SOUTH CAROLINA GEODETIC SURVEY

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# OCONEE COUNTY LiDAR QUALITY ASSESSMENT – OCONEE, SC

# VRS HEIGHT MODERNIZATION 2011

VRS GNSS SURVEY

PROJECT REPORT

October 2011

S.C. GEODETIC SURVEY

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***I. INTRODUCTION***

*Purpose*

This project was conducted to establish a network of geodetic control points of sufficient accuracy and spacing to support a quality assessment (QA) for a LiDAR-produced bare earth digital terrain model for Oconee County, SC. The design and accuracy meets the requirements for QA contained in “South Carolina Geodetic Survey (SCGS) In-Kind Checkpoint Guidelines” dated February 13, 2008. All checkpoints were determined using the SC Virtual Reference Station Network (VRS) utilizing both GPS and GLONASS satellite constellations. The VRS control station coordinates were established using 60-second observations accepting a maximum horizontal tolerance of +/-0.015m horizontally and +/-0.02m vertically. A total of 11 geodetic control checkpoints with repeated observations were used to verify the operation of the VRS across the county. A mean difference between published and observed vertical orthometric heights yielded a value of -0.009m with a standard deviation of 0.026m. A diagram of the QA checkpoints is attached. Five ground cover types were sampled: bare earth (o), urban (u), high grass (h), bush (b) and forested (w). A total of 128 points were observed including control points.

Planning and reconnaissance for the survey ensured that 5-cm orthometric and ellipsoid height accuracy could be met. The horizontal control for the GPS project used the 45 VRS base station network. Each VRS-derived QA checkpoint was positioned by the nearest three base stations, while atmospheric corrections were derived using the statewide network as a whole. All QA checkpoints were obtained using a fixed integer solution, a maximum PDOP of 6 and a minimum of six satellites with a mask angle of 10 degrees.

*B. Time Period*

The field reconnaissance and observations for stations were conducted on June 6, 7, 8 and September 20, 29, and 30, 2011.

*C. Point of Contact*

Any specific problems with or questions about the project should be directed to Matthew J. Wellslager phone 803-896-7715, E-mail *matt.wellslager@scgs.scgov*, 5 Geology Road, Columbia, South Carolina, 29210,

*D. Accuracy Standards*

The survey was designed to meet the standards for quality assurance of LiDAR-based elevation models. The VRS was designed to meet 0.024m 95% horizontal and 0.031m 95% vertical confidence interval including an allowance for NGS network accuracy stated by NGS to be 0.020m for directly connected network points and 0.050m for indirectly connected points *(Geometric Geodetic Accuracy Standards and Specifications For Using GPS Relative Positioning Techniques*, dated May 1988, Version 5.0, page 15). Our comparison checkpoints indicate a vertical accuracy of 0.026m 95% confidence interval including network accuracy indicating that the VRS and network are in good agreement. The computation of VRS accuracy is contained in *GPS + GLONASS for Precision, South Carolina’s Virtual Reference Station Network, Inside GNSS*, July/August 2007. All horizontal positions and ellipsoid heights are referenced to the North American Datum 1983 (2007), while orthometric heights are referenced to North American Vertical Datum 1988. Horizontal positions are expressed in the South Carolina State Plane Coordinate Single Zone 3900, in International feet. Orthometric and Ellipsoidal Heights are expressed in meters.

***II. LOCATION***

The project area was Oconee County, SC.

***III. CONDITIONS AFFECTING PROGRESS***

 No significant problems were encountered during the survey.

***IV. FIELD WORK***

*A. Instrumentation*

The SC Geodetic Survey used three Trimble R-8 GNSS receivers with built-in Trimble dual-frequency Zephyr Geodetic antennas and 45-NetR5 GNSS receivers. Two-meter fixed-height tripods were used on all stations. QA checkpoints we marked by 6-penny or larger spikes at all forested, bush, high grass and bare earth sites. A variety of PK nails and other solid markers were used to mark at urban QA checkpoints. Orange surveyors tape was wrapped around every spike to facilitate recovery.

*B. Number and Type of Ground Covers Observed*

The county was divided up into seven zones that depicted the best overall coverage of the county and representative of all five ground cover types. An attempt was made to measure at least one of each ground cover type in each zone and to obtain a total of 60 points across the county with a minimum of 20 urban, 20 open and 20 combined high grass, bush and forested. The point numbering scheme uses a three digit sequence starting with the county number (SC numbers its counties in alphabetical order), a dash, followed by zone number, a dash and then a sequence number corresponding to order of collection within the zone. The following summarizes the collection by zone:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Zone # | Open | Urban | High | Bush | forest |
| 1 | 7 | 3 | 3 | 3 | 1 |
| 2 | 4 | 4 | 2 | 3 | 3 |
| 3 | 5 | 3 | 4 | 5 | 1 |
| 4 | 5 | 3 | 4 | 2 | 2 |
| 5 | 3 | 3 | 4 | 3 | 2 |
| 6 | 4 | 3 | 4 | 5 | 2 |
| 7 | 4 | 2 | 0 | 1 | 1 |
| Total | 32 | 21 | 21 | 22 | 12 |

Redundant observations were recorded at the same location in wooded areas for zones 2, 3, 5, and 6. Each of the observations were recorded but counted as a single classification data point. As an example, in Zone 2, observations 37-2-12 and 37-2-13 were observed at the same exact location in an attempt to lower the RMS values and collect a data set with better precision. While both points were saved as individual observation, they were only counted as 1 classification point for that specific location.

*Total checkpoints: 128*

*C. Deviation from Instructions*

There were no deviations from instructions.

***V. DATA PROCESSING PERFORMED***

*A. Software Used*

Data was downloaded from the TRIMBLE receivers using Trimble Geomatics Office (TGO) Software. There was no post-processing required. TGO was used to generate reports of coordinates, RMS and ellipsoid heights. The output was reformatted to an Excel spreadsheet per the example provided by Dewberry and Davis.

*B. Data Rejected*

 Four data sets were removed from the list of check points. The classifications were incorrect after review of the photographs taken at the site. Additional observations were recorded in each of the zones to meet the minimum requirements for observed check points.

*C. Equipment*

Receivers were used as described above in part *B. Instrumentation* under section *IV.*

All R-8 antennas were supported on 2-meter, fixed-height poles while VRS base stations are mounted in such a manner as to achieve sub-centimeter stability. Each check point was photographed with a 35mm digital camera and numbered corresponding to the check point number.

*D. Weather*

*Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques*, dated May 1988, Version 5.0, page 15, specifies weather data is not required for surveys that have intended accuracies 1:100,000 or less.

*E. Adjustment*

No adjustment was required as all data was collected and processed in real time.

*F. Closures*

Loop closures were not applicable to this project.

***COMMENTS AND RECOMMENDATIONS***

One CD-ROM is enclosed with this project. Zone 7 did not have the same number of check points as other zones. This is due in part to the remoteness and terrain of the zone. Zone 7 is located in the Sumter National Forest. Due to the mountainous terrain, digital cellular communication was not possible for the entire zone. Data collection using the VRS requires digital cellular communication. Without the digital connection, corrections are unable to reach the roving receiver while it is operating in the zone. SCGS will be happy to supply any additional information as requested.

CD-ROM Contents:

Check Point Photographs

Check Point Excel Spreadsheet

Project Report

Respectfully submitted,

Matthew J. Wellslager