

SECTION 11 11 26
VEHICLE WASHING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Vehicle wash unit is automated and manually operated wash-water recycling system.
- B. Vehicle Wash Specification based on providing and installing the following equipment:
 - 1. Recycle System consisting of Pre-Treatment tank with hydro screen, and Main Bio-Digestion Unit with automated controls.
 - 2. Fiberglass pit with grated cover and sump pump.
 - 3. Stationary electric powered cold water pressure washer.
 - 4. 1890 liters (500 gallon) polyethylene storage tank for finished water storage.
- C. All electrical components and wiring shall conform to NEMA 4 requirements, except as specifically noted.

1.2 RELATED WORK

- A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Section 22 15 00, GENERAL SERVICE COMPRESSED AIR SYSTEMS.
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Vehicle wash-water recycling system.
 - 2. Fiberglass pit with grated cover and sump pump.
 - 3. Stationary electric powered cold water pressure washer.
 - 4. Water storage tank.
- C. Detailed shop drawings showing all components, plumbing and electrical connections.
- D. Complete set of operating and maintenance manuals, including installation drawings.

1.4 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 Society for Testing and Materials (ASTM):
 - D1785-06.....Poly Vinyl Chloride (PVC) Plastic Pipe
 - D2467-06.....Poly Vinyl Chloride (PVC) Plastic Pipe Fittings

D2564-04e1.....Solvent Cements for Poly Vinyl Chloride (PVC)
Plastic Piping Systems
B88-03.....Standard Specification for Seamless Copper
Water Tube

1.5 REQUIREMENTS

A. Available at the site are the following services:

1. Electrical power: 208
2. Compressed Air: 3 SCFM, 550 - 690 kilopascals (80-100 PSI)
3. Domestic Water: 23 - 30 liters/min (6-8 GPM), 310 kilopascals (45 PSI) minimum.

PART 2 - PRODUCTS

2.1 PIPING

- A. Domestic Water piping shall be ASTM D1785-06, schedule 80 PVC.
- B. Compressed Air piping shall be ASTM B88-03, copper type 'K' with wrought copper fitting. Provide drip legs at low points of compressed air lines with bleed valves.

2.2 COLD WATER PRESSURE WASHERS

- A. Stationary, electric-powered cold water pressure washer on wall mount bracket assembly with 1.5 KW (2 horsepower) pump rated for 10.5 liters/min at 6900 kilopascals (2.8 gpm at 1000 psi), stainless steel cabinet, belt-driven pump and stainless steel variable pressure wand. Electrical requirements: 120 volts, single phase, 20 amps.

2.3 WASH WATER RECYCLING SYSTEM

- A. The wash water recycling system consists of Modular components that include a recycle and discharge system and an auxiliary unit. The wash water recycling system shall be automated and feature efficient aerobic microbial digesting, enhanced water circulation, injection of cultured microbes at concentrated levels and the introduction of microbial nutrients blend. Naturally converts organic contaminants, such as oil and grease in a waste stream into harmless water and carbon dioxide. The tank capacity is 2270 liters (600 gallons) and is constructed of high density, cross linked, polyethylene and equipped with water resistant electronics control panel and 194 sq. meters (2,087 sq. ft.) of biomedia. The recycle system contains a 0.56 kilowatts (3/4 horsepower) in-feed/circulation pump, 1.5 kilowatts (2 horsepower) transfer pump and 0.56 kilowatts (3/4 horsepower) ozone pump that requires 230 volts, 3 phase, 20 amps.

2.4 CATCH BASIN

- A. Pre-fabricated, reinforced fiberglass catch basin with sump pump for in ground installation with cover. The catch basin shall have a holding capacity of 600 liters (159 gallons) and measure (118 cm long x 118 cm wide x 147 cm high) 46.5" long x 46.5" wide x 58" high. Sump pump shall be 1/3 kilowatts (1/2 horsepower), 120 volts, single phase. Sump pump shall be installed in catch basin to transfer wash water to wash water recycling or treatment system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All above ground wash water piping required and connections to recycling equipment to be performed by equipment supplier.
- B. Compressed Air piping from valved stub-up service to Bio-digestion unit with automated controls shall be by equipment supplier.
- C. System Operation and set-up shall be function as outlined: Water will flow from the wall mounted pressure washers onto the wash pad. From there the water and solids will flow into the trench drain where solids remain to be cleaned out as they accumulate. The water then flows by gravity through a 7.5 cm (3") PVC drain line that connects to the trench drain to the catch basin with the sump pit. A sump pump installed in the catch basin pumps the water up through a large stainless steel hydro screen. The screen allows the grass clippings to fall into the grass cart that has a stainless steel bottom mesh screen to let the excess water flow out and traps the grass inside. The water that is pumped from the catch basin to the grass screen will flow through the screen into the cone bottomed tank where larger solids will settle out. From there the water will flow into the Main Bio-Digestion Unit where the water will be aerated in the cone bottomed tank using an air stick system and microbes and nutrients will be injected. The tanks are aerated to help the growth of microbes that breakdown the hydrocarbons in the waste stream into a harmless substance consisting mainly of carbon dioxide and water. Water is sent from the Main Bio-Digestion Unit to the finished water tank for storage and will be treated with an ultraviolet ozone generator. When the pressure washers call for water the transfer pump will draw water from the storage tank and pump it to the units for re-use.

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**SECTION 11 41 00
FOOD STORAGE EQUIPMENT**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies self-contained refrigeration equipment as follows:
 - 1. Automatic ice making and dispensing stations.
 - 2. Refrigerators

1.2 RELATED WORK

- A. Plumbing Connections: Section 22 11 00, FACILITY WATER DISTRIBUTION.
- B. Electrical Connections: Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 QUALITY CONTROL

- A. NSF Compliance: Equipment bears NSF Certification Mark or UL Classification Mark:
 - 1. Refrigerators and Freezers: Evaluated according to NSF/ANSI 7.
 - 2. Ice Makers: Evaluated according to NSF/ANSI 12.
- B. UL Listing: Equipment is listed and labeled by UL:
 - 1. Refrigerators and Freezers: Evaluated according to UL 471.
 - 2. Ice Makers: Evaluated according to UL 563.
- C. In-Use Service: At least one factory-authorized service agency for equipment shall be located in the geographical area of the installation and shall have the ability to provide service within 24 hours after receiving a service call.

1.4 WARRANTY

Warrant food service equipment to be free from defects in materials and workmanship in accordance with requirements of "Warranty of Construction", FAR clause 52.246-21, except warranty period for refrigeration compressors shall be five years.

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. NSF International/American National Standards Institute (NSF/ANSI):
 - 7-09.....Commercial Refrigerators and Freezers
 - 12-09.....Automatic Ice Making Equipment

- C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Publication 1767 Kitchen Ventilation Systems & Food Service Equipment Fabrication and Installation Guidelines, 2001.
- D. Underwriters Laboratories Inc. (UL):
 - 471-10.....Commercial Refrigerators and Freezers, 8th Edition: Revised 2004
 - 563-09.....Ice Makers, 7th Edition: Revised 2006

PART 2 - PRODUCTS

2.1 AUTOMATIC ICE MAKING AND DISPENSING STATIONS

- A. General Requirements: Automatic ice makers and dispensers as follows:
 - 1. Stainless-steel exterior, front and sides.
 - 2. Air-cooled compressor.
 - 3. Insulated storage bin with agitator.
 - 4. Cube-type ice.
 - 5. Dispensing area located between 813 and 1016 mm (32 and 40 inches) above the floor.
 - 6. Ice dispenser.
 - 7. Accessories:
 - a. Stainless-steel stand with 152 mm (6 inch) stainless-steel legs.
 - b. Water filter with 0.1-L/s (1.67-gpm) maximum flow rate.
 - 8. Provide Energy Star qualified appliances.
 - 9. Coordinate storage size with Owner's requirements

2.2 REFRIGERATORS AND FREEZERS, ROLL-IN AND ROLL-THROUGH

- A. General Requirements (Residential quality):
 - 1. Exterior Finish: Stainless steel, door, sides, and top.
 - 2. Doors: Full height with locks.
 - 3. Accessories:
 - a. Cord and plug.
 - b. water line for ice maker.
 - 4. Provide Energy Star qualified appliances.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install self-contained refrigeration equipment level and plumb; arranged for safe and convenient operation; with access clearances required for maintenance and cleaning; and according to manufacturer's written instructions.

3.2 CLEAN-UP

- A. At completion of the installation, clean and adjust self-contained refrigeration equipment as required to produce ready-for-use condition.
- B. Where stainless-steel surfaces are damaged during installation procedures, repair finishes to match adjoining undamaged surfaces.

3.3 INSTRUCTIONS

Instruct personnel and transmit operating instructions in accordance with requirements in.

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SECTION 11 83 00
GLOBAL POSITIONING SYSTEM (GPS)

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish all labor, materials, manpower, tools and equipment required to furnish and install and make fully operational a Global Positioning System (GPS) Reference System, comprised of the following equipment and facilities:
 - 1. GPS CORS Type Base Station and appurtenances (to be referred to as "Base Station")
 - 2. Professional geodetic survey grade GPS handheld receiver systems (to be referred to as "Rover Units"). Provide (2) Rover Units.
- B. The Base Station is to be a Continuously Operating Reference System (CORS) comprised of the following specific hardware and software components: global positioning system reference antenna, global positioning system (GPS) receivers, UHF radio transmitter, transmitting antenna, voltage converter, cables and conduits necessary to link the system equipment. The Base Station will not be registered with the NGS as a fully approved CORS facility.
- C. The GPS Base Station shall be installed as indicated on drawings and will provide the 1 centimeter accuracy for point locations within the developed portions of the Cemetery as it will exist at the end of this construction project. The Contractor shall provide all required labor, materials, manpower, tools and equipment necessary to furnish, install, test and certify a fully operational GPS Base Station.
- D. The new GPS Base Station and Rover Units shall be an operating geodetic grade survey reference base station, capable of broadcasting corrections through UHF radio signals at 5 and 35 watt power.
- E. The system shall be capable of Global Positioning System (GPS), Modernized GPS, and GLONASS geodetic, real time surveying capabilities. The system shall be capable of code and phase measurements, and must have internal data storage capabilities. The system shall be capable of internal raw data logging, raw data streaming, and advanced input and output ports.
- F. The operational GPS antenna installed as part of the CORS base station shall be capable of providing GPS coordinates on collected data, according to National Geodetic Standards, as provided by the National Geodetic Survey (www.ngs.noaa.gov). All field data collected by the

Handheld GPS Receiver, shall meet 1 centimeter accuracy according to the Federal Geographic Data Committee, Draft Geospatial Positioning Accuracy Standards, Part 2, Standards for Geodetic Networks.

- G. The Contractor shall provide training for the cemetery staff on the use and maintenance of all equipment, components and software. This training shall be video recorded and made into a DVD for future use by the VA, and the Contractor shall provide O&M Manuals for all equipment. The O&M Manuals shall include specific procedures for operation of equipment provided under this contract and shall include photographs of equipment provided for this project.

1.2 RELATED WORK

- A. See Section: 32 12 16 Asphalt Paving
- B. See Section: 03 30 00 Cast-in-Place Concrete
- C. See Section: 32 05 23 Cement and Concrete Work for Exterior Improvements
- D. See Section: 26 05 33 Raceway and Electrical Boxes
- E. See Section: 31 20 00 Earth Moving
- F. See Section: 11 83 01 Geographic Information System (GIS)
- G. See Section: 11 83 02 GPS & GIS Mapping and GeoData

1.3 REFERENCES

- A. The entire installation shall comply with all local and state laws and ordinances, and with all established codes applicable thereto.
- B. In all cases where the specifications require that the work be performed under the direction and/or inspection of the Resident Engineer, notify the Resident Engineer at least 24 hours in advance of the time when such inspection and/or direction is required. Any alterations to the system needed because of the Contractor's failure to have the required inspections shall be performed at the Contractor's expense.
- C. National Geodetic Survey --www.ngs.noaa.gov
- D. Federal Geographic Data Committee, Draft Geospatial Positioning Accuracy Standards, Part 2, Standards for Geodetic Networks - FGDC-STD-007.2-1998.

1.4 SUBMITTALS

- A. Provide manufacturer's literature and data of system components for review by Resident Engineer and A/E.
- B. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES. Complete shop and installation drawings of all GPS system

components, showing dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorages, attachments, location of all conduit and other items to be installed in the work of other trades, joint treatment, and other work required for a complete installation.

- C. Provide product information, O & M manuals and any additional paperwork associated with each system component, individually tabbed for ease in location, and the entire system in triplicate in separate three-ring binders for Government records. Provide a photo documented record of the installation, with each pieces of equipment identified and referenced to the applicable tabbed location in the three-ring binders.
- D. Include in the O & M manual a troubleshooting list of items to check in the event of system failure. The equipment in the troubleshooting list shall also be photo documented with the actual equipment installed for this project. Provide the owner with a step by step guide of operational checks to try and fix problems, prior to calling technical support.

1.5 QUALITY CONTROL

- A. Have a competent superintendent satisfactory to the Resident Engineer, with authority to act in all matters pertaining to the installation, present on the project site during all installation activities.
- B. Coordinate all work with other site contractors and the Resident Engineer.
- C. The base station installation, including the calibration, startup, testing, and all activities needed to make the station fully functional and operational with the rover units, as well as transferring information to and from the GIS system shall be coordinated with the GPS equipment supplier as well as the GIS contractor for this project. The Contractor shall insure that appropriate quality control is provided throughout the construction process, up to the turn-over of the fully functional GPS system for this project, as required to insure that the end result meets the performance specifications for the GPS system being provided.

1.6 SITE CONDITIONS

- A. Submission of an executed proposal shall be considered evidence that the site, plans and specifications as issued, and/or legally modified, have been examined and accepted.

- B. Report to the Resident Engineer any deviations between contract documents and actual conditions. Failure to do so prior to the installation of equipment and which results in the replacement and/or relocation of equipment shall be at the Contractor's expense.
- C. The exact location of all existing utilities, structures and underground utilities are not indicated on the drawings; their locations shall be field verified by the Contractor prior to starting work, and installation of work shall proceed so as to prevent interruption of service or damage to them. Protect existing structures and utility services, and replace at no cost to the Government if damaged. Where conflicts occur, notify the Resident Engineer of any relocation required to complete the work of this contract.

1.7 GUARANTEE

- A. The furnished and installed operational GPS system shall be capable of providing Real Time Kinematic (RTK) corrections for roving GPS handheld receivers on the cemetery site.
- B. Contractor shall demonstrate complete site coverage at 35 watt UHF radio operation for Real Time Kinematic (RTK) system operation prior to VA acceptance of installation. The GPS components shall be guaranteed as operational in every detail, except for power interruption, for a period of five (5) years from the date of its acceptance. Provide any required labor, manpower, tools, materials and equipment required to repair and/or replace any contractor provided elements of the functional GPS system within that five year period with no cost to the owner.

1.8 ACCEPTANCE

- A. Installation of the CORS Base Station facilities and the Rover Units will be accepted only when the completed system has been demonstrated to function as specified herein. The acceptance of the above systems shall require the demonstration that data collection using the Rover(s) as described in the contract documents can be achieved, and that the data is easily downloaded to the GIS computer as specified in Section 11 83 01 Geographic Information System (GIS). Prior to requesting final inspection of equipment, contact the Resident Engineer to review installation of hardware, software, cable and conduit runs, demonstrate the functionality of the equipment, and schedule staff training. Staff training shall only be initiated after final acceptance of the training program materials submitted to the RE and A/E for review and approval.

The training program shall not be considered complete until after the O&M Manual has been submitted and approved in its final form.

- C. The training for the use of the GPS equipment shall be performed when the equipment can be utilized with the GIS system, so the staff can use both systems as they will be during the operation of the Cemetery after the construction project is completed.

PART 2 - MATERIALS

2.1 REFERENCE RECEIVER FOR GPS BASE STATION

- A. General - Hardware and Software shall be from a single manufacturer. Basis of design is the Trimble NetR9 Ti-1 Reference Station w/Zephyr Antenna or approved equal.
1. GNSS Receiver shall process multi-bit analog-to-digital conversion and Surface Acoustic Wave (SAW) filter at both RF and IF frequencies to provide anti-spoofing performance.
 2. The GNSS Receiver shall after the loss of satellite, provide re-acquisition of both L1 and L2 signals within 15 seconds.
 3. The size of the receiver shall not exceed 19.0 cm (7.5 inches) wide by 11.2 cm (4.4 inches) deep, including connectors.
 4. The Receiver shall not exceed 2.95 lbs to include internal radio modem, internal battery, and UHF antenna.
 5. Shall pass military specifications described by MIL-STD-810F Fig.514.5C-1 for vibration.
 6. Electronics shall be 100% fully sealed from sand, dust, and moisture.
 7. Must withstand a 2 m (6.6 ft) non-operating pole drop onto concrete and operate to 40 G, 10 msec, saw tooth.
 8. Shall be able to operate to measurement specification in temperatures between -40 degrees F to +149 degrees F.
 9. Shall be not less than 100% condensing humidity proof.
 10. Shall be able to be submerged to a depth of 3.28ft without water affecting the equipment.
 11. Shall be waterproof tested to IP67 protection classifications according to DIN 40 050 / IEC 529; definition of indexes.
 12. Shall be dust-proof tested to IP67 protection classification.
 13. Shall be able to be transported or stored in the following temperature range without sustaining damage to the equipment; -40 degrees F to +167 degrees F.

14. Connectors shall fully-seal the receiver or when a like-connector is attached.
 15. Shall have nominal power consumption of <3.2 W at 7.4 V while powering the dual-frequency RTK, GNSS antenna, and the internal radio modem.
 16. Power requirements shall be in the range of 11 V DC -28V DC external power input with over-voltage protection on Port 1 (7-pin Lemo).
 17. The GNSS Receiver signal tracking shall support
 - a. GPS: L1, L2, L5, GLONASS L1/L2, Galileo GIOVE-A and GIOVE-B
 - b. GPS: L1C/A, L2C, L2E, L5
 - c. GLONASS: L1C/A, L5
 - d. SBAS: L1C/A, L5
 - e. Galileo GIOVE-A and GIOVE-B (simultaneous L1 CBOC, E5A, E5B and E5 AltBOC)
 18. When Anti-Spoofing (A/S) (P-code) is activated, the GNSS Receiver shall measure L1 C/A pseudo ranges, L2 and L5 range measurements, and the full cycle L1, L2 and L5 carrier phases
 19. Shall include a Progeny RF ASIC and 6th Generation Maxwell Digital ASIC to produce the highest precision measurements in all noise/operational environments
 20. The GNSS receiver shall contain a high-precision multiple correlator for L1, L2 and L5 pseudo-range measurements
 21. Performance of receiver shall not be lower during times when anti-spoofing is activated, compared to during times when anti-spoofing is not activated
 22. The GNSS receiver shall employ multipath mitigation techniques
 23. The GNSS Receiver must be able to track L1 and L2, L2C, L5 and GLONASS L1/L2 on 26 satellites simultaneously.
 24. GNSS Receiver shall have a total of 220 channels
 25. The 7.4 V, 2.4 Ah Lithium-ion battery must be rechargeable and removable from receiver
 26. Receiver battery compartment shall be fully sealed
 27. All damaged or rejected materials due to defect or non-conformance shall be removed from the site.
- B. Concrete Pier Foundation and Support Hardware
1. Reinforced concrete pier foundation shall be installed per drawings at the location specified on contract drawings, sheet L-606 and E-106; and as detailed on Sheet E-701.

2. All necessary hardware, conduits, junction boxes and fittings required for a complete and functional system in accordance with manufacturer's recommendations shall be provided.
3. Earl Conic eight (8) foot reinforced aluminum mast, with a four place reinforced gusset system along the lower four (4) feet of the mast. All hardware for fastening the mast to the foundation shall be included and be specified according to manufacturer.

C. Global Positioning System Antenna

Basis of design is the Trimble Zephyr Geodetic 2 GNSS Antenna or approved equal.

1. GPS antenna shall be of the same manufacturer as the GPS receiver, capable of receiving: GPS - L1, L2, L5; GLONASS - L1, L2, L3; Galileo - E1, E2, E5, E6; SBAS - WAAS, EGNOS, QZSS, Gagan, MSAS, and Omnistar GNSS satellite signals.
2. Quality signal tracking, even below 3 degrees elevation.
3. Four point antenna feed for phase center stability and enhanced polarization.
4. TNC Female Signal connector.
5. Small cross-sectional area to reduce wind loading.
6. 13 dB amplifier margin supports cable runs of over 60 m without special coaxial cable on in-line amplifiers.
7. North orientation marking on exterior.
8. 50 dB signal gain for reliable tracking in difficult environments.
9. Low voltage, low power consumption.
10. Integral low noise amplifier.
11. 5/8" x 11 female threaded stainless steel mount point.
12. Powered by GNSS receiver via coaxial cable.
13. Advanced LNA (low noise amplifier) to reduce jamming by high power out-of-band transmitters.
14. Stealth Ground Plane - integrated lightweight stealth technology with enhanced right hand circular polarization to reduce multipath interference.
15. Supplementary radome is required.
16. 100% humidity proof, fully sealed.
17. Meets MIL-STD-810-F to survive a 2m drop onto concrete.
18. Meets MIL-STD-810-F on each axis.
19. Input Voltage - 3.4V DC to 20V DC.
20. Input Current - 125 mA maximum.

21. Operating temperature (-40 to +158 degrees F)

D. Handheld GPS Receivers (two required)

Basis of design is the Trimble PROD R8/5800 Rover Kit; Base - Base & Rover Transport Case (5800 and R8); Ant Portable 6" Whip 425-475MHZ or approved equal.

1. The rovers shall receive correction signals from the on-site GPS Base Station, providing real time positional accuracies within the manufacturer's published horizontal and vertical positioning accuracy on all parts of the property. This receiver shall communicate with the GPS satellites and the GPS base station for this project. This receiver assembly shall include a built in antenna, digital camera, transmit/receive UHF radio.

2. The GNSS antenna for the rover shall be able to receive the following frequencies: L1, L2, L5, GLONASS L1\L2, Galileo GIOVE-A and GIOVE-B (simultaneous L1 CBOC, E5A, E5B, and E5 AltBOC). The receiver shall be of the same manufacturer as the receiver used in the CORS Reference Station with full connectivity to the CORS system.

3. The horizontal accuracy classification shall be a one (1) centimeter horizontal accuracy at the 95-percent confidence level.

4. The system shall include a ruggedized carry case that both protects the GPS receiver and provides storage while in the field. The case should include a carry strap that can be affixed to a belt for transportation flexibility.

5. Rovers shall be loaded with the latest version of ESRI ArcGIS Mobile

E. GPS Utility Software

Basis of design is the Trimble TSC3 Controller with Access base software and QWERTY keyboard, perpetual license including a 12-month standard warranty for software and hardware.

F. Accessory Kit with SECO Carbon Fiber Snap-Lock Rover Pole

G. Thumb Release Bipod

H. Heavy Duty GPS Tripod

2.2 SYSTEM CONTROL BOX

A. General

1. The GPS base station system control equipment shall be installed in a weatherproof box in accordance with contract drawings. The control box shall be mounted in the selected location, shall have a painted 1" thick panel board mounted inside of the control box for mounting the equipment. Inside of the control box shall be a

standard surface mounted 110VAC electrical outlet, wired per electrical code on a separate electrical circuit. The size of the control box shall be NO larger than 3 feet wide by 3 feet high, by 1 foot deep. It shall include a locking door.

2. The control box shall provide a secure location for equipment placement and ventilation for continuous system operation.
3. All connections to hardware shall be made in accordance to component manufacturer specifications, including length of cable, type of cable and connection types. No modifications to cables, connections or installation shall be made that would void component manufacturer warranties.
4. Technical instructions on troubleshooting the system and restarting after power failure, shall be created and installed by the Contractor on the inside door of system control box.

2.3 CABLE AND CONDUIT CONNECTIONS

- A. Design basis for cable shall be the Times Microwave LMR 600 Flooded DB (direct bury) coaxial cable, or approved equivalent.
- B. Furnish and install antenna signal amplifier as indicated on drawings. Basis of design is Model LA20RPDC by GPS Networking Inc.(Denver CO).
- C. See Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS, for conduit specifications.
- D. Provide grounding and lightning protection as shown on contract drawings.

2.4 REFERENCE MONUMENTS

- A. General
 1. Five (5) Concrete monuments shall be installed being a minimum 4 inches in diameter, with a 1/2 inch minimum metallic rod centered within the concrete, running the length of the monument. The monuments shall be a minimum 3 feet in length.
 2. Monument locations shall be in accordance with contract drawings.

2.5 INTEGRATION WITH THE GEOGRAPHIC INFORMATION SYSTEM (GIS) EQUIPMENT

- A. The Rover Units shall have software installed and configured to facilitate the collection of data, collection of digital photographs, transfer of information into the GIS data and display, and transfer information from the GIS equipment to the Rover Units to be used to locate an element from the GIS display or data, for physical location, or for continuing the data accumulation of the existing facilities.

PART 3 - EXECUTION

3.1 SITE CALIBRATION AND QUALITY CONTROL

- A. GPS static observations shall be made on all five (5) reference monuments, with a minimum of two (2) hours of static data being collected on each monument, with a geodetic grade GPS receiver.
- B. GPS static observations shall be collected on the GPS CORS Reference Station simultaneous to all reference monuments being observed, to ensure simultaneous data is collected on both the reference station and all reference monuments for final evaluation and approval of adjusted coordinates.
- C. All GPS static observations shall be submitted to the National Geodetic Survey (NGS) Online Positioning User Service (OPUS) for calculation of state plane coordinates, using the State Plane Coordinate System.
- D. Adjusted coordinate values as obtained from the NGS OPUS adjustment shall be used as record coordinates for the CORS Reference Station and on any future data collection of stakeout of site facilities.
- E. The contractor shall install the record coordinates in the CORS Reference Station firmware, and initiate broadcast signals. All reference monuments shall be navigated to using the record coordinates obtained from OPUS. The residual error shall be noted by the contractor and certified to be within tolerances set forth in specification documents.
- F. A/E shall provide CAD files to contractor at NTP for use in building the GIS maps. The contractor shall populate the maps with geodata per Geospatial standards as work progresses. The early turn over area must be completed when the area is transferred to the cemetery so the cemetery may start tracking interments and populating the GIS database.

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SECTION 11 83 01
GEOGRAPHIC INFORMATION SYSTEM (GIS)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide all labor, materials, manpower, tools and equipment required to furnish, install, activate and test a new Geographic Information System (GIS). The GIS software shall be provided on a Contractor furnished and installed PC workstation located as shown on contract drawings. The Contractor shall engage a qualified GIS Consultant to provide, install and configure the system in accordance with GIS standards and functionality as outlined below. This GIS system shall interface with GPS equipment specified under Section 11 83 00 and enable real-time, two-way transfer of information between the GPS-GIS interface.
- B. The GIS software shall be latest version of ESRI ArcGIS for desktop Standard software furnished and installed on the contractor-provided, fully functional computer workstation.
- C. The contractor-provided PC workstation shall meet the following specifications:
- D. The Contractor shall select a GIS Consultant and provide resume and credentials for validation and acceptance by the VA. The GIS consultant shall demonstrate proficiency with successful performance of similar past projects. The contractor shall configure the required software to deliver the requested mapping capabilities in accordance with VA GIS standards. The contractor shall work closely with associated subcontractors, including the surveyor performing the GIS data collection for the work being constructed as part of this project, and the GPS equipment vendor and/or manufacturer. The collaboration among the Contractor team shall result in the fully functional GPS/GIS system that work together to seamlessly transition information back and forth between the Rover units and the Desktop GIS equipment and automatically modify or update the graphical and/or data for the included GIS elements. The software shall be configured to accommodate future expansion of the Cemetery facilities and corresponding additional GPS/GIS data.

1.2 PERFORMANCE OF THE GIS SOFTWARE

- A. The GIS application provided and configured by the contractor shall directly utilize the GIS database that is to be collected in the field utilizing the GPS devices provided as part of Section 11 83 00.

The software installed and made operational with the furnished GPS devices for this project shall be synchronized to the GIS geodatabase hardware and data collection software for this project, according to the data import/export procedures established for this project. The data collection and organization for this project is described below. The contractor shall allow for attribute auditing of geodatabase features.

B. Detailed Description of Functionality -

1. Navigation

- a. The provided GIS application will contain basic map navigation tools (Pan, Zoom In/Zoom Out, Zoom Previous/Zoom Next, Zoom Full Extent).
- b. To allow users to zoom to points of interest, as well as zoom to an XY location entered by the user, the contractor shall develop the necessary components to allow the above described functionality.

2. Search

- a. The configuration shall include a component that will allow the users to search for and report on any features in the cemetery's geodatabase. The Search function shall display a list of available searches associated with map layers. The software shall allow the user to select which map layer to search, and the application shall then displays query fields specific to that map layer. Configure the software so that using test boxes, check boxes, drop-down lists, or calendars, the user can enter as much information as they wish to include in the search. The software shall allow any vector-based map layer to have a search configured in the application.
- b. The configuration shall allow the following:
 - 1) Allow the drop-down lists within the search dialogs to utilize subtype and domain information from the geodatabase where they have been defined.
 - 2) Use Checkboxes to represent binary field types.
 - 3) Create search fields, defined using a calendar tool, to represent date information as part of the functioning software.
 - 4) Represent all other field types by a text box.

- 5) Utilize only the search fields where the user has specified information as part of the attribute search.
 - c. The software shall allow the end user to define which map layers and which fields within those layers will be displayed in the search dialog. The software shall be configured so that the search configuration settings will be managed using an XML file.
3. Select
- a. The configuration shall include necessary components that will:
 - 1) Allow the users to select features on the map.
 - 2) Give the users the ability to select features through a variety of methods including points, rectangle, polygon, polylines, or circle. The users will not be required to choose an active layer for the selection; any visible features that are set up to be selectable will be available for selection using the Select tool on the map.
 - 3) The user shall have the option to choose a single, visible target layer to select from, as part of the management of the search results.
 - 4) When the map selection tool is activated, the user will be presented with a drop down list of visible/selectable layers. By default this list shall be set to "All Visible Layers".
4. Search/Selection Results Data Grid
- a. The configuration shall include necessary components that will:
 - 1) For each record displayed in the data grid, make a Zoom To button available to zoom and center the map display on the feature associated with the grid data.
 - 2) For data associated with photos or other external documents, the developed application shall be set up so the application can be configured to provide a Photo Button or Document Button which displays the image or other document when clicked.
5. Identify/Map Tips
- a. The configuration shall include necessary components that will:
 - 1) Beyond querying or selecting features, the users shall be able to quickly identify features on the map using an identity tool or by hovering the mouse over a feature and getting a map tip. In both cases, the information (features and fields) that can be displayed using the Identify tool or retrieved by a map tip will be configurable.

- 2) The Identify Tool shall work just as the Select Tool does, in that any features that are identifiable and visible will be returned in the identify dialog when the user clicks the map display. For the map tips, if the feature has map tips enabled, a map tip will be displayed when the user hovers the mouse over it. If the features are stacked above one and another, the map tip shall display information for the feature on top.

C. Tools

1. Measure

- a. The configuration shall include necessary components that will:

- 1) Create a Measure Tool that will allow users to measure both linear distance and area. By default, the Measure Tool shall use feet (linear) or square feet (area), but the users shall be able to change the map units being displayed for results. The Measure line tool shall allow users to click two points to define a straight line or multiple points to define an irregular line. As the user moves the mouse, the Measure Tool shall dynamically display the length of the current segment as well as the total distance of the current line. Similarly, the Measure Tool shall allow the users to draw an irregular polygon on screen by picking points that approximately define the area in question, the more accurate the point selection the more accurate the resulting area calculation as the polygon is created on the screen with the Measure Tool. The Measure Tool shall provide the users with a means of quickly obtaining area or distance measurements on the screen.
- 2) The user, when finished with a measurement, shall have the option to add the measurement to the map display as a text element. This measurement shall persist so that the user can then print the map displaying the measurement for use in the field. The application shall allow multiple measurements to be displayed in this manner and then printing the map with the images displayed to take into the field. An example of the use for this feature, is to measure two distances from above ground features shown on the map (approximately perpendicular to each other) to a below ground entity, and printing those measurements to be taken into the field as swing tie

measurements for locating the below ground entity when the GPS location equipment is not available.

2. Draw

a. The configuration shall include necessary components that will:

1) Provide tools for drawing and marking up the map display.

Users shall have the tools to allow them to draw points, lines, polygons, freehand sketches, or text, and shall be able to control the color, style, and size of the drawn elements. The Draw Tool shall allow the users to delete single elements, or clear all drawing elements. The application shall allow elements to persist on the map display until cleared by the user, and shall be printed along with the map display.

3. Bookmarks

a. The configuration shall include necessary components that will:

1) Allow the users to save map extents as bookmarks in order to quickly return to the location in the future.

4. Layer List

a. The configuration shall include necessary components that will:

1) Provide a Layer List which allows the users to toggle the visibility of the map layers on and off, to create the desired map display.

2) In order for the map layers to be defined, the map display shall be authored using ESRI ArcGIS. The use of this software is to maintain consistency with existing conditions, and will allow for the straightforward inclusion of any custom symbols or rendering of map elements that the IGNC staff or representatives have defined. As part of this feature, the users of the application shall not be able to change the symbology (appearance) of the features on the map.

5. Print or Save Map Image

a. The configuration shall include necessary components that will:

1) Allow users to print maps to PDF, or save map images to the local machine. The CGC shall work with the IGNC designated staff member or other designated representative(s) to develop templates for print layouts that the user will be able to select from when printing.

6. Help

a. The configuration shall include necessary components that will:

- 1) Provide a fully functional Help feature that will include help pages describing all functionality in the system.

7. Attribute Editing

- a. The configuration shall include necessary components that will:

- 1) Provide the users with attribute editing capability so that authorized users can update the attribute information for existing features. In this way, the users may update information such as maintenance records or any other desired attributes for features contained in the GIS database. The specific features contained in the GIS database shall govern the access for attribute editing. The list of features that may be edited and the level of security for providing access to editing the specific attributes for the features, shall be developed following detailed discussions with the end users, through coordination with the Resident Engineer.

8. Tag Feature Coordinates

- a. The configuration shall include necessary components that will:

- 1) Through the use of a tool, display the coordinates of a selected feature or set of features on the map for the purpose or printing the map or exporting the map to an image. The coordinates provided shall allow the map to be integrated into or associated with the external software for which the information is being exported.

1.3 APPLICATION DEVELOPMENT

- A. The contractor shall test the application at their office before installing it at the national cemetery. During the testing, the contractor shall utilize a representative sample of the GIS database, allowing their access to all feature types and attributes so that they can correctly define and test all of the application functionality.

1.4 IMPLEMENTATION

- A. A/E shall provide CAD files to contractor at NTP for use in building the GIS maps. The contractor shall populate the maps with geodata per Geospatial standards as work progresses. The early turn over area must be completed when the area is transferred to the cemetery so the cemetery may start tracking interments and populating the GIS database.
- B. The contractor shall complete the testing of the application software, with loaded mapping and geospatial information collected for this

project, prior to installing and configuring the application at the cemetery.

1.5 TRAINING

- A. The contractor shall provide training to key cemetery staff, MSN staff, and others designated by the RE in using and administering the configuration. All training shall be video recorded and turned over to the RE on DVD.

1.6 DOCUMENTATION

- A. In addition to the DVD of the training session, the contractor shall provide a quick reference guide, in written form, showing the most relevant features with quick and easy access for commonly used features without having to review the entire DVD. In addition, there shall be a written O&M manual provided for the application software with access to all of the features, as well as images of screen shots to aid in the process. There shall be a troubleshooting section as well in the O&M manual that covers the problems that may occur, along with possible solutions.

1.7 AERIAL PHOTOGRAPHY

- A. The GIS configuration shall include aerial photography imagery of the cemetery development under this contract. The contractor shall obtain the highest quality imagery for the cemetery property and shall demonstrate a sample of the imagery to the VA for approval prior to purchasing. This imagery shall be utilized to depict the baseline cemetery conditions, prior to this project. Upon completion of the project, during the 11 months following acceptance of the work, the Contractor shall have the entire developed portion of the cemetery flown, with leafs off, and no snow on the ground, to create a new aerial photography image for use in the GIS system. The image shall be flown with survey ground control, so the image can be stretched to fit the real world coordinate system being utilized to display the work installed as part of this project, with 1 centimeter accuracy GPS coordinate "As-Built" drawings.

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SECTION 11 83 02
GPS & GIS MAPPING AND GEODATA

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contractor shall collect GeoData, Global Positioning System (GPS) coordinate locations and elevations for the work to be performed as part of this Project. The GPS coordinates and elevations shall be obtained using GPS base station and equipment provided under Section 11 83 00, GPS and comply with the requirements of that Section.
- B. The Contractor shall collect the GeoData for the features indicated in Part 2 for the new work being performed as part of this project. The net result shall be a complete newly created collection of GeoData for the specific identified features within the developed portions of the cemetery at the end of the project.
- C. The specific means and methods for collecting the GeoData shall be as described herein, to result in the mapping display of the features in the GIS system provided under Section 11 83 01, with the features being displayed as points, lines, polylines or closed polygons with the applicable symbology, line types, layers and colors in accordance with VA Geospatial Data Standards referenced below.

PART 2 - MATERIALS

2.1 GENERAL

- A. For the purpose of this specification section, the production of the electronic information that shall be imported into the GIS system for cemetery mapping are referenced as materials.
 - 1. GPS/GIS information from the Contractor work areas for the project.
The representation of the work constructed by the Contractor as part of the project, is collected according to the standards established herein, where the contractor shall produce detailed description and representation of the system for data collection, documentation and transfer to the GIS system.
 - 2. The various elements within the work area to be collected and represented in the mapping of the GIS software shall be collected and represented using the VA Geospatial Data Standards. The data associated with the polyline elements shall be as indicated below for the respective elements constructed, with the date of installation, (month and year) being provided for all of the new work materials. The Contractor shall coordinate the field collected

data for assimilation and configuration in the GIS software. The Contractor shall be responsible for providing the means and methods for achieving the end results for the mapping, and data, as described in Section 11 83 01 and 11 83 02, to result in the completed fully functional system that performs as indicated and contains the data indicated therein. The following indicates the elements to be collected and represented as well as the type of graphical representation:

2.2 DESCRIPTION OF DATA COLLECTION BY ELEMENT TYPE

A. The data collection for the new project work areas shall be consistent for the same types of entities in each location. The following paragraphs describe the site elements and the way they should be indicated in the GIS mapping, as well as indicating the information that should be included in the GeoData for the respective elements being represented.

1. GPS/GIS data for the Contractor Constructed areas in the Project Area. All of the facilities constructed in the project area shall be documented to the level required in Sections 11 83 00 and 11 83 01. The information for the elements being represented shall be identified to the level of 1 centimeter accuracy for the horizontal and vertical coordinate and elevation, respectively.

a. Points

- 1) Gravesite Grid Monuments and Markers - the features within the burial area established to allow the staff to find their location within the burial section, using taped measurements offset from reference lines between these markers and monuments
- 2) Burial Section Markers - Permanent above ground markers with the identification of the burial section number (typically two per burial section)
- 3) Trees - 6" caliper or smaller where they are not within a wooded area at the perimeter of the developed portion of the cemetery. For larger trees see the requirements for closed polygons.
- 4) Single sign posts
- 5) Sprinkler heads - the actual locations for the installed sprinkler heads shall be collected, and for the data

associated with the heads, the information on the make model and nozzle for the sprinkler shall be included as installed.

- 6) Flag sleeves - The installed sleeves for displaying flag for special days and events, located along the roadways throughout the Cemetery.
- 7) Gas line markers - The above ground markers indicating the location of the gas line, or the easement or no dig areas around the underground gas lines.
- 8) Property corners - monuments, pins, or other markers set by surveyor to identify the Cemetery boundary property line.

b. Polylines

- 1) Property Lines - Lines between the property corners either as found as physical corners, or as calculated corners, that represent the Cemetery property lines.
- 2) Water lines - Location of the waterline, along the centerline on top of the pipe (maximum 50 foot intervals), with GPS location and elevation shots at each change in direction or elevation, at all fittings, valves and any appurtenances. The data associated with the polyline should include the pipe material, size, and Class of pipe. Each fitting, valve or appurtenance shall be identified in the data for the respective location and shall include the size, material, type of joint and class of the fitting, valve or appurtenance.
- 3) Sanitary Sewer Lines - Location of gravity sanitary sewer lines, force mains shall be provided along the top centerline of the pipes when outside of structures. The data shall indicate the size, type and pressure class for the pipe installed, as well as the joint type. For the force mains, any changes in direction or elevation shall be location points for the installed pipe. Same information shall be provided for the data on the pipe. Provide inverts at all junctions.
- 4) Storm System Piping - Location of the Storm drain pipe lines between structures, or between structures and daylight outlet shall be located along the top of the pipe, with the data including the size type and pressure rating for the pipe, and the joint type. Locate the pipes just outside of the structures, and at the approximate midpoint of the pipe for

pipes over 50 feet in length, or at 50 foot intervals for pipes over 100 feet in length. Provide inverts at all junctions.

- 5) Electrical lines - direct bury electrical lines, electrical lines in conduit, direct bury control wiring, control wiring in conduit, ground wires, phone lines, or any other buried wiring. Along with the location and depth for these lines, the data should identify the type, size, purpose, conduit size, whether the information is for the conduit, wire, or encasement of the conduit. Any overhead lines and poles that are in or through the contract work area for the project shall also be located and identified.
- 6) Fencing - All permanent fencing in the project construction area with the data regarding the type and details for the fencing being included.
- 7) Contour lines - The as constructed contour lines, major and minor, with elevation attributes, and 1 foot contour intervals.

c. Closed Polygons

- 1) Pavement - The pavement areas within the developed site shall be documented with the GPS equipment. When areas can be differentiated by time of installation, they should be individually included in separate closed polygons, with the appropriate date of placement indicated in the data for the area. The entire roadway pavement, parking areas, maintenance yard, shall be documented with closed polygons that adjoin to provide a complete area for all of the pavement, when selected. The closed polygons shall be created to adjoin each other, without breaks or overlaps so the selection of all will provide the cumulative square footage for the paving.
- 2) Curbs - Curbs shall be identified as closed polygons with the limits of the respective closed polygons being differentiated by changes in the curb type, age, etc. and the appropriate information differentiating the various areas shall be included in the data associated with the closed polygons. The closed polygons shall be created to adjoin each other, without

breaks or overlaps so the selection of all will provide the cumulative square footage for the curbing.

- 3) Sidewalks - Sidewalks shall be done like the Pavement, with the different types, surfaces, ages, etc. being created as separate closed polygons. The closed polygons shall be created to adjoin each other, without breaks or overlaps so the selection of all will provide the cumulative square footage for the sidewalks.
- 4) Paths - Same as for Pavement, Curbs and Sidewalks.
- 5) Lawn Areas - The closed polygons for the lawn areas shall be created based upon the different types of lawn area (seeded, sod, different times for installation, differing mixes, etc.) The closed polygons shall be created to adjoin each other, without breaks or overlaps so the selection of all will provide the cumulative square footage for the Lawn Area.
- 6) Planter Beds - Closed polygons shall be created for each individual planter bed. Each Planter bed shall be assigned a unique identification designation.
- 7) Burial Plots - Burial plots shall have individual closed polygons that have been created to the nominal size for the plot in the specific area. Example, the crypt field burial plots shall be created as standard size of (3' x 7'-8" or 3' x 8'-0") and the oversized crypt plots shall be created (4' x 10'). Each burial plot shall also be provided with a unique identification (Section and Grave number). The same closed polygon feature shall be created for each in-ground cremains plot, columbarium wall niche, memorial plot, and memorial wall marker. Text fields associated with burial plots shall be provided for the following: plot/grave/crypt number, veteran ID number, veteran name, decedent information number, urn/casket number and headstone number. Clicking on the gravesite polygon will pull up the gravesite identification number. Clicking on the screen displayed casket or urn GPS point will pull up a photo of the casket or casket ID along with basic information of that burial, thereby providing electronic verification that the correct casket has been placed in the correct gravesite. Clicking on the screen

displayed headstone GPS point will pull up the headstone data and a photo of the headstone, thereby providing electronic verification that the correct headstone has been placed on the correct gravesite.

- 8) Valve Box Covers - A closed polygon shall be created for each of the typical valve boxes in the Cemetery, whether round, or rectangular, or square. They should be included as available selectable symbology when taking field location GPS shots. The closed polygons shall be located by taking one or two GPS shots depending upon the shape of the box cover. One shot for round and two for square and rectangular, with the two shots being in the center of opposite sides with the short sides being used for the rectangular boxes. The data for the box covers should include the identification information for that specific valve box location, as well as the type of cover, and the type of valve that is installed below the cover.
- 9) Manhole Covers - A closed polygon symbology shall be created and selectable for each size of manhole cover in the Cemetery. The location for the manhole cover shall be a GPS location at the center of the manhole cover. The data included shall be the identification of the structure, size of the cover, and configuration (solid with non-vented pick holes, solid with closed pick holes and vent holes, solid with only vent holes, open grate, etc.), installation date.
- 10) Manhole Structures - A closed polygon, assumed to be a circle, shall be located based upon the actual size and orientation of the structure in relation to the manhole cover. The location and elevation of the pipeline inverts entering and leaving the manhole structure shall be identified in the data for the manhole structure and sufficient information provided to properly orient the structure to match the pipelines indicated as entering or leaving the structure as part of the pipe polyline locations. The data should include the size and type of pipes in the manhole structure, as well as the date of installation. A digital photograph of the interior of the manhole structure shall be taken and attached to the data file for the manhole, with an orientation key provided on the

photograph (the orientation could be that the photograph is always taken with the top of the image facing north, or some similar method, including providing an annotation on the photograph before it is attached to the manhole location.

- 11) Burial Section Markers - The burial section markers should be represented as closed polygons of the size to match the actual features. A digital photograph of the section marker shall be taken and attached as part of the data for the feature. Each marker shall be identified using a designation appropriate for viewing the section being identified, from the roadway adjoining the section from the front, or closest to the road to which the headstones are closest to facing.
- 12) Flagpoles - Create closed polygons (circles) of the size of the pole base, and provide the GPS location to locate the pole accurately. The data associated shall indicate the type of flag flown, the size of the flag, the date the flag was replaced, the height of the pole, color and finish of the pole, configuration for the pole, and the manufacturer for the pole. Additional data field shall be created that will show the display of the manufacturer's parts catalog for all of the replaceable materials included in the flagpole installation. If the catalog information is not readily available, digital photographs of all of the components installed, or to be installed as part of the flagpole installation shall be taken, and identified by name and manufacturer part number, and included as accessible data for this element.
- 13) Site Walls - The site walls shall be located with the GPS equipment at the top of the caps (or for the base, if the wall does not have any caps), at the edges of the caps at the center of the joints between the caps. The joints between the caps shall be indicated as Lines or polylines as separate elements, so they can be evaluated as to length for replacement. The joints shall be differentiated when they are of different materials. The date for installation of the products as well as the identification (Manufacturer and model) and color of the product shall be included in the data for the element. Site walls are to include all of the wall

types to be found at the site, including the columbarium walls, seat walls retaining walls, memorial walls, decorative walls and any other types not listed. The GPS location information for the walls shall provide accurate position for the walls within the Cemetery, and shall provide accurate location for the visible top of the walls. The elevation information shall be for the finished grade below the points indicated for the tops of the walls. Each columbarium column shall be an individual polygon with three to five points tied to the number of rows of niches above grade. Each point shall have text fields associated and for the following:

plot/grave/crypt number, veteran ID number, veteran name, decedent information number, urn number and marker number. Clicking on the urn point will pull up the gravesite identification number. Clicking on the screen displayed urn GPS point will pull up a photo of the urn ID along with basic information of that burial, thereby providing electronic verification that the correct urn has been placed in the correct niche. Clicking on the screen displayed headstone GPS point will pull up the marker data and a photo of the marker, thereby providing electronic verification that the correct marker has been placed on the correct niche.

- 14) Plazas - The plazas shall be represented by a series of closed polygons. Individual closed polygons shall be created representing the individual concrete elements surrounded by expansion joints or open sides to planter beds, lawn, etc. The closed polygons shall be created to differentiate differing materials used in the creation of the plaza. The data for the individual closed polygons shall indicate the date of construction and the material and finish for the specific closed polygons. In addition to the closed polygons extending to the expansion joints, the expansion joints shall be located and indicated as separate entities, using polylines. The data for the expansion joints shall indicate the materials used for the joint construction as well as the date of installation (month and year is all that is required for dates in the GIS data, TYP.). The accumulation of all the

closed polygons for each respective plaza shall result in the total square footage of surface of the specific materials selected.

- 15) FWS Receptacles - Closed polygons representing the flower spigot, the trash and flower vase receptacles shall be indicated with the elevations at the finished grade being indicated. The data should indicate the manufacturer, make model for the equipment, and a digital photograph of the respective elements shall be taken and attached to the closed polygon representing the individual elements. Each of the elements shall have a unique identifier associated with the element and its location.
- 16) Catch Basin Inlets - Create closed polygons representing the CB Inlets, with data including the rim elevation and the manufacturer make and model number for the inlet.
- 17) Catch Basin Structures - The closed polygon for the catch basin structure shall indicate the outside limits of the structure. The closed polygon shall have a unique identifier. The data shall include the bottom elevation, the inverts for the pipes leaving the structure as well as size and material, and the orientation shall be indicated. A digital photo shall be taken inside of the catch basin, when new, with annotation of north indicated on the photo. The photo shall be accessible as any of the other data associated with the closed polygon.
- 18) Drain Inlets - Same as for the Catch Basins.
- 19) Headwalls - Indicate the limits of the headwall as part of the closed polygon. The data shall include the unique identification for the headwall. The data should also indicate the invert, size and material for the pipe passing through or terminating at the headwall. Provide a digital photograph of the completed headwall as part of the data for the closed polygon.
- 20) Fire Hydrants - Provide a closed polygon (circle) representing the size of the FH at the ground level, with the unique identifier, data indicating the make, model, and configuration of the hydrant, including the threaded connections, and if

available, fire flow test results for the hydrant location, as well as the date for installation. A digital photograph of the completed installation shall be included as part of the data for the closed polygon.

- 21) Water Spigots - Locate the water spigot assemblies using a closed polygon representing the general shape at the ground level. A unique identification shall be created, and the data for the spigot shall include the make and model of the spigot, and the major parts include in the installation. Digital photo(s) shall be provided as part of the data for the closed polygon, that show the completed installation as well as the configuration of the piping with the materials identified prior to installation, so the operations staff can order replacements as needed in the future.
- 22) Wall Lines for Buildings - Provide closed polygons representing the wall lines for the buildings as they exist at the ground surface. For new buildings, provide a set of exterior photos with views of each of the exterior walls that can be accessed as data for the closed polygon. Include the date of completion for new work or the building if new for this project.
- 23) Benches - Provide closed polygons representing the footprint of the benches when installed. The data for the closed polygons shall include one digital photo of one of the installed benches, as well as the manufacturer make and model number for the benches.
- 24) Sign Posts, Pads and Panel Assemblies - Provide a closed polygon display of the posts and panel for the signs. Unique identification shall be provided, either as indicated in the design sign table, or as approved by the operations personnel during development of the GIS system. Each sign shall be digitally photographed at the completion of its installation and the image shall be attached as part of the data for the closed polygon. The thumbnail photograph of the sign shall be displayed when the mouse is run over the sign closed polygon for more than a second, or as established during the testing with the Cemetery staff. The date of the installation shall

be part of the data. If the mouse is clicked on the closed polygon for the post and panel sign, a full sized image shall be displayed, or the data field information, depending upon the display option selected by the user.

- 25) Stairs - Create the closed polygon at the perimeter of the stair where it abuts walls, walks or lawn area. Make sure the expansion joints between any abutting surfaces are created as polylines. The data shall include one or more photographs of the installation showing the complete stair, as well as a identifier, and the date for installation.
- 26) Handicapped Access Ramps - The closed polygons for the ramps shall be to the expansion joints abutting the ramps. The EJ's shall be included as polylines and thus identified with materials and date of installation. The data for the ramps shall indicate the source of any precast units installed in the ramps, as well as the date of construction, and photo(s) of the completed installation shall be included in the data.
- 27) Bollards - The closed polygon shall represent the size at the ground surface, and the elevation at the ground surface shall be provided. The data shall indicate the top elevation of the bollard. A unique ID shall be created for each bollard. If the bollards are covered with plastic, the make and manufacturer shall be indicated in the data. The make and manufacturer and color for the paint on the bollards shall be indicated in the data.
- 28) Downspouts and splash pads - Provide closed polygons indicating the locations and elevations of these facilities at the ground surface.
- 29) Septic Tank - The closed polygon shall indicate the footprint for the septic tank the elevation at each of the corners on the top. The finished grade elevation above the corners shall be included. The data for the septic tank shall include the manufacturer, model and size, special construction (baffle) inlet and outlet "Tees", etc. The data shall include digital photographs of the installation, prior to backfill showing the pipe routing, the access opening(s), and interior photos of

the inlet and outlet pipe configuration. Coating information and date of installation shall be included in the data.

- 30) Distribution Box - Provide the closed polygon indicating the location of the box, as well as the elevations of the top. The data should indicate if there are speed levelers or other means of distributing the flows. Data should also indicate how many laterals. Data should include photo(s) of the D-box installation, before it is buried, with the top off showing the interior, as well as the piping from the septic tank into the D-box and from the D-box to the distribution laterals.
- 31) Septic Tank Access Cover(s) - Provide the actual size for the access cover, its location, elevation and the finished grade elevation above the access cover(s).
- 32) Absorption Bed or Leach field - The piping into the leach field or absorption bed shall be included in an overall closed polygon of the outside of the area for them, so excavation will not disturb the absorption areas. Data for the closed polygon shall include the piping configuration for the system, number size and length of laterals installed. The data shall also include photo(s) of the installation prior to backfill, with the pipes indicated.
- 33) Above Ground Fuel Storage Tank - The closed polygon shall indicate the footprint for the installed tank. Data shall indicate the size, type, number and size of chambers, manufacturer, contact for servicing, as well as photo(s) of the installed tank system.
- 34) Storage Bins - The footprint for the storage bins shall indicated, with each bin being a separate closed polygon. Data shall identify the date of construction, and shall include digital photo(s) of the installation.
- 35) Easements - Closed polygons shall be created to identify the best known location for any easements. Data shall indicate what the easement is for.

PART 3 - EXECUTION

3.1 GENERAL

- A. The required GPS/GIS work shall result in a fully integrated GIS/GPS system with full coverage for the entire developed portion of the

Cemetery. The GIS elements that are created by the Contractor as part of this work shall be sufficient to allow the display of the Cemetery with the surface improvements visible on the GIS mapping software. This work requires the creation of an electronic existing conditions GIS map and data system that covers the entire developed portion of the Cemetery. The GPS information shall be collected for the surface improvements and subsurface facilities.

- B. The various elements that will be used to depict the site using the GIS mapping are to be made up of points, polylines and closed polygons that shall be created and displayed by the Contractor.
- C. A/E shall provide CAD files to contractor at NTP for use in building the GIS maps. The contractor shall populate the maps with geodata per Geospatial standards as work progresses. The early turn over area must be completed when the area is transferred to the cemetery so the cemetery may start tracking interments and populating the GIS database.
- D. The Contractor shall provide a functioning Geographic Information System (GIS), which by definition includes the graphical representation of the location and elevation for the elements in the GIS, as well as the data information for the geographically displayed information. The source for the graphical portion of the GIS shall be from the "As-Built" AutoCAD data supplemented with the field collected data. The geographic coordinate and elevation information for the elements being added to the GIS system, whether points, polylines or closed polygons, shall be collected and represented in the GIS based upon the accuracy level for the GPS equipment being provided for the project.

3.2 DEMONSTRATION

- A. Each of the three specifications sections included as part of the GPS/GIS, Section 11 83 00 Global Positioning System (GPS); Section 11 83 01 Geographic Information System (GIS); Section 11 83 02 GPS & GIS Mapping and Geodata require complete demonstration as part of the demonstration of the entire GPS/GIS system being furnished and installed and made fully functional
- B. The demonstration shall be sufficient to show that all of the GPS/GIS facilities provided perform as approved during the submittal and review process for the project, and that the completed fully functional system, including all hardware, facilities, equipment, software, and appurtenances are completely operational and perform as specified.

C. The GPS/GIS facility demonstration shall be performed to the satisfaction of the RE and the A/E prior to proceeding with the training.

3.3 TRAINING

A. After construction is complete and the Contractor has verified that the system is operating as intended through the Demonstration, the submittal of the training materials and methods shall be completed and accepted through the submittal process, prior to the training. Contractor shall notify the Resident Engineer when he is ready to schedule the cemetery staff training.

1. Provide three (3) eight hour training days, and a follow up two (2) eight hour days, providing staff training on the system operation, field procedures and maintenance.
2. Training may or may not be consecutive days, but should be scheduled in close proximity.
3. All training sessions shall be digitally video recorded and such recordings turned over to the Government for future use.

3.4 WARRANTY

A. The contractor shall provide a five (5) year warranty for defective hardware and software.

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