrete is finished, reinstall flower vase receptacle and trash receptacle. Use new stainless steel anchors and bolts per receptacle manufacturer's recommendations.
 - g. Resod area around flower water station disturbed by construction.
4. Pressure Regulator: Operate spigot to verify factory pressure setting at 30 PSI. Adjust discharge pressure to 30 PSI if necessary.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

A. Mainline Pipe Flushing:

1. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
2. Identify service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
3. Connect 2-inch pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations or erode site.
4. Use a volume of water such that the velocity in the largest pipe flushing to this point is a minimum of 3 FPS.
5. Multiple points may be flushed simultaneously.
6. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.

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7. CO/COR will review the flushing operation and clarity of water before stopping the flushing operation.
8. Disconnect pipe from service tee(s) and install remote control valve(s).

B. Remote Control Valve Assembly:

1. Install per manufacturer's recommendations where indicated on the drawings.
2. Adjust valve to regulate the downstream operating pressure to 70 PSI for pop-up rotary sprinklers and 35 PSI for spray sprinklers.
3. Wire connectors and waterproof sealant will be used to connect low voltage control wire to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
4. Install only one remote control valve to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas. Group valve boxes together where possible equidistant from the adjacent valve boxes.
5. Attach ID tag with controller station number to control wiring at solenoid.
6. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Pop-Up Rotor Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install rotary sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.
8. Install 2-foot square piece of sod around all rotary sprinklers in areas to be seeded.

D. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install spray sprinklers 3-inches from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing pipe and fittings per manufacturer's recommendations.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Controller:

1. Install new controller(s) at location(s) shown in the construction documents.
2. Install electrical connections per control system manufacturer's recommendations. Electrical connections are to be completed by control system manufacturer's trained representative.
3. Lightning protection: Drive grounding rods into soil its full length. Connect #6 AWG copper grounding wire to rods using CADWELD connections.
4. Attach wire markers to the ends of low voltage control wire cable inside controller. Label cable with the identification number per irrigation plan.
5. Install permanent receiver for hand held radio if not factory installed.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 12-inch standard valve box. Coil 2 feet of wire in valve box. Brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.

2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 2-inches below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.
7. Surface mount wire installed above grade in a professional manner with routing approved by the COR.
8. Connect wire to power source.

C. Control Wire:

1. Route low voltage control cable in mainline trench.
2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box or valve-in-head sprinkler.
3. If a cable must be spliced, make splice with waterproof connectors and sealant installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
4. Unless noted on plans, install wire parallel with and below mainline pipe.
5. Install control wire in conduit as indicated on plans.
6. Protect wire not installed with pipe or conduit with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

3.9 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Irrigation System Maintenance:

1. Prior to Final Inspection, provide one 4-hour training session to operating personnel on proper operation and maintenance of the new irrigation system. Training session should cover aspects maintaining, operating and repairing the new irrigation system components.
2. Submit per Section 1.4. Include table of contents and index sheet. Provide sections that are indexed and labeled for the following information:
 - a. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - b. Manufacturer's Operation and Maintenance manuals.
 - c. Manufacturer's Technical Service Bulletins.
 - d. Manufacturer's Warranty Documentation.
 - e. Recommended routine maintenance inspections for weekly, monthly and annual inspections, recommended actions for the inspections, recommended method for recording the findings of the inspections and proper winterization techniques.
 - f. Predictive schedule for component replacement.
 - g. Listing of technical support contacts.
3. Operation and maintenance submittal package must be complete prior to being reviewed by the COR. Incomplete submittals will be returned without review.

B. Control System Programming:

1. Provide the necessary operating data for the new irrigation system to COR such that operating personnel can reprogram the

existing central control system. Data to be supplied by the Contractor must include station number, sprinkler equipment, flow rate, calculated precipitation rate based on the Distribution Uniformity test, calculated peak season run time and recommended turf establishment run time(s).

2. Calculate the peak season run time for each new station using the precipitation rate results of the Distribution Uniformity test(s).
3. Verify operation of program with operating personnel and CO/COR.

C. Colored Controller Charts:

1. Prepare a map diagram showing location of all valves, piping, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared. Map diagram can be constructed using AutoCAD or PDF computer software. Adjacent lateral pipes to be of different color, use four different colors for lateral pipe.
2. Include legend listing components used for the controller. Include a separate sprinkler table listing station number, sprinkler manufacturer and model, zone capacity, and number of sprinklers on the zone.
3. Provide one colored full sized controller chart for each irrigation plan sheet showing the area covered by the controller. Provide four 11"x17" reduced colored charts of the actual "as-built" drawing. Chart must be readable at the reduced size.
4. Laminate one 11"x17" sized colored chart and place laminated chart in lid of each controller.

3.11 PROJECT RECORD DRAWINGS

- A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, two complete sets of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded on Project Documents.
- B. Record irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Special attention must be given to pipe routing and controller stationing.

- C. At completion of installation, Contractor must hire a Professional Licensed Surveyor to survey/document locations of all sprinklers, irrigation components enclosed within a valve box, controllers, flower water stations, wire splice boxes and "coordination points". If necessary, Contractor must flag sprinklers for Surveyor. Surveyor must use "SPR" as attribute data for sprinklers, the branding in the valve box lid (for example "GV", "AV", "QC") as the attribute data for components enclosed within a valve box, "CTLR" as the attribute data for controllers, "FWS" for flower water station, "WS" for wire splice boxes and "CP" for coordination points. COR will provide AutoCAD file for Surveyor showing coordination points to produce "Survey Drawing". Surveyor is to use the AutoCAD files to develop and provide an AutoCAD file and PDF file of the Survey Drawing.
- D. Prior to project completion, Contractor must provide the project redline drawings and the "Survey Drawing" AutoCAD files to COR for delivery to VA's A/E representative. A/E will prepare "Record Drawings" by compiling the information on the Contractor redlines drawings and the "Survey Drawing". Provision of this information prerequisite for Final Inspection.

3.12 MAINTENANCE

- A. Operate and maintain irrigation system for a duration of 30 calendar days from Final acceptance. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

3.13 CLEANUP

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work in this section consists of furnishing and installing turf and grasses specified in locations shown.

1.2 RELATED WORK

- A. Topsoil Testing: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.
- C. Stripping Topsoil, Stock Piling and Topsoil Materials: Section 31 20 00, EARTH MOVING.
- D. Section 32 84 00, PLANTING IRRIGATION.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- C. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- D. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.
 - 2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and

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airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk material with appropriate certificates.

C. Harvest, deliver, store, and handle sod according to requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.

D. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing, certified analysis, name and address of manufacturer, product label, manufacturer's application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

1.5 PROJECT CONDITIONS

A. Verify actual grade elevations, service and utility locations, irrigation system components, and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Plant during the following planting period and conditions:

1. April 1 - August 31 (Spring through Summer); AND

2. All danger of freeze or frost is past.

C. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.6 QUALITY ASSURANCE:

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association with 5 years experience in landscape installation.

2. Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Pesticide Applicator: Licensed in state of project, commercial.

- B. Include an independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
 - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60, "Diagnosis and Improvement of Saline and Alkali Soils".
 - 2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Contracting Officer's Representative. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 - 3. Report suitability of tested soil for plant growth.
 - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- D. Include product label and manufacturer's literature and data for pesticides and herbicides.
- E. Conduct a pre-installation conference at Project site.

1.7 SUBMITTALS

- A. Submit product data for each type of product indicated, including soils:
 - 1. Include EPA approved product label, MSDS (Material Safety Data Sheet) and manufacturer's application instructions specific to the Project.
- B. Qualification data for qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's

- capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- C. Prior to delivery, provide notarized certificates attesting that each type of manufactured product, from the manufacturer, meet the requirements specified and shall be submitted to the Contracting Officer's Representative for approval:
1. Seed and Turf Materials notarized certificate of product analysis.
 2. Manufacturer's certified analysis of standard products.
 3. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- D. Material Test Reports: For standardized ASTM D5268 topsoil, existing native surface topsoil, existing in-place surface soil, and imported or manufactured topsoil.
- E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf and grasses during a calendar year. Submit before start of required maintenance periods.

1.8 TURF ESTABLISHMENT PERIOD

- A. The establishment period for turf shall begin immediately after installation, with the approval of the Contracting Officer's Representative, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Establishment Period the Contractor shall maintain turf as required in Part 3.

1.9 TURF MAINTENANCE SERVICE

- A. Provide initial maintenance service for turf areas by skilled employees of landscape Installer. Begin maintenance immediately after turf is installed and continue until turf is acceptably healthy and well established but for not less than maintenance period below.
1. Maintenance Period: 12 months from date of Final Acceptance.
- B. Obtain continuing maintenance proposal from Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.10 APPLICABLE PUBLICATIONS

- A. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. American National Standards Institute (ANSI):
 - Z60.1-04.....Nursery Stock
- C. Association of Official Seed Analysts (AOSA): Rules for Testing Seed.
- D. American Society For Testing And Materials (ASTM):
 - B221-08.....Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 - C33/C33M-11.....Concrete Aggregates
 - C136-06.....Sieve Analysis of Fine and Coarse Aggregates
 - C516-08.....Vermiculite Loose Fill Thermal Insulation
 - C549-06.....Perlite Loose Fill Insulation
 - C602-07.....Agricultural Liming Materials
 - D977-05.....Emulsified Asphalt (AASHTO M140)
 - D5268-07.....Topsoil Used for Landscaping Purposes
- E. Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada.
- F. Turfgrass Producers International (TPI): Guideline Specifications to Turfgrass Sodding.
- G. United States Department of Agriculture (USDA): Handbook No. 60
Diagnosis and Improvement of Saline and Alkali Soils; Federal Seed Act Regulations.
- H. National Cemetery Administration (NCA):
 - Handbook 3420-08.....Turfgrass Maintenance
 - Appendix TL-08.....Cemetery Construction Requirements for Turfgrass and Landscape Plant Material Installation

1.11 WARRANTY

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom

within a period of one year from final acceptance, unless noted otherwise below. Further, the Contractor will provide all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

1. Turf Warranty Periods will begin from the date of Substantial Completion.
 2. The Contractor shall have completed, located, and installed all turf and seed mix according to the plans and specifications. All turf is expected to be living and in a healthy condition at the time of final inspection.
 3. The Contractor will replace any areas void of turf immediately, unless required to plant in the succeeding planting season. Provide extended warranty for period equal to original warranty period for replacement plant materials. Replacement turf warranty will begin on the day the work is completed.
 4. The Government will reinspect turf at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective turf immediately. The Warranty Period will end on the date of this inspection provided the Contractor has complied with the warranty work required by this specification. The Contractor shall also comply with the following requirements:
 - a. Complete remedial measures directed by the Contracting Officer's Representative to ensure turf survival.
 - b. Repair damage caused while making turf replacements.
- B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.

PART 2 - PRODUCTS

2.1 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36 mm) sieve and a minimum of 75 percent passing through No. 60 (0.25 mm) sieve.
 2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36 mm) sieve and a minimum of 55 percent passing through No. 60 (0.25 mm) sieve.
 3. Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35 mm) sieve and a maximum of 10 percent passing through No. 40 (0.425 mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: ASTM C549, horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30 mm) sieve.
- G. Coarse Sand shall be concrete sand, ASTM C33 Fine Aggregate, clean, sharp free of limestone, shale and slate particles, and toxic materials.
- H. Vermiculite: ASTM C516, horticultural grade and free of any toxic materials.
- I. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- J. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.2 ORGANIC SOIL AMENDMENTS

- A. Organic matter: Commercially prepared compost. Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch (25 mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.
 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.3 TURF FERTILIZERS

- A. Soil Test: Evaluate existing soil conditions and requirements prior to fertilizer selection and application to minimize the use of all fertilizers and chemical products. Obtain approval of Contracting Officer's Representative for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- C. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 PLANTING SOILS

- A. Planting Soil: ASTM D5268 topsoil, with pH range of 6.0 to 7, a minimum of 2 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D5268 topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.
- B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
1. Supplement with planting soil when quantities are insufficient.

2. Mix existing, native surface topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.

C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources can be used if sufficient topsoil is not available on site to meet the depth as specified herein. The Contractor shall furnish imported topsoil. At least 10 days prior to topsoil delivery, notify the Contracting Officer's Representative of the source(s) from which topsoil is to be furnished. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from bogs or marshes.

2.5 WATER

A. Water shall not contain elements toxic to plant life. Water to be obtained from Project Site at no cost to the Contractor.

2.6 ANTIDESICCANT

A. Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.7 TURF SELECTIONS

A. Grasses for Project Site shall be:

1. Celebration Bermudagrass (*Cynodon dactylon* 'Celebration')

B. Common Bermudagrass (*Cynodon dactylon*) All cemetery turf seed mixtures or sod compositions shall conform to the species and cultivar requirements detailed in the "Appendix T/L for NCA Cemetery Construction Requirements". Any deviation from the turf species requirements must receive written approval by the NCA Chief Agronomist and appropriate MSN Agronomist in coordination with the Contracting Officer's Representative.

2.8 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with "AOSA, Rules for Testing Seed" for purity and germination tolerances. Seed shall be labeled in conformance with U. S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable.

B. Seed Species: Not less than 95 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.

1. Seed Species: Common Bermudagrass (*Cynodon dactylon*).

2.9 SOD

- A. Sod: Certified , complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding". Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Sod Species: Grass species as follows, with not less than 95percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 - 1. Sod Species: Celebration Bermudagrass (Cynodon dactylon 'Celebration').

2.10 PESTICIDES

- A. Consider IPM (Integrated Pest Management) practices to minimize the use of all pesticides and chemical products. Obtain approval of Chief Engineer for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Pesticides to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive turf and seed for compliance with requirements and conditions affecting installation and performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a turf or seeding area.

PLANTING

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
 5. Special conditions may exist that warrant a variance in the specified planting dates or conditions. Submit a written request to the Contracting Officer's Representative stating the special conditions and proposal variance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Contracting Officer's Representative and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION AND GRADING

- A. For newly graded subgrades loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 1. Apply any lime and soil amendments directly to subgrade before loosening, at rates recommended by the soils analysis.
 2. Spread topsoil, apply soil amendments on surface, and thoroughly blend planting soil.
 3. Spread planting soil to a depth of 6 inches (150 mm) but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

PLANTING

- a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- B. Finish grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS.

- A. Prepare area as specified in "Turf Area Preparation and Grading" Article.
- B. For erosion control mats, install planting soil in two lifts, with second lift equal to thickness of erosion control mats. Install erosion control mat and fasten with biodegradable materials as recommended by material manufacturer.
- C. Fill cells of erosion control mat with planting soil and compact before planting.
- D. For erosion control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten with biodegradable materials as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 2 lb/1000 sq. ft. (0.9 kg/92.9 sq. m).
- C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and fastened with biodegradable materials according to manufacturer's written instructions.
- E. Protect seeded areas with erosion control mats where shown on Drawings; install and anchor with biodegradable materials according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying, compost mulch or peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm), and roll surface smooth.

3.6 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with biodegradable staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently until sod is established.

3.7 TURF RENOVATION

- A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
 - 1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 - 2. Install new planting soil as required.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
- H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
- I. Apply seed and protect with straw mulch or sod as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Celebration Bermudagrass to a height of 2 to 3 inches (50 to 75 mm).

3.9 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Contracting Officer's Representative:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.10 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Contracting Officer's Representative before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Applied to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Applied only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- E. After installation and before Project Completion, remove debris from plant material, planting areas, and Project site.
- F. Remove nondegradable erosion control measures after grass establishment period.
- G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

--- END ---

SECTION 33 46 13
FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies materials and procedures for construction of foundation drainage systems, including installation, backfill, and cleanout extensions, to a point of connection to storm sewer.

1.2 RELATED WORK

- A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTH MOVING (SHORT FORM).
- B. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.
- C. Submittals: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- D. Section 03 48 21 PRECAST CONCRETE BURIAL CRYPTS.

1.3 DEFINITIONS

- A. Subdrainage: Foundation drainage system that collects and removes subsurface or seepage water from building foundation from building to discharge pond.

1.4 ABBREVIATIONS

- A. PVC: Polyvinyl chloride plastic.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.6 COORDINATION

- A. Coordinate connection to storm sewer main, if approved, with the Public Agency responsible for the storm sewer system.
- B. Coordinate exterior utility lines and connections to foundation building drain.

1.7 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast

integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

- B. Comply with the rules and regulations of the Public Agency having jurisdiction over the connection to public storm sewer lines or the requirements for discharge of subsurface drainage.

1.8 APPLICABLE PUBLICATIONS

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

- B. American Society for Testing and Materials (ASTM):

- A48-03.....Gray Iron Castings
- C14-07.....Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
- C33/C33M-11.....Concrete Aggregates
- C443-10.....Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C444-03(2009).....Perforated Concrete Pipe
- C578-10a.....Rigid, Cellular Polystyrene Thermal Insulation
- C1173-08.....Flexible Transition Couplings for Underground Piping Systems
- D448-08.....Sizes of Aggregate for Road and Bridge Construction
- D1621-10.....Standard Test Method for Compressive Properties of Rigid Cellular Plastics
- D2235-04(2011).....Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
- D2321-11.....Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D2751-05.....Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
- D3034-08.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

- D3350-10a.....Polyethylene Plastic Pipe and Fittings Material
- D4491-99a(2009).....Test Methods for Water Permeability of
Geotextiles by Permittivity
- D4716-08.....Test Method for Determining the (In-plane) Flow
Rate per Unit Width and Hydraulic
Transmissivity of a Geosynthetic Using a
Constant Head
- D5926-09.....Poly (Vinyl Chloride) (PVC) Gaskets for Drain,
Waste, and Vent (DWV), Sewer, Sanitary, and
Storm Plumbing Systems
- D6707-06 (2011).....Circular-Knit Geotextile for Use in Subsurface
Drainage Applications
- F405-05.....Corrugated Polyethylene (PE) Pipe and Fittings
- F477-10.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe
- F667-06.....Larger Diameter Corrugated Polyethylene Pipe
and Fittings
- F2648-10.....2 to 60 Inch Annular Corrugated Profile Wall
Polyethylene (PE) Pipe and Fittings for Land
Drainage Applications

1.9 WARRANTY

The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one years from final acceptance. Further, the Contractor will furnish all manufacturer's and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements.

B. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.3 SOLID-WALL PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: ASTM D3034.

1. Gaskets: ASTM F477.

2.4 SPECIAL PIPE COUPLINGS

A. Comply with ASTM C1173 for joining underground non-pressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant metal tension band and tightening mechanism on each end.

1. Sleeve Materials:

a. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

2. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant metal tension band and tightening mechanism on each end.

2.5 CLEANOUTS

A. Cleanout PVC Extension shall conform to ASTM D3034. PVC extensions shall have watertight joints and long sweep elbow fittings. PVC cleanout shall have threaded plug and threaded pipe hub.

2.6 SOIL MATERIALS

A. Drainage Material

1. Bedding shall be crushed stone, 3/4 inch (20 mm) to No. 4 per ASTM D448, at a minimum or as per geotechnical recommendations.

2. Fill to 1 foot (300 mm) above pipe shall be Crushed stone, 3/4 inch (20 mm) to No. 4 per ASTM D448, at a minimum or as per geotechnical recommendations.

B. Concrete Sand shall be ASTM C33.

2.7 GEOTEXTILE FILTER FABRICS

A. Geotextile fabric shall conform to ASTM 6707. Elongation will be greater than 50 percent and the flow rate shall range from 110 to 330 gpm/sq. ft. (4480 to 13440 L/min. per sq. m).

1. Structure Type shall be Nonwoven, needle-punched continuous filament.
2. Style(s) shall be sock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING APPLICATIONS

- A. Underground Subdrainage Piping shall be:
 1. Perforated PE pipe and fittings, couplings, and coupled joints.
 2. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.
- B. Underslab Subdrainage Piping shall be:
 1. Perforated PVC sewer pipe and fittings and loose, bell-and-spigot joints.
- C. Header Piping shall be:
 1. PVC sewer pipe and fittings, couplings, and coupled joints.

3.3 CLEANOUT APPLICATIONS

- A. In Underground Subdrainage Piping:
 1. At Grade in Earth shall be Cast-iron cleanouts.
 2. At Grade in Paved Areas shall be Cast-iron cleanouts.
- B. In Underslab Subdrainage Piping:
 1. In Equipment Yards and Unfinished Areas shall be Cast-iron cleanouts.

3.4 FOUNDATION DRAINAGE INSTALLATION

- A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches (150 mm) deep and 12 inches (300 mm) wide.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).
- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with tape and install drainage piping.
- E. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.
- F. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).

3.5 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
 - 1. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (915 mm), unless otherwise indicated.
 - 2. Underslab Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
 - 3. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches (915 mm), unless otherwise indicated. However, when water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
 - 4. Lay perforated pipe with perforations down.
 - 5. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install PE piping or PVC piping according to ASTM D2321.

3.6 PIPE JOINT CONSTRUCTION

A. Join PVC pipe and fittings according to ASTM D2729.

B. Join perforated PVC pipe and fittings according to ASTM D2729.

C. Join perforated concrete pipe and fittings with gaskets according to ASTM C443.

D. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.7 CLEANOUT INSTALLATION

A. Cleanouts for Foundation or Retaining-Wall and Landscaping Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (450 by 450 by 300 mm) in depth. Set top of cleanout flush with grade. Cast-iron pipe may also be used for cleanouts in nonvehicular-traffic areas.

3. In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC or HDPE pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches (300 by 300 by 100 mm) in depth. Set top of cleanout plug 1 inch (25 mm) above grade.

B. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

2. Use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

3.8 CONNECTIONS

- A. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.
- B. Where required, daylight low elevations of foundation subdrainage to existing grade as shown.

3.9 IDENTIFICATION

- A. Install PE warning tape or detectable warning tape over ferrous piping.
- B. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.10 FIELD QUALITY CONTROL

Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.11 CLEANING

Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

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