

**DERRY LONDONDERRY EXIT 4A
13065****February 06, 2020****SPECIAL PROVISION****Section 670 – MISCELLANEOUS INCIDENTALS****Item 670.822 - GNSS Construction Inspection Equipment****Description**

1.1 Work shall consist of furnishing, configuring, installing, maintaining, and removing Global Navigation Satellite System (GNSS) equipment as needed for use by the Engineer, including building the digital surface models as necessary and downloading them into the Design-Build Team provided data collectors, and the training of Department staff on the use of the GNSS equipment provided.

Equipment

2.1 The GNSS Construction Inspection Equipment shall include all necessary components; communication devices; integrated antennae, receiver, and cables; data collectors; operating manuals; attachments; and fastening hardware to meet the minimum requirements described herein.

- (a) GNSS equipment provided for a single Contract shall be the same model and manufacturer; and shall include, and be licensed to operate, the same version of GNSS planning/processing software (such as Carlson Survey, Trimble Business Center HCE, or similarly functioned software), and data collection software. The data collection system utilized by the Design-Build Team and Engineer shall be the same. All software provided (including firmware) shall be the most current available or in use by the Design-Build Team. GNSS equipment shall be of the same age as those actively in use by the Design-Build Team. To verify the age of the GNSS equipment, the Design-Build Team shall provide a dated copy of the manufacturer's receipt(s) for the purchase, lease, or rental of the equipment.
- (b) GNSS planning/processing software shall have the following minimum capabilities:
 - (1) Surfaces
 - Build surfaces by triangulation or rectangular grids
 - Calculate earthwork volumes between triangulation or grid surfaces
 - Create surfaces from collected data points
 - Calculate 2D and 3D surface areas from existing and collected data points
 - (2) Centerlines
 - Design or input alignments on screen or in dialog with graphics
 - Create points at specified stations and offsets
 - Report stations and offsets for selected points along centerline

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(3) Points

- User-defined import and export of point data
- Draw points with settings for symbols, layers and styles
- Calculate 2D and 3D lengths from existing and collected point data

(4) Survey

- Upload and download to data collectors
- Create cross section reports from field topo survey.

(c) GPS units shall have the following capabilities:

- (1) Import/Export and display point data.
- (2) Import and display alignment data from an XML file.
- (3) Import and display graphics files from a DGN or DXF format.
- (4) Import and utilize LandXML surfaces.

(d) GNSS equipment shall include both standard USB cable and Bluetooth wireless technology for data transfer between the GNSS equipment and the data collectors.

(e) GNSS equipment shall be equipped, at a minimum, to receive Global Positioning System (GPS) and GLObal NAVigation Satellite System (GLONASS) data.

(f) GNSS equipment shall be equipped to receive, and be capable of utilizing, Real Time Kinematics (RTK) correctional data (current version of RTCM format). This equipment shall include all necessary communication devices, repeaters, and systems; data service plans; and communications to meet the minimum required accuracy and not exceed two (2) second latency at the rover. The Design-Build Team shall ensure that the RTK data shall be available at all locations across the entire Contract site during all hours of construction and inspection operations.

(g) GNSS equipment shall include either an integrated or modular communication device capable of receiving RTK correctional data.

(h) GNSS Equipment shall be capable of collecting dual frequency GPS data.

(i) Minimum Required Kinematic Accuracy relative to primary project control*[Continuous Operating Reference System (CORS)]:

(1) Horizontal: 20mm +1.0 ppm (0.065 ft +1.0 ppm)

(2) Vertical: 20mm + 1.0 ppm (0.065 ft + 1.0 ppm)

* All Automated Machine Grading (AMG) work shall be localized to NHDOT project control. Refer to NHDOT Survey Technical Standard Manual for further requirements.

(j) Necessary hardware and software shall be included (including communication drivers) to connect the GNSS equipment to a Design-Build Team-provided PC and communicate/exchange/process positional data with that Design-Build Team PC. (Design-Build Team-provided PC shall be the PC/Laptop provided under Item 698. __ - Field Office Type __, no additional PC/Laptops will be necessary.)

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- (k) GNSS equipment shall have an internal, or modular, rechargeable battery system capable of operating through all active working hours (may include interchangeable batteries), including the battery charger.
- (l) GNSS equipment shall include a hard or soft shell carry cases, and all appropriate operation manuals.
- (m) GNSS rover shall include one (1) fixed or collapsible height rover rod of two (2) meters (6.56 feet) in length, one attachable bipod which is compatible with the rover rod, and one topo shoe.
- (n) GNSS equipment set up to operate as a base station shall include all necessary additional cables, hardware, fasteners, or accessories necessary to install the equipment in a fixed semi-permanent location. This set up will not be considered as a rover unit and therefore will not require a rover, a bipod, or a topo shoe.
- (o) If a high accuracy machine control system is to be utilized for fine grading, a high accuracy measurement system shall be made available for Department use to check prepared fine graded surfaces. If the supplied GNSS unit is not capable of utilizing the high accuracy system, one that is shall be made available for the purposes of fine grade checking. (This unit will not be considered an additional unit as it will only be made available for fine grading purposes.) High accuracy systems may include, but are not limited to, Laser Tied GPS and Universal Total Station machine guidance.

Construction Requirements

3.1 The Department has electronic data files available for the project. Any files available were originally created with the computer software applications MicroStation® (CADD software) and Bentley® civil design software. The Design-Build Team shall perform any and all necessary conversion of the files for the selected grade control equipment or create the Digital Terrain Model(s) (DTM(s)) as necessary. The electronic data files provided by the Department are listed below:

- (a) Digital Terrain Models
 - DTM(s) representing the existing ground in DGN format.
 - DTM(s) representing the design surfaces in DGN format.
(Include boundaries of the design, e.g. EP to EP or slope line to slope line)
 - DTM(s) representing the existing ground in LandXML format.
 - DTM(s) representing the design surfaces in LandXML format.
(Include boundaries of the design, e.g. EP to EP or slope line to slope line)
 - Automated Machine Grading (AMG) Surface Model.
- (b) Alignment Data Files
 - Geometry files containing horizontal and vertical geometry in DGN format.
 - Geometry files containing horizontal and vertical geometry in LandXML format.
 - Alignment Geometry Report (ASCII Report format).

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(c) Other Files

- MicroStation® cross section design files (DGN & DXF formats).
- MicroStation® ROW design file (DGN & DXF formats).
- MicroStation® existing ground features (DGN & DXF formats).

3.2 Any electronic project design data provided by the Department will not be deemed a part of the contract, and is supplied as a courtesy by the Department. The Design-Build Team shall upon discovery of any ambiguity or error notify the Department before proceeding. The Design-Build Team may convert any electronic data provided by the Department into a format required by the Design-Build Team's system and equipment at the Design-Build Team's expense. Any DTM(s) created by the Design-Build Team to be used for construction layout shall be submitted to the Department as a terrain model in Bentley DGN format or LandXML format for documentation; any other format shall be preapproved by the Department prior to submittal.

3.3 The Design-Build Team shall take particular care shall be taken to ensure that any and all files converted to other file formats maintain the same units of measure and coordinate system of the original data. This includes any necessary conversion from MicroStation® DGN to other drawing formats; as well as from Bentley® civil design software to other engineering formats.

3.4 The Design-Build Team assumes all risk of error if the information is used for any purposes for which the information was not intended.

3.5 Any assumptions the Design-Build Team makes from this electronic information is at the Design-Build Team's risk.

3.6 The Design-Build Team shall download all surface models into the provided data collectors and the planning/processing software to facilitate construction inspection by the Engineer. See 3.1 for provided data/surface files.

3.7 The Design-Build Team shall choose which communication technique and devices will be used which will insure the consistent and reliable delivery of RTK correctional data from the network to the GNSS equipment. When geographic locations or lack of reliable communications network prohibits the use of a network directly, use a Survey Grade GNSS Inspection unit as a base station in place of the network. The Design-Build Team shall semi-permanently mount the base station in a stable and secure location where it shall not be disturbed by construction activities nor be easily damaged by vandalism, and where it shall be capable of providing radio signal coverage over the entire Contract area. A GNSS unit installed as a base station for inspection operations shall only be moved with the approval of the Engineer. Additional base station setups as required by the Engineer for areas outside the Design-Build Team's work area may be requested and paid for in accordance with 109.04.

3.8 The Design-Build Team shall provide the Engineer with a GNSS rover (with the same capabilities as equipment used by the Design-Build Team) for use during the duration of the Contract.

3.9 The GNSS equipment shall be maintained and remain in service until either:

- (a) A maximum of one week after the Engineer requests its removal in writing, or
- (b) The Department relinquishes the Engineer's Field Office.

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3.10 The Design-Build Team shall maintain all GNSS equipment and software in good working condition and shall provide replacement due to breakdown, damage, or theft within two (2) working days. The Design-Build Team shall retain ownership of all supplied GNSS equipment, including the rover, at the end of the Contract.

3.11 The Design-Build Team shall provide the necessary training as follows:

- (a) For all Construction Grade GNSS equipment, the Engineer and/or duly authorized representatives shall be provided with a minimum of 16 hours training on the use and operation of the GNSS equipment and software. Initial training shall occur within one week of delivery of GNSS equipment to the site unless otherwise directed by the Engineer. The remainder of the training hours shall occur at the request of the Engineer. If a Contract has multiple years of work, an additional 8 hour minimum training shall be provided at the request of the Engineer.
- (b) All training shall be performed by a manufacturer-verified trainer or others as approved by the Engineer. The training shall occur at the Engineer's Field Office or at a location agreed to by the Engineer.
- (c) In order to facilitate training of field personnel, provide and install data collector emulator software to emulate the provided data collector(s).