



U.S. Department
of Veterans Affairs

FT. CUSTER NATIONAL CEMETERY
AUGUSTA, MI

CONSTRUCT 2,500 NICHE COLUMBARIUM
PROJECT 909CM3026

PROJECT MANUAL
BID SET
MARCH 4, 2015

PREPARED BY:

LEAD DESIGN CONSULTANT/ LANDSCAPE ARCHITECT:
MTR LANDSCAPE ARCHITECTS, LLC
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KCI TECHNOLOGIES
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IRRIGATION DESIGNER:
AQUA ENGINEERING, INC.
375 EAST HORSETOOTH ROAD BUILDING 2202, FORT COLLINS, CO 80525-3196

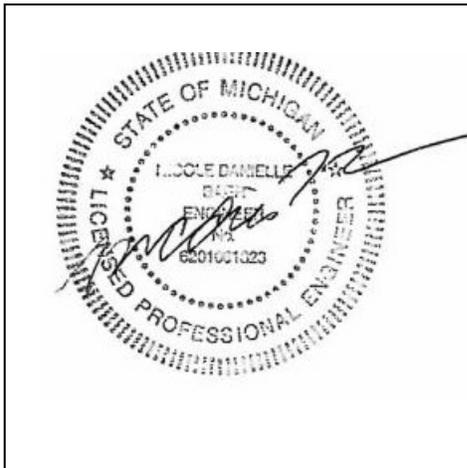
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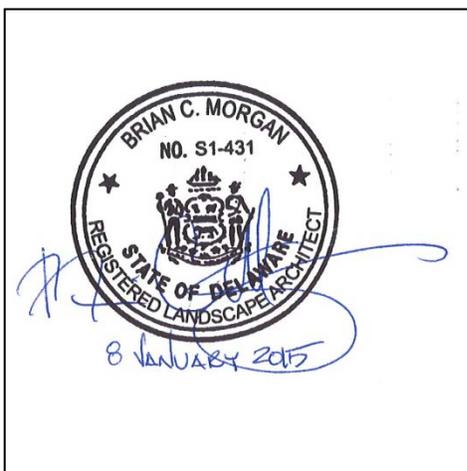
Lead Consultant/ Landscape Architect:
MTR Landscape Architects, LLC

Sections covered by this seal include:
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32 05 23, 32 12 16, 32 30 00, 32 90 00



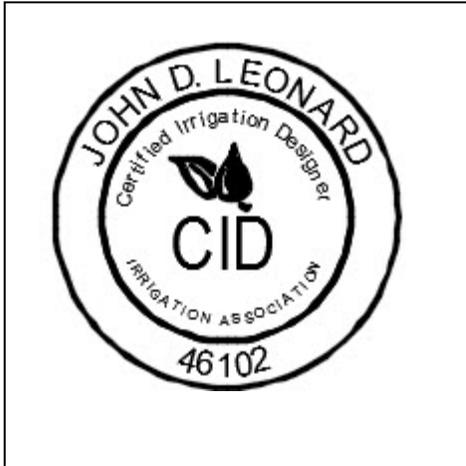
Structural Engineer:
KCI Technologies

Sections covered by this seal include:
03 30 53, 04 05 13, 04 05 16, 04 20 00,



Landscape Architect:
KCI Technologies

Sections covered by this seal include:
33 46 00



Irrigation Designer:
Aqua Engineering, Inc.

Sections prepared by Aqua Engineering
include:
32 84 00

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Ft. Custer National Cemetery
Construct 2,500 Niche Columbarium

Project 909CM3026
Bid Set - March 4, 2015

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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>
01	X-1.0 COVER SHEET / INDEX OF DRAWINGS
02	X-2.0 CONSTRUCTION PHASING PLAN
03	B-1.0 EXISTING CONDITIONS PLAN
04	B-1.1 EXISTING CONDITIONS PLAN
05	D-1.0 DEMOLITION AND CONSTRUCTION ACCESS PLAN
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24	I-101 IRRIGATION DETAILS
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SECTION 01 00 02
GENERAL REQUIREMENTS (MINOR NCA PROJECTS)

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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 furnish labor, materials, equipment and services and perform and complete all work for the columbarium at Ft. Custer 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. Offices of MTR Landscape Architects, as Architect-Engineers (A/E), may render certain technical services during construction. Such services shall be considered as advisory to the Government and shall not be construed as expressing or implying a contractual act of the Government without affirmations by CO/COR/Contracting Officers Representative (RE/COR) or his duly authorized representative.
- D. All employees of general contractor and subcontractors shall comply with security requirements as established by the RE/COR and 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. Contractor's Superintendent shall have the 30-hour OSHA certified Construction Safety course.
 - 2. All employees of general contractor or subcontractors shall, at the minimum, have successfully completed the 10-hour OSHA certified Construction Safety course.
 - 3. Submit OSHA training records of all employees for approval before the start of work.
- G. Working Hours: Working Hours: Contractor shall be permitted to work between the hours of 8:00 am and 4:30pm unless approved by CO/COR and Cemetery Director. Coordinate with Cemetery staff on the schedule of services each week and any required adjustments to working hours.

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:

site clearing and demolition, concrete, columbarium units, asphalt paving, stone masonry, landscaping, site furnishings, and irrigation.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

- A. AFTER AWARD OF CONTRACT, electronic .pdf 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 RE/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 RE/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 RE/COTR.
 - 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 RE/COR.
- C. Key Control:
 - 1. The General Contractor shall provide duplicate keys and lock combinations to the RE/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.

- E. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with RE/COR/Cemetery Director.
- F. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to RE/COR.
- G. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
- H. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
- I. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with RE/COR.
- J. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to RE/COR.
- K. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
- L. Dispose of waste and debris in accordance with NFPA 241. Remove from site weekly or more frequently if needed to maintain safe and orderly operations.
- M. 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 RE/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 RE/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 RE/COR, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the RE/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 RE/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.
 2. Provide unobstructed access to the Cemetery areas required to remain in operation.
 3. 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.
- G. Phasing: To insure such executions, the Contractor shall furnish the RE/COR with a schedule of approximate dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, the Contractor shall notify the RE/COR two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such dates to insure accomplishment of this work in successive phases mutually agreeable to the Cemetery Director, RE/COR and Contractor. See drawings.

- H. Construction Fence: Before construction operations begin, the Contractor shall provide a chain link construction fence, eight feet minimum height, around the construction area indicated on the drawings. Construction fence shall be temporary, free-standing type, 2" mesh opening with posts driven into the ground or in paved areas, panel stands ("feet"), secured by sandbags. 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 RE/COR.
- I. 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 RE/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 RE/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 RE/COR, and Cemetery Director's prior knowledge and written approval.
 2. The Contractor shall submit a request to interrupt any such services to both RE/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 RE/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 RE/COR.
 5. In case of a contract construction emergency, service will be interrupted on approval of RE/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.
- J. 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.
- K. 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 RE/COR.
- L. Coordinate the work for this contract with other construction operations as directed by RE/COR. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.
- M. 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 RE/COR, in arranging

construction schedule to cause the least possible interference with Cemetery activities in 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.

1.8 ENVIRONMENTAL CONTROLS

- A. In general, following preventive measures shall be adopted during construction to keep down dust.
 1. Dampen debris to keep down dust.

1.9 DISPOSAL AND RETENTION

- A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
 1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by RE/COR.
 2. Items not reserved shall become property of the Contractor and be removed by Contractor from the Cemetery.

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, that 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

employ at no additional expense to the Government a certified arborist to trim those limbs or branches with a clean cut and treat the affected area as recommended by the arborist and approved by the RE/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 RE/COR may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

- C. Refer to Section 01 57 19, 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.

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 water/irrigation work without approval of the RE/COR. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the RE/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, 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 KCI Technologies and Materials Testing Consultants, Inc.

(FAR 52.236-4)

- B. A copy of the geotechnical investigation report is included in the specifications and shall be considered part of the contract documents.
- C. 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 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 RE/COR. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the RE/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 RE/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 and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure, walls, roads, parking lots, walkways, etc., 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 RE/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 RE/COR before any major items of concrete work are placed. In addition, furnish to the RE/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. Elevations of columbarium foundations.
 2. Lines and elevations of sewers and of all outside distribution systems.
 3. Lines and elevations of roads, streets and parking lots.
 4. Northing/Easting coordinate locations and depth below finished grade of all water, sanitary, storm, gas and irrigation structures, directional fittings, control wire and lines.
- E. Upon completion of the work, the Contractor shall furnish the RE/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 RE/COR's review, as often as requested.
- C. The Contractor shall deliver two approved completed sets of as-built drawings to the RE/COR within 15 calendar days after acceptance of the project by the RE/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 and, when indicated or authorized by the RE/COR, such existing or Contractor constructed and/or modified temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed or modified 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.

- B. The contractor is responsible for any permits or fees associated with the use of public roads at no additional cost to the Government.

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 RE/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 no utilities available to the Contractor.
- B. 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:
- C. Electricity (for Construction and Testing): Furnish all temporary electric services.
 - 1. 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 burial sections.
- D. 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 RE/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.
- E. 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 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 RE/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 RE/COR and shall be considered concluded only when the RE/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 RE/COR, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

1.20 GOVERNMENT-FURNISHED PROPERTY

- A. The Government shall deliver to the Contractor, the Government-furnished property shown on drawings.
- B. Materials furnished by the Government to be installed by the Contractor will be furnished to the Contractor at the Cemetery.
- C. Storage space for materials will be provided by the Contractor and the Contractor shall be prepared to unload and store such equipment therein upon its receipt at the Cemetery.
- D. Notify RE/COR in writing, 60 days in advance, of date on which Contractor will be prepared to receive materials furnished by Government. Arrangements will then be made by the Government for delivery of materials.
 - 1. Immediately upon delivery of materials, the Contractor shall arrange for a joint inspection thereof with a representative of the Government. At such time the Contractor shall acknowledge receipt of materials described, make notations, and immediately furnish the Government representative with a written statement as to its condition or shortages.
 - 2. The Contractor thereafter is responsible for such material until such time as acceptance of contract work is made by the Government.
- E. Equipment furnished by the Government will be delivered in a partially assembled (knock down) condition in accordance with existing standard

commercial practices, complete with all fittings, fastenings, and appliances necessary for connections to respective services installed under contract. All fittings and appliances (i.e., couplings, ells, tees, nipples, piping, conduits, cables, and the like) necessary to make the connection between the Government furnished equipment item and the utility stub-up shall be furnished and installed by the contractor at no additional cost to the Government.

- F. Completely assemble and install the Government furnished equipment in place ready for proper operation in accordance with specifications and drawings.
- G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.21 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.) 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% or 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/Project Manager via email to NAME@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/Project Manager 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.

1.22 FINAL ELEVATION PHOTOGRAPHS

- A. Final photographs shall be taken by a commercial/professional photographer. They shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day at as large a scale as possible to obtain sufficient detail to show depth and to provide clear, sharp pictures. All images shall become property of the Government.
- B. Photographs shall be artistically composed showing full front elevations of new columbarium court site features and surrounding landscapes. A minimum of thirty six (36) images shall be taken as per these specifications.
- C. Minimum digital photo file size for final photos is 20 mb un-interpolated, preferably 52 mb. Submit proofs, via e-mail or web photo gallery, from which the COR/Project Manager will select the final images for printing.
- D. Pictures selected by the COR/Project Manager for printing shall be printed on regular weight paper, matte finish archival grade photographic paper and produced by a RA4 process from the digital image with a minimum 300 PPI. Photographs shall have full picture print with no margin.
- E. Submit two (2) 400 mm x 500 mm (16 x 20) framed prints and three (3) 8 x 10 prints of the final selected photos. Deliver to the COR/Project Manager, in boxes suitable for shipping,
- F. Submit a CD-ROM to the COR/Project Manager containing all (minimum 36) final digital photo files.

1. Images on CD-ROM shall be recorded in JPEG format with a minimum of 24 bit color and no reduction in actual picture size. 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 date the image was taken, the Project number and a unique sequential identifier.
 3. The CD-ROM shall also contain an index of all the images contained therein in either a TXT or Microsoft Word format.
- G. Each of the selected 16 x 20 prints shall be placed in a frame with a minimum 2 inches, maximum 3 inches, of appropriate matting as a border. Provide a selection of 3 different mats and 3 different frames from which the COR will select one mat and one frame style to frame both prints. Preferred frame style is wood molding, matte black finish, box frame, 1-1/8" wide x 7/8-inch deep.
- H. Place a typewritten self-adhesive identity label on the back of each final print without damage to photograph. PHOTO NUMBER shall be included in both the digital file name on the CD and on the photo print label.
- I. The following information shall be on the identity-label for photographs:
1. PHOTO NUMBER;
 2. CEMETERY NAME
 3. LOCATION;
 4. PROJECT TITLE;
 5. PROJECT NUMBER;
 6. DATE TAKEN;
 7. CONSTRUCTION COMPANY;
 8. CONTRACT NUMBER.

1.23 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 RE/COR verbally, and then with a written follow up.

1.24 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 01 32 17
NETWORK ANALYSIS SCHEDULES
(MICROSOFT PROJECT GANTT CHART)

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The Contractor shall develop a Microsoft Project 2003 (or later) Gantt Chart (bar chart) schedule demonstrating fulfillment of the contract requirements. The Contractor shall keep the network up-to-date in accordance with the requirements of this section. The Contractor shall utilize the plan for scheduling, coordinating and monitoring work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The Gantt Chart will be utilized to satisfy time applications.

1.2 CONTRACTOR'S REPRESENTATIVE:

- A. The Contractor shall designate an in-house representative who will be responsible to prepare the schedule, review the schedule and report progress of the project to the Contracting Officer's Representative.
- B. The Contractor's in-house representative shall be given authority to act on behalf of the Contractor in fulfilling the requirements of this specification section. Such authority shall not be interrupted throughout the duration of the project.

1.3 COMPUTER PRODUCED SCHEDULES:

- A. The contractor shall provide to VA monthly computer processing of all computer produced schedules generated from monthly project updates. The Contractor shall provide to VA two (2) copies of the updated Microsoft Project Gantt Chart and an electronic copy of this data. This must be submitted with and substantively support the contractor's monthly payment request.
- B. The Contractor is responsible for the correctness and timeliness of the computer-produced reports. The Contractor is also responsible for the accurate and timely submittal of the updated project schedule.
- C. VA shall report errors in computer-produced reports to the Contractor's representative within ten (10) calendar days from receipt of reports. The Contractor shall reprocess the Gantt Chart and associated CDs, when requested by the Contracting Officers Representative, to correct errors that affect the schedule for the project.

1.4 THE COMPLETE PROJECT GANTT CHART SUBMITTAL:

- A. The Complete Project Microsoft Project Gantt Chart will contain at least 50 work activities/events as necessary to fully detail the project schedule.
- B. Within ten (10) calendar days after receipt of the Notice to Proceed, the Contractor shall submit for the Contracting Officer's review, a Microsoft Project Gantt Chart and a CD. Each activity/event on the Gantt Chart schedule shall contain as a minimum, but not limited to, activity/event description, duration, start dates and finish dates. Activity constraints, not required by the contract, will not be accepted. Logic events (non-work) will be permitted where necessary to reflect proper sequence among work events, but must have zero duration.
- C. The complete working Gantt Chart shall reflect the Contractor's approach to scheduling the complete project. The final Gantt Chart in its original form shall contain no contract changes or delays that may have been incurred during the final Gantt Chart development period. It shall reflect the Contractors "AS BID" or "DAY 1" schedule. Changes and /or delays shall be entered at the first monthly update after the final Gantt Chart has been approved. The Contractor should provide their requests for time and supporting time extension analysis for contract time as a result of contract changes/delays, after this update, and in accordance with Article, ADJUSTMENT OF CONTRACT COMPLETION.
- D. Within ten (10) calendar days after receipt of the complete project Gantt Chart, the Contracting Officer or his representative, will do one or both of the following:
 - 1. Notify the Contractor concerning his actions, opinions, and objections.
 - 2. Schedule a meeting with the Contractor at, or near the job site, for joint review, correction or adjustment of the proposed plan. Within ten (10) calendar days after the joint review, the Contractor shall revise and shall submit two (2) copies of the revised Gantt Chart and a revised CD as specified to the Contracting Officer. The revised submission will be reviewed by the Contracting Officer and, if found to be as previously agreed upon, will be approved.

1.5 WORK ACTIVITY/EVENT AND COST DATA INFORMATION:

- A. The Contractor shall not be required to "cost load" the computerized Microsoft Project Gantt Chart. As part of this submission, the

Contractor shall provide a separate **Schedule of Costs** on AIA document G703. This Schedule of Costs shall reflect and contain all the same activities/events identified on the Gantt Chart.

- B. The Contractor and the Contracting Officer shall use this Schedule of Costs for monthly payment purposes as referenced in the General Conditions of this agreement.
- C. The Contractor and Contracting Officer shall agree on percentages for monthly work accomplished. The cumulative total amount of all cost loaded activities/events (including alternates) shall equal the total contract price.
- D. Prorate overhead, profit and general conditions on all work activities/events for the entire project. Negative work activity/event cost data will not be acceptable, except on VA issued contract changes.

1.6 GANTT CHART REQUIREMENTS:

- A. Show on the Gantt Chart the sequence and interdependence of work activities/events required for complete performance of all items of work. In preparing the Gantt Chart, the Contractor shall:
 - 1. Show the following on each work activity/event:
 - a. Concise description of the work represented by the activity/event.
 - b. Duration (in work days.)
 - 2. Show activities/events as:
 - a. Contractor's time required for submittal of shop drawings, templates, fabrication, delivery and similar pre-construction work.
 - b. Contracting Officer Representative's and Architect-Engineer's review and approval of shop drawings, equipment schedules, samples, template, or similar items.
 - c. Interruption of VA Cemetery utilities, delivery of Government furnished equipment, project phasing and any other specification requirements.
 - d. Test, balance and adjust various systems and pieces of equipment.
 - e. VA inspection and acceptance activity/event with a minimum duration of five (5) work days at the end of each phase and immediately preceding any VA move activity/event required by the contract phasing for that phase.
 - 3. Break up the work into activities/events of durations no longer than thirty (30) work days each, except as to non-construction

- activities/events (i.e., procurement of materials, delivery of equipment, concrete and asphalt curing) and any other activities/events for which the Contracting Officer may approve the showing of a longer duration. [The duration for VA approval of any required submittal, shop drawing, or other submittals shall not be less than ten (10) workdays.] The construction time as determined by the Gantt Chart schedule from start to finish for any sub-phase, phase or the entire project shall not exceed the total contract duration. Describe work activities/events clearly, so the work is readily identifiable for assessment of completion. Activities/events labeled "start," "continue," or "completion," are not specific and will not be allowed. Lead and lag time activities will not be acceptable.
4. Exterior Label Information: Provide the following information on an external label attached to each diskette(s):
- a. VA project number and project location.
 - b. Name and telephone number of a point of contact, preferably the person who created the CD
 - c. The CD number and total number of CDs in the set
 - d. The project data status date.

1.7 PAYMENT TO THE CONTRACTOR:

- A. Monthly, the contractor shall submit the Gantt Chart updated for remaining activity durations and a Schedule of Costs updated for costs. AIA application and certification for payment documents G702 and G703 will be used. The payment request should reflect and be in accordance with the provisions of the following Article, PAYMENT AND PROGRESS REPORTING, as the basis upon which progress payments will be made pursuant to Article, PAYMENT UNDER FIXED-PRICE CONSTRUCTION CONTRACTS of Section GENERAL CONDITIONS. The Contractor is entitled to a monthly progress payment upon approval of estimates as determined from the currently approved updated Schedule of Costs unless, in special situations, the Contracting Officer permits an exception to this requirement. Monthly payment requests shall include: two (2) copies of the updated Microsoft Project Gantt Chart, a listing of all project schedule changes, and associated data, made at the update. These must be submitted with and substantively support the contractor's monthly application and certificate for payment request documents.

- B. When the Contractor fails or refuses to furnish to the Contracting Officer the information and the associated updated Gantt Chart data, which, in the sole judgment of the Contracting Officer, are necessary for validating the monthly progress payment, the Contractor shall not be deemed to have provided supporting schedule data upon which progress payment may be reasonably determined.

1.8 PAYMENT AND PROGRESS REPORTING:

- A. Monthly job site progress meetings shall be held on dates mutually agreed to by the Contracting Officer (or Contracting Officer's Representative) and the Contractor. Presence of subcontractors during the progress meeting is optional unless required by the Contracting Officer (or Contracting Officer's Representative). Job progress will be reviewed to verify:
1. Actual start and/or finish dates for updated/completed activities/events.
 2. Remaining duration, required to complete each activity/event started, or scheduled to start, but not completed.
 3. Time and cost data for change orders, and supplemental agreements that are to be incorporated into the Gantt Chart.
 4. Percentage for completed and partially completed activities/events.
 5. Logic and duration revisions required by this section of the specifications.
 6. Activity/event duration and percent complete shall be updated independently.
- B. The Contractor shall submit a narrative report as a part of his monthly review and update, in a form agreed upon by the Contracting Officer. The narrative report shall include a description of problem areas; current and anticipated delaying factors and their estimated impact on performance of other activities/events and completion dates; and an explanation of corrective action taken or proposed. This report is in addition to the daily reports pursuant to the provisions of Article, DAILY REPORT OF WORKERS AND MATERIALS in the GENERAL CONDITIONS.
- C. As part of the monthly jobsite progress meeting, the General Contractor, specifically requested subcontractors and the Contracting Officers Representative shall meet to discuss the monthly updated schedule. The main emphasis shall be to address work activities to avoid slippage of project schedule and to identify any necessary

actions required to maintain project schedule during the reporting period.

1.9 RESPONSIBILITY FOR COMPLETION:

A. Whenever it becomes apparent from the monthly progress review meeting or the monthly computer-produced Gantt Chart schedule that phasing or contract completion dates will not be met, the Contractor shall execute some or all of the following remedial actions:

1. Increase construction manpower in such quantities and crafts as necessary to eliminate the backlog of work.
2. Increase the number of working hours per shift, shifts per working day, working days per week, the amount of construction equipment, or any combination of the foregoing to eliminate the backlog of work.
3. Reschedule the work in conformance with the specification requirements.

B. Prior to proceeding with any of the above actions, the Contractor shall notify and obtain approval from the Contracting Officer for the proposed schedule changes. If such actions are approved, the revisions shall be incorporated by the Contractor into the Gantt Chart before the next update, at no additional cost to the Government.

1.10 CHANGES TO GANTT CHART SCHEDULE:

A. Within ten (10) calendar days after VA acceptance and approval of any updated computer-produced schedule, the Contractor shall submit a revised Gantt Chart, the associated CDs, and a list of any activity/event changes including predecessors and successors for any of the following reasons:

1. Delay in completion of any activity/event or group of activities/events, which indicate an extension of the project completion by twenty (20) working days or 10 percent of the remaining project duration, whichever is less. Such delays which may be involved with contract changes, strikes, unusual weather, and other delays will not relieve the Contractor from the requirements specified unless the conditions are shown on the Gantt Chart as the direct cause for delaying the project beyond the acceptable limits.
2. Delays in submittals, or deliveries, or work stoppage are encountered which make rescheduling of the work necessary.
3. The schedule does not represent the actual prosecution and progress of the project.

4. When there is, or has been, a substantial revision to the activity/event costs of the network diagram regardless of the cause for these revisions.
- B. Revisions made under this paragraph, which affect the previously approved computer-produced schedules for Government furnished equipment, contract phase(s) and sub phase(s), utilities furnished by the Government to the Contractor, or any other previously contracted item, must be furnished in writing to the Contracting Officer for approval.
- C. Contracting Officer's approval for the revised Gantt Chart and all relevant data is contingent upon compliance with all other paragraphs of this section and any other previous agreements by the Contracting Officer or the Contracting Officer's Representative.
- D. The cost of revisions to the Gantt Chart resulting from contract changes will be included in the cost of the change.
- E. The cost of revisions to the Gantt Chart not resulting from contract changes is the responsibility of the Contractor.

1.11 ADJUSTMENT OF CONTRACT COMPLETION:

- A. The contract completion time will be adjusted only for causes specified in this contract. Request for an extension of the contract completion date by the Contractor shall be supported with a justification, Gantt Chart data and supporting evidence as the Contracting Officer may deem *necessary for determination as to whether or not the Contractor is* entitled to an extension of time under the provisions of the contract. Submission of proof based on revised activity/event logic, durations (in work days) and costs is obligatory to any approvals.
- B. The Contracting Officer's determination as to the total number of days of contract extension will be based upon the current computer-produced Gantt Chart schedule for the time period when the change took place and all other relevant information. The Contracting Officer will, within thirty (30) calendar days after receipt of such justification and supporting evidence, advise the Contractor in writing of his decision on the matter.
- C. The Contractor shall submit each request for a change in the contract completion date to the Contracting Officer in accordance with the provisions specified under Article, CHANGES, in the Section, GENERAL CONDITIONS. The Contractor shall include, as a part of each change order proposal, a sketch showing all revisions, duration (in work days)

changes, and cost changes, for work in question and its relationship to other activities on the approved network diagram.

- D. All delays due to non-work activities/events such as RFI's, WEATHER, STRIKES, and similar non-work activities/events shall be analyzed on a month by month basis.

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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, 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 CO/CORCO/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 therefore by Contracting Officer, 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 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 assumes no responsibility for checking quantities or exact numbers included in such submittals.
 - A. Submit 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 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 shall be tested, at the expense of Contractor, in a commercial laboratory approved by Contracting Officer.
1. Laboratory shall furnish Contracting Officer 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 approved commercial testing laboratory.
 4. Contractor shall send a copy of transmittal letter to both CO/COR and to Architect-Engineer simultaneously with submission of material to a commercial testing laboratory.
 5. Laboratory test reports shall be sent directly to CO/COR for appropriate action.
 6. 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.
 7. 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 CO/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 (except laboratory samples), shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

MTR Landscape Architects

101 Bellevue Rd., Ste 200

Pittsburgh, PA 15229

- 1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the CO/COR.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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)

- A. The specifications and standards cited in this solicitation can be examined at the following location:
United States Department of Veteran Affairs
Technical Information Library
www.cfm.va.gov/til/

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)

- A. The specifications cited in this solicitation may be obtained from the associations or organizations listed below.
- AA Aluminum Association, Inc.
www.aluminum.org
- AABC Associated Air Balance Council
www.aabchq.com

AADM	American Association of Automatic Door Manufacturers www.aaadm.com
AATC	American Association of Textile Chemists and Colorist www.aatcc.org
AAMA	American Architectural Manufacturer's Association www.aamanet.org
AAN	American Nursery and Landscape Association www.anla.org
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org/Pages/default.aspx
ACGIH	American Conference of Governmental Industrial Hygienists www.acgih.org
ACI	American Concrete Institute www.aci-int.net
ACPA	American Concrete Pipe Association www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association www.acppa.org
ADA	American with Disabilities Act www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag
ADC	Air Diffusion Council flexibleduct.org
AGA	American Gas Association www.aga.org
AGC	Associated General Contractors of America www.agc.org
AHA	American Hardboard Association www.domensino.com/AHA/
AIHA	American National Standards Institute/American Industrial Hygiene Association www.aiha.org/Pages/default.aspx
AISC	American Institute of Steel Construction www.aisc.org
AISI	American Iron and Steel Institute www.steel.org

AITC	American Institute of Timber Construction www.aitc-glulam.org
ALI	Automotive Lift Institute www.autolift.org/
AMCA	Air Movement and Control Association www.amca.org/
ANLA	American Nursery & Landscape Association www.anla.org
ANSI	American National Standards Institute, Inc. www.ansi.org
APA	Architectural Precast Association www.archprecast.org/
APA	The Engineered Wood Association www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute www.lightindustries.com/ARI/
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org/
ASAE	American Society of Agricultural Engineers www.asabe.org
ASCE	American Society of Civil Engineers www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers www.ashrae.org
ASME	American Society of Mechanical Engineers www.asme.org
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org
ASTM	American Society for Testing and Materials www.astm.org
AWI	Architectural Woodwork Institute www.awinet.org
AWS	American Welding Society www.aws.org
AWPA	American Wood Protection Association www.awpa.com

AWWA	American Water Works Association www.awwa.org
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com
BIA	The Brick Industry Association www.bia.org
CAGI	Compressed Air and Gas Institute www.cagi.org
CARB	California Environmental Protection Agency Air Resources Board arb.ca.gov/hompage.html/
CFR	Code of Federal Regulations www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR
CGA	Compressed Gas Association, Inc. www.cganet.com
CID	Commercial Item Description www.gsa.gov/portal/content/100847
CISCA	Ceilings and Interior Systems Construction Association www.cisca.org
CISPI	Cast Iron Soil Pipe Institute www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org
CPA	Composite Panel Association www.compositepanel.org/
CRA	California Redwood Association www.calredwood.org
CRI	Carpet and Rug Institute www.carpet-rug.com
CRRC	Cool Roof Rating System coolroofs.org/
CRSI	Concrete Reinforcing Steel Institute www.crsi.org
CSI	Cast Stone Institute www.caststone.org
DASMA	Door and Access Systems Manufacturers Association www.dasma.com/
DHI	Door and Hardware Institute www.dhi.org

DOE U.S. Department of Energy
www.energy.gov/

EEI Edison Electric Institute
www.eei.org

EGSA Electrical Generating Systems Association
www.egsa.org

EIMA Exterior Insulation Manufacturers Association
www.eima.com/

EPA Environmental Protection Agency
www.epa.gov

ETL ETL Testing Laboratories, Inc.
www.envirotestinglabs.com/

FCC Federal Communications Commission
www.fcc.gov

FHA Federal Highway Administration
www.fhwa.dot.gov/

FM FM Global
www.fmglobal.com

FPS The Forest Products Society
www.forestprod.org

FSC Forest Stewardship Council
www.fscus.org

GA Gypsum Association
www.gypsum.org

GANA Glass Association of North America
www.glasswebsite.com

GBI Green Building Initiative
www.thegbi.org/

GS Green Seal
www.greenseal.org

GSA General Services Administration
www.gsa.gov

HI Hydraulic Institute
www.pumps.org

HPVA Hardwood Plywood & Veneer Association
www.hpva.org

ICC The International Code Council
www.iccsafe.org/Pages/default.aspx

ICEA Insulated Cable Engineers Association Inc.
www.icea.net

IEEE Institute of Electrical and Electronics Engineers
www.ieee.org/

IGMA Insulating Glass Manufacturers Alliance
www.igmaonline.org

ITS Intertek Training Services
www.intertek.com/

MBMA Metal Buildings Manufacturers Association
www.mbma.com

MHI Material Handling Industry of America
www.mhi.org/

MIA Marble Institute of America
www.marble-institute.com/

MIC Masonry Industry Council

MPI Master Painters Institute
www.mpi.net/

MSJC Masonry Standards Joint Committee
www.masonrysociety.org/msjc/

NAAMM National Association of Architectural Metal Manufacturers
www.naamm.org

NAPHCC Plumbing-Heating-Cooling Contractors Association
www.phccweb.org/

NBS National Bureau of Standards
See - NIST

NEC National Electric Code
See - NFPA National Fire Protection Association

NEMA National Electrical Manufacturers Association
www.nema.org

NFPA National Fire Protection Association
www.nfpa.org

NFRC National Fenestration Rating Council
www.nfrc.org/

NHLA National Hardwood Lumber Association
www.natlhardwood.org

NIH National Institute of Health
www.nih.gov

NIOSH The National Institute for Occupational Safety and Health
www.cdc.gov/niosh/

NIST National Institute of Standards and Technology
www.nist.gov

NLMA Northeastern Lumber Manufacturers Association, Inc.
www.nelma.org

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

NPCA National Precast Concrete Association
www.precast.org

NRCA National Roofing Contractors Association
www.nrca.net

NSF National Sanitation Foundation
www.nsf.org

NSF NSF International
www.nsf.org/

NTMA National Terrazzo and Mosaic Association
ntma.com/

NWWDA Window and Door Manufacturers Association
www.nwwda.org

OSHA Occupational Safety and Health Administration
Department of Labor
www.osha.gov

PCA Portland Cement Association
www.cement.org/

PCI Precast Prestressed Concrete Institute
www.pci.org

PPI The Plastic Pipe Institute
www.plasticpipe.org

PEI Porcelain Enamel Institute, Inc.
www.porcelainenamel.com

PTI Post-Tensioning Institute
www.post-tensioning.org

RCSC Research Council of Structural Connections
www.boltcouncil.org/

RFCI	The Resilient Floor Covering Institute www.rfci.com
RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. www.rma.org
SCAQMD	South Coast Air Quality Management District www.aqmd.gov
SCMA	Southern Cypress Manufacturers Association www.cypressinfo.org
SDI	Steel Deck Institute www.sdi.org
SDI	Steel Door Institute www.steeldoor.org
SEI	Structural Engineering Institute www.asce.org/SEI/
SJI	Steel Joist Institute www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. www.smacna.org
SPRI	Single Ply Roofing Industry www.spri.org
SSPC	The Society for Protective Coatings www.sspc.org
STI	Steel Tank Institute www.steeltank.com
SWI	Steel Window Institute www.steelwindows.com
SWRI	Sealant Waterproofing and Restoration Institute www.swrionline.org/
TCNA	Tile Council of North America, Inc. www.tileusa.com
TPI	Truss Plate Institute, Inc. www.tpinst.org/
UL	Underwriters' Laboratories Incorporated www.ul.com

ULC Underwriters' Laboratories of Canada
www.ulc.ca

USDA U.S. Department of Agriculture
www.usda.gov

USGBC U.S. Green Building Council
www.usgbc.org

WCLIB West Coast Lumber Inspection Bureau
www.wclib.org/

WDMA Window and Door Manufacturers Association
<https://www.wdma.com/>

WH Warnock Hersey
www.intertek.com/marks/wh/

WRCLA Western Red Cedar Lumber Association
www.wrcla.org/

WWPA Western Wood Products Association
www2.wwpa.org/

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor. Refer to Section 01 00 02, GENERAL REQUIREMENTS, for additional information.

1.2 RELATED DOCUMENTS

- A. Section 01 00 02, GENERAL REQUIREMENTS.

1.3 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 Association of State Highway and Transportation Officials (AASHTO):

T27-11	Sieve Analysis of Fine and Coarse Aggregates
T96-02(R2006)	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
T99-10	The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop
T104-99(R2007)	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
T180-10	Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
T191-02(R2006)	Density of Soil In-Place by the Sand-Cone Method

- C. American Society for Testing and Materials (ASTM):

A325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A370-12a	Definitions for Mechanical Testing of Steel Products
A490-12	Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

C31/C31M-12	Making and Curing Concrete Test Specimens in the Field
C33/C33M-13	Concrete Aggregates
C39/C39M-12	Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-12	Compressive Strength of Hydraulic Cement Mortars
C138/C138M-12a	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-13	Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-12	Slump of Hydraulic Cement Concrete
C172/C172M-10	Sampling Freshly Mixed Concrete
C173/C173M-12	Air Content of freshly Mixed Concrete by the Volumetric Method
C330/C330M-09	Lightweight Aggregates for Structural Concrete
C567/C567M-11	Density Structural Lightweight Concrete
C780-12a	Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-11	Sampling and Testing Grout
C1064/C1064M-12	Freshly Mixed Hydraulic Cement Concrete
C1077-13	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-12	Compressive Strength of Masonry Prisms
C1364-10b	Architectural Cast Stone
D698-12	Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143/D1143M-07	Deep Foundations Under Static Axial Compressive Load
D1188-07	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07	Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-12	Laboratory Compaction Characteristics of Soil Using Modified Effort

D2166-06	Unconfined Compressive Strength of Cohesive Soil
D2167-08	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2974-07	Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
D3666-11	Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-12a	Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock
E94-04(2010)	Radiographic Examination
E164-08	Contact Ultrasonic Testing of Weldments
E329-11c	Agencies Engaged in Construction Inspection, Testing, or Special Inspection
E543-13	Agencies Performing Nondestructive Testing
E709-08	Guide for Magnetic Particle Testing
E1155-96(2008)	Determining FF Floor Flatness and FL Floor Levelness Numbers

D. American Welding Society (AWS):

D1.1-07	Structural Welding Code-Steel
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1.4 REQUIREMENTS

A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the Contracting Officer a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the Contracting Officer for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials must meet the requirements of ASTM E329.

2. Laboratories engaged in testing of concrete and concrete aggregates must meet the requirements of ASTM C1077.
 3. Laboratories engaged in testing of bituminous paving materials must meet the requirements of ASTM D3666.
 4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, must meet the requirements of ASTM D3740.
 5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.
 6. Laboratories engaged in non-destructive testing (NDT) must meet the requirements of ASTM E543.
 7. Laboratories engaged in Hazardous Materials Testing must meet the requirements of OSHA and EPA.
- B. Inspection and Testing: Testing laboratory to inspect materials and workmanship and perform tests described herein and additional tests requested by RE/COR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory must direct attention of RE/COR to such failure.
- C. Written Reports: Testing laboratory to submit test reports to RE/COR and Contractor within 24 hours after each test is completed unless other arrangements are agreed to in writing by the RE/COR. Submit reports of tests that fail to meet construction contract requirements on colored paper.
- D. Verbal Reports: Give verbal notification to RE/COR immediately of any irregularity.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK

- A. General: The Testing Laboratory is to 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 is as identified herein including, 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 RE/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 RE/COR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.
2. Provide full time observation of fill placement and compaction and field density testing in pavement 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 D1557.
 2. Make field density tests in accordance with the primary testing method following ASTM D2922 wherever possible. Field density tests utilizing ASTM D1556 AASHTO T191, or ASTM D2167 to 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 must provide satisfactory explanation to the RE/COR before the tests are conducted.
 - a. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
 - b. Pavement Subgrade: One test for each 335 m² (400 square yards), but in no case fewer than two tests.
 - c. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
 - d. 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.
 - e. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to RE/COR. In each compacted fill layer below wall footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.

- C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.
- D. Testing Materials: Test suitability of on-site and off-site borrow as directed by RE/COR.

3.3 LANDSCAPING

- A. Topsoil: Provide one soil test for each 200 CY topsoil from either stockpile source or borrow source.
 - 1. Sample: Prepare as required by testing lab.
 - 2. Testing reports shall include the following at minimum:
 - 1) pH
 - 2) Organic matter
 - 3) USDA soil texture classification
 - 4) Soluble salts
 - 5) Percentage of foreign materials such as rock, roots, and vegetation.
 - 6) Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Magnesium, and Calcium.
 - 7) Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful plant and turfgrass growth. Amendment / fertilization recommendations should be provided separately for landscape plants, turf seeding, and turf sodding. Recommendations for turf shall be for the highest quality installation.
 - 3. The topsoil shall be improved with soil amendments as recommended by the soil testing lab and approved by the CO/COR. Topsoil shall be amended to meet the requirements of 32 90 00 PLANTING for parameters including but not limited to pH and organic matter content. Test amended soil a second time to verify that it meets the specified requirements.
 - 4. Costs of soil amendment and testing will be by Contractor, including follow up tests if needed.
 - 5. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.
 - 6. Submit laboratory test report of topsoil to Architect-Engineer and CO/COR.

- B. Organic Soil Amendment (compost): Provide one test for each source. Tests shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists.
 - 1. Sample: Prepare as required by testing lab.
 - 2. Testing Parameters: Refer to 32 90 00 Planting.
 - 3. Submit laboratory test report of organic amendment to CO/COR.
- C. Submit laboratory test report of topsoil to CO/COR.

3.4 ASPHALT AND CONCRETE PAVING

A. Aggregate Base Course:

- 1. Determine maximum density and optimum moisture content for aggregate base material in accordance with ASTM D1557, Method D.
- 2. Make a minimum of three field density tests on each day's final compaction on each aggregate course in accordance with ASTM D1556.
- 3. Sample and test aggregate as necessary to insure compliance with specification requirements for gradation, wear, and soundness as specified in the applicable state highway standards and specifications.

B. Asphalt:

- 1. Aggregate: Sample and test aggregates in stock pile and hot-bins as necessary to insure compliance with specification requirements for gradation (AASHTO T27), wear (AASHTO T96), and soundness (AASHTO T104).
- 2. Temperature: Check temperature of each load of asphalt concrete at mixing plant and at site of paving operation.
- 3. Density: Make a minimum of two field density tests in accordance with ASTM D1188 of asphalt base and surface course for each day's paving operation.

3.5 SITE WORK CONCRETE

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

3.6 CONCRETE

A. Batch Plant Inspection and Materials Testing:

- 1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of RE/COR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by RE/COR.
- 2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to RE/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. RE/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 RE/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.
 19. Other inspections:
 - a. Grouting under base plates.
 - b. Grouting anchor bolts and reinforcing steel in hardened concrete.
- 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 RE/COR. Compile laboratory test reports as follows: Compressive strength test to be the result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it must be discarded and strength of spare cylinder to be used.
 2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
 3. Furnish certified compression test reports (duplicate) to RE/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.

3.7 REINFORCEMENT

- A. Review mill test reports furnished by Contractor.

3.9 ARCHITECTURAL CAST STONE

- A. Perform testing according to ASTM C1364 or verify compliance by reviewing previous test results of same product.
- B. Inspect the plant to verify that specification requirements for curing and finishes have been met.

3.10 MASONRY

A. Mortar Tests:

- 1. Laboratory compressive strength test:
 - a. Comply with ASTM C780.
 - b. Obtain samples during or immediately after discharge from batch mixer.
 - c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
 - d. Test one sample at 7 days and 2 samples at 28 days.
- 2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

- 1. Laboratory compressive strength test:
 - a. Comply with ASTM C1019.
 - b. Test one sample at 7 days and 2 samples at 28 days.
 - c. Perform test for each 230 m^2 (2500 square feet) of masonry.

C. Masonry Unit Tests:

- 1. Laboratory Compressive Strength Test:
 - a. Comply with ASTM C140.
 - b. Test 3 samples for each 460 m^2 (5000 square feet) of wall area.

- D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m^2 (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

- E. Field Inspection and Materials Testing:
 - 1. Verify the following prior to grouting:
 - a. Grout space is clean.
 - b. Type, spacing, and placement of reinforcement, connectors, and anchors comply with the contract requirements.

3.15 TYPE OF TEST

	Approximate Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soils:	
(ASTM D1557)	3
Field Density, Soils (AASHTO T191, T205, or T238)	30
Penetration Test, Soils	6
B. Landscaping:	
Topsoil Test	2
Organic Soil Amendment Test	2
Amended Soil Test	2
C. Aggregate Base:	
Laboratory Compaction, (ASTM D1557)	2
Field Density, (ASTM D1556)	40
Aggregate, Base Course	
Gradation (AASHTO T27)	2
Wear (AASHTO T96)	2
Soundness (AASHTO T104)	2
D. Asphalt Concrete:	
Field Density, ASTM D1188	10
Aggregate, Asphalt Concrete	
Gradation (AASHTO T27)	2
Wear (AASHTO T96)	2
Soundness (AASHTO T104)	2
E. Concrete:	
Making and Curing Concrete Test Cylinders (ASTM C31)	65
Compressive Strength, Test Cylinders (ASTM C39)	65
Concrete Slump Test (ASTM C143)	60
Concrete Air Content Test (ASTM C173)	60
Unit Weight, Normal Concrete (ASTM C567)	65
Aggregate, Normal Weight:	
Gradation (ASTM C33)	2
Deleterious Substances (ASTM C33)	2
Soundness (ASTM C33)	2
Abrasion (ASTM C33)	2
Flatness and Levelness Readings (ASTM E1155) (number of days)	2
F. Masonry:	
Making and Curing Test Cubes (ASTM C109)	5
Compressive Strength, Test Cubes (ASTM C109)	5
Sampling and Testing Mortar, Comp. Strength (ASTM C780)	5
Sampling and Testing Grout, Comp. Strength (ASTM C1019)	3

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Masonry Unit, Compressive Strength (ASTM C140)	3
Prism Tests (ASTM C1314)	3

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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, and solid waste, 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. Affect other species of importance to humankind.
 - 4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

1.2 DEFINITIONS OF POLLUTANTS

- A. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
- B. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
- C. Sediment: Soil and other debris that has been eroded and transported by runoff water.
- D. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from project construction activities.
- E. 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 "waters of the United States" and require a permit to discharge water from the governing agency.
- F. Rubbish: Combustible and noncombustible wastes such as, but not limited to, paper, plastic, metal and plastic containers and cans, boxes, metal and lumber scrap.
- G. Sanitary Wastes: Domestic Sanitary Sewage.

1.3 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, ordinances and note any corrective action taken.

1.4 REFERENCES

- 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. U.S. National Archives and Records Administration (NARA):
33 CFR 328 Definitions, Waters of the United States.
- C. Federal Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:
 - 1. Storm water permits; refer to The Office of Wastewater Management, NPDES Storm Water Program: www.epa.gov/npdes/stormwater
 - 2. Dredge and fill (Section 404) permits; refer to U.S. EPA Office of Wetlands, Oceans, and Watersheds (OWOW): www.epa.gov/owow/
 - 3. RCRA hazardous and non-hazardous solid waste requirements; refer to EPA's Office of Solid Waste and Emergency Response:
www.epa.gov/epaoswer/osw/laws-reg.htm
 - 4. Oil spill requirements for construction activities; refer to EPA Oil Program web site: www.epa.gov/oilspill/
 - 5. Hazardous substances (Superfund Liability) requirements for construction activities; refer to EPA's Superfund website:
www.epa.gov/superfund/index.htm
 - 6. Polychlorinated Biphenyl (PCB) waste requirements; refer to EPA's Polychlorinated Biphenyl (PCB) Homepage:www.epa.gov/pcb/
 - 7. Air quality requirements for construction activities; refer to EPA'S Air Program Mobile Sources Page:
www.epa.gov/eftpages/airmobilesources.html
 - 8. Asbestos requirements for construction activities; refer to EPA's Asbestos Management and Regulatory Requirements Website:
www.epa.gov/fedsite/cd/asbestos.html
 - 9. National Environmental Policy Act (NEPA) requirements for construction activities
 - 10. Endangered Species Act; refer to The US Fish and Wildlife Service Endangered Species Program: endangered.fws.gov/

11.National Historic Preservation Act

C. State and Local Environmental Regulatory Requirements: Comply with applicable regulations. The following is for Contractor's information only:

1. Michigan Department of Environmental Quality
2. Kalamazoo County Drain Commissioner
3. The Construction Industry Compliance Assistance Center:
www.cicacenter.org/index.cfm
4. The National Environmental Compliance Assistance Clearinghouse:
cfpub.epa.gov/clearinghouse/

1.5 SUBMITTALS

A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, the Contractor shall furnish the following:

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, meet with the Resident Engineer/Contracting Officer's Representative (RE/COR) 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, prepare and submit to the RE/COR for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
 - a. Name(s) and qualifications of person(s) within the Contractor's organization who is (are) responsible for:
 - 1) Ensuring adherence to the Environmental Protection Plan.
 - 2) Training the Contractor's environmental protection personnel.
 - b. Description of the Contractor's environmental protection personnel training program.
 - c. 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.
 - d. 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.

- e. Procedures to provide environmental protection that complies 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.
 - f. Permits, licenses, and the location of the solid waste disposal area.
 - g. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion and Sedimentation Control Plan approved by the COR and the Department of Veterans Affairs.
 - h. Environmental Monitoring Plans for the job site including land, water, air, and noise.
 - i. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of construction limits or protected areas. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion and Sedimentation Control Plan.
- B. Within 20 days after the date of its submittal, the RE/COR shall approve the Contractor's Comprehensive Environmental Protection Plan, or respond with an explanation for its rejection and resubmittal.
- C. 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.

1.6 TREE PROTECTION

- A. Tree Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.
- 1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart. Safety orange color, nonfading. Fencing shall be 4 feet high with 3 foot wide access gates.
 - 2. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering. An 8 ½" x 11" sign indicating the

- area as a tree protection zone shall be prominently displayed on each fence panel.
3. The Contractor shall be responsible for the installation and maintenance of all tree protection fencing. Protective fencing shall remain undisturbed until all construction activities have been completed. The Contractor shall remove fencing upon completion of construction.
 4. If protective fencing is damaged, the Contractor shall immediately execute the necessary repairs to re-establish the protective fencing to original configurations.
- B. No construction activity, including storage of materials, staging and stockpiling, shall start until all tree protection measures and procedures as indicated are completed.
- C. The following construction activities are prohibited within Tree Protection Zones:
1. Storage of any construction materials, equipment, stockpiling, excavation or fill, soil, gravel, etc.
 2. Equipment or vehicle parking.
 3. Masonry set up, clean up or washout.
 4. Dumping of any chemicals, (i.e. paint thinner from cleaning brushes), wash-out materials from cleaning equipment, concrete or mortar remainder, trash, garbage, or debris of any kind.
 5. Burning within or in proximity to protected areas
 6. Felling trees into protected areas.
 7. Trenching or grading within the Protection Zone of protected trees for any purpose without notifying the COTR and AE 10 days in advance of operation in writing. This includes but is not limited to the following: silt fence, sediment erosion control, utilities, site lighting, irrigation, drainage, curbs, and footings.
 8. Contractor shall prevent any contamination of the soil within the Protection Zone by construction materials, debris, silt, fuel, oils, concrete, or any other chemical substance. Contractor shall notify the COTR of any such spills, compaction, or other disturbance within the Protection Zone and take immediate action using methods approved by the COTR.
 9. Excessive foot traffic
- D. The following restrictions apply to the Tree Protection Zones:

1. Any grading, construction, demolition, or other work that is expected to encounter tree roots shall be made in consultation with the CO/COR.
2. Any roots 2 inches in diameter or less that sustain damage during construction shall be exposed to sound tissue and cleanly pruned close to the tree side of the excavation. Clean cuts shall be made at all times. The cutting of tree roots greater than 2 inches in diameter must be approved and supervised by a licensed arborist.
3. Trees to be removed adjacent to the tree root protection zones shall be cut near ground level and the stump ground out completely to avoid damaging existing roots by pulling and breaking.
4. Any digging that must occur within Protection Zones must utilize alternative excavation methods including, but not limited to hand excavation or air spading. This includes planting operations.
5. Within the Protection Zones, precautions will be taken to avoid compaction of the soil, including such methods as:
 - a. Using hand methods in lieu of heavy equipment.
 - b. Using low-pressure vehicles; No use of tracked or skid-steer vehicles
 - c. Establishment of temporary haul roads for vehicular traffic.
Vehicles and equipment shall not leave the temporary haul roads.
6. See drawings for temporary haul road detail.

1.7 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 and after the project is complete, based upon leaving the site prior to final vegetation establishment. Confine construction activities to areas defined by construction limits, the specifications and drawings.
- 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, land forms, wetlands or wetland buffers without prior approval from the RE/COR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or dictated by special emergency use.
 1. Work Area Limits: Prior to any construction, mark/fence/protect the areas that require work to be performed under this contract. Prior

- to construction, mark/fence/protect monuments, works of art, and any other markers to remain. Convey to all personnel the purpose of marking and protecting all marked and protected objects.
2. Protection of Specific Regulated Elements: Wetlands and wetland buffers and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved protective techniques.
 - a. Protect trees and shrubs to remain on site to protect from damage per contract details.
 - b. Tree Protection - see Paragraph 1.6 Tree Protection
 3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas only as needed to use to work the area to be developed. Form earthwork to final grade as shown as quickly as possible to minimize potential erosion damage. Immediately protect side slopes and back slopes upon completion of rough grading or clearing with appropriate material as defined in the Sediment and Erosion Control Plan.
 4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, check dams and berms to retard and divert runoff from the construction site to protected drainage areas as intended under paragraph 208 of the Clean Water Act.
 - a. Reuse or conserve the collected topsoil sediment as directed by the RE/COR. Topsoil use and requirements are specified in Section 31 20 11, EARTH MOVING (SHORT FORM).
 - b. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
 5. Erosion and Sedimentation Control Devices: Construct or install all temporary and permanent erosion and sedimentation control features shown on the Erosion and Sedimentation Control Plan to avoid violating water quality in accordance with federal and state regulations. Maintain temporary erosion and sediment control measures such as filter sock, silt fence, berms, dikes, drains, sedimentation basins, grassing, and mulching, straw waddles, fiber rolls, until permanent drainage and erosion control facilities are completed and operative.

6. Manage and control borrow and spoil areas on and off Government property to minimize erosion and to prevent soil and/or sediment from entering nearby water courses or lakes.
 7. Protect adjacent areas from despoilment by temporary excavations and embankments.
 8. 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.
 9. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
 10. Handle discarded materials other than those included in the solid waste category as directed by the RE/COR.
- 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 sediment basins prior to entering retention/detention ponds, allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
 2. Monitor water areas, wetlands and wetland buffers 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 protected 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 Michigan Air Pollution Statute, Rule, or

Regulation 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 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, 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, or other methods are permitted to control particulates in the work area as approved in the Environmental Protection Plan.
 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. Noise Control: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the Resident Engineer/COR. 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 6:00 /a.m. and 9:00 a.m. and 3:00pm and 6:00pm unless otherwise permitted by local ordinance and the RE/COR. Repetitive impact noise on the property shall not exceed the following Decibel A-scale (dBA) limitations:

Time Duration of Impact Noise	Sound Level in dBA
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 as measured with an A-scale decibel measuring device at 15 m (50 feet) (dBA):

CATEGORY OF EQUIPMENT			
EARTHMOVING		MATERIALS HANDLING	
EQUIPMENT STYLE	SOUND LEVEL dBA	EQUIPMENT STYLE	SOUND LEVEL dBA
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	Not allowed
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

- b. Provide soundproof housings or enclosures for noise-producing machinery.
 - c. Use efficient silencers on equipment air intakes.
 - d. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
 - e. Line hoppers and storage bins with sound deadening material.
 - f. 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 75 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 A weighted sound level 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 Resident Engineer/COR 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 as approved by the RE/COR. The site shall be left meeting the requirements of the local and state environmental requirements associated with the Erosion and Sedimentation Control Plan as submitted. Cleaning shall include off-cemetery 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, clearing, logging and general construction in accordance with state and local regulations and the contract.

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies the requirements for the management of non-hazardous building construction and demolition waste.
- B. Waste disposal in landfills shall be minimized to the greatest extent possible. Of the inevitable waste that is generated, as much of the waste material as economically feasible shall be salvaged, recycled or reused.
- C. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators, and facilitate their salvage and recycle not limited to the following:
 - 1. Waste Management Plan development and implementation.
 - 2. Techniques to minimize waste generation.
 - 3. Sorting and separating of waste materials.
 - 4. Salvage of existing materials and items for reuse or resale.
 - 5. Recycling of materials that cannot be reused or sold.
- D. At a minimum the following waste categories shall be diverted from landfills:
 - 1. Soil.
 - 2. Inerts (eg, concrete, masonry and asphalt).
 - 3. Clean dimensional wood and palette wood.
 - 4. Green waste (biodegradable landscaping materials).
 - 5. Engineered wood products (plywood, particle board and I-joists, etc).
 - 6. Metal products (eg, steel, wire, beverage containers, etc).
 - 7. Cardboard, paper and packaging.
 - 8. Bitumen roofing materials.
 - 9. Plastics (eg, ABS, PVC).

1.2 QUALITY ASSURANCE

- A. Contractor shall practice efficient waste management when sizing, cutting and installing building products. Processes shall be employed to ensure the generation of as little waste as possible. Construction /Demolition waste includes products of the following:
 - 1. Excess or unusable construction materials.
 - 2. Packaging used for construction products.
 - 3. Poor planning and/or layout.

4. Construction error.
 5. Over ordering.
 6. Weather damage.
 7. Contamination.
 8. Mishandling.
 9. Breakage.
- B. Establish and maintain the management of non-hazardous building construction and demolition waste set forth herein. Conduct a site assessment to estimate the types of materials that will be generated by demolition and construction.
- C. Contractor shall develop and implement procedures to reuse and recycle new materials to a minimum of 50 percent.
- D. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling. Any revenues or savings obtained from salvage or recycling shall accrue to the contractor.
- E. Contractor shall provide all demolition, removal and legal disposal of materials. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by local, state, federal regulations. The Whole Building Design Guide website www.wbdg.org/tools/cwm.php provides a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects.
- F. Contractor shall assign a specific area to facilitate separation of materials for reuse, salvage, recycling, and return. Such areas are to be kept neat and clean and clearly marked in order to avoid contamination or mixing of materials.
- G. Contractor shall provide on-site instructions and supervision of separation, handling, salvaging, recycling, reuse and return methods to be used by all parties during waste generating stages.
- H. Record on daily reports any problems in complying with laws, regulations and ordinances with corrective action taken.

1.3 TERMINOLOGY

- A. Class III Landfill: A landfill that accepts non-hazardous resources such as household, commercial and industrial waste resulting from construction, remodeling, repair and demolition operations.

- B. Clean: Untreated and unpainted; uncontaminated with adhesives, oils, solvents, mastics and like products.
- C. Construction and Demolition Waste: Includes all non-hazardous resources resulting from construction, remodeling, alterations, repair and demolition operations.
- D. Dismantle: The process of parting out a building in such a way as to preserve the usefulness of its materials and components.
- E. Disposal: Acceptance of solid wastes at a legally operating facility for the purpose of land filling (includes Class III landfills and inert fills).
- F. Inert Backfill Site: A location, other than inert fill or other disposal facility, to which inert materials are taken for the purpose of filling an excavation, shoring or other soil engineering operation.
- G. Inert Fill: A facility that can legally accept inert waste, such as asphalt and concrete exclusively for the purpose of disposal.
- H. Inert Solids/Inert Waste: Non-liquid solid resources including, but not limited to, soil and concrete that does not contain hazardous waste or soluble pollutants at concentrations in excess of water-quality objectives established by a regional water board, and does not contain significant quantities of decomposable solid resources.
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A solid resource processing facility that accepts loads of mixed construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing non-recyclable materials.
- K. Permitted Waste Hauler: A company that holds a valid permit to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal.
- L. Recycling: The process of sorting, cleansing, treating, and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
 - 1. On-site Recycling - Materials that are sorted and processed on site for use in an altered state in the work, i.e. concrete crushed for use as a sub-base in paving.
 - 2. Off-site Recycling - Materials hauled to a location and used in an altered form in the manufacture of new products.

- M. Recycling Facility: An operation that can legally accept materials for the purpose of processing the materials into an altered form for the manufacture of new products. Depending on the types of materials accepted and operating procedures, a recycling facility may or may not be required to have a solid waste facilities permit or be regulated by the local enforcement agency.
- N. Reuse: Materials that are recovered for use in the same form, on-site or off-site.
- O. Return: To give back reusable items or unused products to vendors for credit.
- P. Salvage: To remove waste materials from the site for resale or re-use by a third party.
- Q. Source-Separated Materials: Materials that are sorted by type at the site for the purpose of reuse and recycling.
- R. Solid Waste: Materials that have been designated as non-recyclable and are discarded for the purposes of disposal.
- S. Transfer Station: A facility that can legally accept solid waste for the purpose of temporarily storing the materials for re-loading onto other trucks and transporting them to a landfill for disposal, or recovering some materials for re-use or recycling.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:
- B. Prepare and submit to the COR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
 - 1. Procedures to be used for debris management.
 - 2. Techniques to be used to minimize waste generation.
 - 3. Analysis of the estimated job site waste to be generated:
 - a. List of each material and quantity to be salvaged, reused, recycled.
 - b. List of each material and quantity proposed to be taken to a landfill.
 - 4. Detailed description of the Means/Methods to be used for material handling.
 - a. On site: Material separation, storage, protection where applicable.

- b. Off site: Transportation means and destination. Include list of materials.
 - 1) Description of materials to be site-separated and self-hauled to designated facilities.
 - 2) Description of mixed materials to be collected by designated waste haulers and removed from the site.
 - c. The names and locations of mixed debris reuse and recycling facilities or sites.
 - d. The names and locations of trash disposal landfill facilities or sites.
 - e. Documentation that the facilities or sites are approved to receive the materials.
- B. Designated Manager responsible for instructing personnel, supervising, documenting and administer over meetings relevant to the Waste Management Plan.
- C. Monthly summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

1.5 APPLICABLE PUBLICATIONS

Publications listed below form a part of this specification to the extent referenced. Publications are referenced by the basic designation only. In the event that criteria requirements conflict, the most stringent requirements shall be met.

- A. U.S. Green Building Council (USGBC):
LEED Green Building Rating System for New Construction

1.6 RECORDS

Maintain records to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Records shall be kept in accordance with the LEED Reference Guide and LEED Template.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. List of each material and quantity to be salvaged, recycled, reused.
- B. List of each material and quantity proposed to be taken to a landfill.
- C. Material tracking data: Receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices, net total costs or savings.

PART 3 - EXECUTION

3.1 COLLECTION

- A. Provide all necessary containers, bins and storage areas to facilitate effective waste management.
- B. Clearly identify containers, bins and storage areas so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.
- C. Hazardous wastes shall be separated, stored, disposed of according to local, state, federal regulations.

3.2 DISPOSAL

- A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state and federal regulations.
- B. Construction or demolition materials with no practical reuse or that cannot be salvaged or recycled shall be disposed of at a landfill or incinerator.

3.3 REPORT

- A. With each application for progress payment, submit a summary of construction and demolition debris diversion and disposal including beginning and ending dates of period covered.
- B. Quantify all materials diverted from landfill disposal through salvage or recycling during the period with the receiving parties, dates removed, transportation costs, weight tickets, manifests, invoices. Include the net total costs or savings for each salvaged or recycled material.
- C. Quantify all materials disposed of during the period with the receiving parties, dates removed, transportation costs, weight tickets, tipping fees, manifests, invoices. Include the net total costs for each disposal.

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**SECTION 02 41 10
DEMOLITION AND SITE CLEARING**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies all site preparation work, 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, EARTH MOVING (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.
- E. Waste Management: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT

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.
- 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 02, GENERAL REQUIREMENTS.
- 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.
- F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:
1. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for

- immediate use. Instruct all possible users in use of fire extinguishers.
2. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
- G. Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery; any damaged items shall be repaired or replaced as approved by the Resident Engineer/Contracting Officer's Representative (RE/COR). Coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. 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 RE/COR's approval.
- H. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

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 SITE CLEARING

- A. General: Remove trees, shrubs, grass, and other vegetation, pavements, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes complete removal and off-site disposal of stumps and roots.
 1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction. Cut roots and branches cleanly

- with proper pruning tools or saws. Do not rip or tear roots with excavation equipment.
- B. Erosion Control: Provide 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. Install filter logs and inlet protection as shown and as per requirements of the Erosion and Sedimentation Control Plan, prior to any soil disturbance activities. Provide temporary seeding as required by the Erosion and Sedimentation Control Plan.
 - C. Maintain site controls in accordance with the Erosion and Sedimentation Control Plan and repair as directed by COTR to sustain compliance with NPDES permit if applicable. Maintain all records as required by the permit and applicable regulations. Perform inspections of the temporary control measures daily and within 24 hours of a measurable rain event.
 - D. Clearing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing. Clear within the limits of earthwork operations as shown on the Contract Documents. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash and any other obstructions. Remove materials from the Cemetery Property unless otherwise indicated on Contract Documents.
 - E. Grubbing: Completely grind out and remove stumps and roots in areas with proposed paving and/or structures. No roots or stumps shall be left within the proposed subgrade of pavements or structures. Roots at the edge of earthwork and construction areas shall be pruned cleanly, not ripped or torn by earthmoving equipment.
 - F. Tree Protection: See Section 01 57 19: TEMPORARY ENVIRONMENTAL CONTROLS, PARAGRAPH 1.6 TREE PROTECTION.
 - G. Topsoil stripping: See Section 31 20 11 - EARTH MOVING (SHORT FORM)
 - H. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
 - I. Continue maintenance of erosion controls in compliance with the Erosion and Sedimentation Control Plan until the work is completed, soil is stabilized, and lawn "grow-in" is at 85% complete. Temporary erosion control devices shall not be removed until the area is certified as being stabilized by the Qualified Inspector.

3.2 DEMOLITION

- A. 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 RE/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.
- B. 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 RE/COR. When Utility lines are encountered that are not indicated on the drawings, the RE/COR shall be notified prior to further work in that area.

3.2 CLEAN-UP

- A. On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to RE/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.

- - - E N D - - -



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SECTION 02 50 00
GEOTECHNICAL REPORT

*Information in this report is provided to
the contractor for reference only.*

GEOTECHNICAL REPORT
FT. CUSTER NATIONAL CEMETERY
AUGUSTA, MICHIGAN

Prepared For:

KCI ENGINEERING OF NEW YORK, PC
Rochester, New York

Prepared By:

MATERIALS TESTING CONSULTANTS, INC.
Grand Rapids, Michigan

December 2014
MTC Project No. 141433



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December 2, 2014
Project No. 141433

KCI Engineering of New York, PC
255 East Avenue, Suite 302
Rochester, New York 14604

Attention: Case H. Smeenk, P.E.

Reference: Report of Geotechnical Investigation
Ft. Custer National Cemetery – New Columbarium
Augusta, Michigan

Dear Mr. Smeenk:

We have completed a geotechnical investigation for the above-referenced project. The purpose of this investigation has been to identify the general subsurface soil conditions in the vicinity of the proposed construction, analyze the conditions relative to the planned construction and to provide recommendations for the design of foundations. This work has been performed as described in our proposal dated October 29, 2014.

Presented herein are descriptions of our understanding of the design considerations, the geotechnical investigation, encountered conditions and engineering recommendations. The Appendix contains the report limitations and data collected during this investigation.

DESIGN CONSIDERATIONS

Available Information

We have been provided the following documents and information for use in this investigation:

- Topographic and location plan indicating the existing site ground elevation contours and the proposed Columbarium area prepared by KCI Engineering, received on October 28, 2014.

KCI Engineering of New York, PC
Project No. 141433
December 2, 2014
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Location and Type of Structure

The proposed construction will be located in plan as shown on Figure No. 1. The site is located along Chippewa Way inside Ft. Custer National Cemetery at 15501 Dickman Road in Augusta, Michigan.

The construction consists of a columbarium facility with several rows of structures approximately 20,000 sf in plan with the slab supported on-grade, no below grade levels will be present. The existing ground surface elevations in the proposed construction area vary from el 826 to 827, we have considered the finish floor slab will be approximately el 826.

We should be informed of any changes between the actual design conditions and those described herein as this information may affect our recommendations.

INVESTIGATION METHODOLOGY

Conventional soil test borings and sampling along with field engineering reconnaissance were used to investigate the subsurface conditions. Boring locations are shown on Figure No. 1. Investigation procedures, soil classification information and boring logs are provided in the Appendix.

Number of Borings	2
Boring Depth Range, ft.	10 to 25

Borings were drilled and other sampling was conducted solely to obtain indications of subsurface conditions as part of a geotechnical exploration program. No services were performed to evaluate subsurface environmental conditions.

INVESTIGATION RESULTS

Regional Geology

The *Map of the Surface Formations of the Southern Peninsula of Michigan*, published by the State of Michigan, indicates the site is in an area of outwash and glacial channels. Soil conditions typically are found to range from clay and silt to sand and gravel with possible cobbles and boulders in this type of geologic area.

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Site Conditions

At the time of our field work, the area of investigation in the building area was covered with a forested area of mature trees mixed with undergrowth. Cemetery areas were present to the east and west of the wooded site with the asphalt paved Chippewa Way directly to the north of the site. The site, in general, was relatively flat with elevations of approximately el 826 to 827 at the boring locations. Indications of previous structures such as abandoned foundations or slabs were not observed during our field staking activities.

Subsurface Conditions

The investigation, in Boring B-1, in general, encountered 8 inches of dark brown sandy topsoil over very loose to loose brown *poorly graded sand with silt* (SP-SM) to approximately 5.5 ft below grade. The sand with silt was underlain by medium dense brown *silty sand with gravel* (SM) to approximately 17 ft where dense brown *poorly graded sand with gravel* (SP) extended to the explored depth of 25 ft below grade. Difficult drilling was noted at approximately 3 ft below grade on possible cobble. Poor sample recovery was noted in the 3.5 and 23.5 ft sample intervals on possible coarse gravel or cobble.

The investigation, in Boring B-2, in general, encountered 6 inches of dark brown sandy topsoil over very loose to loose brown *poorly graded sand with silt and gravel* (SP-SM) to approximately 5.5 ft below grade. The sand with silt was underlain by loose brown *poorly graded sand with gravel* (SP) to the explored depth of 10 ft below grade. Poor sample recovery was noted in the 3.5, 6.0, and 8.5 ft sample intervals on possible coarse gravel or cobble.

Groundwater was not encountered during the drilling activities. Groundwater levels may fluctuate due to seasonal variations such as precipitation, snowmelt, nearby river or lake levels and other factors that may not be evident at the time of measurement. Groundwater levels may be different at the time of construction.

This section has provided a generalized description of the encountered subsurface soil conditions. The boring logs located in the Appendix should be reviewed for detailed soil descriptions. Some variation between boring locations may be expected.

Laboratory

Soil samples were reviewed by one of our engineers and technically classified according to the methods of ASTM D 2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)".

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Selected samples were subjected to the following tests in our laboratory:

- ASTM D 422 "Test Method for Particle-Size Analysis of Soils"
- ASTM D 1140 "Test Method for Material in Soils Finer than the No. 200 (75- μ m) Sieve"
- ASTM D 2216 "Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures"

The samples subjected to the grain-size testing were reclassified according to ASTM D 2487 procedures "Standard Test Method for Classifications of Soils for Engineering Purposes". The ASTM D2487 and D2488 classifications are included on the boring logs. A sample of topsoil was submitted to the MSU Laboratory Extension. Laboratory tests are provided in the Appendix.

CONCLUSIONS AND RECOMMENDATIONS

Foundations

A conventional shallow continuous and spread foundation system is recommended for support of the proposed structure. It is important that the recommendations of this report, in-particular those pertaining to subgrade preparation, construction observation and testing, be implemented during design and construction.

The following parameters are recommended for foundation design:

Foundation Design Parameters

Bearing pressure for square or rectangular foundations, maximum net allowable, psf	2000
Bearing pressure for continuous foundations, maximum net allowable, psf	2000
Minimum width of square or rectangular foundations, inches	24
Minimum width of continuous foundations, inches	18
Minimum embedment depth for frost protection, inches	42

Foundations are expected to bear on the brown *poorly graded sand with silt* (SP-SM) as encountered in the borings or on approved engineered fill. Subgrade preparation recommendations are contained in the following section.

Foundation recommendations presented herein are based on a safety factor to resist bearing capacity failure of at least 3.0 and a maximum anticipated total foundation settlement of 1 inch or less.

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Site and Subgrade Preparation

The slab foundation system is expected to bear on the *poorly graded sand with silt* as encountered in the soil borings or on approved engineered fill. Any topsoil, vegetation, roots and any other miscellaneous debris should be removed from within the proposed construction areas. Due to the encountered very loose *poorly graded sand with silt* in approximately the upper 3 ft and its susceptibility to frost heave, we recommend it be removed and replaced with Class II sand beneath the slab. The limits of the proposed construction area, prior to the placement of any structures or engineered fill material, should be inspected and tested by qualified geotechnical personnel familiar with the geotechnical recommendations. As part of the inspection and testing, the subgrade should be verified to be consistent with the conditions encountered in this investigation.

Engineered fill is approved soil meeting the gradation requirements of MDOT Class II soil. Granular engineered fill and backfill should be compacted to at least 95 percent of the soil's maximum dry density as determined by the Modified Proctor test (ASTM D 1557). Vibratory compaction methods are typically found to be most effective in granular soils.

The fill should be placed and compacted in horizontal layers not exceeding 9 inches. Field density tests (ASTM D 2922) should be taken on each lift, as the fill is being placed, to verify compliance with compaction specifications. If the earthwork takes place during winter months, fill must not be placed on frozen ground and fill with frozen conglomerations of soil must not be used.

Slopes and Temporary Excavations

The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequences and operations of construction operations. We are providing the following information solely as a service on this project and, under no circumstances, should our provision of the following information be construed to mean that we are assuming responsibility for construction site safety or the contractor's activities; such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations; e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. For this site, the overburden soil encountered in our exploratory program is a granular soil. We anticipate that OSHA will classify these materials as Type C.

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Page 6

OSHA recommends a maximum slope inclination of 1 ½H:1V for this type of soil under ideal conditions.

Concrete Floor Slabs

Subgrade preparation in floor slab areas should be as described in the "Site and Subgrade Preparation" section of this report. For design of the concrete floor slabs and rigid pavements supported on-grade, a modulus of subgrade reaction value, K_{30} , of 100 psi/inch is recommended. We recommend placement of at least 12 inches of MDOT Class II fill directly beneath the floor slab. Design of concrete slabs should be in accord with ACI and the applicable building code recognized design guidelines. If a vapor sensitive covering will be placed over the floor slab or the slab will be in a humidity controlled area, a vapor retarder/barrier is recommended following ACI 302.1R-04 guidelines and the floor covering manufacturer's guidelines.

CLOSURE

In this report, descriptions of the geotechnical investigation, encountered conditions and recommendations for the design of foundations have been presented. The limitations of this study are described in the Appendix.

The recommendations presented in this report are based upon a limited number of subsurface samples obtained from various sampling locations. The samples may not fully indicate the nature and extent of the variations that actually exist between sampling locations. For that reason, among others, we strongly recommend that we be retained to observe earthwork construction. If variations or other latent conditions become evident during construction, it will be necessary for us to review these conditions and our recommendations as appropriate.

KCI Engineering of New York, PC
Project No. 141433
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We appreciate the opportunity to provide this service to you on this project. Should you have any questions or require further assistance, please contact our office.

Sincerely,

MATERIALS TESTING CONSULTANTS, INC.

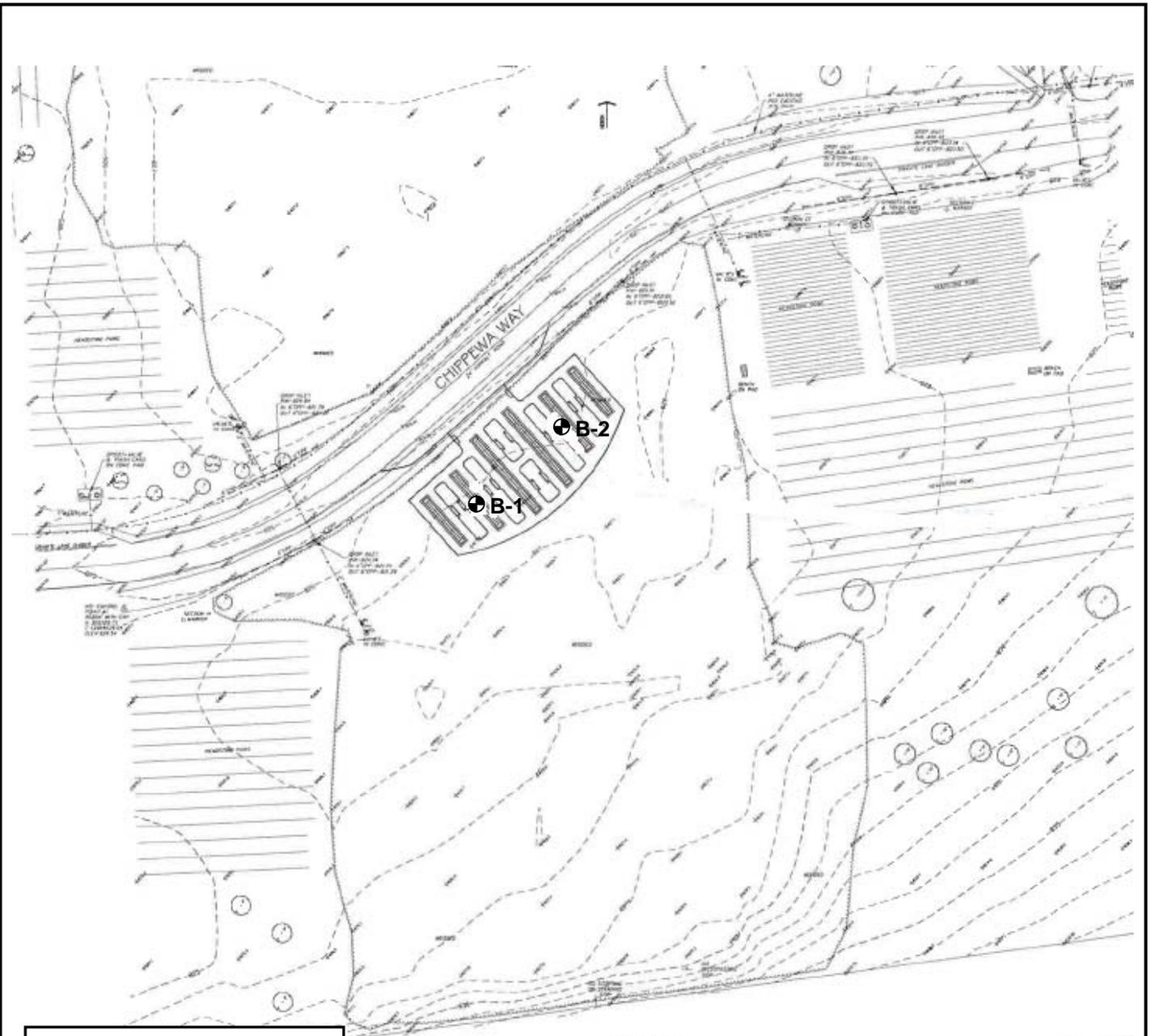


Aaron J. Vanderhill, E.I.T.
Assistant Project Engineer



Douglas W. Sabin, P.E.
Senior Project Manager

Attachments: Figure No. 1 - Boring Location Plan
Appendix
- Limitations
- Test Drilling and Sampling Procedures
- Boring Log Terminology
- Soil Classification Chart
- Boring Logs
- Laboratory Data



**SITE VICINITY
MAP
NOT TO SCALE**

LEGEND

● BORING LOCATION (TYP)



TITLE: BORING LOCATION PLAN			PROJECT: FT. CUSTER
SCALE: NTS	DATE: 11/24/14	PROJECT NO.: 141433	Materials Testing Consultants, INC. 693 PLYMOUTH N.E., GRAND RAPIDS, MICH. 49505 • PHONE 616-456-5469
FIG. NO.: 1	DR. BY: AV	REV. BY: DS	

APPENDIX

- **Limitations**
- **Test Drilling and Sampling Procedures**
- **Boring Log Terminology**
- **Soil Classification Chart**
- **Boring Logs**
- **Laboratory Data**

LIMITATIONS

Soil Variations

The recommendations in this report are based upon the data obtained from the soil borings. This report does not reflect variations which may occur between these borings, and which would not become evident until construction. If variations then become evident, it would be necessary for a re-evaluation of recommendations of this report, after performing on-site observations.

Warranties

We have prepared this report in accordance with generally accepted soil and foundation engineering practices. We make no other warranties, either expressed or implied, as to the professional advice provided under the terms of our agreement and included in this report. This report is prepared exclusively for our client and may not be relied upon by other parties without written consent from our office.

Boring Logs

In the process of obtaining and testing samples and preparing this report, we follow reasonable and accepted practice in the field of soil engineering. Field logs maintained during drilling describe field occurrences, sampling locations, and other information. The samples obtained in the field are subjected to additional testing in the laboratory and differences may exist between the field logs and the final logs. The engineer reviews the field logs and laboratory test data, and then prepares the final boring logs. Our recommendations are based on the contents of the final logs.

Review of Design Plans and Specifications

In the event that any changes in the design of the building or the location, however slight, are planned, our recommendations shall not be considered valid unless modified or approved in writing by our office. We recommend that we be provided the opportunity to review the final design and specifications in order to determine whether changes in the original concept may have affected the validity of our recommendations, and whether our recommendations have, in fact, been implemented in the design and specifications.

Test Drilling and Sampling Procedures

Test Drilling Methods:

- Hollow stem auger
- Mud rotary
- Casing advancer
- Rock coring

Sampling Methods:

- SPT, ASTM D1586, CME Auto hammer (140 lb., 30" drop, 2" OD split spoon sampler)
- Thin-walled tube sampler (Shelby), ASTM D1587

Note: The number of hammer blows required to drive the SPT sampler 12 inches, after seating 6 inches, is termed the soil N-value and provides an indication of the soil's relative density and strength parameters at the sample location. SPT blow counts in 6 inch increments are recorded on the boring logs.

Drill Rig:

- Geoprobe 7822DT (ATV)
- CME 45 Trailer (skid)
- CME 55LC (ATV)
- CME 750 Rubber tired (ATV)
- CME 850 Track (ATV)
- CME 95 Truck

Boreholes Backfilled With:

- Excavated soil
- Cement bentonite grout
- Piezometer or Monitoring Well (see notes on logs)
- Concrete or asphalt patch where appropriate

Sample Handling and Disposition:

- SPT samples labeled, placed in jars, returned to GR Laboratory
- Discard after 60 days

Boring Log Terminology

Soil Classification Systems:

- ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D2488 Standard Practice for Description and Identifications of Soils (Visual-Manual Procedure)

Minor Component Quantifying Terms:

Trace (less than 5%); Few (5 to 10%); Little (15 to 25%); Some (30 to 45%); Mostly (50 to 100%)

Sample Types and Numbering:

S	SPT, split-barrel sample, ASTM D1586	U	Shelby tube sample, ASTM D1587
*S	Other than 2" split barrel sample	A	Auger cuttings
L	SPT with liner, ASTM D1586	R	Rock core run
		G	Geoprobe liner

Grain Size:

Boulder	>12"
Cobble	12" to 3"
Coarse Gravel	3" to 0.75"
Fine Gravel	0.75" to No. 4
Coarse Sand	No. 4 to No. 10
Medium Sand	No. 10 to No. 40
Fine Sand	No. 40 to No. 200

Clay - Soil passing a No. 200 sieve that can be made to exhibit plasticity (putty-like properties) and exhibits considerable strength when air dry (ASTM D2487).

Silt - Soil passing a No. 200 sieve that is nonplastic or very slightly plastic and exhibits little or no strength when air dry (ASTM D2487).

Peat - A soil composed of decomposed vegetable tissue with organic odor, dark brown to black color, spongy consistency, and a fibrous to amorphous texture.

"Grades with" or "Grades without" may be used to describe soil when characteristics vary within a stratum.

Moisture Condition:. Dry (absence of visible moist.); Moist (damp but no visible water); Wet (visible free water)

Compactness (Coarse Grained Soils) and Consistency (Fine Grained Soils):

N-value	Relative Density	Compactness	N-value	Approx. Shear Strength, ksf	Consistency
0 - 4	0 - 20%	Very Loose	0 - 2	0.25	Very Soft
5 - 10	20 - 40%	Loose	3 - 4	0.25 - 0.5	Soft
11 - 30	40 - 70%	Med. Dense	5 - 8	0.5 - 1	Med. Stiff
31 - 50	70 - 90%	Dense	9 - 16	1 - 2	Stiff
>50	90 - 100%	Very Dense	17 - 32	2 - 4	Very Stiff
			>32	>4	Hard

Groundwater Observations:

During - indicates water level encountered during the boring

End - indicates water level immediately after drilling

Date and Depth - Measurements at indicated date

Water observations in pervious soils are considered reliable for the date. Water observations in impervious soils may not be accurate groundwater measurements unless records are made over several days time. Groundwater levels will fluctuate for both pervious and impervious soils.

ASTM D2488 Soil Classification Chart - Coarse Grained Soil:

Primary Soil Type	Group Name and (Group Symbol)	Criteria	
GRAVEL	Well-graded GRAVEL (GW) Poorly graded GRAVEL (GP)	<5% fines, <15% sand	
	Well-graded GRAVEL with sand (GW) Poorly-graded GRAVEL with sand (GP)	<5% fines, >15% sand	
	Well-graded GRAVEL with silt (GW-GM) Poorly graded GRAVEL with silt (GP-GM) Well-graded GRAVEL with clay (GW-GC) Poorly-graded GRAVEL with clay (GP-GC)	10% fines, <15% sand	
	Well-graded GRAVEL with silt and sand (GW-GM) Poorly graded GRAVEL with silt and sand (GP-GM) Well-graded GRAVEL with clay and sand (GW-GC) Poorly graded GRAVEL with clay and sand (GP-GC)	10% fines, >15% sand	
	Silty GRAVEL (GM) Clayey GRAVEL (GC)	>15% fines, <15% sand	
	Silty GRAVEL with sand (GM) Clayey GRAVEL with sand (GC)	>15% fines, >15% sand	
	SAND	Well-graded SAND (SW) Poorly-graded SAND (SP)	<5% fines, <15% gravel
		Well-graded SAND with gravel (SW) Poorly-graded SAND with gravel (SP)	<5% fines, >15% gravel
		Well-graded SAND with silt (SW-SM) Poorly-graded SAND with silt (SP-SM) Well-graded SAND with clay (SW-SC) Poorly-graded SAND with clay (SP-SC)	10% fines, <15% gravel
		Well-graded SAND with silt and gravel (SW-SM) Poorly-graded SAND with silt and gravel (SP-SM) Well-graded SAND with clay and gravel (SW-SC) Poorly-graded SAND with clay and gravel (SP-SC)	10% fines, >15% gravel
Silty SAND (SM) Clayey SAND (SC)		>15% fines, <15% gravel	
Silty SAND with gravel Clayey SAND with gravel		>15% fines, >15% gravel	

ASTM D2488 Soil Classification Outline - Fine Grained Soil:

Primary Soil Type	Group Name and (Group Symbol)	Criteria	
SILT	SILT (ML) Elastic SILT (MH)	<15% plus No. 200	
	SILT with sand (ML) Elastic SILT with sand (MH)	15-25% plus No. 200, % sand > % gravel	
	SILT with gravel (ML) Elastic SILT with gravel (MH)	15-25% plus No. 200, % gravel >% sand	
	Sandy SILT (ML) Sandy Elastic SILT (MH)	>30% plus No. 200, % sand > % gravel, <15% gravel	
	Sandy SILT with gravel (ML) Sandy Elastic SILT with gravel (MH)	>30% plus No. 200, % sand > % gravel, >15% gravel	
	Gravelly SILT (ML) Gravelly Elastic SILT (MH)	>30% plus No. 200, % gravel > % sand, <15% sand	
	Gravelly SILT with sand (ML) Gravelly Elastic SILT with sand (MH)	>30% plus No. 200, % gravel > % sand, >15% sand	
	CLAY	Lean CLAY (CL) Fat CLAY (CH)	<15% plus No. 200
		Lean CLAY with sand (CL) Fat CLAY with sand (CH)	15-25% plus No. 200, % sand > % gravel
Lean CLAY with gravel (CL) Fat CLAY with gravel (CH)		15-25% plus No. 200, % gravel >% sand	
Sandy lean CLAY (CL) Sandy fat CLAY (CH)		>30% plus No. 200, % sand > % gravel, <15% gravel	
Sandy lean CLAY with gravel (CL) Sandy fat CLAY with gravel (CH)		>30% plus No. 200, % sand > % gravel, >15% gravel	
Gravelly lean CLAY (CL) Gravelly fat CLAY (CH)		>30% plus No. 200, % gravel > % sand, <15% sand	
Gravelly lean CLAY with sand (CL) Gravelly fat CLAY with sand (CL)		>30% plus No. 200, % gravel > % sand, >15% sand	

Note: Percentages are based on estimated amounts of fines, sand and gravel to the nearest 5%

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**LOG
OF
BORING**

**Project No.: 141433
Boring No.: B-1
Sheet: 1 of 1**

Project: Ft. Custer
Client: Case Smeenk
Location: Augusta, MI
Drill Type: GeoProbe 7822DT
Crew Chief: CJ
Field Eng.: AV
Rev. By: AV
Elevation: 826 ft. +/-
Datum:
Notes:

Date Begin: 11/14/14 Date End: 11/14/14

	Type	Dia.	Groundwater, ft.	
Casing	HSA	4 1/4"	During	None
Sampler	SPT	2"	End	NA
Core			Seepage	
Tube			Date	Depth, ft.

Depth Drilled: 25.0 ft.

Plugging Rcd: Backfilled with compacted cuttings. Cave-in at 6.7'.

Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100% QP = Calibrated Penetrometer Reading (tons/sq.ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Penetration (Blows Per 6") ASTM D 1586	*Unified Soil Class.	*DESCRIPTION	REMARKS	QP
825	1					8" dark brown sandy Topsoil		
824	2	S-1	1.3	WOH-1-1	SP-SM	Brown poorly graded SAND with silt; mostly coarse to fine sand, few silty fines, moist	Difficult drilling at 3' +/- on possible coarse gravel or COBBLE	
823	3							
822	4							
821	5	S-2	0.7	4-3-2	SP-SM	Grades with little fine gravel	5.5' +/-	
820	6							
819	7	S-3	1.5	6-7-8	SM	Brown silty SAND with gravel; mostly coarse to fine sand, little coarse to fine gravel, little silty fines, moist		
818	8							
817	9							
816	10	S-4	1.2	6-10-10	SM			
815	11							
814	12							
813	13							
812	14							
811	15	S-5	1.5	5-11-18	SM		17' +/-	
810	16							
809	17							
808	18							
807	19							
806	20	S-6	0.9	16-25-10	SP	Brown poorly graded SAND with gravel; mostly coarse to fine sand, little coarse to fine gravel, trace silty fines, moist	S-2, S-6 Poor recovery, possible coarse gravel or COBBLE	
805	21							
804	22							
803	23							
802	24							
801	25	S-7	1.2	11-15-22	SP			
	26							
	27							
	28					End of Boring at 25.0'		
	29							
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed

**MATERIALS
TESTING
CONSULTANTS, INC.**

**LOG
OF
BORING**

**Project No.: 141433
Boring No.: B-2
Sheet: 1 of 1**

Project: Ft. Custer
Client: Case Smeenk
Location: Augusta, MI
Drill Type: GeoProbe 7822DT
Crew Chief: CJ
Field Eng.: AV
Rev. By: AV
Elevation: 826 ft. +/-
Datum:
Notes:

Date Begin: 11/14/14 Date End: 11/14/14

	Type	Dia.	Groundwater, ft.	
Casing	HSA	4 1/4"	During	None
Sampler	SPT	2"	End	NA
Core			Seepage	
Tube			Date	Depth, ft.

Depth Drilled: 10.0 ft.

Plugging Rcmd: Backfilled with compacted cuttings. Cave-in at 4.7'.

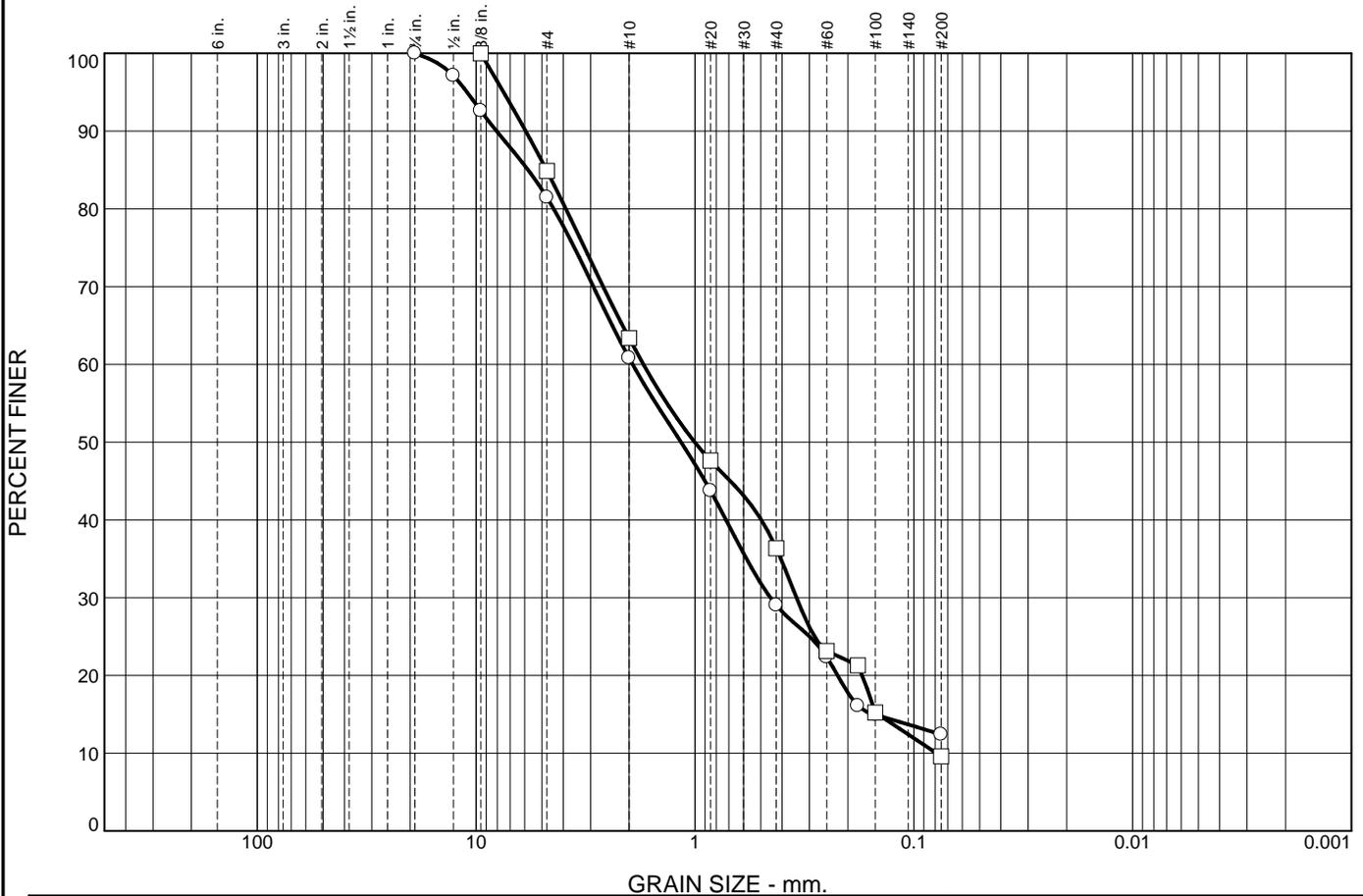
Component Percentages: Trace < 5%, Few 5-10%, Little 15-25%, Some 30-45%, Mostly 50-100%

QP = Calibrated Penetrometer Reading (tons/sq.ft.)

Elev. FT.	Depth FT.	Sample Number	Recov. FT.	Penetration (Blows Per 6") ASTM D 1586	*Unified Soil Class.	*DESCRIPTION	REMARKS	QP
825	1					6" dark brown sandy Topsoil		
824	2	S-1	1.4	WOH-1/12"	SP-SM	Brown poorly graded SAND with silt and gravel; mostly fine sand, little fine gravel, few silty fines, moist		
823	3							
822	4							
821	5	S-2	0.5	5-5-4	SP-SM	Grades with mostly coarse to fine sand, little coarse to fine gravel	S-2, S-3, S-4. Poor recovery, possible coarse gravel or COBBLE	
820	6							
819	7	S-3	0.6	3-3-2	SP	Brown poorly graded SAND with gravel; mostly coarse to fine sand, little coarse to fine gravel, trace silty fines, moist		
818	8							
817	9							
816	10	S-4	0.7	4-3-3	SP			
	11							
	12							
	13							
	14							
	15							
	16							
	17							
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	39							
	40							

* Visual estimate following ASTM D 2488 unless laboratory testing has been performed

Particle Size Distribution Report



		% Gravel		% Sand			% Fines	
% +3"		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
<input type="radio"/>	0.0	0.0	18.5	20.7	31.8	16.6	12.4	
<input type="checkbox"/>	0.0	0.0	15.1	21.5	27.0	26.8	9.6	

		LL	PL	D85	D60	D50	D30	D15	D10	Cc	Cu
<input type="radio"/>				5.7909	1.9267	1.1577	0.4524	0.1529			
<input type="checkbox"/>				4.7727	1.7192	1.0027	0.3435	0.1458	0.0788	0.87	21.82

Material Description	USCS	AASHTO
<input type="radio"/> Silty Sand with Gravel	SM	
<input type="checkbox"/> Poorly Graded Sand With Silt and Gravel	SP-SM	

Project No. 141433 Client: Case Smeenk Project: Fort Custer	Remarks:
<input type="radio"/> Location: Boring B-1, S-4 Depth: 8.5 ft - 10 ft Sample Number: 113459 <input type="checkbox"/> Location: Boring B-2, S-2 Depth: 3.5 ft - 5 ft Sample Number: 113460	

SOIL TEST REPORT FOR:				CONSULTANT			
AARON VANDERHILL MATERIALS TESTING CONSULTANTS 693 PLYMOUTH AVE. NE GRAND RAPIDS MI 49505							

DATE	LAB #	COUNTY	GROWER'S EMAIL	ACRES	FIELD ID	SOIL	TEXTURE
11/24/2014	182351	Kent	avanderhill@mtc-test.com		Area 1	Mineral	Sandy Loam
Next to Lake or Stream?		Year Area Planted		Fertilizer Tilled in Prior to Planting?			How Deep?
							6 Inches

SOIL NUTRIENT LEVELS		Below Optimum	Optimum	Above Optimum
¹ Soil pH 5.5	Lime Index 65.0			
² Phosphorus (P) 22 ppm		■■■■■■■■■■	■■■■■■■■■■	
³ Potassium (K) 77 ppm		■■■■		
³ Magnesium (Mg) 73 ppm		■■■■■■■■■■	■■■■■■■■■■	

ADDITIONAL RESULTS:			Optional Tests:								
³ Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases			Micronutrients (ppm)					Organic Matter %	Nitrate-N ppm
		K	Mg	Ca	B	Cu	Mn	Zn	Fe		
333	8.5	8.0	24.6	67.4						2.4	

RECOMMENDATIONS FOR: *Trees, deciduous - home*

Limestone: 107 lb/1000 sq ft

NUTRIENT NEEDS:			
Nitrogen (N) 3 lb/1000 sq ft	Phosphate (P₂O₅): NONE	Potassium (K₂O): 6.2 lb/1000 sq ft	Target pH: 6.0

FERTILIZER OPTIONS:

MESSAGES

Maximum suggested single nitrogen application is 1.0 lb N per 1000 sq.ft. Make no fertilizer applications in August.

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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.
- C. Shop Drawings: Reinforcing steel: Complete shop drawings.
- 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):
 - 117R-06.....Tolerances for Concrete Construction and Materials
 - 211.1-91(R2002).....Proportions for Normal, Heavyweight, and Mass Concrete
 - 301-05.....Specification for Structural Concrete
 - 305R-06.....Hot Weather Concreting
 - 306R-2002.....Cold Weather Concreting
 - SP-66-04ACI Detailing Manual
 - 318/318R-05.....Building Code Requirements for Reinforced Concrete

- 347R-04.....Guide to Formwork for Concrete
- C. American Society for Testing And Materials (ASTM):
 - A185-07.....Steel Welded Wire, Fabric, Plain for Concrete Reinforcement
 - A615/A615M-08.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - C31/C31M-08.....Making and Curing Concrete Test Specimens in the Field
 - C33-07.....Concrete Aggregates
 - C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens
 - C94/C94M-07.....Ready-Mixed Concrete
 - C143/C143M-05.....Standard Test Method for Slump of Hydraulic Cement Concrete
 - C150-07.....Portland Cement
 - C171-07.....Sheet Material for Curing Concrete
 - C172-07.....Sampling Freshly Mixed Concrete
 - C173-07.....Air Content of Freshly Mixed Concrete by the Volumetric Method
 - C192/C192M-07.....Making and Curing Concrete Test Specimens in the Laboratory
 - C231-08.....Air Content of Freshly Mixed Concrete by the Pressure Method
 - C260-06.....Air-Entraining Admixtures for Concrete
 - C330-05.....Lightweight Aggregates for Structural Concrete
 - C494/C494M-08.....Chemical Admixtures for Concrete
 - C618-08.....Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - D1751-04.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
 - D4397-02.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
 - E1155-96(2008).....Determining F_F Floor Flatness and F_L Floor Levelness Numbers

PART 2 - PRODUCTS

2.1 FORMS:

- A. 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.
- H. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).
- 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. 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 shall be not less than 25mpa 3000 psi. Refer to drawings for specific locations and requirements.
- 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	Non-Air-Entrained		Air-Entrained	
	Min. Cement	Max. Water	Min. Cement	Max. Water
Min. 28 Day Comp.				

Str. MPa (psi)	kg/m ³ (lbs/c. yd)	Cement Ratio	kg/m ³ (lbs/c. yd)	Cement Ratio
35 (5000) ^{1,3}	375 (630)	0.45	385 (650)	0.40
30 (4000) ^{1,2}	325 (550)	0.50	340 (570)	0.50
25 (3000) ^{1,2}	280 (470)	0.55	290 (490)	0.55

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.

* 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 following table:

**TABLE I - TOTAL AIR CONTENT
 FOR VARIOUS SIZES OF COARSE AGGREGATES (NORMAL CONCRETE)**

Nominal Maximum Size of Coarse Aggregate	Total Air Content Percentage by Volume
10 mm (3/8 in)	6 to 10
13 mm (1/2 in)	5 to 9
19 mm (3/4 in)	4 to 8
25 mm (1 in)	3 1/2 to 6 1/2
40 mm (1 1/2 in)	3 to 6

2.4 BATCHING & MIXING:

A. Store, batch, and mix materials as specified in ASTM C94.

1. Job-Mixed: Concrete mixed at job site shall be mixed in a batch mixer in manner specified for stationary mixers in ASTM C94.

2. 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. Contractor is responsible for setting and maintaining concrete formwork to assure erection of completed work within tolerances specified to accommodate installation or other rough and finish materials. Remedial work necessary for correcting excessive tolerances is the responsibility of the Contractor. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
 - 2. 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.

3.3 VAPOR BARRIER:

- A. Except where membrane waterproofing is required, place interior concrete slabs on a continuous vapor barrier.
- B. Place 100 mm (4 inches) of fine granular fill over the vapor barrier to act as a blotter for concrete slab.
- C. Lap joints 150 mm (6 inches) and seal with a compatible pressure-sensitive tape.

D. Patch punctures and tears.

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. Before placing new concrete on or against concrete which has set, existing surfaces shall be roughened and cleaned free from all laitance, foreign matter, and loose particles.
- 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.
2. Interior and Exterior Exposed Areas (to be painted): Fins, burrs and similar projections on surface shall be knocked off flush by mechanical means approved by COR and rubbed lightly with a fine abrasive stone or hone. Use an ample amount of water during rubbing without working up a lather of mortar or changing texture of concrete.
3. Interior and Exterior Exposed Areas (finished): Finished areas, unless otherwise shown, shall be given a grout finish of uniform color and shall have a smooth finish treated as follows:
 - a. After concrete has hardened and laitance, fins and burrs have been removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone or stone.
 - b. Apply grout composed of 1 part portland cement and 1 part clean, fine sand (smaller than 600 micro-m (No. 30) sieve). Work grout into surface of concrete with cork floats or fiber brushes until all pits and honeycomb are filled.
 - c. After grout has hardened, but still plastic, remove surplus grout with a sponge rubber float and by rubbing with clean burlap.
 - d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish for any area in same day. Confine limits of finished areas to natural breaks in wall surface. Do not leave grout on concrete surface overnight.

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. Steel Trowel Finish: Applied toppings, concrete surfaces to receive resilient floor covering or carpet, future floor roof and all monolithic concrete floor slabs exposed in finished work and for which no other finish is shown or specified shall be steel troweled. Final steel troweling to secure a smooth, dense surface shall be delayed as long as possible, generally when the surface can no longer be dented with finger. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure on trowel to compact cement paste and form a dense, smooth surface. Finished surface shall be free of trowel marks, uniform in texture and appearance.
5. Broom Finish: Finish all exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after the surfaces have been floated.
6. 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.
- C. Non-Slip Finish: Except where safety nosing and tread coverings are shown, apply non-slip abrasive aggregate to treads and platforms of all concrete steps and stairs, and to surfaces of exterior concrete ramps and platforms. Aggregate shall be broadcast uniformly over concrete surface. Trowel concrete surface to smooth dense finish. After curing,

rub the treated surface with abrasive brick and water sufficiently to slightly expose abrasive aggregate.

3.10 APPLIED TOPPING:

- A. Separate concrete topping with thickness and strength shown with only enough water to insure a stiff, workable, plastic mix.
- B. Continuously place applied topping until entire section is complete, struck off with straightedge, compact by rolling or tamping, float and steel trowel to a hard smooth finish.

3.11 RESURFACING FLOORS:

- A. Remove existing flooring, in areas to receive resurfacing, to expose existing structural slab and to extend not less than 25 mm (1 inch) below new finished floor level. Prepare exposed structural slab surface by roughening, broom cleaning, wetting, and grouting. Apply topping as specified.

3.12 RETAINING WALLS:

- A. Concrete for retaining walls shall be as shown and air-entrained.
- B. Install and construct expansion and contraction joints, waterstops, weep holes, reinforcement and railing sleeves as shown.
- C. Finish exposed surfaces to match adjacent concrete surfaces, new or existing.
- D. Porous backfill shall be placed as shown.

3.13 PRECAST CONCRETE ITEMS:

- A. Precast concrete items, not specified elsewhere, shall be cast using 30 MPa (4000 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.

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SECTION 03 48 24
PRECAST CONCRETE COLUMBARIUM UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers the manufacture and installation of precast concrete columbarium units, as shown on the drawings and specified herein, including but not limited to: the steel reinforcement, steel embedment plates, required sleeves, finished exposed surfaces, preparation of setting surface, adhesive, columbarium fasteners, and niche cover anchor clip assemblies.
- B. Acceptable designs of the columbarium units' components are provided as shown on the Drawings. The Contractor may use this design for this Work or may propose alternate designs of the corresponding components as follows:
 - 1. Design for alternate columbarium units shall comply with the design criteria as per Articles 1.3.F and shall comply with the functional tests as per Article 1.3.G of this Specification.
 - 2. Unless indicated otherwise, all provisions of this Specification shall apply to the Contractor proposed design.
- C. The Government may accept or reject part or all of any design proposed by the Contractor.
- D. This section includes preparation, cleaning and finishing of exposed faces of the columbarium units as indicated on drawings or described herein.

1.2 RELATED DOCUMENTS

- A. Section 31 20 11, EARTH MOVING (Short Form)
- B. Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM) for Cast-in-place concrete work.

1.3 QUALITY ASSURANCE

- A. Manufacturer's and Installer's Qualifications: Prior to commencement of work, submit documentation regarding the experience of his precast concrete supplier and his precast concrete installer in the design, manufacture and installation of Precast Concrete structures and custom units.
- B. Precast concrete manufacturer's qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements.

- C. Codes and regulations of the Federal, State and County authorities shall apply.
- D. Fabricate to dimensions shown or approved. Replace or correct Columbarium Units that do not comply with the individual dimensions and tolerances.
- E. Before starting production of Precast Concrete Columbarium Units, furnish at the site, two complete Precast Concrete Columbarium Units, to demonstrate quality of construction. Commence production of columbarium units only after written approval has been obtained from the Resident Engineer/COR.
- F. Design Criteria:
1. The Columbarium Units shall be of the following type, style, and size:
 - a. Type: Precast concrete, reinforced.
 - b. Size: Interior and exterior dimensions as indicated on plans.
 2. Columbarium top shall be capable of structurally supporting imposed service live load of no less than 240 Kgs./Square Meter (50 lb./ft²), and dead loads based on cap (coping) thickness and heights, including material composition and element section properties, mortar and grout, and dead loads based on concrete top element sectional properties.
 3. Submit to the CO/COR for review and approval 5 sets of design documentation showing structural design of the complete Columbarium. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer. For manufacturers regularly providing these units for NCA projects, a variance from this requirement may be requested by the contractor and approved following submittal of the past history of successful installations at NCA projects, at the CO/COR's discretion.
- G. Functional Load Tests: If required by the CO/COR, a functional load test will be made at the Contractor's expense to insure that the columbarium proposed by the Contractor, as furnished, will be capable of supporting loads stated in Article 1.3.F.2. The functional test will consist of the following loading conditions:
1. Unconfined Loading: The columbarium will be placed on a flat surface with no support against the sides. The entire top of the

columbarium will be subjected to a simulated uniform load of live load of 240 Kgs./Square Meter (50 lb./ft²) and required dead load simulating cap, mortar, and grout as they will be installed. The load will be maintained for no less than 72 hours. At end of the loading period, the maximum deflection of the Columbarium top elements shall be no more than 3 mm (1/8"). Upon removal of the load from the unit the residual deflection shall be no more than 1.5 mm (1/16") and concrete elements shall be free of all structural distress.

1.4 MANUFACTURER AND INSTALLER QUALIFICATIONS

- A. Precast concrete columbarium units shall be product of manufacturer who has a minimum of 3 years of experience in fabrication of the precast concrete columbarium units similar in material, design, and quantity to that indicated on the drawings and specified herein.
- B. Precast concrete columbarium units installer shall have been regularly engaged for at least three years in installation of precast concrete similar to this project.
- C. Supply and Installation of fastener system shall be by product manufacturers and installers, both whom have had a minimum of 3 years of experience in installation of similar design to that indicated on the drawing.

1.5 ALLOWABLE TOLERANCES

- A. In addition to tolerances of individual elements required by American Concrete Institute Publication 533.3R, erection tolerances shall be as follows:
 - 1. Variation of anchors and fasteners from dimensions specified:
3 mm (1/8")
 - 2. Variation in overall dimensions of precast element (height and width): 3 mm (1/8")
 - 3. Maximum differential between adjacent units in erected position:
3 mm (1/8")
 - 4. Variation in thickness of precast panels and elements:
3 mm (1/8")
 - 5. Maximum vertical differential between adjacent columbarium units in installed position: 3 mm (1/8")

1.6 SUBMITTALS

- A. In accordance with Division 1 Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES, furnish the following:

1. Samples of all fastening systems, mounting hardware and exposed surface finishes including, but not limited to, the following:
 - a. Stainless Steel Angle with threaded spring clip to receive the Tamper Proof Stainless Steel Bolt
 - b. Stainless Steel Bolt, Nut and Washers
 - c. Tamper Proof Stainless Steel Bolt
 - d. Stainless Steel Rosette
 - e. Stainless Steel Expansion Anchors, Bolts and pins
 - f. Stainless Steel Ferrule loop insert.
 - g. Shims
 - h. Washers
2. Samples of two complete Precast Concrete Columbarium Units, to demonstrate quality of construction, delivered to the site to be approved prior to production.
3. Samples of adhesives and grouts.
4. Samples of concrete repair and/or patching materials.
5. Shop Drawings: Complete shop and erection drawings of all precast concrete columbarium units, showing:
 - a. All dimensions and details of construction.
 - b. Installation and relation to adjoining work.
 - 1) Show the individual units open ended against closed ended, where applicable and that web centerline distance is maintained across the joint between units.
 - 2) Show that the overall length of the wall, with multiple precast units is to be set with the indicated overall in place length, within the allowable tolerances (show the installation tolerances).
 - 3) For back to back precast niche units show that the web centerlines for the back to back units will align, for the locations below the cap joints, within the allowable tolerances.
 - 4) Detail where the precast niche units are to be set in the field so the centerline of niche webs will align with the centerline of cap joints above, within the allowable tolerances, when the drawings or details indicate this alignment.

- c. Reinforcements, anchorage, attachments, inserts, location of all pre-drilled sleeves and other items to be installed in the work of other trades.
 - d. Joint treatment, joint alignment coordinated with cap stone joints.
 - e. Any other work required for a complete installation.
 - f. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction, and that the construction of the concrete support (foundations) work has been coordinated with the precast columbarium unit manufacturer and installer.
6. Production Drawings:
- a. Elevation view of each structural element.
 - b. Planometric view of unit.
 - c. Sections and details to show quantities and position of reinforcing steel, anchors, inserts, and essential embedded and non-embedded hardware for fabrication, handling, transportation and installation.
 - d. Lifting and erection inserts.
 - e. Dimensions and finishes.
 - f. Method of transportation.
 - g. Method of erection and handling.
7. Erection Drawings:
- a. Elevation view of each typical wall segment of interconnected precast niche units, with the overall in place length and position of the precast niche assembly.
 - b. Section view of the precast niche units, as they are to be installed, with the critical alignment elements and field placed dimensions indicated. For double sided units, as an example, the face of niche unit to face of backed up niche unit shall be indicated with the construction tolerances for the in place units indicated. Clearly indicate how the units are going to be set in the field to achieve the intended installed conditions.
 - c. Provide setting drawing(s) that indicate how the precast niche units are to be positioned on the foundations, to meet the design drawings. The setting drawings shall be submitted based upon the field conditions for the foundations for the segments upon which

the precast niche units are to be set. Any discrepancies that exist greater than 1/4" from the design drawings shall be clearly indicated as the foundations are to be constructed within this tolerance. The setting of the precast concrete niche units shall not begin until this information has been provided and approved by the RE/COR, or adjustments made to the foundations that are acceptable to the RE/COR.

- d. Provide coordination drawings indicating the locations for the weld plates in the precast niche units as well as in the foundations, and coordinate this information so the weld plates are installed in the correct locations to align within allowable tolerances.
8. Manufacturer's Literature and Data:
 - a. Each type of Concrete Fastener, including adhesive and anchor devices.
 - b. Instructions for final cleaning
 9. Certificates: Manufacturer's qualifications specifying precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.
 10. Certificates: Installer's qualifications documenting the quality and quantity of experience of the precast concrete installer in the installation of Precast Concrete structures and custom units.
 11. Certificates: Manufacturer of the precast niche units shall provide a written certification, prior to shipping the materials, that the products being shipped have been checked and that they meet the dimensional criteria as indicated, within the allowable tolerances for individual units, and that they can be assembled as part of the identified wall segments, within the allowable in place dimensions indicated, within the allowable tolerances indicated. The above manufacturing certifications shall be provided no later than immediately before the units are offloaded at the site. Units that do not meet these criteria shall either be returned or marked in such a manner that indicates they are not to be used for the project work. It is the Contractor's responsibility to ensure that all units that are installed in the project work have been certified by the manufacturer of the units. The Contractor shall be responsible for disposal of any units that are not acceptable for installation in the project work at no cost to the Government.

1.7 DELIVERY, STORAGE

- A. Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage including vandalism, injurious effects of weather and inclusion of foreign matter.
- B. Provide access to the units for field verification of the manufacturing dimensions and whether the units are within allowable tolerances.

1.8 COORDINATION

- A. Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete columbarium unit work. See Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for details regarding the coordination of work.

1.9 GUARANTEE

- A. Guarantee precast concrete columbarium unit work, including anchorage, joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling, and after erection, completed work will be subject to terms of "Guarantee" article in Division 1 Specification Sections except that guarantee period is one year.

1.10 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. Federal Specifications (Fed. Spec.):
 - QQ-S-766C (5) Steel Plates, Sheets, and Strip-Corrosion Resisting
 - QQ-W-423B Wire, Steel, Corrosive-Resisting
 - TT-S-00227E (3) Sealing Compound Elastomeric Type, Multi-Component (For Caulking, Sealing, And Glazing In Building And Other Structures)

TT-S-00230C (2) Sealing Compound: Elastomeric Type, Single
Component (For Caulking, Sealing and Glazing In
Building and Other Structures)

C. American Concrete Institute (ACI) Publications:

ACI 533.3R-70 Fabrication, Handling And Erection of Precast
Concrete.

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

A36/A36M-08 Structural Steel

ASTM A276-13 Stainless Steel Bars and Shapes

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

A1064/A1064M-13 Standard Specifications for Carbon-Steel Wire
and Welded Wire Reinforcement, Plain and
Deformed, for Concrete.

C33/C33M-12 Concrete Aggregates

C150/C150M-12 Portland Cement

E. American Welding Society (AWS) Publications:

AWS D1.1/D1.1M-12(e11) Structural Welding Code

AWS D1.4/D1.4M-11 Welding Reinforcing Steel

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Manufacturers that have previously completed at least one successful
NCA columbarium project are deemed to be acceptable for processing
their units through the procedures according to these specifications
and the drawings.

B. Manufacturers that do not have previous successful experience for a NCA
columbarium project may be selected by the Contractor for the project.
Contractor is hereby notified that the submittal process for a
manufacturer with no previous NCA experience with a successful
columbarium project, typically takes longer to process.

2.2 COARSE AGGREGATE

A. Hard durable aggregate carefully graded from coarse to fine in
proportions required to match approved samples of precast concrete
columbarium units.

2.3 AGGREGATE FOR BACK-UP MIX (FINE AND COARSE AGGREGATE LIGHTWEIGHT):

A. ASTM C33. Limit gradation as required to produce the specified
appearance and quality of concrete.

2.4 PORTLAND CEMENT

- A. ASTM C150, Type I and Type II; Color as required.

2.5 STRUCTURAL STEEL

- A. ASTM A36.

2.6 STEEL FABRIC REINFORCEMENT

- A. ASTM A1064, galvanized.

2.7 STEEL WIRE REINFORCEMENT

- A. ASTM A1064, cold drawn.

2.8 REINFORCING STEEL

- A. ASTM A615, deformed, Grade 60.

2.9 MISCELLANEOUS GALVANIZED STEEL ITEMS

- A. Bolts, nuts, washers, anchors, inserts, and the like for handling, erection, or use by trades.

2.11 NICHE COVER ATTACHMENT HARDWARE (ROSETTES)

- A. VA National Cemetery Administration, standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the niche covers to the precast columbarium units are to be as shown on drawings:

1. Rosettes

- a. ASTM Type 316 stainless steel sheet goods, 2.7 mm (0.100 inch) thick.
- b. Die stamp, producing an eight-petal flower pattern as shown on drawings, 25 mm (one-inch) diameter with slight convex; center hole of 5.5 mm (0.218"), concentric to outer edge, with shoulder recess of 10 mm(0.400") in diameter and 1mm (0.035") in depth.
- c. Luster finish.

2. Interior mounting and attachment elements:

- a. ASTM Type 304 or 316 stainless steel tamper-resistant bolts, nuts, washers, anchors, mounting brackets, neoprene washers, inserts and the like.

2.12 BACK-UP MATERIAL

- A. Closed cell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1-1/3 times the joint width.

2.13 BOND BREAKERS IF USED

- A. Type and material recommended by sealant manufacturer.

2.14 SEALING COMPOUND IF USED

- A. Fed. Spec. TT-S-00230 C, Type II, Class A, or ASTM C 920-11, Type S, Grade NS, Class 25.

2.15 FABRICATION

- A. Precast concrete columbarium units shall NOT be: fabricated, delivered or incorporated in the work until samples have been approved. Precast concrete shall comply with ACI 533.3R, except as modified herein.
1. Concrete for precast columbarium units shall have minimum compressive strength of 35 MPa (5,000 psi) at 28 days.
 2. Provide additional steel reinforcing as required for casting, handling and erection loads.
 3. Back-up Mix: Porosity, strength, weight and gradation of coarse aggregate shall be as required to produce specified characteristics.
 4. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in oiled forms. Form oil shall be non-staining type. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.
 - a. Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
 - b. Fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling into precast concrete columbarium units, after fabrication, shall not be acceptable, except where pins are to be inserted through the tops of the units into the caps above, or where pins are to be inserted through the bottom of the precast niche units into the foundation below.
 5. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
 6. Finish: Exposed faces shall have smooth natural concrete finish, unless otherwise noted. The face of the units shall be processed by the manufacturer, following removal from the forms to insure that the discoloration and blemishes on the niche faces are removed before shipping to the site.

- a. Back side of single columbarium units, with back exposed to view shall have surface finish as indicated on the drawings.
 - b. Specified surface finish for the exposed back of the columbarium units shall be applied during the appropriate time of fabrication and curing. Seal coating of exposed back of units shall be applied as per manufacturer's recommendations.
7. Curing: Precast concrete 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 and minimize warping, without staining the exposed faces.

PART 3 - EXECUTION

3.1 HANDLING AND INSTALLATION

- A. Before beginning installation, inspect work of other trades in-so-far as it affects the work of this Section. Install units by competent installation crews meeting the requirements of paragraph 1.4 B. Commencing installation of precast concrete columbarium units will be construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improperly installed units.
1. Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with approved shop and erection drawings.

3.2 SETTING

- A. Each precast element shall be set level and true to line with uniform joints as specified within the allowable tolerances, and as needed to result in the overall length of the wall assembly being the specified dimension, within the allowable construction tolerances. Joints that are required to have sealants shall be kept free of dirt and other contaminants for at least the depth to the contact points of the backer rod. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.

- B. Setting of the precast niche units is intended to meet the design drawings within the allowable construction tolerances indicated. There are certain visual relationships that are most critical in the final installation to achieve the design intent. Generally, the consistency of the cap overhang in front of the precast niches, as well as the symmetry of the overhang distance are critical. For double sided columbarium units, as an example, the distance from the face of niche unit to the face of niche units, when installed back to back, is a critical dimension when setting the units. Maintaining this dimension in setting the units, especially at the top of the precast niche units, will allow that the caps be manufactured the same width, and the placement should produce the correct overhang and be symmetrical. The distance from the center of vertical webs on adjoining units, especially across the joints between precast niche units where open and closed end units are joined, are critical as maintaining these allows the proper setting of the niche covers. Refer to the drawings for additional information regarding the critical element relationships to be used during the creation of the foundations and setting of the precast units.
- C. Where shown, joints shall be filled with sealant. Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter.

3.3 SEALING OF JOINTS

- A. Where shown and/or wherever required to make the work watertight, joints between precast concrete columbarium units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.
1. Workmanship shall be in accordance with Division 1 Specification Sections and Section 07 92 00, JOINT SEALANTS.
 2. All joints shall be mechanically cleaned, then cleaned with the sealant manufacturer's recommended joint primer, immediately prior to placing the joint sealant.
 3. Use painters tape or otherwise ensure that joints receiving sealant have a consistent thickness and appearance.

4. Joint sealant process shall be undertaken when there is not dirt and dust in the air, until the sealant has set. Joints shall be protected from contamination by airborne particles so that sealant will not be permanently discolored by dirt, dust or debris that sticks to the surface of the sealant before it dries.

3.4 CLEANING

- A. After erection is complete, clean precast columbarium units using materials, equipment and methods recommended by manufacturer.

3.5 REPLACEMENT AND REPAIR

- A. Precast concrete columbarium units which are damaged, cracked, stained, improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects not affecting serviceability or appearance may be repaired when approved by the CO/COR. Repaired work shall be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

3.6 FINISHING OF EXPOSED FACES

- A. Exposed faces of precast columbarium units shall have a smooth, grout rubbed finish.

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**SECTION 04 05 13
MASONRY MORTARING**

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies mortar materials and mixes.

1.2 RELATED WORK:

- A. Mortar used in Section:
1. Section 04 05 16, MASONRY GROUTING.
 2. Section 04 20 00, UNIT MASONRY.
 3. Section 04 43 00, MANUFACTURED STONE VENEER.

1.3 TESTING LABORATORY-CONTRACTOR RETAINED

- A. Engage a commercial testing laboratory approved by COR to perform tests specified below.
- B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to COR.

1.4 TESTS

- A. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
- B. Mortar:
1. Test for compressive strength and water retention; ASTM C270.
 2. Mortar compressive strengths 28 days as follows:
Type M: Minimum 17230 kPa (2500 psi) at 28 days.
Type S: Minimum 12400 kPa (1800 psi) at 28 days.
Type N: Minimum 5170 kPa (750 psi) at 28 days.
- C. Cement:
1. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 2. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
- D. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
1. Testing laboratory's facilities and qualifications of its technical personnel.
 2. Indicating that following items meet specifications:

- a. Portland cement.
- b. Masonry cement.
- c. Mortar cement.
- d. Hydrated lime.
- e. Fine aggregate (sand).
- f. Color admixture.
- C. Laboratory Test Reports:
 - 1. Mortar, each type.
 - 2. Admixtures.
- D. Manufacturer's Literature and Data:
 - 1. Cement, each kind.
 - 2. Hydrated lime.
 - 3. Admixtures.
 - 4. Liquid acrylic resin.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-04.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-05.....Masonry Cement
 - C109-07.....Compressive Strength of Hydraulic Cement Mortars
(Using 2-in. or 50-MM Cube Specimens)
 - C144-04.....Aggregate for Masonry Mortar
 - C150-05.....Portland Cement
 - C207-06.....Hydrated Lime for Masonry Purposes
 - C270-07.....Mortar for Unit Masonry
 - C595-08.....Blended Hydraulic Cement
 - C780-07.....Preconstruction and Construction Evaluation of
Mortars for Plain and Reinforced Unit Masonry
 - C979-05.....Pigments for Integrally Colored Concrete
 - C1329-05.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR

A. ASTM C144 and as follows:

1. Light colored sand for mortar for laying face brick.
2. Limit fine aggregate to stone less than 3/8" in diameter.

B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 BLENDED HYDRAULIC CEMENT

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT

A. ASTM C91. Type N, S, or M.

2.5 MORTAR CEMENT

ASTM C1329, Type N, S or M.

2.6 PORTLAND CEMENT

A. ASTM C150, Type I.

2.7 LIQUID ACRYLIC RESIN

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.8 WATER

Potable, free of substances that are detrimental to mortar, masonry, and metal.

2.9 MASONRY MORTAR

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures, except color admixtures if approved by COR.
2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
3. Do not use antifreeze compounds.

C. Colored Mortar:

1. Maintain uniform mortar color for exposed work throughout.
2. Match mortar color in approved sample or mock-up.

D. Color Admixtures:

1. Proportion as specified by manufacturer.

2.10 COLOR ADMIXTURE

A. Pigments: ASTM C979.

- B. Use mineral pigments only. Organic pigments are not acceptable.
- C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION

3.1 MIXING

- A. Mix in a mechanically operated mortar mixer.
 - 1. Mix mortar for at least three minutes but not more than five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
- D. Mortar that has stiffened because of loss of water through evaporations:
 - 1. Re-tempered by adding water to restore to proper consistency and workability.
 - 2. Discard mortar that has reached its initial set or has not been used within two hours.

3.2 MORTAR USE LOCATION

- A. Use Type M mortar for precast concrete panels and waterproof parging below grade.
- B. Use Type S mortar for setting cast stone and engineered reinforced unit masonry work.
- C. Use Type N mortar for other masonry work, except as otherwise specified.

- - - E N D - - -

SECTION 04 05 16
MASONRY GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies grout materials and mixes.

1.2 RELATED WORK:

- A. Grout used in Section:
1. Section 04 20 00, UNIT MASONRY.
 2. Section 04 05 13, MASONRY MORTARING.
 3. Section 04 43 00, MANUFACTURED STONE VENEER.

1.3 TESTS:

- A. Test grout and materials specified.
- B. Certified test reports.
- C. Identify materials by type, brand name and manufacturer or by origin.
- D. Do not use materials until laboratory test reports are approved by COR.
- E. After tests have been made and materials approved, do not change without additional test and approval of COR.
- F. Testing:
1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
 2. Grout:
 - a. Test for compressive strength; ASTM C1019.
 - b. Grout compressive strength of 13790 kPa (2000 psi) at 28 days.
 3. Cement:
 - a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
 - b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
 4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Certificates:
1. Indicating that following items meet specifications:
 - a. Portland cement.
 - b. Masonry cement.
 - c. Grout.

- d. Hydrated lime.
- e. Fine aggregate (sand).
- C. Laboratory Test Reports:
 - 1. Grout, each type.
 - 2. Admixtures.
- D. Manufacturer's Literature and Data:
 - 1. Cement, each kind.
 - 2. Hydrated lime.
 - 3. Admixtures.
 - 4. Liquid acrylic resin.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.
- B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.6 APPLICABLE PUBLICATIONS:

- A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - C40-04.....Organic Impurities in Fine Aggregates for
Concrete
 - C91-05.....Masonry Cement
 - C150-07.....Portland Cement
 - C207-06.....Hydrated Lime for Masonry Purposes
 - C404-07.....Aggregate for Masonry Grout
 - C476-08.....Grout for Masonry
 - C595-08.....Blended Hydraulic Cement
 - C979-05.....Pigments for Integrally Colored Concrete
 - C1019-09.....Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 BLENDED HYDRAULIC CEMENT:

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

- A. ASTM C91. Type N, S, or M.

2.5 PORTLAND CEMENT:

- A. ASTM C150, Type I.

2.6 LIQUID ACRYLIC RESIN:

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.7 WATER:

Potable, free of substances that are detrimental to grout, masonry, and metal.

2.8 GROUT:

- A. Conform to ASTM C476 except as specified.
- B. Grout type proportioned by volume as follows:
 - 1. Fine Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - 2. Coarse Grout:
 - a. Portland cement or blended hydraulic cement: one part.
 - b. Hydrated lime: 0 to 1/10 part.
 - c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
 - d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
 - 3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

PART 3 - EXECUTION

3.1 MIXING:

- A. Mix in a mechanically operated grout mixer.
 - 1. Mix grout for at least five minutes.
- B. Measure ingredients by volume. Measure by the use of a container of known capacity.
- C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

- A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.

B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).

C. Do not use grout for filling bond beam or lintel units.

- - - E N D - - -

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

- A. Mortars and grouts: Section 04 05 13, MASONRY MORTARING, Section 04 05 16, MASONRY GROUTING.
- B. Sealants and sealant installation: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Shop Drawings:
 - 1. Drawings, showing wall reinforcement per drawings and reinforcing masonry for embedment of anchors.
 - 2. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Comply with ACI 315.
- C. Certificates:
 - 1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
 - 2. Indicating that the following items meet specification requirements:
 - a. Solid and load-bearing concrete masonry units.
 - 3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.
- D. Manufacturer's Literature and Data:
 - 1. Anchors, ties, and reinforcement.
 - 2. Reinforcing bars.

1.4 WARRANTY

Warranty exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be five years.

1.5 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 Society for Testing and Materials (ASTM):
 - A580/A580M-14.....Standard Specification for Stainless Steel Wire

- A615/A615M-09.....Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement.
- C67-08.....Sampling and Testing Brick and Structural Clay
Tile
- C90-08.....Load-Bearing Concrete Masonry Units
- C476-08.....Standard Specification for Grout for Masonry
- C612-04e1.....Mineral Fiber Block and Board Thermal Insulation
- C744-08.....Prefaced Concrete and Calcium Silicate Masonry
Units.
- D1056-07.....Flexible Cellular Materials - Sponge or Expanded
Rubber
- D3574-08.....Flexible Cellular Materials-Slab, Bonded, and
Molded Urethane Foams
- F1667-05.....Fasteners: Nails, Spikes and Staples
- C. Masonry Industry Council:
Hot and Cold Weather Masonry Construction Manual,1999.
- D. American Welding Society (AWS):
D1.4-05.....Structural Welding Code - Reinforcing Steel.
- E. Masonry Standards Joint Committee; Specifications for Masonry Structures
(ACI 530.1-08/ASCE 6-05/TMS 602-05) (MSJC).
- F. American Concrete Institute (ACI)
ACI 315-99.....Details and Detailing of Concrete Reinforcement

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
 - 1. Unit Weight: Normal weight.
 - 2. Sizes: Modular.

2.2 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A615, deformed bars, 420 MPa (Grade 60) for bars No. 10 to No. 57 (No. 3 to No. 18), except as otherwise indicated.
- B. Joint Reinforcement:
 - 1. Form from AISI Type 304 Stainless Steel wire complying with ASTM A580.
 - 2. Width of joint reinforcement 40 mm (1 5/8-inches) less than nominal width of masonry wall or partition.
 - 3. Joint reinforcing at least 3000 mm (10 feet) in length.
 - 4. Joint reinforcing in rolls is not acceptable.
 - 5. Joint reinforcing that is crimped to form drip is not acceptable.

6. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.
7. Ladder Design:
 - a. Longitudinal wires deformed 4 mm (0.19 inch) diameter wire.
 - b. Cross wires 2.6 mm (0.10 inch) diameter.
8. Trussed Design:
 - a. Longitudinal and cross wires not less than 4 mm (0.19 inch nominal) diameter.
 - b. Longitudinal wires deformed.

2.3 ANCHORS, TIES, AND REINFORCEMENT

- A. Adjustable Veneer Anchor for Concrete Piers:
 1. Two piece, adjustable anchor and tie.
 2. Anchor and tie may be either type; use only one type throughout.
 3. Loop Type:
 - a. Anchor Slots: Form from 26 gage (0.45 mm), stainless steel Type 304 sheet, 1 inch (25 mm) wide by 1 inch (25 mm) deep by 5/8 inch (16 mm) throat.
 - b. Triangular Ties: Triangular tie, fabricated of 5 mm (0.20 inch) diameter stainless steel wire. Ties long enough to engage the anchor and be embedded not less than 50 mm (2 inches) into the bed joint of the masonry.
 4. Dovetail Corrugated Wall Tie:
 - a. Anchor Slots: Form from 26 gage (0.45 mm), stainless steel Type 304 sheet, 1 inch (25 mm) wide by 1 inch (25 mm) deep by 5/8 inch (16 mm) throat.
 - b. Corrugated Tie: Form from 1.5 mm (0.0598 inch) thick corrugated, stainless steel 30 mm (1-1/4 inches) wide by lengths so as to extend at least 100 mm (4 inches) into joints of new masonry plus 38 mm (1-1/2 inch) turn-up.

2.4 PREFORMED COMPRESSIBLE JOINT FILLER

- A. Thickness and depth to fill the joint as specified.
- B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
- C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

2.5 ACCESSORIES

- A. Masonry Cleaner:
 1. Detergent type cleaner selected for each type masonry used.
 2. Acid cleaners are not acceptable.
 3. Use soapless type specially prepared for cleaning brick or concrete masonry as appropriate.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Protection:

1. Cover tops of walls with nonstaining waterproof covering, when work is not in progress. Secure to prevent wind blow off.
2. On new work protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.

B. Cold Weather Protection:

1. Masonry may be laid in freezing weather when methods of protection are utilized.
2. Comply with MSJC and "Hot and Cold Weather Masonry Construction Manual".

3.2 CONSTRUCTION TOLERANCES

A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:

B. Maximum variation from plumb:

1. In 3,000 mm (10 feet) - 6 mm (1/4 inch).
2. In 6,000 mm (20 feet) - 10 mm (3/8 inch).

C. Maximum variation from level:

1. In any bay or up to 6,000 mm (20 feet) - 6 mm (1/4 inch).
2. In 12,000 mm (40 feet) or more - 13 mm (1/2 inch).

D. Maximum variation from linear building lines:

1. In any bay or up to 6,000 mm (20 feet) - 13 mm (1/2 inch).
2. In 12,000 mm (40 feet) or more - 19 mm (3/4 inch).

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:

1. Minus 6 mm (1/4 inch).
2. Plus 13 mm (1/2 inch).

F. Maximum variation in prepared opening dimensions:

1. Accurate to minus 0 mm (0 inch).
2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

A. Keep finish work free from mortar smears or spatters, and leave neat and clean.

B. Anchor masonry as specified in Paragraph, ANCHORAGE.

C. Wall Openings:

1. Fill hollow metal frames built into masonry walls and partitions solid with mortar as laying of masonry progresses.

2. If items are not available when walls are built, prepare openings for subsequent installation.

D. Tooling Joints:

1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
2. Tool while mortar is soft enough to be compressed into joints and not raked out.
3. Finish joints in exterior face masonry work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
4. Tool Exposed interior joints in finish work concave unless specified otherwise.

E. Lintels:

1. Lintels are not required for openings less than 1,000 mm (3 feet 4 inches) wide that have hollow metal frames.
2. Openings 610 mm (2 feet 0 inches) wide to 1600 m (5 feet 4 inches) wide with no structural steel lintel or frames, require a lintel formed of concrete masonry lintel or bond beam units filled with grout per ASTM C476 and reinforced with 1- #15m (1-#5) rod top and bottom for each 100 mm (4 inches) of nominal thickness unless shown otherwise.
3. Use steel lintels, for openings over 1600 m (5 feet 4 inches) wide, and brick masonry unless shown otherwise.
4. Length for minimum bearing of 100 mm (4 inches) at ends.

F. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.

G. When new masonry partitions start on existing floors, machine cut existing floor finish material down to concrete surface.

H. Wetting and Wetting Test:

1. Test and wet brick in accordance with BIA 11B.
2. Do not wet concrete masonry units before laying.

3.4 ANCHORAGE

A. Masonry to Concrete Piers:

1. Use adjustable veneer anchors.
2. Fasten anchor to masonry backup by stagger ties in alternate courses.
3. Space anchors not more than 400 mm (16 inches) on center vertically at each stud or 600 mm (24 inches) maximum horizontally.

3.5 REINFORCEMENT

A. Joint Reinforcement:

1. Use as joint reinforcement in single wythe concrete masonry unit walls.

B. Steel Reinforcing Bars:

1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.

3.6 CONCRETE MASONRY UNITS

A. Kind and Users:

1. Provide special concrete masonry shapes as required. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units or grout the cell of hollow units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.

B. Laying:

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
8. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar.
9. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
10. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
11. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.

3.7 GROUTING

A. Preparation:

1. Clean grout space of mortar droppings before placing grout.
2. Close cleanouts.

B. Placing:

1. Consolidate each lift of grout after free water has disappeared but before plasticity is lost.
2. Interruptions:
 - a. When grouting must be stopped for more than an hour, top off grout 40 mm (1-1/2 inch) below top of last masonry course.

3.8 PLACING REINFORCEMENT

- A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other places unless accepted by the RE/COTR. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide not less than minimum lap as indicated on shop drawings, or if not indicated, as required by governing code.
- E. Embed metal ties in mortar joints as work progresses, with a minimum mortar cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations.
- F. Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 15 mm (5/8 inch) on exterior face of walls and 13 mm (1/2 inch) at other locations. Lap joint reinforcement not less than 150 mm (6 inches) at ends. Use prefabricated "L" and "T" sections to provide continuity at corners and intersections. Cut and bend joint reinforcement as recommended by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- G. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

3.9 CLEANING AND REPAIR

- A. General:

1. Clean exposed masonry surfaces on completion.
 2. Protect adjoining construction materials and landscaping during cleaning operations.
 3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
 4. Remove mortar droppings and other foreign substances from wall surfaces.
- B. Concrete Masonry Units:
1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
 2. Allow mud to dry before brushing.

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SECTION 04 42 00

STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies cut limestone for columbarium copings and accessories.

1.2 RELATED WORK

- A. Cast-in-place concrete: Section 03 30 53, (SHORT FORM) CAST-IN-PLACE CONCRETE.
- B. Precast Concrete Columbarium Niches: 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.
- C. Setting and Pointing Mortar: Section 04 05 13, MASONRY MORTARING
- D. Joint Sealant and Application: Section 07 92 00, JOINT SEALANTS.
- E. Manufactured stone veneer: Section 04 43 00, MANUFACTURED STONE VENEER

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
1. Provide full size samples of:
 - a. Columbarium coping, half width x 4 inches, with dimensions and finish per the finished work including edges and drip slots
 - b. Identification panel, one full size sample
- C. Shop Drawings:
1. Each coping piece showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing, shim and mortar locations, coping piece dimensions and sizes.
 2. For any copings, the approved shop drawings must indicate which surfaces will be exposed in the final installation.
 4. Setting drawings with setting mark.
 5. Lifting Devices:
 - a. Submit design details for lifting devices.
 - b. Lifting devices are required for all coping stones.
 - c. Design lifting devices that function to safely lift coping stones by contacting the stones on the bottom finished edges, so the units can be set into position without causing any marking or damage to the stones. Lifting devices shall be in accordance with Indiana Limestone Handbook.

- D. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.
- E. Installer Qualifications: Provide documentation of requirements specified herein.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All stone shall be received and unloaded at the site with care in handling to avoid damaging or soiling.
- B. Store stone under waterproof covers on planking clear of ground. Stone shall be stored clear of the ground on nonstaining skids (cypress, white pine, poplar, or yellow pine without an excessive amount of resin). Chemically treated wood should not be used. DO NOT use chestnut, walnut, oak, fir, and other woods containing tannin.
- C. Protect from handling, dirt, stain, and water damage.
- D. Mark production units with the identification marks as shown on the shop drawings.
- E. Package units and protect them from staining or damage during shipping and storage.
- F. Provide packaging and lifting devices from the manufacturer that are designed to permit the installer easy removal for inspection, or to handle the stone for installation without causing damage to the units.
- G. Provide an itemized list of product to support the bill of lading.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be two years.

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.
 - 1. Indiana Limestone Handbook (current edition); Indiana Limestone Institute

1.8 QUALITY ASSURANCE

- A. Fabricator:
 - 1. Member in good standing of the Indiana Limestone Institute.
 - 2. Must provide documentation demonstrating a minimum of five years' experience fabricating limestone.

B. Installer:

1. Must provide documentation demonstrating that they have a minimum of five years' experience setting limestone.
2. Provide written handling and installation procedures that will be followed for the installation of the work for stones lifted, moved, adjusted in any way, other than by hand. Describe procedure starting at the inspection of the products once delivered to the site, and continue through the final setting of the stone units with them being secured into place in the work. Include procedures with description of the equipment that will be used, as well as all protection procedures to be followed, to ensure that no exposed surfaces or edges of the stone are damaged during handling or installation.
3. Provide written procedures for removal and replacement of 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 sealing of joints.

D. Pre-Installation Conference: Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations, tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

1.9 FABRICATION 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.

- E. Coping underside (exposed to view overhang) shall be finished to match top and sides of cap (regarding finish, texture & color); drip slots shall be straight and consistent in depth and width; coping pieces that do not meet these requirements will be rejected.

1.10 MOCK-UP

- A. Provide full size unit(s) for use in construction of columbarium wall as mockup sample wall(s); the mockup(s) becomes the standard of workmanship for the project.
- B. Coordinate the size and location for the mockup wall(s) with the RE/COR; mockup wall(s) cannot become part of the final project work.
 - 1. Mockup size: 1 full size pier and 1 full size columbarium unit (double sided) complete with CMU backup, coping, manufactured stone veneer, mortar, joint sealants, identification panel, and all masonry accessories.
 - 2. The contractor shall modify the mockup as needed until acceptance by the CO/COR at no additional expense to the Government.
- C. Demonstrate the construction tolerances for the construction of the foundations, as well as the quality of the exposed edges and the finish of the final exposed surfaces.
- D. Demonstrate the options for color selection for sealant, grout, etc. on the mockups so they can be judged against the various possible materials and their colors and finishes.
- E. Install precast niche units and demonstrate the construction tolerances, finish, placement of adjoining units, joints, surface treatment, attachment hardware, installed niche, rosette bolt alignment, washers, pins, shims, weep vents, backer rod and joint sealant.
- F. Install manufactured stone veneer to illustrate field pattern and color range of stone of stone, field cutting of units where required, and color and tooling of mortar joints.
- G. Install stone copings, including the placement of shims, the alignment of the joints in relationship of cap joints compared to niche cover or marker placement, backer rod, joint sealant, weep vents, flashing, joint size, and any other elements needed to demonstrate the quality of the final product installation.
- H. When there are options or selections to be made for the final installation, the mockup must demonstrate the multiple options available for selection as the final product and installation.

- I. Mockup shall remain in place throughout finish stonework until contractor is directed to remove it by the CO/COR.

1.11 PROJECT CONDITIONS

- A. Field Measurements: Verify actual conditions to receive stone components by field measurements before production.
- B. Dimensions on shop drawings to be based upon field measurements.

PART 2 - PRODUCTS

2.1 LIMESTONE

- A. All limestone specified or shown on drawings shall be Indiana Oolitic Limestone, as quarried in Lawrence, Monroe, and Owen Counties, Indiana, meeting the standards of the Indiana Limestone Handbook and ASTM C 568.
- B. Stone shall have a smooth finish.
- C. Color: Buff
- D. Grade: Standard
- E. Chipping on edges or surfaces of copings, where they will be visible in the final installation, whether resulting from shipment, delivery or other factors or causes is not acceptable, and the units must be removed and replaced with new units.
- G. All stone shall be cut accurately to shape and dimensions and full to the square, with jointing as shown on approved drawings. All exposed faces shall be dressed true. Beds and joints shall be at right angles to the face, and joints shall have a uniform thickness as shown on drawings.

2.2 EMBEDDED ANCHORS AND OTHER INSERTS

- A. Fabricate from stainless steel complying with ASTM A240/A240M, ASTM A276, or ASTM A666, Type 304.

2.3 DAMPPROOFING

- A. Dampproofing shall be cement-based, waterproof coating compatible with Indiana Limestone: Thoroseal, Tamoseal, or approved equal.

2.4 SHIMS

- A. Shims or setting pads shall be resilient, nonferrous, non-rusting.

2.5 FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows: Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.4 mm) thick.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing

manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.6 WEEP TUBE

- A. Clear round plastic weep tube manufactured from Medium Density Polyethylene, with stainless steel filter. Plastic tube shall be 3/8 inch outside diameter, 1/4 inch inside diameter, 4 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 SETTING TOLERANCES

- A. Set stones 3 mm (1/8 in.) or less, within the plane of adjacent units.
- B. Joints, plus - 1.5 mm (1/6 in.), minus - 3 mm (1/8 in.).

3.3 JOINTING

- A. Joint Materials:
 - 1. Mortar, Type N, ASTM C270. Limit fine aggregate size to less than 3/8" diameter.
 - 2. Use a full bed of mortar at all bed joints.
 - 3. Leave all joints with exposed tops or under relieving angles open for sealant.
 - 4. Leave head joints in coping and projecting components open for sealant.
- B. Location of Joints:
 - 1. As shown on shop drawings.
 - 2. At control and expansion joints unless otherwise shown.

3.4 DAMPPROOFING

- A. All unexposed faces of limestone copings, including interior faces of stones at joints, shall be coated with a cementitious dampproofing material per the Indiana Limestone Handbook.
- B. Apply dampproofing per manufacturer's instructions, including number of coats and curing requirements.

3.5 SETTING

- A. Preparation
 - 1. When necessary, before setting in the wall, all stones shall be thoroughly cleaned on all exposed surfaces by washing with fiber

brush and soap powder, followed by a thorough drenching with clear water.

B. Mortar Bed Setting:

1. Drench units with clean water prior to setting.
2. Fill dowel holes and anchor slots completely with silicone sealant.
3. Setting pads shall be placed under coping stones in same thickness as joint, and in sufficient quantity to avoid squeezing mortar out. Shims or setting pads shall not create point loads on the stones.
4. Set units in full bed of mortar containing water repellent.
5. Rake mortar joints to receive backer rod and sealant.
6. Remove excess mortar from unit faces immediately after setting.

3.6 JOINT PROTECTION

- A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.
- B. All cornice, copings, projecting belt courses, other projecting courses, steps, and platforms (in general, all stone areas either partially or totally horizontal) should be set with unfilled vertical joints. After setting, insert properly sized backup material or backer rod to proper depth, and gun in sealant.
- C. Prime ends of units, insert properly sized backing rod at the correct depth and install required sealant.

3.7 PROTECTION, REPAIR AND CLEANING

- A. During construction, tops of walls shall be carefully covered at night, and especially during any precipitation or other inclement weather.
- B. At all times, walls shall be adequately protected from droppings.
- C. Whenever necessary, substantial wooden covering shall be placed to protect the stonework. Nonstaining building paper or membrane shall be used under the wood. Maintain all covering until removed to permit final cleaning of the stonework.
- D. The stone shall be washed with fiber brushes, mild soap powder or detergent and clean water or approved mechanical cleaning process. Cleaning shall not damage adjacent materials.

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SECTION 04 43 00
MANUFACTURED STONE VENEER

PART 1. GENERAL

1.1 SECTION INCLUDES

- A. Manufactured "Cultured" stone veneers adhered to unit masonry backup.

1.2 RELATED SECTIONS

- A. Section 03 30 53 - Cast-in-Place Concrete
- B. Section 04 05 13 - Masonry Mortaring
- C. Section 07 92 00 - Joint Sealants

1.3 REFERENCES

- A. ASTM C 39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- B. ASTM C 67, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- C. ASTM C 91: Specification for Masonry Cement.
- D. ASTM C 150: Specification for Portland Cement.
- E. ASTM C 177-71: Test Method for Thermal Conductivity by Means of the Guarded Hot Plate.
- F. ASTM C 192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- G. ASTM C 207: Specification for Hydrated Lime for Masonry Purposes.
- H. ASTM C 270: Specification for Mortar for Unit Masonry.
- I. ASTM C 482, Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement
- J. UL 723: Test for Surface Burning Characteristics of Building Materials.
- K. Uniform Building Code (UBC) Standard No. 14-1. Kraft Waterproof Building Paper

1.4 SUBMITTALS

- A. Product data for all products, including but not limited to:
 - 1. Manufactured stone
 - 2. Masonry accessories
 - 3. Stone manufacturer's installation instructions and a certificate prepared and signed by the manufactured stone manufacturer showing compliance with quality standards
 - 4. Certification that mortar mixes meet requirements of stone manufacturer's installation instructions.
- B. Samples
 - 1. For each stone type indicated.

- C. Quality Assurance
 - 1. Proof of manufacturer qualifications.
 - 2. Proof of installer qualifications

- D. Closeout Submittals
 - 1. Maintenance Instructions
 - 2. Manufacturer's warranty

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum five years experience in producing manufactured masonry.
 - 2. Member of following organizations:
 - a. MSJC - Masonry Standards Joint Committee of the Masonry Society
 - b. ACI - American Concrete Institute
 - c. ASTM - American Society for Testing and Materials
- B. Installer Qualifications
 - 1. Company experienced in installation of manufactured stone veneers of the type specified with five (5) or more years experience.

1.6 MOCK-UP

- A. Comply with requirements of 04 72 00 STONE MASONRY

1.7 PROJECT CONDITIONS

- A. Maintain materials and surrounding air temperature to minimum 4_C (40_F) prior to, during, and for 48 hours after completion of work.
- B. Protect materials from rain, moisture, and freezing temperatures prior to, during, and for 48 hours after completion of work.
- C. Allow no construction activity on opposite side of wall during installation, and for 48 hours after completion of work.
- D. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work.
- E. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried.
- F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- G. Store moisture-sensitive materials in weather protected enclosures.

1.8 SPECIAL WARRANTY

- A. Provide manufacturer's 50 year limited warranty.

PART 2. PRODUCTS

2.1 MANUFACTURED STONE UNITS

- A. Subject to compliance with requirements, provide the following basis-of-design product:
- B. Cultured Stone®, Split Face
1. Manufacturer: Boral Stone Products LLC, One Owens Corning Parkway, Toledo, OH 43659, www.culturedstone.com
 2. Blend of 50%, Superior (CSV-2003) and 50% Great Lakes (CSV-2087).
- C. Physical Properties
1. Compressive Strength: ASTM C 192 and ASTM C 39, 1800 psi (12.4 MPa)
 2. Bond Between Stone Unit, Type S Mortar, and Backing: ASTM C 482, 50 psi (345 kPa).
 3. Thermal Resistance: ASTM C 177, R-factor, 0.355 per inch (25.4 mm) of thickness.
 4. Freeze/Thaw: ASTM C 67, 50 cycles, no disintegration and less than 3 percent weight loss.
 5. Fire Hazard Test, UL 723:
 - a. Flame spread: 0.
 - b. Smoke Development: 0.
 6. Maximum Veneer Unit Weight: 15 psf (73 kg/m²).

2.2 MORTAR

- A. See Section 04 05 13 MASONRY MORTARING for requirements
- B. Color of mortar for exposed mortar joints: Light grey to match adjacent exposed concrete surfaces

PART 3. EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to stone manufacturer's instructions.
1. Concrete and Masonry Surfaces, New, Clean, and Untreated
 - a. Examine concrete or CMU closely to ensure that its finished surface contains no releasing agents (form oil). If it does contain form oil, etch surface with muriatic acid, rinse thoroughly, and/or score with a wire brush, or use high pressure water or sandblasting to remove.

3.2 MORTAR MIXING

- A. Comply with requirements of Section 04 05 13 - Masonry Mortaring

- B. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C 270.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.

3.3 APPLICATION

- A. Apply in accordance with manufacturer's installation instructions.
- B. Apply 1/2 inch to 3/4 inch of mortar to dampened masonry, covering a maximum of 10 square feet at one time. Press the units firmly into position in soft mortar bed, wiggle and apply slight pressure to unit to ensure firm bonding causing mortar to extrude slightly around edges of units.
- C. Place units with uniform mortar joints, cut and trim as required to achieve consistent width in mortar joints. Stone joints should not be over 1 inch in width.
- D. Perform necessary cutting with proper tools to provide uniform edges; take care to prevent breaking unit corners or edges. Position cut edges up when they are above eye level, down when they are below eye level. Avoid cutting stones to retain natural look when possible.
- E. Remove excess mortar; do not allow mortar to set up on face of units.
- F. Grouting Joints
 - 1. If additional mortar is required, use a grout bag to fill in joints. Care must be taken to avoid smearing mortar on surface of stone. Accidental smears should be removed only after mortar has become crumbly using a whisk broom or dry bristle brush. Never use a wet brush or wire brush.
- G. Finishing Joints
 - 1. When the mortar joints have become firm or thumb-print dry (setting time will vary depending on wall surface and climatic conditions), they should be pointed up with a wood stick or metal jointing tool. Rake out excess mortar, compact and seal edges around stones. Careful attention to proper and even jointing will result in a professional looking finish.
- H. Cleaning Finished Job
 - 1. At the end of the work day, or when mortar is sufficiently set up, the finished job should be broomed or brushed to remove loose mortar and to clean the face of the stone. **A wet brush should never be used to treat the mortar joints** as this will cause staining that will be difficult, or impossible, to remove. **Do not use acid or acid base products.**

**SECTION 04 73 00
COLUMBARIUM NICHE COVERS**

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

1. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

- A. Work Included: Provide labor and materials necessary to complete the work of this Section, including but not limited to the following:
 1. The Department of Veterans Affairs (VA) shall furnish niche covers for all of the new Columbarium Niches being installed by the Contractor. This specification section is for all work necessary for the Contractor to accept, handle, store, move and install one, government approved and provided, blank columbarium niche cover for each of the new precast niches created in the new columbarium walls. The government shall also provide, as part of the niche cover products manufactured for this project, a predetermined minimum number of approved blank niche covers to act as spares. The spare niche covers are to be used to replace niche covers should any damage occur, or for re-inscription necessitated by additional interment at a specific niche location.
 2. The number of approved government provided spare columbarium niche covers for this project to be accepted, offloaded and stored at the designated location is up to 260.

1.3 INSTALLER QUALIFICATIONS

- A. Installation of columbarium niche covers will be performed by those companies who, through an approved certification process, have demonstrated previous experience in installation of similar design as indicated in the drawings and specified herein.

1.4 RELATED WORK

- A. The following items are not included in this Section and will be performed under the designated Sections:
 1. Section 03 48 24: PRECAST CONCRETE COLUMBARIUM UNITS, the precast concrete niche units with: niche cover mounting hardware assemblies (installed); and niche cover attachment hardware assemblies (provided for use to attach the Government provided niche covers). Four each of the niche cover mounting hardware assemblies shall be

furnished and installed for each precast concrete niche opening. Four each of the niche cover attachment hardware assemblies shall be provided for each precast niche opening, to be used to mount the approved government niche covers as indicated and on the drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 NICHE COVERS (GOVERNMENT PROVIDED) - CONTRACTOR ACCEPTANCE

A. Niche covers that have been inspected and accepted as being in compliance with manufacturing tolerances for size, hole size and placement, perpendicularity, finish, and product stone quality shall be furnished by the Government and delivered to the site on pallets. They shall be of size, type, manufacturing, finish and quantities required for this project. The covers shall be delivered to the site Freight on Board (FOB) and the Contractor shall be responsible to offload and secure them at the job site. The general quantity and condition shall be observed and an adequate count to cover all the installed columbarium units, plus required spares shall be verified by the Contractor prior to accepting the units and performing the offloading operations. Note any shipping damage and reject any damaged covers before the delivery truck leaves the site. Once satisfied, take ownership of the acceptable covers, as all being approved as meeting the government specifications and being suitable for installation at this project. Once the niche covers are accepted at the site, they shall become the Contractors responsibility until installed and the installation is accepted by the Resident Engineer/Contracting Officer's Representative (RE/COR).

3.2 INSPECTION

A. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the RE/COR.

3.3 NICHE COVER ATTACHMENT HARDWARE

A. Each of the four niche cover attachment hardware assemblies provided, for each new precast concrete niche opening, as part of Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS, consists of: the stainless

steel rosette, stainless steel tamperproof screw and the white or clear washer beneath the rosette, that is to bear against the niche cover when rosette is snugged up causing the cover to stay in place against the face of the niche opening due to friction. All of the niche cover hardware (mounting and attachment assemblies) shall be as submitted and approved as part of the work in Section 03 48 24, PRECAST CONCRETE COLUMBARIUM UNITS.

- B. The Contractor performing the installation of the niche covers shall maintain control of the niche cover attachment hardware assemblies from delivery to the site through acceptance of the installation of the government provided niche covers.

3.4 INSTALLATION

- A. Installation of the government provided niche covers shall include all materials, manpower, tools and equipment required to receive the approved government provided niche covers from the manufacturer, and handle them as necessary and perform whatever work is needed to result in the successful installation of one niche cover for every precast concrete niche space created for this project.
- B. The niche covers shall be installed so as to create a visual straight line along the top of the row of covers agreed to by the CO/COR as the primary visual vertical reference line in the installation. The covers shall be spaced achieve, as close as possible, the intended design spacing, taking into consideration the allowable fluctuations in the manufacturing tolerances for the government provided niche covers.
- C. The niche cover attachment assemblies shall be installed so that the threaded end of the tamperproof screw is inserted into the threads of the spring clip on the mounted angle bracket behind each of the mounting holes in the niche covers. This should result in the head of the screw being parallel with the face of the niche cover. The threaded hole in the spring clip shall be fully visible when looking through the mounting hole in the niche cover to the respective spring clip behind the hole. The position of the spring clip shall be adjusted so the threaded tamperproof screw will enter the threaded hole in the spring clip and that the attachment assembly can be tightened to secure the cover in the intended position. To achieve this installation, the angle brackets shall be adjusted to be the correct height from the niche wall so the hole in the spring clip can have the

respective tamper proof screw inserted and tightened. To achieve the proper positioning of the spring clips, the angle brackets shall be adjusted in their position, or the hole in the angle bracket through which the tamper proof screw passes when tightened into the spring clip, shall be enlarged as necessary to allow the adjustment of the spring clip to align with the hole in the niche cover so the tamper proof screws through the individual rosettes can each be inserted and tightened using the threaded spring clip. Only correct installations of the tamperproof screws, inserted into the threads of the spring clip and being tightened are acceptable. The head of the tamperproof screw shall be snugged up tight against the rosette, and shall be seated against the rosette, which occurs when the tamperproof screw is approximately perpendicular to the face of the niche cover.

3.5 CLEANING AND PROTECTION

- A. Columbarium niche covers shall be shop cleaned at the time of fabrication. After installation, carefully clean the markers, removing all dirt stains, and all other incident defacements.
 - 1. Stiff bristle fiber brushes may be used, but the use of wire brushes or acid-type cleaning agents and other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted regarding the use of any cleaners and must approve of them before use.
 - 2. Protection of Finished Work: All covers that are installed as part of the work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.
- B. Clean up area of excess material and debris. Clean visible portions of all covers.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK

- A. Expansion joint filler for site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
- B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.
- D. Sealing joints in cast stone: Section 04 72 00, CAST STONE MASONRY.

1.3 QUALITY CONTROL

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 - 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
 - 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
 - 5. Determine sealants will not stain joint substrates according to ASTM C1248.

- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer's recommendations:
1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer.
 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 3. Notify RE/COR seven days in advance of dates and times when test joints will be erected.
- E. Meet VOC requirements of pertinent CARB and/or SCAQMD Rule for sealants VOC (4 percent by weight VOC or less in less than 16 ounce package or less than 250 g/L in larger package). All non-porous sealant primers must be below 250g/L and primers for porous substrates less than 775 g/L.
- F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution:
1. Joints in mockups of assemblies specified in other sections, that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's installation instructions for each product used.
- C. Cured samples of exposed sealants for each color where required to match adjacent material.
- D. Manufacturer's Literature and Data:
 2. Primers.
 3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.6 PRE-INSTALLATION CONFERENCE

- A. Convene a meeting on site, after submittals are received and approved but before any work, to review drawings and specifications, submittals, schedule, manufacturer instructions, site logistics and pertinent matters of coordination, temporary protection, governing regulations,

tests and inspections; participants to include RE/COR and all parties whose work is effected or related to the work of this section.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not proceed with installation of joint sealants under following conditions:

a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).

b. When joint substrates are wet.

c. When dust or airborne particles would adhere to joint sealant.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 DELIVERY, HANDLING, AND STORAGE

A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.

B. Carefully handle and store to prevent inclusion of foreign materials.

C. Do not subject to sustained temperatures less than 5° C (40° F) or exceeding 32° C (90° F).

1.9 DEFINITIONS

A. Definitions of terms in accordance with ASTM C717 and as specified.

B. Back-up Rod: A type of sealant backing.

C. Bond Breakers: A type of sealant backing.

D. Filler: A sealant backing used behind a back-up rod.

1.10 WARRANTY

A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period to be extended to five (5) years.

B. General Warranty: Special warranty specified in this Article will not deprive Government of other rights Government may have under other provisions of Contract Documents and are in addition to, and run

concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.11 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 Society for Testing and Materials (ASTM):

C612-10	Mineral Fiber Block and Board Thermal Insulation
C717-12b	Standard Terminology of Building Seals and Sealants
C734-06(2012)	Low Temperature Flexibility of Latex Sealants after Artificial Weathering
C834-10	Latex Sealants
C919-12	Use of Sealants in Acoustical Applications
C920-11	Elastomeric Joint Sealants
C1021-08	Laboratories Engaged in Testing of Building Sealants
C1193-13	Use of Joint Sealants
C1248-08(2012)	Staining of Porous Substrate by Joint Sealants
C1330-02(2013)	Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants
D217-10	Cone Penetration of Lubricating Grease
D1056-07	Flexible Cellular Materials—Sponge or Expanded Rubber
E84-12c	Surface Burning Characteristics of Building Materials

C. California Air Resources Board (CARB)

D. South Coast Air Quality Management District (SCAQMD)

E. Sealant, Waterproofing and Restoration Institute (SWRI):
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS

A. S-1:

1. ASTM C920, polyurethane.
2. Type M or S.
3. Class 25.

4. Grade NS.
 5. Shore A hardness of 20-40.
- B. S-2:
1. ASTM C920, polyurethane.
 2. Type M.
 3. Class 25.
 4. Grade P.
 5. Shore A hardness of 25-40.
- C. S-3:
1. ASTM C920, polyurethane.
 2. Type S.
 3. Class 25, joint movement range of plus or minus 50 percent.
 4. Grade NS.
 5. Shore A hardness of 15-25.
 6. Minimum elongation of 700 percent.
- D. S-4:
1. ASTM C920 polyurethane.
 2. Type S.
 3. Class 25.
 4. Grade NS.
 5. Shore A hardness of 25-40.
- E. S-5:
1. ASTM C920, polyurethane.
 2. Type S.
 3. Class 25.
 4. Grade P.
 5. Shore hardness of 15-45.
- F. S-6:
1. ASTM C920, silicone, neutral cure.
 2. Type S.
 3. Class: Joint movement range of plus 100 percent to minus 50 percent.
 4. Grade NS.
 5. Shore A hardness of 15-20.
- G. S-7:
1. ASTM C920, silicone, neutral cure.
 2. Type S.
 3. Class 25.

4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

H. S-8:

1. ASTM C920, silicone, acetoxo cure.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Structural glazing application.

I. S-9:

1. ASTM C920 silicone.
2. Type S.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 25-30.
6. Non-yellowing, mildew resistant.

J. S-10:

1. ASTM C920, coal tar extended fuel resistance polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 15-20.

K. S-11:

1. ASTM C920 polyurethane.
2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

L. S-12:

1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

2.3 COLOR

- A. Match color of mortar joints at exposed masonry.
- B. Match color of adjacent concrete at unpainted concrete.

C. Match color of columbarium copings at coping joints.

2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 FILLER

- A. Mineral fiber board: ASTM C612, Type IVA.
- B. Thickness same as joint width.
- C. Depth to fill void completely behind back-up rod.

2.6 PRIMER

- A. As recommended by manufacturer of caulking or sealant material.
- B. Stain free type.

2.7 CLEANERS-NON POROUS SURFACES

- A. Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.
- B. Coordinate for repair and resolution of unsound substrate materials.

- C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.2 PREPARATION

- A. Prepare joints in accordance with manufacturer's instructions and as specified only when installers are ready to initiate sealant application as soon as practicable after preparation and before subsequent surface deterioration.
- B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer paint, or other foreign matter that would tend to destroy or impair adhesion.
 - 1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
 - 2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- C. Do not cut or damage joint edges.
- D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.

1. Apply primer prior to installation of back-up rod or bond breaker tape.
2. Use brush or other approved means that will reach all parts of joints.

F. Take all necessary steps to prevent three sided adhesion of sealants.

3.3 BACKING INSTALLATION

- A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.
- B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
- C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
- D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
- E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
- F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 SEALANT DEPTHS AND GEOMETRY

- A. At widths up to 6 mm (1/4 inch), sealant depth equal to width.
- B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface.

3.5 INSTALLATION

- A. General:
 1. Comply with manufacturer's written installation instructions for products and applications indicated.
- B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.

3.6 CLEANING

- A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.
- B. After filling and finishing joints, remove masking tape.
- C. Leave adjacent surfaces in a clean and unstained condition.

3.7 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction

operations or other causes so sealants are without deterioration or damage at time of completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 LOCATIONS

A. Exterior Columbarium Joints, Horizontal and Vertical:

1. Metal to Metal: Type S-6, S-7.
2. Metal to Masonry or Stone: Type S-1.
3. Masonry to Masonry or Stone: Type S-1.
4. Stone to Stone: Type S-1.
5. Cast Stone to Cast Stone: Type S-1.
6. Threshold Setting Bed: Type S-1, S-3, S-4.
7. Masonry Expansion and Control Joints: Type S-6.
8. Wood to Masonry: Type S-1.

B. Metal Reglets and Flashings:

1. Flashings to Wall: Type S-6.
2. Metal to Metal: Type S-6.

C. Sanitary Joints:

1. Walls to Plumbing Fixtures: Type S-9.
2. Counter Tops to Walls: Type S-9.
3. Pipe Penetrations: Type S-9.

D. Horizontal Traffic Joints:

1. Concrete Paving, Unit Pavers: Type S-11.

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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. Post and Panel - to match existing signs
 - 2. Flower Watering Station Faucet Post with Sign Panel
 - 3. Cast Aluminum Dimensional Letters and Numbers.

1.2 RELATED WORK

- A. Flower Watering Station piping, appurtenances and mounting: Section 32 30 00 SITE FURNISHINGS.

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 Resident Engineer or Contracting Officer's Representative (RE/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.
 - 1. Post & panel sign mock-up, not less than 200 mm by 250 mm (8" by 10"), shall be constructed and submitted, showing typical color, texture and fonts shown on Contract Drawings. Mock-up shall show typical fabrication methods, including panel to post(s) connection. Sample shall be capable of demonstrating how the face panels can be

- removed, for repair or replacement, from the mounted location between the posts, for a two post sign system. Mock-ups of all other sign systems for post mounted signs shall be capable of demonstrating how the sign panels are to be removed and replaced from the posts, or mounting support system attached to the posts, without moving the posts. Top surface of the sign panel shall not contain screws or metal joints that could trap or allow water to enter the sign assembly.
2. Square tube post, 150 mm (6") minimum length, showing typical color and finish. Attachments for the sign panels shall be provided to demonstrate the complete signage system materials and functionality.
 3. Aluminum samples showing full range of finish colors available.
 4. Cast Aluminum Letter, of the style, size and finish indicated
 5. Color samples of each color, 150 mm x 150 mm (6 inches x 6 inches). Show anticipated range of color and texture.
 6. Sample of typeface, arrow and symbols in a typical full size layout.
 7. Directory panels and frames, with letters and symbols, each type.
- 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. Full size layout (proof) in full color of all signs and cast letters.
- E. 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.
- F. 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.
- G. Refurbishment Plan: Submit written description of process for removing, repairing, refurbishing, and reinstalling existing signs.

1.6 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.

1.7 WARRANTY

- A. Sign Manufacturer shall guarantee the text and symbols applied to the powder coated aluminum for an extended warranty period of five years following final acceptance of the project. A warranty inspection shall be performed no later than one year following project final acceptance 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 coating system itself, is causing damage to, or failure of, the coating system. All work to produce replacement sign panels with new lettering and/or coating system shall be provided at no cost to the Government, as part of the Warranty work for the signage system.

1.8 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.
- D. American Society for Testing and Materials (ASTM):
 - B209-10 Aluminum and Aluminum-Alloy Sheet and Plate
 - B221-12 Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
 - B449-93(2010)e1 Standard Specification for Chromates on Aluminum
- E. American Architectural Manufacturer's Association (AAMA):

AAMA 2605-05 Performance Requirements and Test Procedures
for High Performance Organic Coatings on
Aluminum extrusions and Panels.

F. Federal Specifications (Fed. Spec.):

MIL-P-8184F Plastic Sheet, Acrylic, Modified.

A-A-59502 Plastic Sheet, Polycarbonate

PART 2 - PRODUCTS

2.1 ALUMINUM 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 PRECAST CONCRETE/ CAST STONE

A. Manufacturer:

- 1. Must have five years minimum continuous operating experience, and have facilities for producing cast stone of the shapes, quantities and size required for this project.
- 2. Must be a producer certified by the Cast Stone Institute or the Architectural Precast Association.

B. Manufacturing tolerances:

- 1. Cross section dimensions must not deviate by more than + 3 mm (1/8 in.) from approved dimension.
- 2. 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.
- 3. Warp bow or twist of units must not exceed length 3 mm (/360 or + 1/8 in.), whichever is greater.
- 4. 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.

C. Precast Concrete/ Cast Stone shall comply with ASTM C1364.

D. 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.

E. Raw materials

1. Portland Cement: Type I or Type III, white and/or grey, ASTM C150.
2. Coarse Aggregates: Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
3. Fine Aggregates: Manufactured or natural sands, ASTM C33, except for gradation.
4. Colors: Inorganic iron oxide pigments, ASTM C979 except that carbon black pigments cannot be used.
5. Admixtures: Comply with the following:
 - a. ASTM C260 for air-entraining admixtures.
 - b. ASTM C494/C495M Types A-G for water reducing, retarding, accelerating and high range admixtures.
 - c. 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.
 - d. Produce units with water repellent accepted by fabricator within mix design; product for mix design and setting mortar to be from same source.
 - e. ASTM C618; do not use mineral admixtures of dark and variable colors in surfaces intended to be exposed to view.
 - f. ASTM C989; granulated blast furnace slag may be used to improve physical properties, as verified by testing documentation.
6. Water: Potable.
7. Reinforcing Bars:
 - a. ASTM A615/A615M, Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 37 mm (1.5 in.).
 - b. Welded Wire Fabric: ASTM A185 where applicable for wet cast units.

F. Color and Finish

1. Color: to match columbarium limestone copings.

2. 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.
2. Units must exhibit a texture of no less quality than the approved sample when viewed under direct daylight illumination at a 3 m (10 ft.) distance.
3. Units to comply with ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
 - a. Total color difference - not greater than 6 units.
 - b. Total hue difference-not greater than 2 units.
- G. Chipping on edges or surfaces of units, where they will be visible in the final installation, whether resulting from shipment, delivery or other factors or causes is not acceptable, and the units must be removed and replaced with new units.
- H. The occurrence of crazing or efflorescence may constitute a cause for rejection, at the sole discretion of the RE/COR.
- I. Remove cement film, if required, from exposed surface prior to packaging for shipment.
- J. Reinforcement
 1. Reinforce the units as required by the shop drawings, and prepared under direction of professional engineer, for safe handling and structural stress. For wall caps, include adequate reinforcing to prevent the caps from breaking when supported by shims at the ends of the units, and having workers on top of the units.
 - a. Reinforcing to be minimum 0.25 percent of the cross section area.
 2. 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.

2.3 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. Resident Engineer and/or Contracting Officer's Representative (RE/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.

2.4 SIGN STANDARDS

- A. Typography:
 - 1. Type Style: To match existing or as indicated on drawings. Capitalization as indicated in Site Signage Plan, unless otherwise indicated.
 - 2. Arrow: See graphic standards in drawings.
 - 3. Letter spacing: See graphic standards on drawings.
 - 4. 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 match existing signs at cemetery (dark bronze).

2.5 TEXT AND GRAPHICS

- A. There are multiple Message Layout types for some of the different size signs within the same type of sign. See the drawing layout and detail drawings for the specifics of the locations for the signs, as well as the size, types, materials and messages for the individual signs for the project.

1. Surface applied letters, numbers and graphics shall be of a published quality and life expectancy equal to or exceeding that for reflective white opaque Engineering Grade 3M™ Scotchlite™ vinyl, unless otherwise noted. Color shall match existing. Font Type Style shall be as indicated in Paragraph "SIGN STANDARDS" as approved during the submittal process.
- B. 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 to 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 RE/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 DOUBLE-POST-PANEL SIGNS

- A. Post and Panel Signs: Furnish the standard post style for each of the Post and Panel Signs, as designated in the drawings and to match existing Cemetery signs.
 - 1. Metal post signs:

- a. The posts, frame and panel(s) that make up the metal post sign system shall be constructed of an aluminum tubing system to match existing cemetery signs.
- b. When the sign panel system is mounted to the posts, there shall be no openings for insects to enter. Mounting holes for attaching the sign panel and frame to the posts shall be pre-drilled before the coating system is applied. The entire sign panel and frame system shall be coated with the submitted and approved powder coating system, as indicated herein or on the drawings. The sign panels shall be secured to the frame system with tamperproof screws and each panel face shall be removable, without removing the sign system from the posts.
- c. Sign panel assembly shall be constructed with extruded aluminum support channels and fasteners that secure a removable powder-coated aluminum sign panel assembly. Aluminum sign panel faces shall be 3 mm (1/8") minimum thick. The design for the sign panel system shall be such that the sign panels can be removed and replaced, if damaged, without having to move the posts that secure the sign panel assembly. The sign panel assembly shall be constructed so there are no gaps or holes in the assembly that could let insects enter and construct nests or otherwise become a nuisance. The top of the sign panel assembly shall be constructed such that it is water tight from above and shall not have unsealed joints where water can collect or enter the assembly. The sign configuration and mounting shall be as depicted in the drawings.
- d. Lettering shall be as indicated on the applicable "Site Details" type of Drawing(s).
- e. Exposed fasteners shall be aluminum or stainless steel, tamper-proof type, and shall be colored to match the color for the sign panels.
- f. Finishes of exposed aluminum surfaces:
 - 1) Pretreatment: Before the finish is applied, a five-stage pretreatment must be applied to assure maximum adhesion and corrosion resistance:
 - a) Stage 1: High alkaline cleaner to prepare the surface
 - b) Stage 2: Water rinse

- c) Stage 3: Combination of chromic, phosphoric and hydrofluoric acids that produce the chrome-phosphate conversion coating for maximum adhesion and corrosion resistance.
 - d) Stage 4: Water rinse
 - e) Stage 5: Water rinse
- 2) Coating: The coatings for the metal signs shall produce results that meet or exceed the testing results indicated in AAMA 2605-05. After pretreatment, the metal is dried and paint is then applied. The aluminum shall have an electrostatically applied baked-on flexible acrylic finish that meet or exceeds industry standard tests, achieving a 75 - 125 micron (3.0 - 5.0 mil) thickness, super-tough finish with maximum exterior durability and superior adhesion characteristics. Color as indicated on the drawings and approved submittal.
- 3) Tests:
- a) AAMA 2605-05 (covers Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum extrusions and Panels)
 - b) ASTM D2247 (Humidity resistance of 1,000 hours)
 - c) ASTM B117 (Salt spray resistance of 1,000 hours)
 - d) Accelerated weathering for 500 hours under Method 6152 of Federal Test Method 141 shall show no adhesion loss, with only slight fading, chalking and water staining.
 - e) Outdoor weathering shall show no adhesion loss, checking or crazing, with only slight fade and chalk when exposed for one year in Florida facing south at a 45 degree angle.
 - f) Minimum hardness of 2H using ASTM D3363.
 - g) Color of exposed portions of fastenings shall match sign panel being attached.
- B. Refurbished signs: Refurbished existing signs shall meet the same standards for preparation, pretreatment, and coating as signs made of new material. All existing lettering and coating shall be removed and any damage to existing signs repaired. New powder coating and lettering shall be applied and signs shall be reinstalled per the requirements for new signs. Contractor may provide new signs in lieu of refurbished in order to meet the requirements of this section.

2.9 PRECAST CONCRETE FAUCET POST WITH SIGN PANEL

- A. The posts are used to mount the water pipe and the spigot at the Flower Watering Stations. Details for the water pipe, appurtenances, and mounting are included in the related Section 32 30 00 SITE FURNISHINGS.
- B. The posts shall be precast concrete (cast stone), with location, materials, color, messages and configuration as indicated on the Drawings
- C. Posts shall have recesses to receive aluminum sign plates. The recesses shall have a beveled transition to the sign plate mounting surface.
- D. Faucet Posts shall be manufactured 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.
- E. Aluminum sign plate
 - 1. The mounting surface for the aluminum sign plate for each recess, 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.
 - 2. The aluminum sign plate 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.
 - 3. The dimensions for the aluminum sign plates 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 sign plate, as complete. Dimensions shown on detailed construction drawings shall take precedence over the specifications.

4. The aluminum sign plates shall be mounted using Stainless Steel tamper-proof screws, with matching powder coating with approved concrete anchors.
5. "Do Not Drink" decal - The "Do Not Drink" decal shall be the universal symbol with a faucet above a glass with water, and a red circle and diagonal line through the symbol. Decal has black background with white text and black and red symbol. The text "Do Not Drink" shall be stacked vertically below the international symbol. Decal shall be aligned vertically to fit the metal or concrete post location, as submitted and approved.

2.10 CONCRETE MOW COLLARS OR STRIPS

A. Reinforced concrete mow collars shall be provided for all new single elements in this Specification Section, where they are to be located in lawn areas and are not connected to another adjoining element. For all elements that are connected to another adjoining element, like double post signs, provide a continuous reinforced concrete mow strip. The requirements for the collars and strips are as follows:

1. Reinforced and free floating, concrete not in contact with the element.
 - a. As detailed on the drawings
 - b. Separated from the element with expansion joint material the fill depth of the concrete.
 - c. Closed steel rebar, with overlap at joint, 50mm (2") minimum distance from surrounding earth.
 - d. Minimum 10mm (#3) diameter rebar as enclosing the element or elements approximately 50mm (2") inside the perimeter of the concrete. On the strips, there shall be an additional bar in the middle between the elements that extends to within 50mm (2") from the closest parts of the adjoining elements.
 - e. Comply with requirements of Section 32 05 23 CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.
 - f. Construct the collars and/or strips to be 25mm (1") above finished grade at the junction with the lawn, and with a slope up

toward the element(s) and or middle, for drainage, of 13mm (1/2")
to 19mm (3/4").

2.11 DIMENSIONAL LETTERS

- A. Dimensional Letters shall be individually mounted on the provided substrate material. The location, alignment, letter configuration, size, font, material and finish shall be as indicated on the Drawings.
- A. Letters to be mounted to other than flat surfaces, like stone masonry veneer walls with irregular shaped and faced stones, and with random joints shall be mounted based upon the wall construction. Before manufacturing the letters, a full sized template of the letters, with correct size and spacing, shall be placed on the wall at the correct location and temporarily secured. The letter template shall be marked for each letter indicating where the joints are located immediately below the letter placement. The marking of the template is to locate where the relatively flat portions of the stones are below the letters so the pins can be manufactured and installed out of the joints between the stones. The template with the joint locations (or flatter portions of the stones) shall be provided to and/or used by the letter manufacturer so the pin placement supporting the individual letters can be adjusted and placed so the pins do not extend into the joints below the letters during the installation of the letters.
- B. Materials, color, and finish for the individual letters shall be as indicated on the drawings and/or approved samples.

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. Signs shall be installed with direct burial of post into concrete as shown on Contract Drawings. Depth of posts shall be such that the bottom of the concrete surrounding the posts is at least below the frost, or as indicated in the drawings, whichever is the greater depth.
- C. Protect aluminum in contact with dissimilar metals or mortar as specified in Paragraph "PROTECTION OF ALUMINUM".
- D. 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.

- E. Provide anchoring devices and fasteners as shown and as necessary for securing signs to construction as specified.
- F. Utilize approved layout template for the installation of the cast metal lettering on the entry wall. Pins shall be securely anchored as detailed. Face of all lettering shall be in a constant plane, while at the same time minimizing the distance between the back of the letters and the stone wall. Maintain a minimum gap as detailed between the back of the letter and the face of the stone wall.
- G. 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.
- H. 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.
- J. Furnish and install concrete collars and/or mow strips, with reinforcing to prevent cracking as well as expansion joints around the posts, or other elements of this section installed in the lawn areas, to allow for movement due to frost action. The mow strips shall be set so they are parallel to the finished grade around the sign posts, so mowers can drive around them without hitting the concrete, or going into a depression.
- K. Sign message panels shall be mounted using tamper-proof mechanical fasteners that are coated and colored to match the message panels.
- L. Install permanent caps on top of all aluminum posts.
- M. 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.

- -END- - -

EXTERIOR SIGNAGE

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SECTION 31 20 11
EARTH MOVING (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, proof rolling, or similar methods of improvement.
3. Existing Subgrade (footings only): Same as Paragraph 1, but no fill or backfill. If materials differ from the geotechnical investigation performed by Materials Testing Consultants, Inc. dated December 2014 or design requirements, excavate to acceptable strata subject to CO/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 trench work 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 or D1557 .

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

1.3 RELATED WORK

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety Requirements: Section 01 00 02, GENERAL REQUIREMENTS.

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.

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.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.6 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):
T99-01 (R2004).....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop
T180-01 (2004).....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):
D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort
- E. Michigan Department of Transportation, Standard Specifications for Construction (Latest Edition). (MDOT SSC)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fills: Suitable materials approved from on site and off site sources having a minimum dry density of 1760 kg/m³ (110 pcf), a maximum Plasticity Index of 6, and a maximum Liquid Limit of 30.
- B. Granular Fill:
 - 1. Bedding for sanitary and storm sewer pipe, crushed stone or gravel graded from 13 mm (1/2 inch) to 4.75 mm (No. 4).

- C. Aggregate Base and subbase for vehicular and pedestrian paving: See Section 32 12 16 ASPHALT PAVING AND 32 05 23 CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

PART 3 - EXECUTION

3.1 SITE PREPARATION

- A. Clearing: See Section 02 41 10 DEMOLITION AND SITE CLEARING
- B. Grubbing: See Section 02 41 10 DEMOLITION AND SITE CLEARING
- C. Tree Protection: See Section 01 57 19: TEMPORARY ENVIRONMENTAL CONTROLS, PARAGRAPH 1.6 TREE PROTECTION.
- 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.
1. 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.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines when possible to prevent damage to root system.
 2. 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.
 3. 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 Cemetery property. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading.
 4. 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.
 5. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion in accordance with the Erosion and Sedimentation Control Plan and/or Storm Water Pollution Prevention Plan. Refer to Division 2 Section 32 90 00, "Planting" for soil amendments required prior to spreading topsoil.

- a. Stockpile shall be contained with erosion and sediment controls (silt fence) and stabilized if undisturbed in accordance with the Storm Water Pollution Prevention Plan.
- 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material only after approval of the CO/COR.
- E. 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.
- F. 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. No burning of materials is permitted onsite.

3.2 EXCAVATION

- A. Shoring, Sheet piling 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 CO/COR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by CO/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 CO/COR. Approval by the CO/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 CO/COR should be contacted to consider the use of flowable fill.

C. Blasting: Blasting shall not be permitted.

D. Earthwork for Structures:

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.
5. Compact subgrades for footings to 95% of the soil's maximum dry density as determined by ASTM D 1557.

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 undisturbed earth unless a mechanical support is shown.
 - d. The length of open trench in advance of pipe laying shall not be greater than is authorized by the CO/COR.
2. Sanitary and 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 undisturbed soil or granular fill.
 - 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.
- F. Site Earthwork: Excavation shall be accomplished as required by drawings and specifications. Remove subgrade materials, that are determined by the CO/COR or inspector 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 CO/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 REQUIREMENTS 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. Lawn Areas - 6 inches) below the finished grade, unless otherwise specified or indicated on the drawings.
 - 3. Planting beds within columbarium plaza - 18 inches minimum 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 CO/COR.
- B. Proof-rolling Existing Subgrade: Proof-roll with a fully loaded dump truck. Make a minimum of one pass in each direction. Remove unstable uncompactable material and replace with granular fill material completed to mix requirements specified.
- C. 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.

- D. 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 CO/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 each layer to not less than 95 percent of the maximum density determined in accordance with ASTM D1557 Method A.

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 1800 mm (6 feet).
- 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 CO/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 AND PLANTING AREAS

- A. General: General: Harrow and till to a depth of 6 inches, new or existing lawn areas to remain, which are disturbed during construction. Do not till lawn areas within tree drip lines. Do not carry out lawn areas earthwork out when the soil is wet so that the tilth of the soil will be destroyed.

- B. Place topsoil and perform finish grading in accordance with 32 90 00 PLANTING.
- C. Install sod in accordance with 32 90 00 PLANTING.

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 CO/COR. Provide erosion and sedimentation control at soil stockpiles.
 - 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 CO/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.
- E. Provide erosion and sedimentation control for on- and off-site soil stockpiles as required by law.

3.6 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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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. Construction shall include the following:
- B. Pedestrian Pavement: Walks, flower/water stations, plaza areas.

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 11, EARTH MOVING-SHORT FORM.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.
- D. Joint Sealants: Section 07 92 00, JOINT SEALANTS.

1.3 DESIGN REQUIREMENTS

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

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.4 E., for Cold Weather Placement and Article 3.4 D., for Cold Weather Placement of Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
 - 1. Expansion joint filler
 - 2. Joint sealant and backer rod
 - 3. Reinforcement
 - 4. Curing materials
 - 5. Protective coating
- C. See 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE for additional submittal requirements.

1.6 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. Refer to the latest edition of all referenced Standards and codes.

B. American Association of State Highway and Transportation Officials (AASHTO):

- M31-07.....Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)
- M55M/55M-09.....Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)
- M147-04.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)
- M148-05.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)
- M171-05.....Sheet Materials for Curing Concrete (ASTM C171)
- M182-05.....Burlap Cloth Made from Jute or Kenaf
- M213-05.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
- T99-09.....Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
- T180-09.....Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

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

- C94/C94M-09.....Ready-Mixed Concrete
- C143/C143M-08.....Slump of Hydraulic Cement Concrete
- C1116/C1116M-08.....Fiber Reinforced Concrete

D. Michigan Department of Transportation (MDOT):

- SSC Standard Specifications for Construction (Latest Edition)

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be 4,000 psi air-entrained as specified in Section 03 30 53, SHORT FORM CAST-IN-PLACE CONCRETE, with the following requirements:

TYPE	MAXIMUM SLUMP*
Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")

Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Max slump 4" 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.
- B. Welded wire-fabric shall conform to AASHTO M55.
- C. Dowels shall be plain steel bars conforming to AASHTO M31 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.

2.3 AGGREGATE BASE

- A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined, meeting the requirements of the MDOT SSC (Latest Edition)
- B. Base aggregate: MDOT 21AA Dense Graded Aggregate

2.4 FORMS

- A. Use metal or wood 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 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
 - 1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
 - 2. Impervious Sheeting conforming to AASHTO M171.
 - 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum .

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

2.7 CONCRETE PROTECTIVE COATING

Linseed Oil mixture shall conform to AASHTO M233.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 11, EARTH MOVING-SHORT FORM and as specified in this Section.
- B. Shape to line and grade and compact with self-propelled rollers.
- C. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- D. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- E. Compact subgrade to 95% of the maximum dry density per ASTM D1557.
- F. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- G. 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 AGGREGATE BASE COURSE

- A. Place aggregate base courses on compacted subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact aggregate base course under pavements and walks as follows:
 - 1. Shape base course to required crown elevations and cross-slope grades.
 - 2. Place base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 3. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
- 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.

3.3 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 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) 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.

C. The Contractor's Registered Professional Land Surveyor, specified in Section 01 00 02, GENERAL REQUIREMENTS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.

1. Make necessary corrections to forms immediately before placing concrete.
2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

- A. The CO/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 REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the CO/COR shall approve the reinforcement, which shall be accurately and securely fastened in place

with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.6 PLACING CONCRETE - GENERAL

- A. Obtain approval of the CO/COR before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the CO/COR 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.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENTS, 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.

3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.

- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes/areas without approval by the CO/COR.

3.9 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.

3.10 CONCRETE FINISHING PEDESTRIAN PAVEMENT

- A. Walks, flower/water stations, and plaza areas:
 - 1. Finish the surfaces to grade and cross section with a metal float, troweled smooth and finished with a broom moistened with clear water.
 - 2. Brooming shall be transverse to the line of traffic.
 - 3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
 - 4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
 - 5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
 - 6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
 - 7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.11 JOINTS - GENERAL

- A. Place joints, where shown, 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.

3.12 CONTROL (CONTRACTION) JOINTS

- A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown. Joints may be sawed after tooling to achieve the proper depth. Sawing shall be performed prior to initial shrinkage of concrete. Ravelling at edges of joints due to sawing is unacceptable.
- B. Finish edges of all joints with an edging tool having the radius as shown.

3.13 EXPANSION (ISOLATION) 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 slip dowels where indicated.
 - 3. Using joint filler of the type, thickness, and width as shown.
 - 4. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.14 CONSTRUCTION JOINTS

- A. Place construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- B. Use a butt-type joint with slip dowels if the joint occurs at the location of a planned control joint.
- C. Tool edges of construction joint to look the same as control joints.

3.15 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.

3.16 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 CO/COR. The finished concrete shall be of a uniform color and texture. Curing method shall not cause mottling or staining in the finished concrete surface.

- 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 0.1 mm (4 mils) 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 300 mm (12 inches). Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m²/L (200 square feet per gallon) 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.
 - 5. Curing compound shall be compatible with concrete finish and shall not create mottled or uneven color or texture in the finished work.

3.17 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 herein specified.

4. Protective Coating - apply protective coating of linseed oil mixture to exposed-to-view concrete surfaces, drainage structures, and features that project through, into, or against the items constructed under this section to protect the concrete against the action of deicing materials.
5. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.18 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 CO/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 CO/COR.

3.19 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the construction site.

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. 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 leveling course and asphalt wearing 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.
- B. The Contractor shall obtain a certificate of compliance from the asphalt paving producer. Certificate of compliance shall cover quality and gradation of aggregate base, quality and grades of asphalt course materials, and that the job-mixture meets or exceeds the requirements of the Michigan Department of Transportation (State Highway Department).

1.2 RELATED WORK

- A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Paragraph 3.3 and 31 20 11 EARTH MOVING (SHORT FORM).

1.3 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor specified in Section 01 00 02, GENERAL REQUIREMENTS 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.

1.4 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 Subbase Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
 - 2. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.

2. Asphalt Leveling/ Wearing Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.

3. Job-mix formulas for asphalt leveling course and wearing course.

C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.

2. Asphalt binder certificate of conformance to State Highway Department requirements.

3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification and meets the requirements of this section.

D. One copy of State Highway Department Specifications (Latest Version).

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

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. American Association of State Highway and Transportation Officials (AASHTO):

HM29M.....Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 29th Edition and AASHTO Provisional Standards, 2009 Edition

MP1.....Specification for Performance Graded Asphalt

T 283.....Standard Method of Test for Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage

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

C29-07.....Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

C977-03.....Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization

D3786.....Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method

- D4355-07.....Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- D4632-08.....Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- D6390-05.....Standard Test Method for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
- D. National Asphalt Paving Association (NAPA):
 - 131 (2003).....Design, Construction, and Maintenance Guide for Porous Asphalt Pavements, Information Series
- E. Michigan Department of Transportation (MDOT):
 - SSC Standard Specifications for Construction (Latest Edition)
 - 12SP501(F) Special Provision for Marshall Hot Mix Asphalt Mixture
 - HMA MDOT HMA PRODUCTION MANUAL (2014)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Aggregate base materials, Sealing Materials, and asphalt pavement 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" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA CO/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, meeting the requirements of the MDOT SSC (Latest Edition)
- B. Subbase aggregate: MDOT Granular Material, Class II.
- C. Base aggregate: MDOT 21AA Dense Graded Aggregate.
- D. Aggregates for asphaltic concrete paving: Meet MDOT SSC (Latest Edition) requirements for specified hot mix asphalt type.

2.3 NON-WOVEN GEOTEXTILE FABRIC

- A. Fabric shall consist of needled nonwoven polypropylene fibers and meet the following properties:
 - 1. Grab Tensile Strength (ASTM-D4632) \geq 120 lbs.
 - 2. Mullen Burst Strength (ASTM-D3786) \geq 225 psi

3. Flow Rate (ASTM-D4491) \geq 95 gal/min/ft²
4. UV Resistance after 500 hours (ASTM-D4355) \geq 70%
5. Heat-set or heat-calendared fabrics are not permitted.
6. Mirafi 140N, Amoco 4547, Geotex 451, or approved equal.

2.4 ASPHALTIC MATERIALS

- A. Comply with provisions of MDOT SSC (Latest Edition)
 1. Bond coat: per MDOT SSC (Latest Edition).

2.5 HOT MIX ASPHALT PAVING

- A. Mix designs shall be in accordance with the requirements of MDOT publication 12SP501, Special Provision for Marshall Hot Mix Asphalt Mixture and the other MDOT publications referenced herein.
- B. Leveling course: MDOT Mixture No. 13A
- C. Wearing course: MDOT Mixture No. 36A

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 State Highway Specifications (MDOT SSC - Latest Edition) for the type of material specified.

3.2 WEATHER AND SEASONAL LIMITATIONS

- A. Do not place HMA or apply bond coat when moisture on the existing surface prevents curing;
- B. Do not place HMA unless the temperature of the surface being paved is at least 35 °F and there is no frost on or in the grade or on the surface being paved.
- C. Place only HMA courses that are greater than 200 pounds per square yard if the temperature of the surface being paved is greater than 35 °F;
- D. Place only HMA courses that are greater than 120 pounds per square yard if the temperature of the surface being paved is at least 40 °F; and
- E. Place any HMA course if the temperature of the surface being paved is at least 50 °F
- F. HMA Seasonal Limitations. Unless otherwise approved by the CO/COR in writing, place HMA in accordance with subsection 501.03.I.1 of the MDOT SSC (Latest Edition) and the following seasonal limitations.
 1. From June 1 to October 15 for the Upper Peninsula;
 2. From May 15 to November 1 for the Lower Peninsula, north of M-46; and
 3. From May 5 to November 15 for the Lower Peninsula, south of M-46.

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. If MDOT requirements differ from the above, comply with MDOT requirements.

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. Compact subgrade to 95% of the maximum dry density per ASTM D1557.
- F. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA CO/COR or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

- A. Subbase
 - 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. 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 bond coat, and tack coat where required, and allow to dry in accordance with MDOT requirements.
- 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), or 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 COLD MILLING

- A. Clean existing pavement surface of loose or deleterious material immediately before cold milling. Remove existing asphalt pavement to grades and cross sections indicated.
1. Mill to a depth of 38mm (1-1/2 inches).

3.8 PATCHING

- A. Hot Mix Asphalt Pavement: Sawcut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 300mm (12 inches) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing aggregate base course to provide new subgrade.

- B. Tack Coat: Apply uniformly to vertical and horizontal surfaces abutting area to receive new hot mix asphalt paving at a rate of 0.2 to 0.7 L/sq.M. (0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure before applying hot mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, remove spillage and clean affected surfaces.
- C. Patching: Fill excavated pavement with hot mix asphalt base mix for full thickness of patch; while still hot compact flush with adjacent pavement surface.

3.9 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the pavement is cured and does not track under foot or wheeled traffic.

3.10 FINAL CLEAN-UP

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

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SECTION 32 30 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made part of this Section of the Specifications.

1.2 DESCRIPTION

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Furnish and install the Flower-watering stations, including trash receptacles, water spigot, and flower vase container and complete any required work necessary to make the water supply equipment operate using the water supply source indicated.
2. Furnish and install benches at the specified locations.

1.3 RELATED WORK

A. The following items are not included in this Section and will be performed under the designated Sections:

1. Section 033053: CAST-IN-PLACE-CONCRETE (Short Form)
2. 10 14 00 Exterior Signage - for precast concrete flower watering station faucet post

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

1. General: For each item specified in description of work or Part 2 - Products, provide information showing complete detail, location in the project, material and size of components, method of joining various components and assemblies, finish, and location, size and type of anchors. Mark items requiring field assembly for erection identification and furnish erection drawings and instruction.
2. Provide templates and rough-in measurements as required.
3. Provide samples of full range of colors and finishes available for review and approval, prior to ordering.

1.5 REFERENCE STANDARDS

The publications listed below form a part of this specification and the work shall comply with pertinent standards of the latest editions as specified below or by industry standards unless designated otherwise herein.

- A. American Society for Testing and Materials (ASTM):
B221-08Aluminum and Aluminum-Alloy Extruded Bars, Rods,
Wire, Shapes, and Tubes
- B. American Welding Society (AWS):
D1.2-97..... Structural Welding Code Aluminum
- C. National Association of Architectural Metal Manufacturers (NAAMM)

PART 2 - PRODUCTS

2.1 FLOWER WATERING STATIONS: GENERAL

- A. Flower watering station materials, finishes and colors shall fully comply with the specifications and Contract Drawings or be deemed as approved equal.

2.2 TRASH RECEPTACLE

- A. Trash receptacles shall completely meet the specifications and Contract Drawings or be approved as an equal. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the specifications and Contract Drawings is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the specifications and Contract Drawings, they must be identified in the submittal. If the differences result in a product that is deemed less than that specified and shown in the Contract Drawings, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted with a variance request along with explanation of the differences, why they should be accepted and any cost or project completion factors shall be included.

B. MATERIALS

- 1. Main body construction shall be 9.53mm x 25.4mm (3/8" x 1") vertical solid steel bar; 6.35mm x 63.5mm (1/4" x 2-1/2") horizontal solid steel bands; 9.53mm x 76.2mm (3/8" x 3") steel support bars; 15.88mm (5/8") solid steel top ring; leveling feet with a 9.53mm (3/8") diameter threaded steel shaft. All trash receptacles shall be signed to read "TRASH" as indicated on the details in the Contract Drawings. Sign material, finish, color, font and font size shall be as shown on the Contract Drawings. Mounting of signs shall be as shown on approved Shop Drawings. All joints of steel components shall be fully welded and ground smooth throughout.
- 2. Unit shall contain one 136 liter (36-gallon) capacity high density plastic inner liner with its weight not to exceed 2.72 kg (6 lbs.). The unit manufacturer shall provide the black plastic inner liners

which shall be molded on tooling designed for and owned by the unit manufacturer. The inner liner shall offer maximum capacity and strength with lightweight construction using critical molded ribs, integral handholds, and high strength materials. This style of inner liner shall minimize handling difficulty and facilitate easy emptying and storage while affording long service life.

C. REQUIRED OPTIONS

1. Lids: Units shall be shipped with manufacturer's standard tapered formed lid with formed dome and with self-closing door. The lids shall be made of the manufacturer's standard high strength plastic material designed to match the selected manufacturer's standard color. Each lid shall be provided with a stainless steel aircraft cable and attachments to secure the lid to the unit.
2. Standard colors: Victor Stanley Standard Green to match existing receptacles at the Cemetery.
3. Mounting plate: Standard (1) anchor bolt hole.

D. FINISHES

1. All fabricated metal components are steel shotblasted, etched, phosphatized, preheated, and electrostatically powder-coated with TGIC polyester powder coatings. Products are fully cleaned and pretreated, preheated and coated while hot to fill crevices and build coating film. Coated parts are then fully cured to coating manufacturer's specifications.

The thickness of the resulting finish averages 8-10 mils (200-250 microns).

2.3 FLOWER VASE RECEPTACLE

- A. Flower vase receptacles shall completely meet the specifications and Contract Drawings or be approved as an equal. To achieve approval as an equal, submittal of a point by point comparison of the proposed equal product to the specifications and Contract Drawings is required by the Contractor during the submittal process. If the product being submitted for approval as an equal has any features that are different than the specifications and Contract Drawings, they must be identified in the submittal. If the differences result in a product that is deemed less than that specified and shown in the Contract Drawings, then the process for attempting approval as an equal shall NOT be performed during submittals. The product should be submitted for consideration as part of a variance request along with explanation of the differences, why

they should be accepted and any cost or project completion factors shall be included.

B. MATERIALS:

1. Flower vase receptacles shall be regularly produced by the manufacturer for use at VA Cemeteries, with a special light weight hinged lid designed for the VA Cemeteries. Flower vase receptacles shall be of the size indicated on the Contract Drawings, and shall be of the same construction, finish and indicated Victor Stanley color as the trash receptacles, with the following exceptions:
2. All flower vase receptacles shall be signed to read "FLOWER VASES" as indicated on the details in the Contract Drawings.
3. The "Floral Regulations" decal shall be as indicated on the Contract Drawings and be factory applied in location shown on the Contract Drawings. Decal shall be pressure sensitive vinyl designed for outdoor use. The content of the decal, lettering color and background color of decal shall be as approved during the shop drawing process. The materials for the decal shall be regularly used by the manufacturer for flower vase receptacles at VA National Cemeteries.

2.4 WATER SPIGOT ASSEMBLIES

- A. Water spigots shall be constructed as indicated on the drawings. The water spigot indicated on the drawings shall be an ADA compliant spigot operated with a paddle that allows the water to flow when pushed either right or left, with 2 Kg (5 lbs) of force or less. The assembly shall be installed with a pressure regulating valve and isolation valve installed in the meter box and the assembly is to be (blown out) if located in a region where the temperatures seasonally go below freezing. The spigot assembly shall contain all pipes, fittings, attachments, mounting base, and any other ancillary materials or equipment to produce a fully functional water spigot assembly, as indicated on the drawings, from the connection to the irrigation water system at the isolation valve for the spigot.

2.5 BENCHES

- A. To establish an acceptable level of quality for the bench materials and fabrication process, the following manufacturing features are listed and required for the purpose of identifying manufacturers that provide work and materials generally complying with these specifications. Their selection for this work shall not relieve them from performing the work as specified.

- B. Bench: Victor Stanley RB-28 Bench, 6 foot length, or approved equal.
- C. Manufacturing Features: Front welds are to be ground and polished until they form a continuous surface from the top tubular section to each vertical steel slat. Steel seat members shall be gently reverse contoured for maximum comfort. The end sections shall be solid steel bar, welded and ground, structurally adequate for the maximum loads, including an industry standard or greater design load safety factor. End arm rests are required and shall be standard integral welded configuration, with no center arm rests. All fabricated metal components are to be steel shotblasted, etched, phosphatized, preheated and electrostatically powder-coated with TGIC polyester powder coatings.
- D. Benches shall be at the locations, sizes and in the quantities indicated on the Contract drawings.
- E. Bench color shall be VS Green, as approved during the submittal process.
- F. All mounting hardware shall be stainless steel. Use of acorn nuts is required; exposed bolt ends or flat bolt heads are not acceptable.
- G. WARRANTY:
 - 1. All benches shall be free from defects in material and/or workmanship for a minimum period of three years, from final acceptance. Warranty shall not apply to damage resulting from accident, alteration, misuse, tampering, negligence or abuse.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to installation of any of the work in this section, contractor shall inspect the planned installation locations to insure that conditions are not significantly different from those indicated on the contract drawings. All materials shall be inspected prior to installation to insure compliance with the contract documents and to insure there is no damage. Should conditions be different from those indicated on the contract documents, contractor should immediately notify the Resident Engineer.

3.2 PREPARATION

- A. Stake alignment and locations for all site furnishings for review and approval by Resident Engineer. Verify that all elements in this section "fit" within location provided.
- B. Install items rigid, plumb and true to lines and levels shown.
- C. Assemble (if required) and install items as per manufacturer's printed instructions, or approved shop drawings, unless otherwise specified or shown.

3.3 INSTALLATION

A. Flower Watering Stations:

1. Stake location of flower watering stations and obtain approval from Owner's Representative prior to forming concrete pad. Install concrete pad in accordance with 033053 - CAST-IN-PLACE CONCRETE (Short Form).
2. Anchor trash receptacle and flower vase containers as shown on the Contract Drawings and following the manufacturer's recommended installation instructions.
3. Install water spigot assemblies according to manufacturer's recommendations, including pipe, isolation valve, fittings, pressure reducing valve and valve boxes. All anchoring hardware shall be stainless steel. Coordinate all work with other trades.

B. Benches:

1. Benches shall be shipped assembled. Mount benches as recommended by the manufacturer and as specified herein. All mounting hardware shall be stainless steel. Use of acorn nuts is required; exposed bolt ends or flat bolt heads are unacceptable.

3.4 CLEAN UP

- A. Clean up area of excess material and debris. Clean above ground portions of all receptacles and other site improvements.

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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 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(; 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. 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:

PLANTING IRRIGATION

32 84 00-1

1. 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 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's Technical Representative. 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. 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. 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.
- E. Testing: 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.
- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. 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):
 - B40.1-91.....Gauges-Pressure Indicating Dial Type Elastic Element
- D. American Society of Agricultural Engineers (ASAE):
 - S398Sprinkler Testing and Performance Reporting.
- E. American Society for Testing and Materials (ASTM):
 - B61-93.....Steam or Valve Bronze Castings
 - B62-93.....Composition Bronze or Ounce Metal Castings
 - D1785-91.....Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120
 - D2241-89.....Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
 - D2287-81.....Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
 - D2464-91.....Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - D2466-90.....Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
 - D2564-94.....Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe And Fittings
 - D2855-96.....Making Solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
 - D3350.....Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - F714.....Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
 - F477-90.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - F2164.....Field Leak Testing of Polyethylene Pressure Piping Systems
 - B209-96.....Aluminum and Aluminum-Alloy Sheet and Plate

F. American Water Works Association (AWWA):

C110-93.....Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch for Water and Other Liquids

C111-90.....Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe Fittings.

C115-94.....Flanged and Ductile Iron and Gray Iron Pipe with Threaded Flanges

C151-93.....Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids

C153-94.....Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for Water and Other Liquids.

C500-93.....Gate Valves for Water and Sewerage Systems

C504-87.....Rubber Sealed Butterfly Valves

C600-93.....Installation for Ductile-Iron water Mains and Their Appurtenances

C901-02 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service

G. Irrigation Association (IA): Technical Resources, Irrigation Best Practices & Standards

H. Manufacturers Standardization Society (MSS):

SP70-90.....Cast Iron gate Valves, Flanged and Thread Ends

I. National Electrical Manufacturers Association (NEMA):

250-85 Enclosures for Electrical Equipment (1000 Volts Maximum);
Revision 1, May 1986

J. National Electric Code: (latest edition 2011)

K. Uniform Plumbing Code: (latest edition)

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 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies outside of the normal irrigation season. Upon completion of the irrigation system or completion of portions thereof. 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 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.

1.8 TESTING

- A. Notify the Contracting Officer's Technical Representative 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 Contracting Officer's Technical Representative.
- 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 ~~125 percent of the operating pressure rounded to the nearest 10 PSI~~ 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.
- ~~4-7.~~ 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
- ~~5-8.~~ 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)
- ~~6-9.~~ Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
- ~~7-10.~~ Cement or caulking to seal leaks is prohibited.
11. Contractor may sub-contract testing to pipeline testing company approved by Owner.

F. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:

1. Subject pipe to a hydrostatic pressure equal to the anticipated operating pressure of 60 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 Contracting Officer's Technical Representative 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 Contracting Officer's Technical Representative 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 Owner.
- H. 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 Contracting Officer's Technical Representative.
 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 Contracting Officer's Technical Representative. 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 Contracting Officer's Technical Representative to schedule Final Inspection. Substantial completion consideration is only given after the 14 day test has been accepted.

1.9 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer's Technical Representative 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 Contracting Officer's Technical Representative 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.

1.10 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 Final Inspection by Contracting Officer's Technical Representative. 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 Contracting Officer's Technical Representative.
- 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.

1.11 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with Contracting Officer's Technical Representative. 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 Contracting Officer's Technical Representative.

PART 2 - PART 2 - MATERIALS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. Contracting Officer's Technical Representative must approve equipment prior to construction. The Contractor 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. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length. Acceptable manufacturer for casing spacers is Ford Meter Box Company or approved equal.
 - 5. Install joint restraints at all mainline joints, acceptable joint restraint manufacturer is Megalug or approved equal.

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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 (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, 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 Hunter HQ-5LRC, Rain Bird 5-LRC, Toro 474-44 or approved equal.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco 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 (ABS) 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

C. Flower Water Hydrant: As presented in the installation details.

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

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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.

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 (ABS) large valve box with black lid or combination of standard and round valve boxes with black lid. Acceptable manufacturer is Carson, 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.
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 model is HunterI-20 to match existing.
3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Rain Bird, Spears, Lasco or approved equal.

C. Pop-Up Spray Sprinkler Assembly:

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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 in turf and 12-inches in planter beds. Acceptable manufacturer and model is Hunter Pro Spray to match existing.
3. Swing Joint: Use pre-manufactured triple swing joint with ½-inch inlet. Acceptable manufacturer is Spears, Lasco or approved equal.

2.7 CONTROL SYSTEM COMPONENTS

A. 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 splices as recommended by control system manufacturer.
4. Valve Box: Use plastic (ABS) standard rectangular valve with black lid. Acceptable manufacturer is Carson, Pentek, Rain Bird or approved equal.
5. 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 - 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 Contracting Officer's Technical Representative 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 Contracting Officer's Technical Representative one week in advance of review. The Contracting Officer's Technical Representative 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, 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 Contracting Officer's Technical Representative.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

- 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. Minimum cover:

1. 24-inches over irrigation mainline pipe in landscaped areas. (distance from top of pipe to finish grade)
2. 18-inches over irrigation lateral pipe to sprinklers. (distance from top of pipe to finish grade)
3. 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)
4. 6-inches vertical separation between mainline pipe and lateral pipe installed in a common trench.
5. 4-inch minimum horizontal separation between pipes and wiring in a common trench.
6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.

D. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Contracting Officer's Technical Representative.

E. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.

F. 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 Contracting Officer's Technical Representative.

G. 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.

H. 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%

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Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.

- I. 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.
- J. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves where it is not installed using horizontal boring techniques.
- K. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the Contracting Officer's Technical Representative.
- L. Resod all trenches and areas disturbed by construction of the irrigation system.
- M. Where utilities conflict with irrigation trenching and pipe work, contact the Contracting Officer's Technical Representative for trench depth adjustments.

3.4 SLEEVING AND BORING

- 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.
- D. Directional boring slurry to be disposed of legally off site by the contractor.

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

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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"

B. PVC 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.

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

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.

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.

E. Joint Restraint Harness:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.
2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's requirements.

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:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

A. Mainline Pipe Flushing:

1. Thoroughly flush mainline before installation of Remote Control Valve or Valve-in-Head Sprinkler 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.
7. Contracting Officer's Technical Representative 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) or valve-in-head sprinkler(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 50 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:

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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. Control Wire:

1. Route low voltage control cable in trench as shown on drawings.
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

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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. Protect wire not installed with pipe 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. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide 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.
2. Operation and maintenance submittal package must be complete prior to being reviewed by the Contracting Officer's Technical Representative. Incomplete submittals will be returned without review.

B. Control System Programming:

1. Create and program controller with a grow-in and a peak season irrigation schedule for the areas being irrigated by the controller.

C. Colored Controller Charts:

1. Update existing map diagram provided by the Owner 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

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drawings. Special attention must be given to pipe routing and controller stationing.

- C. Prior to project completion, Contractor must provide the project redline drawings and the "Survey Drawing" AutoCAD files to Contracting Officer's Technical Representative 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.
- D. Prior to project completion provide 1 30" X 42" laminated drawing of the entire system for wall mount, drawing need not be to scale.

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.

- - - END - - -

**SECTION 32 90 00
PLANTING**

PART 1 - GENERAL

1.1 DESCRIPTION AND REQUIREMENTS

A. This work consists of furnishing and installing all planting materials required for landscaping at all NCA construction projects hereinafter specified in locations as shown. The landscape contractor shall be required to visit the site prior to submitting Bid Proposal to become familiar with all conditions affecting the proposed work. The contractor shall identify and review all underground utility locations prior to commencing work and shall exercise caution when working close to utilities and shall notify the Resident Engineer (RE) and/or Contracting Officer's Technical Representative (COTR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.

1.2 EQUIPMENT

Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

- A. Section 31 20 11, EARTH MOVING, Stripping Topsoil and Stock Piling.
- B. Section 01 45 29, TESTING LABORATORY SERVICES, Soil Testing.
- C. Section 31 20 11, EARTH MOVING, Topsoil Materials.
- D. Section 32 84 00, PLANTING IRRIGATION.

1.4 SUBMITTALS

A. Samples: Submit the following samples for approval before work is started:

Organic Mulch	2.3 kg (5 pounds) of each type to be used.
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- B. Pesticides: EPA approved labeling and MSDS sheet for each such product selected for use. Required for all pesticides, including but not limited to preemergence or post emergence herbicides, insecticides, and/or fungicides.
- C. Nursery Source List: Within 21 days of contract award, submit a complete list of nursery sources for plants. Plants that do not meet the specified requirements when delivered to the site will be rejected and replaced at the Contractor's expenses. No substitutions for plant species and/or varieties will be allowed without approval by the Landscape Architect and CO/COR.
- D. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the CO/COR for approval:
 - 1. Plants (Department of Agriculture certification by State Nursery Inspector from the state in which the plants originate declaring material to be free from insects and disease).

2. Fertilizers: submit certificates of analysis for each type of fertilizer.
 3. Seed: Certificates shall include the guaranteed percentages of pure live seed, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted certificates.
 4. Sod
 5. Organic soil amendment: proof of EPA minimum heating requirements for pathogen/ weed seed destruction.
- C. Manufacturer's Literature and Data:
1. Antidesiccant
 2. Erosion control materials
 3. Pre-emergent herbicide
 4. Lime and inorganic soil amendments
 5. Deer protection
 6. Watering bags
- D. Licenses: Licenses of Arborist shall be submitted (one copy), to the Resident Engineer.
- E. See 01 45 29 Testing Laboratory Services for required soil and organic soil amendment tests. Submit results of testing.

1.5 DELIVERY AND STORAGE

- A. Delivery:
1. Notify the Resident Engineer of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
 2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches with a breathable cover. Do not bend, bind, or tie plants in a manner that damages bark, breaks, branches, or destroys the plant's natural shape. Do not drop ball and burlap plants during delivery. Do not prune prior to delivery.
 3. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.
 4. Deliver fertilizer and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
 5. During delivery: Protect sod from drying out and seed from contamination.

6. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

B. Storage:

1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
2. Keep seed, lime, and fertilizer in dry storage away from contaminants.
3. Store plants not installed on the day of arrival at the site as follows:
 - a. Shade and protect plants from the wind when stored outside.
 - b. Heel in bare root plants.
 - c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.
 - d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

- A. Perform landscape planting operations within the following dates: From March 1 to June 30 for spring and from September 1 to November 15 for fall, but not before irrigation system installed, tested, and approved, if applicable.
- B. Perform turfgrass installation operations within the following dates, but not before irrigation system installed, tested, and approved.
 1. Spring Planting: April 1 to May 15.
 2. Fall Planting: September 1 to October 15.
- C. Perform meadow and woodland seeding operations within the following dates:
 1. Spring Planting: April 1 to June 1.
 2. Fall Planting: October 1 to November 15.
- D. No work shall be done when the ground is frozen, snow covered, too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance in the specified planting dates or conditions. Submit a written request to the Resident Engineer stating the special conditions and proposal variance for approval.

1.7 LANDSCAPE PLANT, TURF AND SEEDED AREAS ESTABLISHMENT PERIOD

- A. The Establishment Period for landscape plants, turfgrass, and seeded areas shall begin immediately after installation, with the approval of the COR and continue for a period of time during the growing season sufficiently long (optimally a minimum of 3 months) for the seeded areas, turfgrass and landscape plant materials to achieve an establishment condition and

appearance satisfactory to the MSN Agronomist and NCA. These conditions and appearance are described as follows: Turfgrass shall have obtained a minimum of 98% surface cover that is generally weed-free, seeded areas shall have 98% cover of cover crop (spring and fall plantings) and evidence of meadow/woodland seedlings emerging (spring plantings only) that is generally weed free, and Landscape Plant Materials shall be fully rooted, actively growing and healthy and planting beds generally weed-free. The contractor shall be responsible for the health and maintenance of plants and turfgrass during the establishment period. Plants and turfgrass will not be accepted until after completion of an acceptable establishment period. During the Landscape Plant, Turfgrass, and Seeded Areas Establishment Period the Contractor shall:

1. Water all plants, turfgrass, and seeded areas to maintain a moist soil surface at all times until the plants and turfgrass are well established. An adequate supply of moisture must also be maintained within the root zone. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turfgrass. The actual quantity of applied water required to achieve and maintain these conditions is best determined on site by the MSN Agronomist in consultation with the Project Engineer.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy straps, and eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the Resident Engineer in coordination with the MSN Agronomist.
6. Provide the following during turfgrass establishment:
 - a. Eradicate all weeds. Water, fertilize, overseed, and perform any other operation necessary to promote the growth of turfgrass.
 - b. Mow the turfgrasses as often as necessary to maintain the NCA specified mowing height for each type of turfgrass prior to final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrasses mow at heights as appropriate for species and

cultivar as directed by the RE/COTR in consultation with the MSN Agronomist. Final mowing height is 65 mm (3.0 inch) for cool season turfgrasses and as appropriate for warm season turfgrasses and mow as often as necessary to maintain the proper height while never removing more than 1/3 of the total height of grass leaves in a single mowing. Mow any portion of the newly developing turfgrass stand that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.

7. Provide the following meadow/woodland seeded areas maintenance during establishment:
 - a. Watering: Water with a light spray to minimize erosion. Do not water if soil is already moist from natural rainfall. First eight weeks after spring seeding: Water every two or three days. Soil should not dry out completely. After eight weeks: water only if it does not rain for one week. Fall seeding: do not water.
 - b. Mowing: Spring seeding: Mow about once per month during the first growing season. Trim meadow to 8 inches tall with a string trimmer or flail mower whenever weed growth reaches 12" height to reduce weed competition. Do not mow lower than 8 inches during the first growing season. Do not use a lawn mower. Fall seeding: Do not mow until spring.
 - c. Weeding: Spot treat the following problem weeds, if present, with herbicide: Canada thistle, Spotted Knapweed, Burdock, Wild Parsnip, Sweet Clover, Queen Anne's Lace
8. Replace dead, missing or defective plant material during the establishment period and an active growing season. Immediately replace each plant with one of the same size and species.
9. Replant any areas void of turfgrass during an active growing season only.
 - a. Sod shall be evaluated for species and health thirty (30) days after laying the last piece of sod and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 - b. Turfgrass seeding shall be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

Unsatisfactory areas shall be reseeded within seven (7) days during an active growing season.

10. Meadow and woodland seeding shall be evaluated for species and health thirty (30) days after final planting and reevaluated each 15 days during the establishment period. A satisfactory stand of cover crop plants from the seeding operation shall be 98%. Bare spots shall be a maximum of one-half (0.5) square foot. Unsatisfactory areas shall be reseeded within seven (7) days during an active growing season.
11. Complete remedial measures directed by the RE/COTR in consultation with the MSN Agronomist to ensure plant, seed, and turfgrass survival.
12. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURFGRASS ACCEPTANCE.

- A. Landscape plant and turfgrass acceptance will occur after completion of the LANDSCAPE PLANT AND TURFGRASS ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass are expected to be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request two weeks prior to final inspection of the landscape plants and turfgrass. Upon inspection when work is found to not meet the specifications, the PLANT AND TURFGRASS ESTABLISHMENT PERIOD shall be extended at no additional cost to the Government until work has been satisfactorily completed, inspected and accepted.
- B. Criteria for acceptance of landscape plants.
 1. Planter beds and earth mound water basins are properly mulched and free of weeds.
 2. Tree support stakes and ties are in good condition.
 3. Total plants on site as required by specifications and required number of replacements have been installed.
 4. Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.
- C. Criteria for acceptance of turfgrass shall be as follows:
 1. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture and well rooted into the soil below so that gentle pulling of the turfgrass leaves by hand does not dislodge the sod. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.
 2. A satisfactory stand of turfgrass plants from the seeding operation shall be 98% coverage uniform in color and leaf texture. Bare spots shall be a maximum of one-half (0.5) square foot.

1.9 PLANT, SEEDED AREAS, AND TURFGRASS WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of the GENERAL CONDITIONS, including the following supplements:
1. A One Year Plant, Seeded Areas, and Turfgrass Warranty will begin on the date that the Government accepts the plants, seeded areas and turfgrass but not before the end of the Landscape Plant, Seeded Areas, and Turfgrass Establishment Period.
 2. The Contractor will replace any dead plant material and any areas void of turfgrass immediately during the warranty period and during an active growing season. A one year warranty for the plants and turfgrass that are replaced will begin on the day the replacement work is completed and accepted.
 3. Replacement of relocated plants, that the Contractor did not supply, is not required unless they die from improper handling and care during transplanting. Loss through Contractor improper handling, care, or negligence requires replacement in kind and size.
 4. The Government will reinspect all replacement plants and turfgrass at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turfgrass immediately and during an active growing season. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification.
 5. The Contractor shall remove stakes, guy straps and any required tree wrappings from plants having been installed for one year, unless otherwise directed by the RE/COTR in consultation with the MSN Agronomist.

1.10 APPLICABLE PUBLICATIONS

- A. NCA Handbook 3420 - Turfgrass Maintenance in VA National Cemeteries re-certified 2011. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor's official reference guide to all establishment and preliminary maintenance practices employed during this construction project.
- B. 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.
- C. American National Standards Institute (ANSI) Publications:
ANSI Z60.1-04 Nursery Stock
ANSI Z133.1-06 Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush-Safety Requirements

- D. A - Z Encyclopedia of Garden Plants, American Horticultural Society, most current edition..
- E. American Society for Testing and Materials (ASTM) Publications:
 - C136-06 Sieve Analysis of Fine and Coarse Aggregates
 - C516-08 Vermiculite Loose Fill Thermal Insulation
 - C549-06 Perlite Loose Fill Insulation
 - D977-05 Emulsified Asphalt (AASHTO M140)
 - D1557-09 Test Methods for Laboratory Compaction of Soil
 - D2028-97 (Rev. 2004) ... Cutback Asphalt (Rapid-curing Type)
 - D2103-08 Polyethylene Film and Sheeting
 - D5851 (Rev 2006) Planning and Implementing a Water Monitoring Program
- F. Turfgrass Producers International: Turfgrass Sodding.
- G. U. S. Department of Agriculture Federal Seed Act.
Amended July 2011 Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

All plant and turfgrass material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in A-Z Encyclopedia of Garden Plants.

2.2 ORGANIC SOIL AMENDMENT (COMPOST)

- A. All areas to receive turfgrass seeding or sodding may require an organic soil amendment to increase organic content and water retention as well as enhance turfgrass growth. If native topsoil has an organic matter content below 4% it should be amended in-place after grading activities are completed to effectively create a satisfactory topsoil horizon.
- B. Organic soil amendment will be spread and incorporated into the topsoil in order to raise the organic content of the soil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment when installing topsoil to meet the required finished grades as per the grading plans.
 - 1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material should pass a one inch (1") screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.
 - 2. Acceptable types of Organic Soil Amendments include well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as

food or animal residuals, yard trimmings, or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.

3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27% to 80%
pH	5.5-8.5
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%
C:N Ratio	25-30:1
CEC	50-150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Soluble Salts	< 6 Ds/m (mmhos/cm)
Water-Holding Capacity	150-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements

4. Provide tests of Organic Soil Amendment to demonstrate compliance with the parameters listed above and per requirements of 01 45 29 Testing Laboratory Services.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.
6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications and results provided to the RE/COTR/MSN Agronomist.

2.3 PLANTS

- A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.
- B. Balled and burlapped stock:

1. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting. No soil is to be heaped on the top of plant root flares. Any plants delivered with such heaped soil over the root flare will have the soil removed before planting. If the root ball depth does not satisfy ANSI Z60.1 requirements after soil is removed, the plant will be rejected.
 2. Plants wrapped in inorganic burlap will be rejected from the job site.
- C. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project.
- D. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Resident Engineer, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.
- E. Provide nursery grown, Grade 1, plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting. Never pick-up or move tree species by grasping the trunk. Trees must be moved by lifting the root ball, box or container.
- F. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
- G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
- H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the Resident Engineer in consultation with the MSN Agronomist

authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

- I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.4 LABELS

Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.5 TOPSOIL

- A. Topsoil shall be a well-graded soil of good uniform quality. It shall be a natural, friable soil representative of productive soils in the vicinity. Topsoil shall be free of admixture of subsoil, foreign matter, objects larger than 25 mm (one inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and shall have a pH value of not less than 6.0 nor more than 7.0, and should be best suited to the region, climate and plant material specific to the project.
- B. Obtain material from stockpiles established under Section 31 20 11, EARTH MOVING, subparagraph, Stripping Topsoil that meet the general requirements as stated above. Amend topsoil not meeting the pH range specified by the addition of pH Adjusters.
- C. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the Resident Engineer of the source(s) from which topsoil is to be furnished. Obtain topsoil from well drained areas. Additional topsoil shall meet the general requirements as stated above and comply with the requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.6 SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 90 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve. Moisture is not to exceed 10%.

- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- E. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- F. Pine Bark shall be horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm. (.004in. and .59in.).
 - 1. Pine bark shall be aged sufficiently to break down all woody material.
Pine bark shall be screened
 - 2. pH shall range between 4.0 and 7.0.
 - 3. Submit manufacturer's literature for approval.
- F. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.7 PLANT FERTILIZERS

- A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.
- B. For new plant material, provide a uniform free-flowing granular complete analysis fertilizer containing a minimum of 10% by weight of nitrogen, phosphoric acid and potash with a minimum of 50% of the nitrogen from a controlled release source such as sulfur coated urea.
- C. For existing trees, provide a uniform free-flowing granular fertilizer bearing the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 10% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea.), 10% available phosphoric acid, and 10% potash.

2.8 TURFGRASS FERTILIZER

Provide turfgrass fertilizer that is commercial grade, free flowing, uniform in composition, and conforms to applicable state and federal regulations. Granular fertilizer shall bear the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 20% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea), 5% available phosphoric acid, and 15% potash. Liquid starter fertilizer for use in the hydro mulch slurry will be commercial type with 50 percent of the nitrogen from a controlled release source.

2.9 MULCH

- A. Mulch: Shredded hardwood tree bark, composted minimum one year, with shredding to produce an approved size ranging from fines to 2" with 50% over $\frac{3}{4}$ "; pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; not exceeding 0.5 percent inert contaminants and free of twigs, limbs, wood shaving, saw dust, and foreign or toxic substances. Salinity to be less than 6 dS/m (mmhos/cm).
- B. Mulch shall be stored as to prevent inclusion of foreign material.
- C. Mulch for turfgrass
1. Straw for turfgrass seed bed mulch shall be stalks from oats, wheat, rye, barley, or rice that are free from noxious weeds, mold or other objectionable material. Straw shall be in an air-dry condition and suitable for placing with blower equipment.
 2. Wood cellulose fiber mulch for use with hydraulic application (Hydro mulch) with fertilizer shall consist of specially prepared wood cellulose fiber, processed to contain no growth or germination-inhibiting factors, and dyed an appropriate color to facilitate visual metering of the application of materials. Do not apply any turfgrass seed in this type mixture. On an air-dry weight basis, the wood cellulose fiber shall contain a maximum of 12 percent moisture, plus or minus three percent at the time of manufacture. The pH range shall be from 3.5 to 5.0. The wood cellulose fiber shall be manufactured so that:
 - a. After addition and agitation in slurry tanks with fertilizers, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogenous slurry.
 - b. When hydraulically sprayed on the ground, the material will form a blotter like cover.
 - c. The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil.

2.10 ASPHALT ADHESIVE

Asphalt adhesive for application with straw mulch shall be liquid asphalt conforming to ASTM D2028, designation RC-70, or emulsified asphalt conforming to ASTM D977, Grade RS-1.

2.11 EROSION CONTROL

- B. Erosion control blanket material shall be cellulose fiber blanket without netting weighing 10 kg/100 m² (20 pounds per 1000 square feet) in 1250 mm (50 inch) wide rolls.

2.12 ACCESSORIES

- A. Tree Staking Materials:
1. Stakes: 2" hardwood free of defects that would impair strength.

2. Guying material shall be ¾" flat woven polypropylene strap with 900 lb. break strength such as DeepRoot Arbor Tie (1-800-458-7668) or approved equal, black color.

B. Watering bags for trees

1. 20 gallon, UV-treated polyethylene bag reinforced with nylon webbing, with water release holes. Treegator, www.treegator.com, or equal.
2. Use "donut style" watering bag for multi-stem trees where appropriate.

C. Deer protection - 48" high, 4" diameter black rigid plastic mesh tree guards

2.13 WATER

Water shall not contain elements toxic to plant life. It shall be obtained // from the existing irrigation system at no cost to the Contractor .

2.14 ANTIDESICCANT

Antidesiccant shall be an emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.15 TURF SEED

- A. Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's warranted analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. 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. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. Onsite seed mixing shall be done only in the presence of the Resident Engineer. All turfgrass seeding operations shall be done separately and prior to the application of any mulch material.
- B. Minimum Acceptable Seed Quality standards for all turfgrass seed utilized are as follows: Purity 95%, Germination 85%, Weed Seed Content less than 0.5%, Noxious Weeds 0.0%, Inert Material less than 3%, Germination Test Date no older than 6 months.
- C. All turfgrass seed mixtures, or sod composition shall conform to the species and cultivar requirements detailed here: The seed mixtures listed below are representative of an almost endless list of acceptable seed mixtures that roughly approximate these guidelines.

Cool Season Turfgrass Seed Mixtures: Seed is % by weight

Primary mixture* - 50% perennial ryegrass, 30% Ky bluegrass, 20% fine fescue
SEEDING RATE = 6 lb/1000 sq.ft.

Each of these species components should be a blend composed of a minimum of 2 regionally adapted cultivars.

Any deviation from these turfgrass species requirements must be approved in writing by the NCA Chief Agronomist and/or appropriate MSN Agronomist in coordination with the RE and/or COTR.

2.16 TURF SOD

- A. Sod shall be nursery grown, certified sod as classified in the TPI 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 must also conform to the turfgrass species limitations as outlined in seeding mixtures in 2.20C above in this spec. Sod composition shall match the existing turfgrass at the Cemetery.
- C. Sod composition shall be approved in writing by the NCA Chief Agronomist and/or appropriate MSN Agronomist in coordination with the CO/COR.

2.17 HERBICIDES AND OTHER PESTICIDES

All herbicides and other pesticides shall be properly labeled and registered with the U.S. Environmental Protection Agency. Keep all pesticides in the original labeled containers indicating the analysis and method of use.

2.18 WOODLAND SEED MIX

- A. Shall be clean and fresh, packed in sealed bags showing net weight, composition of mix, date of germination tests and supplier's name.
- B. Composition

- 1. "Woodland Edge Mix" from Michigan Wildflower Farm, (517) 647-6010, www.michiganwildflowerfarm.com,

<u>Scientific name</u>	<u>Common name</u>	<u>% by wt.</u>
<i>Allium cernuum</i>	Nodding Wild Onion	2
<i>Anemone canadensis</i>	Canada anemone	1
<i>Anemone virginiana</i>	Tall thimbleweed	1
<i>Aquilegia canadensis</i>	Wild columbine	4
<i>Aster cordifolius</i>	Heart-leaved aster	2
<i>Campanula americana</i>	Tall bellflower	2
<i>Desmodium canadense</i>	Showy tick-trefoil	2
<i>Eupatorium rugosum</i>	Snakeroot	4
<i>Geranium maculatum</i>	Wild geranium	1
<i>Helianthus divaricatus</i>	Woodland sunflower	2
<i>Monarda fistulosa</i>	Bergamot	4
<i>Penstemon digitalis</i>	Foxglove beardtongue	4
<i>Penstemon hirsutus</i>	Hairy beardtongue	1
<i>Solidago caesia</i>	Bluestem goldenrod	2
<i>Thalictrum dasycarpum</i>	Purple meadow rue	3
<i>Elymus canadensis</i>	Canada Wild Rye	30

<i>Hystrix patula</i>	Bottlebrush grass	10
<i>Koeleria cristata</i>	June Grass	3
<i>Schizachyrium scoparium</i>	Little bluestem	22

2. Seed must not contain more than 0.1% by weight weed seed, no more than 1.5% inert matter, no more than 0.1% other crop seed and no noxious weed seed or undesirable grass species.

C. Seeding rate: 5 oz. per 1,000 sf or 10 lbs/ acre

D. Seed with a cover crop of the following:

E. Seed with an annual cover crop as follows:

<u>Planting Date</u>	<u>Scientific Name</u>	<u>Common Name</u>	<u>Seeding Rate</u>
April-October	<i>Avena sativa</i>	Oats	15 lbs/ac
October-April	<i>Secale cereal</i>	Grain rye	15 lbs/ac

2.19 MEADOW SEED MIX

A. Shall be clean and fresh, packed in sealed bags showing net weight, composition of mix, date of germination tests and supplier's name.

B. Composition

1. "Native Grass Mix" from Michigan Wildflower Farm, (517) 647-6010, www.michiganwildflowerfarm.com,

<u>Scientific name</u>	<u>Common name</u>	<u>% by wt.</u>
<i>Andropogon gerardii</i>	Big bluestem	24
<i>Panicum virgatum</i>	Switch grass	12
<i>Schizachyrium scoparium</i>	Little bluestem	40
<i>Sorghastrum nutans</i>	Indian grass	24

2. Seed must not contain more than 0.1% by weight weed seed, no more than 1.5% inert matter, no more than 0.1% other crop seed and no noxious weed seed or undesirable grass species.

C. Seeding rate: 15 lbs/ acre

D. Seed with an annual cover crop as follows:

<u>Planting Date</u>	<u>Scientific Name</u>	<u>Common Name</u>	<u>Seeding Rate</u>
April-October	<i>Avena sativa</i>	Oats	15 lbs/ac
October-April	<i>Secale cereal</i>	Grain rye	15 lbs/ac

PART 3 - EXECUTION

3.1 LAYOUT

Stake plant locations and bed outlines on project site for approval by the Resident Engineer before any plant pits or beds are dug. The Resident Engineer may approve adjustments to plant material locations to meet field conditions.

3.2 EXCAVATION AND SOIL PLACEMENT FOR PLANTING BEDS

- A. CO/COR will inspect subgrades prior to topsoil placement. Notify CO/COR minimum of 1 week prior to topsoil placement to that inspection may take place.
- B. Prior to excavating for planting beds, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.
- C. Excavate planting beds to depth shown on drawings. Remove existing soil and dispose of legally.
- D. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the CO/COR may select other locations for plant material.
- E. Loosen plant pit subgrade to a depth of six inches with a prybar or shovel. Do not till.
- F. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off property. Leave rough. Do not rake.
- G. Spread topsoil to depths as shown on plans, but not less than required to meet finish grades after addition of organic soil amendment, light rolling and natural settlement. Do not spread if topsoil or subgrade is frozen, muddy, or excessively wet.
- H. Rake soil to remove any hard clumps, rocks, or other debris larger than 1 inch in any dimension from top surface.
- I. Till in organic and/or inorganic soil amendments and fertilizers per soil test lab recommendations. A one (1) inch depth of organic soil amendment shall be applied to the surface of the planting beds and tilled into the top six inches of the soil, in addition to any other amendments recommended by the soil testing lab.

3.3 EXCAVATION FOR TREE/PLANT PITS

- A. Prior to excavating for plant pits, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that

are to be preserved in a manner that will effectively protect them during the project construction.

- B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the CO/COR may select other locations for plant material.
- C. Do not use an auger or tree spade for planting pit excavation. Hand digging, machine digging, or other methods that create a plant pit with rough, loose sides are acceptable. Pits with smooth, hard sides are not acceptable.
- D. Loosen plant pit subgrade to a depth of six inches with a prybar or shovel. Do not till.
- E. Fill plant pits with water and allow to percolate before planting. Where pits will not drain in 24 hours and will affect the health of the plant, notify the Landscape Architect. Landscape Architect may direct relocation of the plant or recommend an underdrain connected to an outfall to provide positive drainage. If underdrains are needed an adjustment will be made to the contract amount.

3.4 SETTING PLANTS

- A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants so that the root flare is 2" higher than the surrounding grade. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil.
- B. For balled and burlapped plants, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
- C. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- D. Backfill balled and burlapped and container-grown plants with the soil removed from the planting hole to approximately half the depth of the ball and then tamp and water. It is desirable to use 100% percent native soil to backfill the hole, but do not use unsuitable fill containing clay, rock or other unsuitable material.

3.5 TREE STAKING

- A. Tree staking is optional. Staking of trees is not required as part of the Scope of Work, and if performed will be at no additional cost. Should Contractor elect to perform staking, the methods and material will be as

detailed on the Drawings as approved by the Landscape Architect. All trees to be set plumb for Final Acceptance. Do not use and install tree wrappings on trunks. All stakes and guy straps are to be removed after 1 year.

3.6 EDGING PLANT BEDS

- A. Uniformly edge beds and tree mulch circles using a sharp tool to provide a clear cut division line between the planted area and the adjacent turfgrass, if applicable. Do not use any type of manufactured edging material unless indicated on plans. The properly mowed and maintained turfgrass will serve as edging for all landscape beds.

3.7 WATERING BAGS FOR TREES

- A. Install per manufacturer's directions. Refill with water once per week or as needed for plant establishment.
- B. Watering bags to be left on trees for Final Acceptance.

3.8 MULCHING PLANTS

- A. Mulch within 48 hours after planting to depths indicated on plans and apply a preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.
- B. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.9 PRUNING

- A. Prune new plants and indicated existing plant material in the following manner: Remove dead, broken and crossing branches. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove the leader. Remove trimmings from the site. Do not use any type of wound dressing on pruning cuts.
- B. Existing trees to be pruned are shown on the drawings. Perform tree pruning and cavity work by a licensed arborist an arborist in accordance with ANSI Z 133.1. Remove dead wood 13 mm (1/2 inch) or more in diameter, branches interfering with or hindering the healthy growth of the trees, and diseased branches with a clean cut made flush with the branch collar. Cut back or remove branches as necessary to give the trees proper shape and balance. In removing large limbs, make the initial cut on the underside at a safe distance from the trunk or lateral, to prevent ripping of bark. Ensure branches and trimmings do not endanger traffic or cause damage to property during removal. Section large branches or limbs that cannot be removed in one piece without endangering traffic or property. Lower sections by ropes. Repair any damage resulting from the Contractor's negligence during pruning. Workmen are not permitted to climb trees with climbing spurs. To promote

proper healing, cut off flush with the branch collar stubs or limbs that have resulted from improper cuts or broken as a result of former pruning. Remove girdling roots.

3.10 SITE PREPARATION - UNDISTURBED AND TREE PROTECTION AREAS

- A. For seeding in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Scarify and loosen surface soil by raking. Do not cut tree roots. Do not till.
 - 3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- B. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.11 TILLAGE FOR TURFGRASS AND MEADOW AREAS (DISTURBED AREAS)

Thoroughly till the subsoil to a depth of at least 150 mm (6 inches) by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used. Remove all debris and stones larger than 25 mm (one inch) remaining on the surface after tillage in preparation for finish grading. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a 50 mm (one inch) depth and remove debris and stones. Areas used for construction storage shall be prepared per the above instructions. **Do not till in tree protection zones.**

3.12 FINISH GRADING

After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of 150 mm (6 inches). Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into the subsoil to avoid soil layering. Do not spread topsoil when frozen or excessively wet or dry. Correct irregularities in finished surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic. Complete lawn work only after areas are brought to finished grade.

3.13 APPLICATION OF FERTILIZER AND LIME FOR TURFGRASS AREAS

- A. Spread lime or other soil amendments as recommended by the soil test results.
- B. Incorporate soil amendments into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation.
- C. Apply turfgrass fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft.

- D. Starter fertilizer should be lightly mixed with the top ½ inch of soil.
- E. Immediately restore the soil to an even condition before any seeding or sod placement.
- F. Do not apply fertilizer or lime in meadow or woodland seeding areas.

3.14 TURF MECHANICAL SEEDING

- A. Broadcast seed by approved application equipment at the rate specified. All turfgrass seed shall be planted prior to the application of any mulch material. The seed shall be uniformly distributed in a minimum of 2 directions at right angles to each other. Drag the seeded area to inter-mingle the seed and surface soil by means of spike-tooth harrow, cultipacker, or other approved device.
- B. Immediately after dragging, firm the entire area with a roller not exceeding 225 kg/m (150 pounds per foot) of roller width.
- C. Immediately after preparing the seeded area, evenly spread an organic mulch of straw by hand or by approved mechanical blowers at the rate of 0.5 kg/m² (2 tons per acre). Application shall allow some sunlight to penetrate and air to circulate but also reduce soil and seed erosion and conserve soil moisture. Anchor mulch by a mulch tiller, asphalt emulsion, twine, or netting. When asphalt emulsion is used, apply either simultaneously or in a separate application. Take precautionary measures to prevent asphalt materials from marking or defacing structures, pavements, utilities, or plantings.

3.15 TURF HYDRO-MULCHING

When hydro-mulching, mix the slow release starter fertilizer, approved wood cellulose mulch material in the required amount of water to produce a homogenous slurry and then uniformly apply slurry under pressure to deliver the recommended quantity of fertilizer per 1000 sq.ft.

3.16 TURF SODDING

- A. Accomplish sodding in accordance with the ASPA Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at the bottom of the slope.
- B. After completing the sodding operation, blend the edges of the sodded area smoothly into the surrounding area. All sod should be rolled with a light-weight roller after being laid to eliminate air spaces between the sod and the firmed soil.

3.17 WATERING

- A. Apply water to the turfgrass, meadow, and woodland areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least 50 mm (2 inches). Supervise watering operation to

prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations.

1. Turfgrass: Keep soil surface constantly moist, not wet, until turfgrass plants are well established.
2. Meadow and woodland seeding: For spring plantings, water meadow and woodland seeded areas once per week for six weeks after seeding whenever natural rainfall is less than 1 inch per week. For fall plantings, water immediately after seeding only.

B. Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the CO/COR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

3.18 PROTECTION OF TURFGRASS AREAS

Immediately after installation of the turfgrass areas, protect against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.19 EROSION CONTROL MATERIAL

- A. Install and maintain erosion control material meeting the requirements of this specification on the designated areas as shown and specified. Prepare, fertilize and vegetate the area(s) to be covered, as specified, before the erosion material is placed. Immediately following the planting operations lay the material evenly and smoothly and in contact with the soil throughout. Omit the straw mulch from all seeded areas receiving the erosion control material.
- C. When using erosion control material on slopes, place the material either horizontally or vertically to the slope with the edges and ends of adjacent strips butted tightly against each other.
- D. Staple each strip in three rows (each edge and center with the center row alternately spaced) with staples spaced not more than 1200 mm (4 feet) longitudinally. When using two or more strips side by side on slopes, use a common row of staples on the adjoining strips. Staple all end strips at 300 mm (one foot) intervals at the end. Firmly embed staples in the underlying soil.
- E. Maintenance shall consist of repairs made necessary by erosion, wind, or any other cause. Maintain, protect, repair, or replace the erosion control material until the Termination of the Plant and Warranty Period.

3.20 MEADOW AND WOODLAND SEEDING

A. Broadcast seeding

1. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other including cover crop.
2. Sow seed at rates noted under seed mixes.
3. Drag the seeded area to inter-mingle the seed and surface soil by means of spike-tooth harrow, cultipacker, or other approved device.
4. Immediately after dragging, firm the entire area with a roller not exceeding 225 kg/m (150 pounds per foot) of roller width.
5. Immediately after rolling the seeded area, evenly spread an organic mulch of straw by hand or by approved mechanical blowers at the rate of 0.5 kg/m² (2 tons per acre). Application shall allow some sunlight to penetrate and air to circulate but also reduce soil and seed erosion and conserve soil moisture. Anchor mulch by a mulch tiller or asphalt emulsion. When asphalt emulsion is used, apply either simultaneously or in a separate application. Take precautionary measures to prevent asphalt materials from marking or defacing structures, pavements, utilities, or plantings.

3.21 RESTORATION AND CLEAN-UP

Where existing or new turfgrass areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turfgrass work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

3.22 ENVIRONMENTAL PROTECTION

All work and Contractor operations shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

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SECTION 33 46 00

SUBDRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall address materials and installation requirements for subsurface drainage systems that will serve as underdrains for gravel trenches and overflow conveyance systems for dry wells.

1.2 DEFINITIONS

- A. HDPE: High-density polyethylene plastic.
- B. PE: Polyethylene plastic.
- C. CPP: Corrugated polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.3 SUBMITTALS

- A. See Section 01 33 23 - Submittal Procedures
- B. Product Data: For the following:
 - 1. Perforated-wall pipe and fittings.
 - 2. Solid-wall pipe and fittings.
 - 3. Geotextile filter fabrics.
 - 4. Joint solvents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified or approved equal.

2.2 PIPING MATERIALS

- A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, fitting, and joining materials.

2.3 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PVC Schedule 40 Pipe and Fittings:
 - 1. 4" perforated pipe meeting ASTM D 1785 with 2 rows of holes, 120 degrees apart. Holes are ½" in diameter spaced 5" on center.
 - 2. Couplings: Manufacturer's standard, solvent weld.
- B. Perforated single wall HDPE Pipe and Fittings:
 - 1. 6" perforated pipe meeting ASTM F 405 with 3 rows of slots at 120 degrees apart. Slots are 0.875 inches in length and 0.120 inches in width with a minimum inlet area of 1 square inch/foot.
 - 2. Couplings: Manufacturer's standard external snap coupler meeting ASTM F 405 or ASTM F 667.

2.4 SOLID-WALL PIPES AND FITTINGS

- A. Solid PVC Schedule 40 Pipe and Fittings:
 - 1. 4" and 6" solid wall pipe meeting ASTM D 1784.
 - 2. Couplings: Manufacturer's standard, solvent weld meeting ASTM D 2665.
- B. Solid-wall HDPE Pipe and Fittings:
 - 1. 6" solid wall pipe meeting ASTM F 405.
 - 2. Couplings: Manufacturer's standard external snap coupler meeting ASTM F 405 or ASTM F 667.

2.5 SOLVENTS

- A. Solvents shall include a two-step process with primer conforming to ASTM F 656 and solvent cement conforming to ASTM D 2564.

2.6 CLEANOUTS

- A. Cast-Iron Cleanouts: ASME A112.36.2M; with round-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.
- B. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

2.7 DRAINAGE CONDUITS

- A. Single-Pipe Drainage Conduits: Perforated PVC Schedule 40 complying with ASTM D 1785 or HDPE complying with ASTM F 405 and wrapped in geotextile filter fabric.
 - 1. Available Manufacturers:
 - a. Charlotte Pipe
 - b. JM Eagle
 - c. GF Harvel
 - d. Advanced Drainage Systems
 - 2. Size: Nominal size 4 - 6 inches.
 - 3. Filter Fabric: Nonwoven, PP geotextile.
 - 4. Fittings: PVC Schedule 40 and HDPE snap type.
 - 5. Couplings: PVC Schedule 40 and corrugated HDPE snap type.
 - 6. Filter Fabric: Specified in Part 2 "Geotextile Filter Fabrics" Article.

2.8 SOIL MATERIALS

- A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section 31 20 11 "Earth Moving."

2.9 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.
 - 1. Structure Type: Nonwoven, needle-punched continuous filament.
 - 2. Style(s): Flat and 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 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section 31 20 11 "Earth Moving."

3.3 PIPING APPLICATIONS

- A. Gravel Trench Subdrainage Piping:
 - 1. Perforated PVC Schedule 40 pipe and fittings, couplings, and coupled joints within the stone bed.
 - 2. Solid wall PVC Schedule 40 pipe and fittings, couplings and coupled joints outside of stone bed.

- B. Dry Well Overflow Subdrainage Piping:
 - 1. Perforated HDPE pipe and fittings, couplings, and coupled joints within the stone bed.
 - 2. Solid wall HDPE pipe and fittings, couplings and coupled joints outside of stone bed.

3.4 CLEANOUT APPLICATIONS

- A. In Gravel Trench Subdrainage Piping:
 - 1. Below Grade in stone trench: PVC cleanouts.

- B. In Drywell Observation Ports:
 - 1. At Grade in lawn areas: PVC cleanouts with cast iron frame and cover.

3.5 GRAVEL TRENCH 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.

- 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.

- D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

- E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for subdrainage.

- F. Add drainage course to width of 12 inches on side away from wall and to top of pipe to perform tests.

- G. After satisfactory testing, cover drainage piping with drainage course to width of 12 inches on side away from columbarium wall and above top of pipe to 3 inches below finish grade.

- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

- I. Top-dress over flat-style geotextile filter fabric with 3 inches of drainage course to finish grade.

3.6 DRY WELL OVERFLOW DRAINAGE INSTALLATION

- A. Excavate subgrade material to bottom of trench elevation.
- B. Place course aggregate stone with flat-style non-woven geotextile fabric extending up the sides of the trench. Bottom to remain open for infiltration enhancement.
- C. Install drainage piping as indicated in Part 3 "Piping Installation" Article for dry well overflow drainage. Place perforations facing down and center pipe between trench walls.
- D. Add drainage course to top of pipe to perform tests.
- E. After satisfactory testing, cover drainage piping with drainage course to elevation as shown and wrap top of drainage course with flat-style non-woven geotextile filter fabric.
- F. Place topsoil to finished grade.

3.7 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. Gravel Trench Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 4 inches, unless otherwise indicated.
 - 2. Dry Well Overdrain Subdrainage: Install piping with invert as shown on the plans.
 - 3. Lay perforated pipe with perforations down.
 - 4. Excavate recesses in trench bottom for bell ends of pipe and/or fittings. 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 PVC piping according to ASTM D 2321 and ASTM F 1668.
- D. Install HDPE piping in accordance with ASTM D 2321 and manufacturer's recommendations.

3.8 PIPE JOINT CONSTRUCTION

- A. Join solid wall PVC pipe and fittings according to ASTM F 656 and ASTM D 2564 with a two-step primer and solvent application.
- B. Join perforated PVC pipe and fittings according to ASTM F 656 and ASTM D 2564 with a two-step primer and solvent application.
- C. Join HDPE pipe and fittings according to ASTM F 405 or ASTM F 667 using external snap couplers.
- 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.

3.9 CLEANOUT INSTALLATION

- A. Cleanouts for Subdrainage and Observation Ports:
 - 1. Install cleanouts from piping to grade. Locate cleanouts as shown. Install fittings so cleanouts open in direction of flow in piping.
 - 2. In nonvehicular-traffic areas, use NPS 4 PVC 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 in depth. Set top of cast iron cover flush with grade.

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.11 FIELD QUALITY CONTROL

- A. 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.

3.12 CLEANING

- A. 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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