Lidar Quality Assurance and Quality Control Report for Jasper County, South Carolina

Vertical Accuracy Assessment Report: Lidar Data for Jasper County, South Carolina

Qualitative Assessment of Jasper County Lidar

National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center

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Executive Summary

Lidar data for Jasper County, South Carolina, were collected in winter 2006–2007 and reviewed for accuracy and quality by the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center. The data were collected with a point spacing of approximately 1.3 meters. The data have a fundamental vertical accuracy of 12 centimeters (cm) (bare earth) and a consolidated vertical accuracy of 30 cm (all land cover types). Qualitative aspects of the data such as flight line match and feature/vegetation classification were reviewed, and the data met, and in most cases exceeded, quality specifications and expectations.

Accuracy testing by the NOAA Coastal Services Center indicates that the lidar data meet the accuracy specified in the statement of work.

- Using Federal Geographic Data Committee (FGDC), Federal Emergency Management Agency (FEMA), National Digital Elevation Program (NDEP), and American Society for Photogrammetry and Remote Sensing (ASPRS) methodology: **Tested 12 cm vertical accuracy at 95% confidence level in open terrain.**
- Using NDEP and ASPRS methodology: **Tested 30 cm vertical accuracy at 95% confidence level in all land cover categories combined.**
- Using FGDC and FEMA methodology: **Tested 27 cm vertical accuracy at 95% confidence level in all land cover categories combined.**

Table of Contents

Lidar Quality Assurance and Quality Control Report for Jasper County, South Carolina

This report consists of two separate sections. The first is the vertical accuracy assessment of the lidar data for Jasper County, South Carolina, and the second is the qualitative assessment of the lidar and the accompanying digital elevation models (DEMs). The data were collected by Photo Science in the winter of 2006–2007 for the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center and the South Carolina Department of Natural Resources. The data were processed to classify points as bare earth, water (surface), or unclassified (e.g., vegetation, houses). The bare earth elevations, along with breaklines, were used to create a DEM that will support Federal Emergency Management Administration (FEMA) Flood Mapping Activities within the State of South Carolina. The point data were reviewed to make certain that they met the accuracy specified in the statement of work (Appendix A), were free of questionable artifacts, and provided a usable data set for multiple types of projects, including flood mapping.

Vertical Accuracy Assessment Report

Background: Data Standards

Data standards for topographic data have improved because of the increased-resolution data sets being generated by private industry, advances in technology, and the data's widespread application and use. Four primary documents have helped define the process of measuring, reporting, and defining the accuracy of Jasper County lidar elevation data. *Guidelines for Digital Elevation Data* (NDEP, 2004), "ASPRS Guidelines: Vertical Accuracy Reporting for Lidar Data" (ASPRS, 2004), and "National Standard for Spatial Data Accuracy" (FGDC, 1998) provide guidance and formulas for determining elevation data accuracy. "Guidance for Aerial Mapping and Surveying" by the Federal Emergency Management Agency (FEMA, 2003) draws on these other data-standard documents and includes a definition of what types of data are needed for some specific flood-mapping applications.

The specific requirements for the data being reviewed are provided below (Table 1). These requirements are meant to define how well the actual terrain was measured in 1) open areas and 2) obscured or vegetated areas. Several measures, $Accuracy_{z,}$ and the Consolidated and Supplemental Accuracies are used to assess these two important aspects.

$Accuracy_z$ is the 95% confidence level of the data (i.e., 95% of the data meets or exceeds the specified vertical $Accuracy_z$) and relates to the data accuracy in areas without trees; thus, this is an overall measure of the quality of the data collection process and adjustment for flight parameters. The fundamental vertical accuracy (FVA) statistic is the same thing as $Accuracy_z$; it is a FEMA-specific term. These measures are calculated using the root mean square error (RMSE) of the data points and are dependent on the data errors being normally distributed; the formula (RMSE x 1.96) follows guidance provided by the FGDC (1998). For this data set, the goal was to achieve a 15 centimeter (cm)

RMSE or $Accuracy_z$ of 29.4 cm, which is a tighter accuracy specification than the FEMA specification (FVA of 36.3 cm).

The supplemental and consolidated vertical accuracy is a 95th percentile confidence statistic. In this case, the values provide a measure of how well the lidar penetrated the tree or shrub canopy, and how well the vegetation, structures, and other nonground features have been removed (processed), while still providing enough information about the ground surface in their vicinity to accurately portray the terrain. These "obscured" data are not normally distributed, since there are many different types of vegetation/features and therefore the calculation of the value is done graphically. FEMA guidance (FEMA, 2003) suggests that for coastal areas (relatively flat) the supplemental vertical accuracy (SVA) and consolidated vertical accuracy (CVA) values be 36.3 cm or better. These are suggested values and, while not dictating the acceptance of the data, provide some additional guidance for their use.

Table 1. NOAA Coastal Services Center and FEMA Accuracy Requirements from Statement of Work

Vertical Accuracy Criteria	NOAA/FEMA Measures of Acceptability
$RMSE_z$ = National Standard for Spatial Data Accuracy (FGDC, 1998) vertical accuracy statistic at 68% confidence level	15 cm in open terrain only
$Accuracy_z$ = National Standard for Spatial Data Accuracy (FGDC, 1998) vertical accuracy statistic at the 95% confidence level = $RMSE_z$ x 1.9600	29.4 cm (15 cm $RMSE_z$ x 1.9600) in open terrain only
Fundamental vertical accuracy (FVA) in open terrain only = 95% confidence level	36.3 cm (18.5 cm $RMSE_z$ x 1.9600) for open terrain only
Supplemental vertical accuracy (SVA) in individual land cover categories = 95% confidence level	36.3 cm (based on 95th percentile per category; this is a target value only, not mandatory)
Consolidated vertical accuracy (CVA) in all land cover categories combined = 95% confidence level	36.3 cm (based on combined 95th percentile)

There are ongoing discussions on whether the values for non–bare earth points (e.g. forest, scrub-shrub) should be calculated using RMSE x 1.96 or the 95th-percentile-confidence-level techniques. FEMA and National Standard for Spatial Data Accuracy (FGDC, 1998) guidance specify that RMSE x 1.96 should be used; ASPRS and NDEP guidance specify that the 95th percentile should be used. We provide values using both techniques for future reference; however, the acceptability measures in Table 1 are being used as the criteria for the validation of the data set.

Ground Control Point Collection

Ground control points (GCPs) were collected to measure the difference between ground elevations and lidar elevations. The points were collected by personnel from the NOAA Coastal Services Center and National Geodetic Survey during the fall of 2006. Complete documentation of the point collection is provided in Appendices B and C. The process typically included setting two temporary benchmarks using survey-grade Global Positioning System (GPS) receivers in static mode. The temporary benchmarks were used both as GCPs and as references for total station (TS) surveys of individual points in various land covers. The calculated accuracy of the GPS points was held to 4 cm or better. The accuracy of the points collected with the TS is subject to the GPS accuracy and additional TS instrument and operator error. An averaging technique using multiple measurements per point was used to minimize operator error. It is estimated that the error is no larger than 2 cm. In general, the surveyed

points are judged to have accuracies (5 cm) that are approximately three times better than the target RMSE (15 cm).

There were 13 “test sites” where points representing the target land covers were collected (Figure 1). The surveyed points were grouped in one of five different land cover categories, and photographs of each point were taken to provide information on its specific land cover aspects. The five land cover categories are 1) bare earth, 2) urban, 3) forest, 4) scrub/shrub, and 5) weeds and crops. These groups were used to compute errors across the spectrum of different land covers.

The five different land cover types did not always occur within each test site, and at some sites more than one point per land cover type was collected (Figure 2). The point collection included the two subcollection areas, Inland Jasper County (Figure 1, blue outline) and Coastal Jasper County (Figure 1, red outline). A total of 130 points were collected, with 42 points in open terrain, 19 points in weeds and crops, 21 points in scrub/shrub, 26 points in forest, and 22 points in built-up or urban land covers.

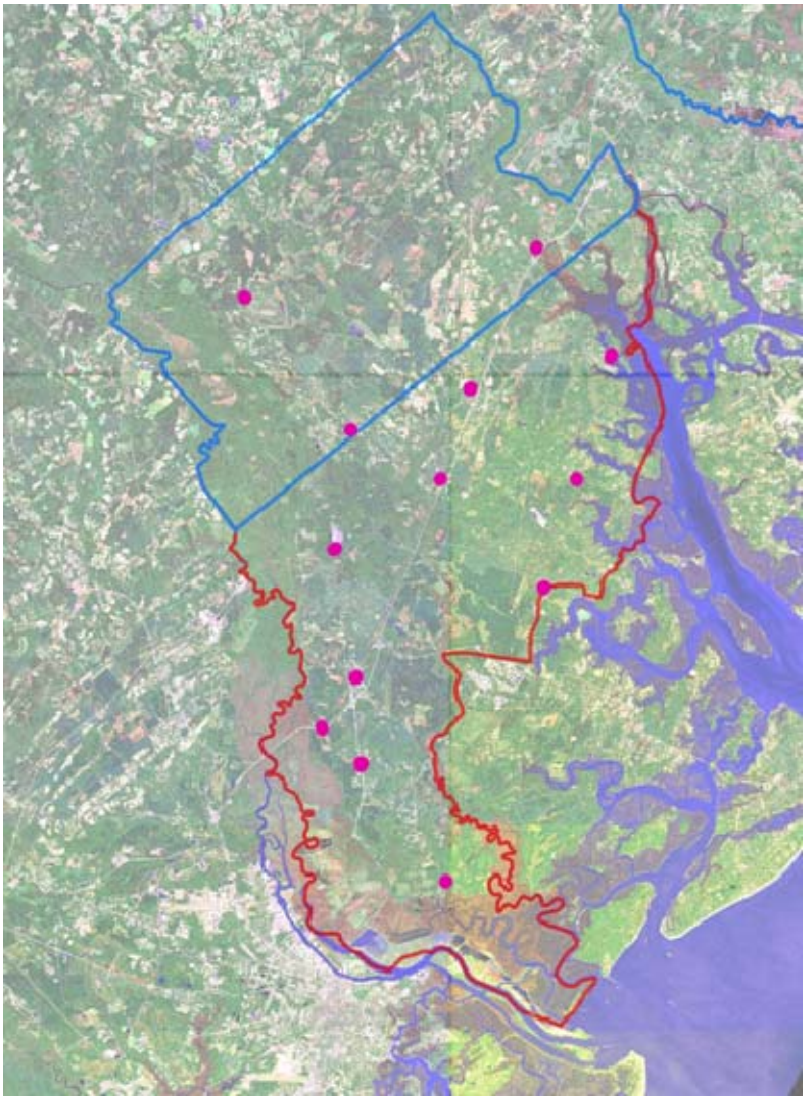

Figure 1. Location of Sample Sites in Jasper County

Figure 2. Example of Point Collection at a Test Site

Vertical Accuracy Tests

To test the vertical accuracy of the lidar data, the NOAA Coastal Services Center first generated a digital terrain model (DTM) by creating a triangulated irregular network (TIN) surface of the bare earth classified points. This DTM was then used to assign each surveyed point a lidar-generated elevation. The difference between the surveyed and lidar elevation was taken as the error. From these errors and land cover groupings, the various statistics were computed ($Accuracy_z$, FVA, SVA, CVA) using the guidance documents.

Upon review of its error value and location, one forest point was removed from the GCP set. It was located in an area of high slopes (15-20 degrees) on an earthen embankment. The lidar-derived elevation value was lower than the surveyed elevation, which was inconsistent with the data trends for forest points. It was deemed that while the actual error was not beyond the magnitude of other points, the point carried a measurement bias. The data were compared and statistics computed in an Excel spreadsheet (Appendix D).

Results

The critical pass or fail results are highlighted (bolded text) in Table 2; all the values are in centimeters. The technique used to survey the points generated additional open-terrain points and ended up doubling the number of open terrain GCPs. This is better than too few; however, to keep from having those values dominate the CVA value, a random selection of 20 open-terrain points was performed to better represent the data set (thinned). In either case, the difference was minor given that the outliers (typically forest or shrub) have a higher impact on the 95 percentile values.

Table 2. Ground Control Point Values

Land Cover Type	# of Points	RMSE (cm)	$Accuracy_z$ or FVA (1.96 x RMSE) (cm)	Consolidated Vertical Accuracy, CVA (95^{th} percentile) (cm)	Supplemental Vertical Accuracy, SVA (95^{th} percentile) (cm)
Total Combined (all points)	130	13.0	25	**29**	
Total Combined (Open terrain Thinned)	108	13.9	27	**30**	
Open Terrain	42	**6.2**	**12**		11
Weeds/Crops	19	12.3	24		20
Scrub/Shrub	21	17.8	35		32
Forest	26	19.3	38		31
Built-up/Urban	22	7.1	14		12

The error values for each land cover type show a fairly normal trend but do contain a few outliers (Figure 3). The overall error is low, which tends to highlight any deviations from the "normal" curve. The mean of the data is slightly above the actual surveyed surface and reflects the presence of incomplete vegetation removal (Table 3; Figure 4). This is a common problem, since taller grasses, branches, weeds, and twigs are difficult to remove fully without decimating the data.

Skewness (an argument for not using the RMSE x 1.96 methods to determine $Accuracy_z$) is below 0.5 for forest, built-up (urban), and scrub/shrub, and above 1 for open terrain (bare earth) and weeds and crops. The skewness for bare earth and weeds/crop classes appears to be the result of 1 (weeds/crops) or 2 (open terrain) points at the high end of the error distribution (Figure 3).

Given that the largest error within the 130 points was just over the 95% accuracy requirement, it appears that this data set is very consistent throughout the land covers and can be used with confidence in all types of settings. A large fraction of the data is within 10 cm of the surveyed ground elevation (Figure 4).

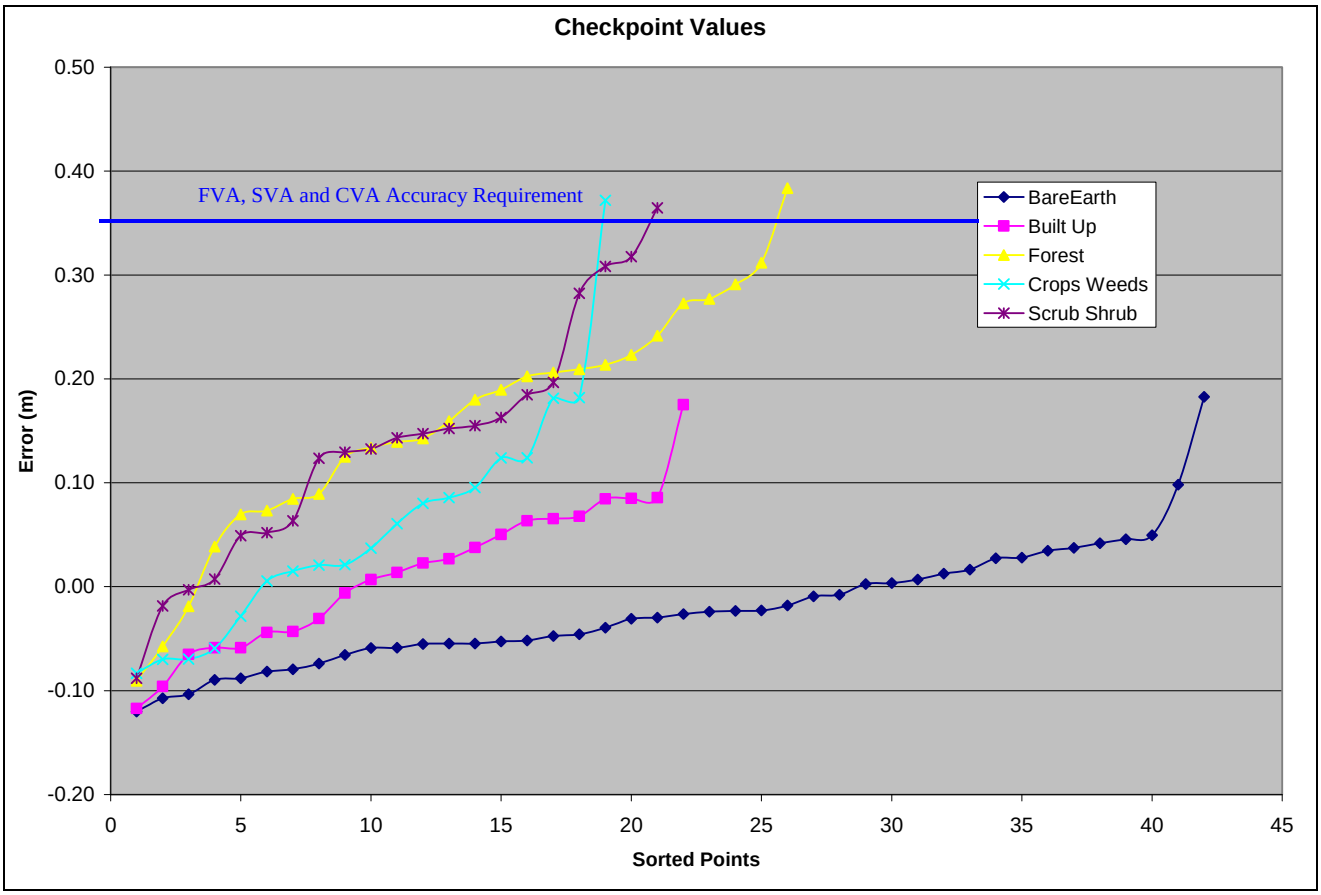

Figure 3. Sorted Check-Point Values

Table 3. Point Statistics

	RMSE (m)	Mean (m)	Median (m)	Skew	Std Dev (m)	# of Points	Min (m)	Max (m)
Total	0.130	0.06	0.04	0.78	0.12	130	-0.12	0.38
Open Terrain	0.062	-0.02	-0.03	1.09	0.06	42	-0.12	0.18
Weeds/Crop	0.123	0.06	0.04	1.18	0.11	19	-0.08	0.37
Scrub	0.178	0.14	0.14	0.17	0.12	21	-0.09	0.36
Forest	0.193	0.16	0.17	-0.35	0.11	26	-0.09	0.38
Built-up	0.071	0.01	0.02	0.15	0.07	22	-0.12	0.18

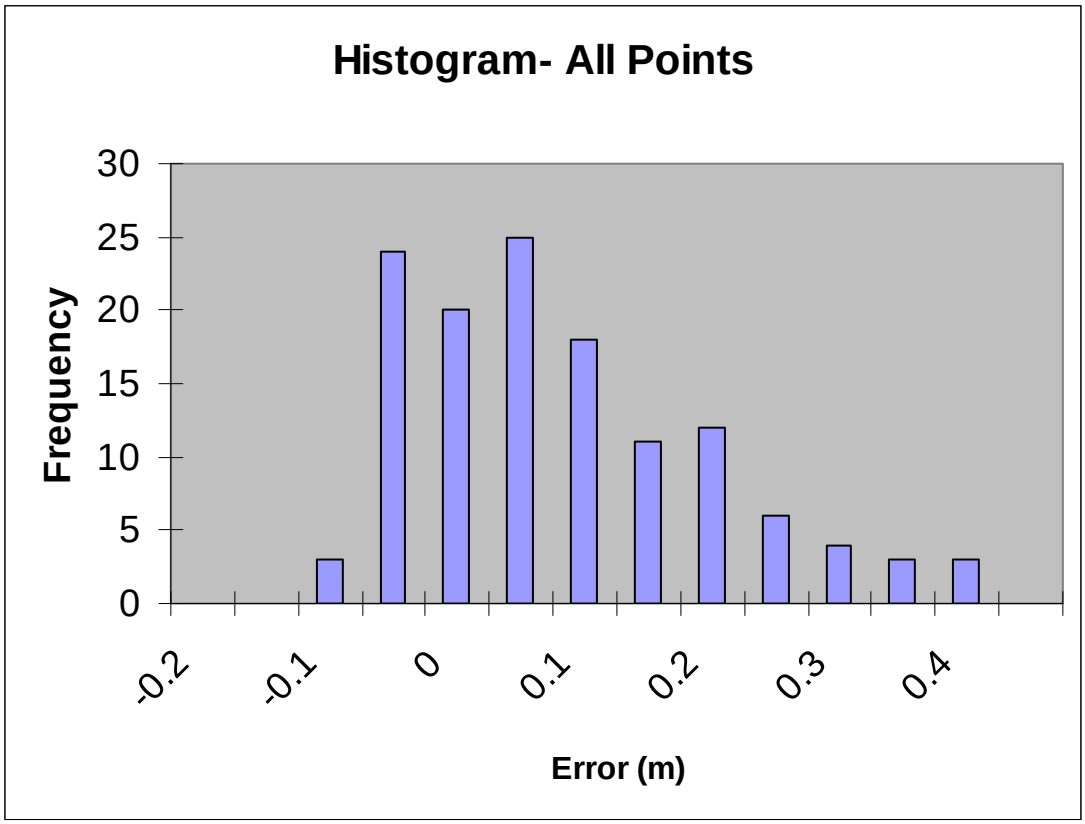

Figure 4. Error Histogram of All Ground Control Points (GCPs)

Fundamental and Consolidated Vertical Accuracy

The data passed the FVA and CVA measures specified in the initial statement of work (SOW) (Table 1, Figure 3). The measured FVA is 12 cm (29.4, NOAA Coastal Services Center specification; 36.3 cm, FEMA specification) and the CVA is 30 cm (36.3 cm, FEMA specification). Only three of the 130 points fell outside of the FEMA 36.3 cm specification (Figure 3).

Table 4. Points Not Meeting Specifications and Point Removed

Land Cover	Error	Notes
Scrub Shrub	36.5 cm	Low scrub
Grass – Crops	37.2 cm	
Forest	38.4 cm	
*Forest**	*- 26 cm*	*Not consistent with data trends; in an area of high slopes.*

*Removed from the analysis

Supplemental Vertical Accuracy

All the land cover categories passed the 36.3 cm SVA target using the 95th percentile method (Table 2). The only "nonconforming" specification is the SVA value for the forest category if using the RMSE x 1.96 method ($Accuracy_z$); however, the value was only about 2 cm higher, and this is not the typical technique for calculating this statistic. The SVA values are target values in the FEMA guidelines (2003) and not a strict pass/fail test.

Spatial Accuracy Trends

An aspect of remote sensing data collected with GPS is the spatial correlation of the error across the collection area associated with the changing quality of positional information (i.e., changes in PDOP, or positional dilution of precision). To define this variation, the accuracies of each point were normalized (divided) against the $Accuracy_z$ of its associated land cover classification. The mean of the normalized values was then generated for each "test site" to produce a relative site error. The site error was then mapped and a mathematical surface (spline) created to model the variation (Figure 5). It appears that the northwestern portion of the county may have a slight bias towards poorer values, but in most cases, the average is well below the accuracy requirements. In fact, the largest average test site errors are about the same as the RMSE values (approximately 0.5 of the $Accuracy_z$) such that there are no distinct outlier error locations (i.e. all sites had an acceptable level of accuracy).

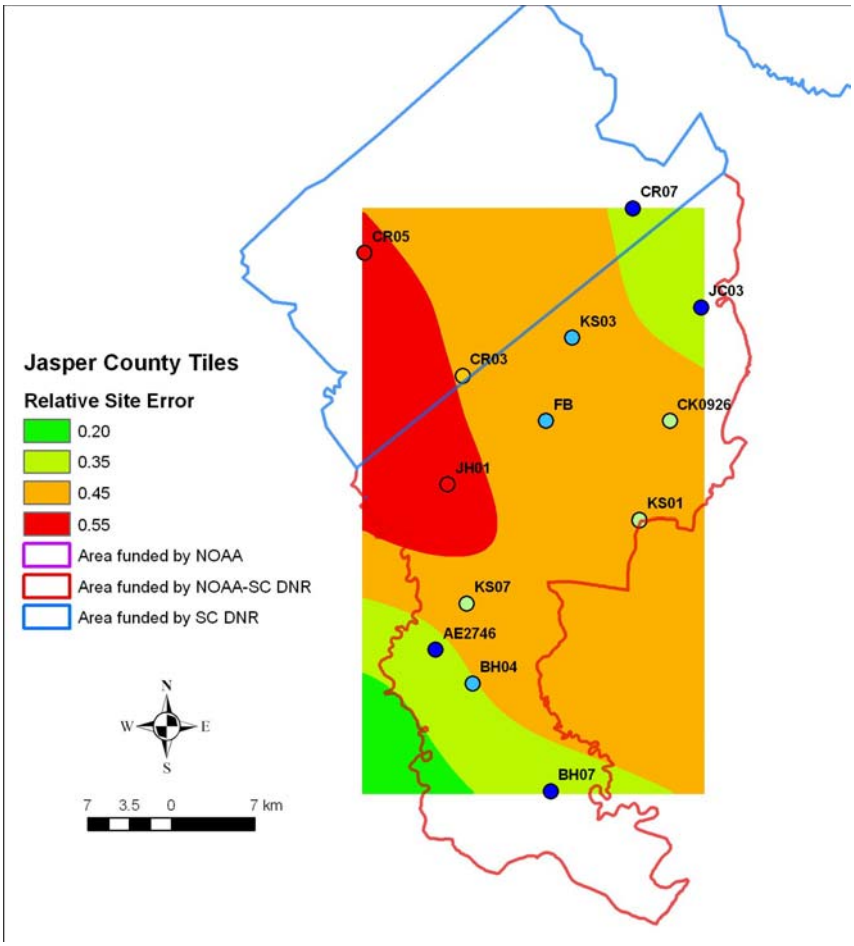

Figure 5. Error Trends in Jasper County

Accuracy Assessment Summary

Accuracy testing by the NOAA Coastal Services Center indicates that the lidar data meet the accuracy specified in the statement of work.

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Qualitative Assessment of Jasper County Lidar

The qualitative assessment of the Jasper County lidar consisted of three procedures. The point data (LAS files) were checked for macro (i.e., general data and format) and micro (i.e., accuracy and feature processing) issues (Figure 6). Digital elevation models (DEMs) were also provided and inspected for micro issues only. These analyses were performed on the draft data delivery, and the issues were sent to Photo Science for closer inspection. Photo Science addressed all the issues to the satisfaction of the NOAA Coastal Services Center's quality assurance (QA) team.

The LAS files were checked for macro issues such as existence of data within each file, correct projection, correct file name, classification of data, return information, intensity, and format. This was an integrity check to see that all the files were received and were not corrupted. For this portion of the QA, 80% of the files were checked. The LAS files were then checked for micro problems, which would include checking for point density, flight line match, corn rows or other artifacts, high or low values, feature removal, and point smoothing, among other usability aspects. This level of review was carried out for approximately 25% of the tiles. Taken in total, almost every LAS tile was reviewed at some level (Figure 6).

The DEM files were reviewed separately since they included both the LAS data and breakline information generated as a separate work product. These DEM products will likely be used more by the partners than by the NOAA Coastal Services Center. These files were checked for micro issues similar to the LAS files but were checked to see if hydro-enforcing was performed (i.e., the water ran downstream). A total of 30% of the DEM tiles were reviewed.

Procedures

The files were reviewed using several software packages and techniques. The macro reviews were typically carried out in PointVue software, which is a native 3D point-only viewing program. Here the projection and datum, classifications, outliers, intensity, and data format were checked.

The micro reviews were primarily performed using LASEdit. Triangulated irregular network (TIN) surfaces from the points (primarily those classified as bare earth), as well as 3D views and profiles, were used to examine the data for irregularities.

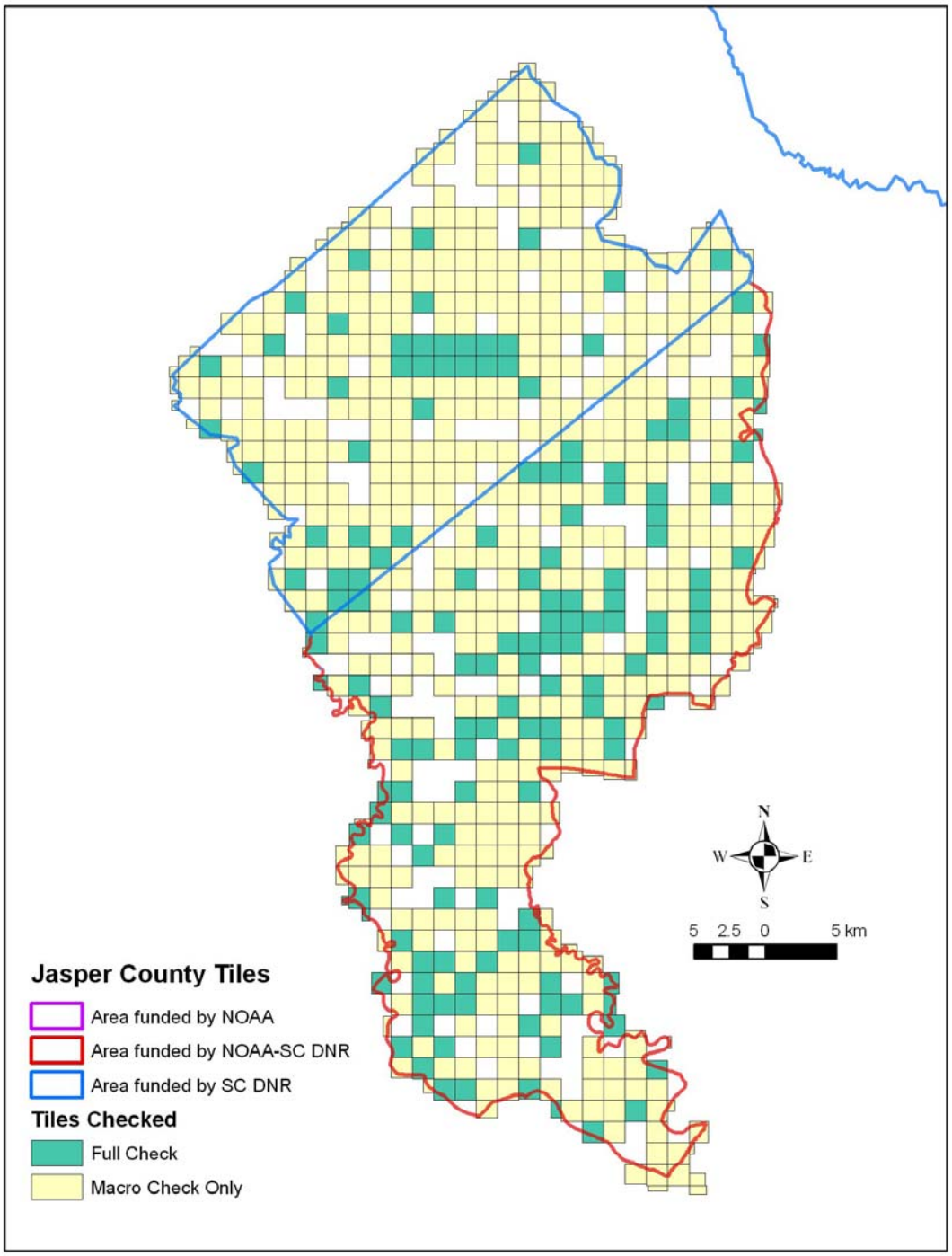


Figure 6. LAS Files in Jasper County Checked, and the Level of Review

LAS Reviews

More than 80% of the tiles were checked at the macro, micro, or both levels of review. The data were in almost all cases very clean of artifacts, corn rows, and flight line mismatch problems. There were very few issues. The issues that were most apparent stemmed from the extremely flat terrain (Figure 7). Some of the tiles, which were several kilometers wide and long, had elevation changes on the order of 1 meter; this made inconsistency in flight lines the most recognizable artifact or issue. Structure and

tree removal were performed well, since the elevation differences between the very flat ground and any tree, shrub, or building were probably easily recognized by the automated classification process. The level of smoothness to the data was also noted—there being very few pits and spikes.

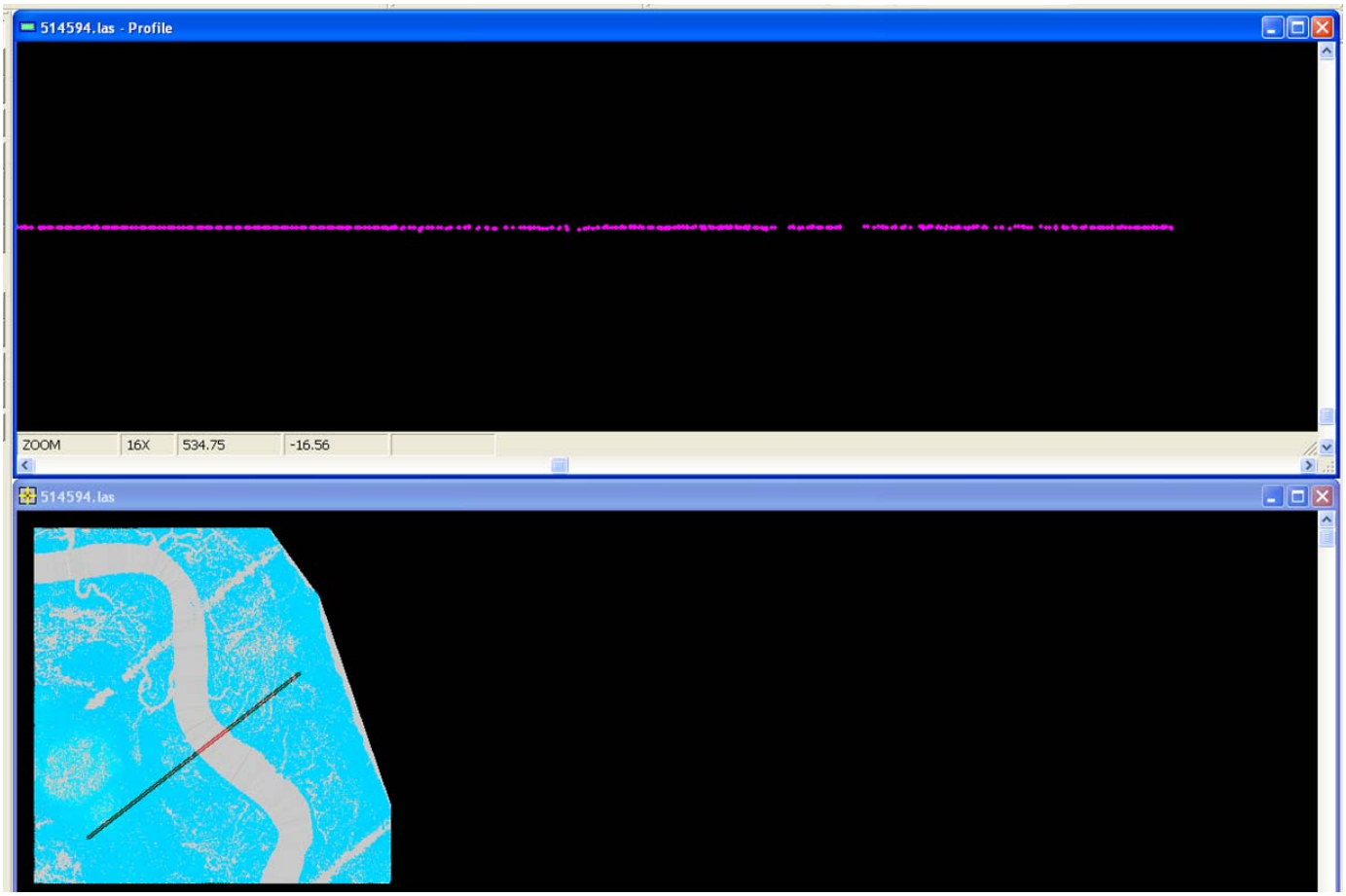


Figure 7. Example of Flat Terrain; Profile Is over 1.0 km

Results

Macro Review

The results of the macro review confirmed that the data were complete and incorrupt. The only real issue noted was the use of classification no. 12 of points that were either first or middle returns. This was addressed by Photo Science and all no. 12 classified points were changed to no. 1 (unclassified). An issue with the header information was also noted, in that the number of points for each return (i.e., return 1, return 2) was missing. This is not considered a problem, since the processing of the data by the Center should correct this. Photo Science believes that this problem is a Terrascan/Terrasolid issue.

Micro Review

In general, the LAS files were very clean of artifacts, and very few qualitative issues were noted. This is consistent with the high quality of the data documented in the accuracy assessment. Some tile-specific issues were noticed, but for the most part these were relatively minor. Of the 200 LAS tiles reviewed in depth, only 16 showed notable issues (Figure 8).

These issues were generally minor, difficult to find, and for the most part related to flight line matches. The terrain is exceedingly flat in most of the county, so very small offsets become visible. The offsets noted were typically less than 20 cm, which is well within the accuracy specifications of the data. There were, however, some tiles with flight line mismatches greater than 20 cm (Figure 9). Flight line mismatches were much less noticeable in tiles where the overlap points were kept; in some tiles, or sections of tiles, the overlap points were removed and this 1) appeared to increase the appearance of flight line mismatches or 2) may have been required because there was some slight flight line mismatches. Flight line mismatches were addressed by Photo Science to the satisfaction of the NOAA Coastal Services Center QA team.

Given the very flat terrain, slight flight line mismatches may be important for modeling water flow. Mismatches below about 10 cm were difficult to see in the data, but above that, they started to become noticeable. Previous QA reports from Florida counties (Northwest Florida Water Management District) suggested that 20 to 30 cm was about the cutoff between acceptable and unacceptable. For the terrain in Jasper County, the cutoff may be a bit lower; 15 cm seems to be about where the difference can be discerned as changes in terrain contours. Only a few tiles had flight line mismatches above this threshold to begin and all were corrected.

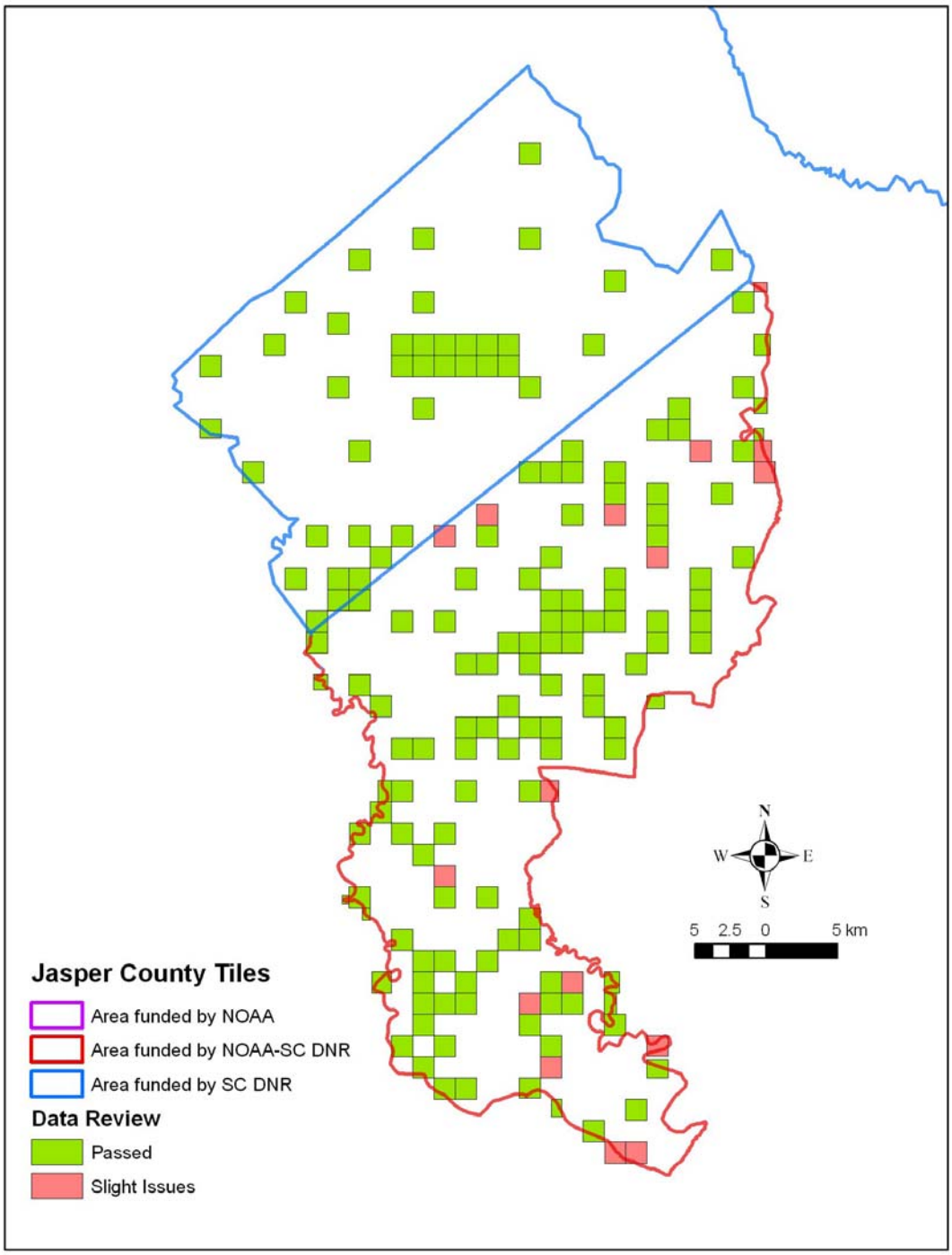


Figure 8. Jasper Tiles Reviewed at Micro Level

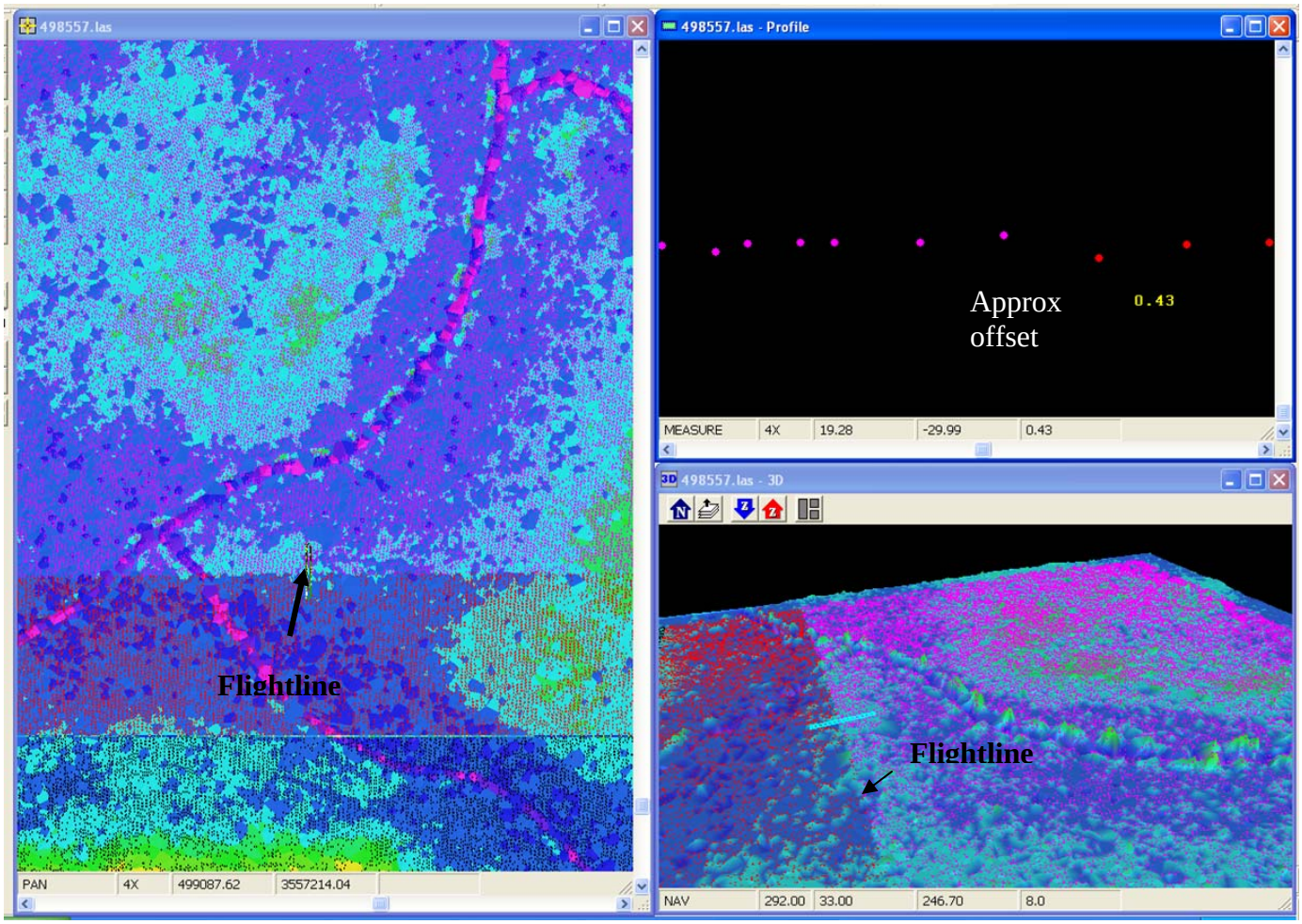


Figure 9. Example of Flight Line Mismatch and Approximate Offset of about 40 cm

The list of flagged files (below) is the extent of the problems founds in the draft data. Issues are typically small but were submitted for review. The problems have been addressed to the satisfaction of the QA team.

Table 5. LAS Files for Review

Tile	region	Notes	Contractor Response
490567	coast	one slight questionable mound	Reviewed/ok
492560	coast	slight mound, slight corn row	Reviewed/ok
492566	coast	flight line overlap issue	Fixed
492590	inland	40 cm flight line mismatch	Fixed
493572	coast	some low points for removal	Fixed
495591	inland	slight pitting	Fixed
496561	coast	maybe a bit over aggressive on point removal	Fixed
498551	coast	ever so slight corn rows	Remain
498557	coast	slight flight line mismatch	Fixed

498617	inland	15 cm flight line mismatch	Fixed
499552	coast	slight flight line	Fixed
499572	coast	maybe slightly overaggressive smoothing	Reviewed/ok
501558	coast	slight flight line mismatch	Fixed
504546	coast	slight flight line mismatch	Fixed
504591	inland	slight cornrows	Remain
505546	coast	slight flight line mismatch	Fixed
507554	coast	very slight flight line mismatch	Fixed
507588	inland	slight pitting	Fixed
510596	inland	slight flight line mismatch	Fixed
513606	inland	about 5 to 8 cm corn rows	Fixed
514594	inland	Birds	Fixed
514596	inland	Birds?	Fixed
514597	inland	couple high points	Fixed
514608	inland	some birds and slight flight line issue	Fixed

The following figures provide examples of the non-flight line mismatches found in the draft data set. These issues are, again, very minor; they are being included mainly for the data user's general information. In all cases, the issues were addressed and changes made or the cause of the issue discussed. The only remaining unsolved problems were some slight "corn rows" (Figure 11), which are caused by slight scan-line discrepancies (i.e., the forward scan line has a slight bias vs. the backward scan line) that are nearly impossible to remove. The biases are removed in the gridding process, so the minor differences (typically about 6 cm) are averaged out. For this reason, the existence of corn rows was generally left alone.

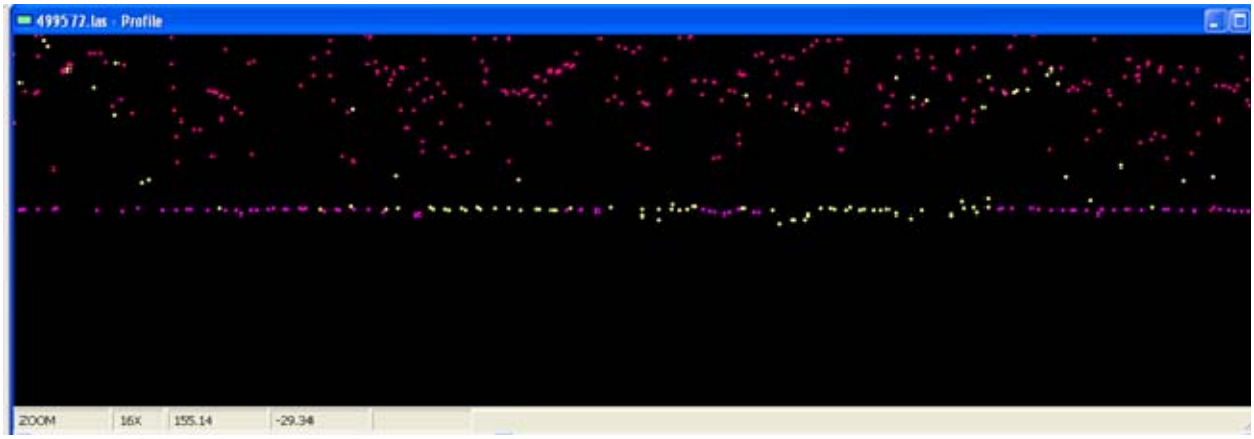


Figure 10. Overaggressive Point Removal. The yellow points are unclassified points that appear to be bare earth. Removal of the points from the data reduces the effective point density and, thus, the accuracy of the terrain model. The cases where this occurred were reviewed and classifications modified if they were judged to reduce the surface accuracy.

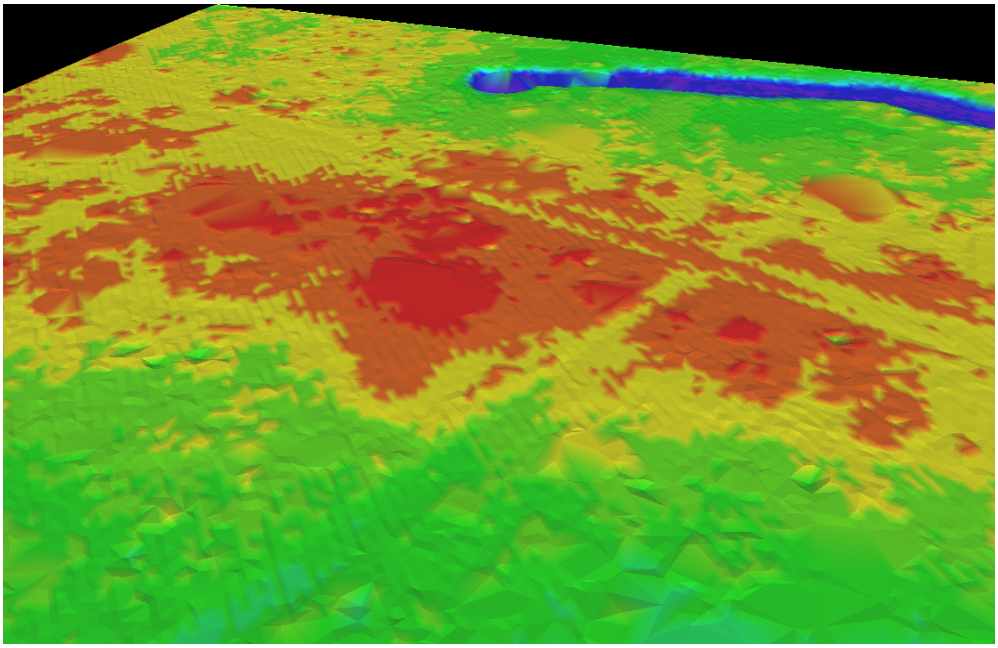


Figure 11. Corn Rows (about 6 to 9 cm) Remain in Data Set

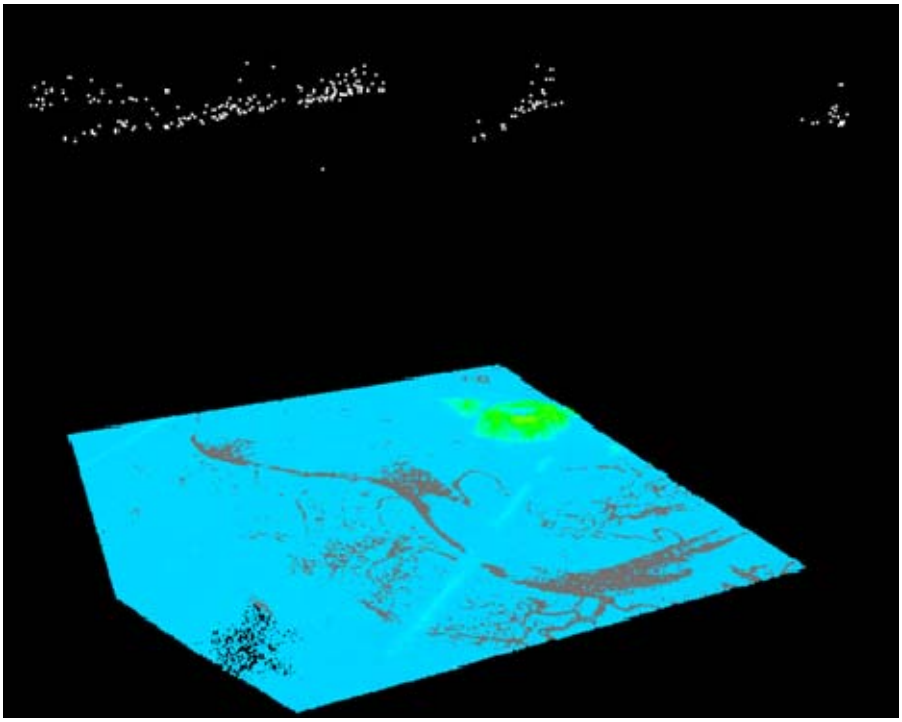


Figure 12. Potential Birds or Clouds about 1500 Meters above the Ground Surface. This issue was noticed in several tiles along the rivers in Jasper County. This is not a problem for most applications, since the points are unclassified, but they should be removed for creation of a digital surface model (e.g., tops of trees, houses).

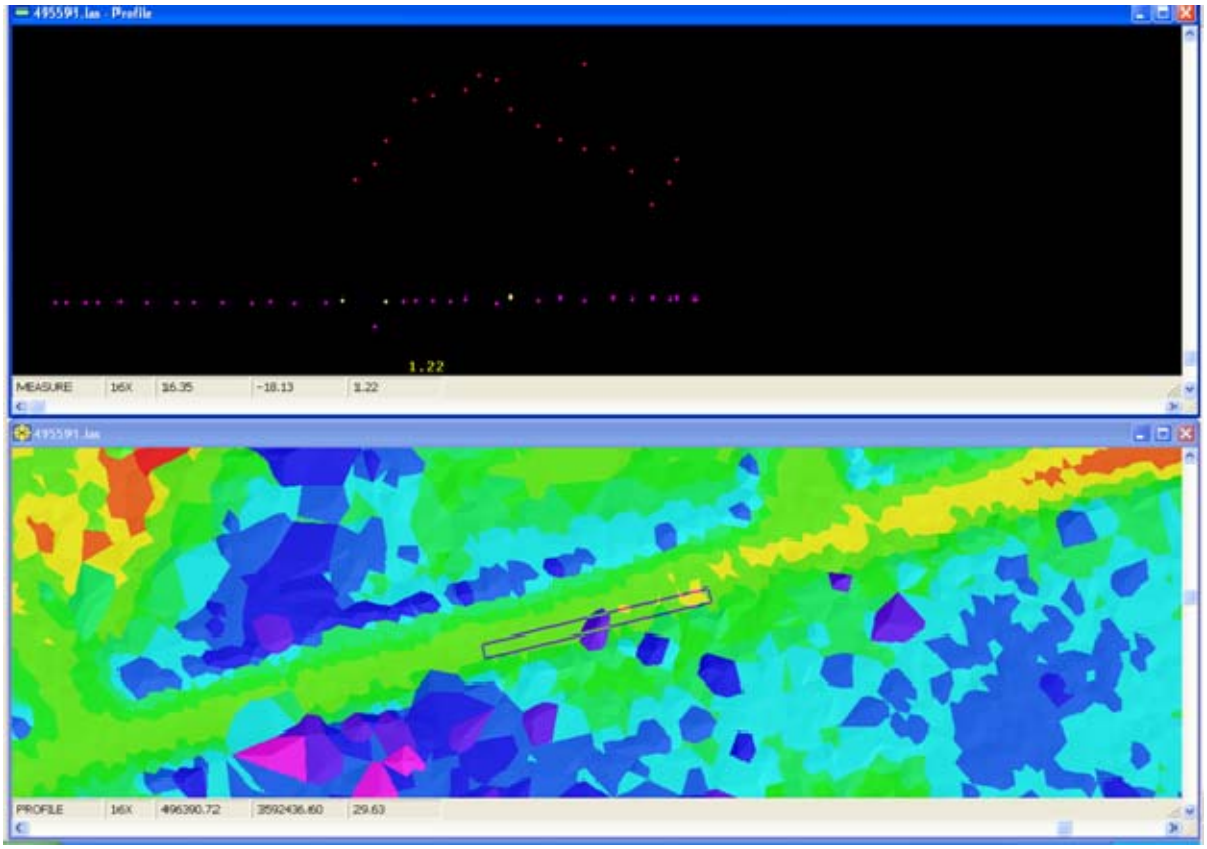


Figure 13. Slight Pit (1.22 meters) on Flat Road with Other Pits Appearing to the East (right). This is typically caused by one low point that appears to affect the adjacent points (i.e., the two adjacent yellow points in the profile defined as unclassified are likely actually falling on the ground surface). These can be difficult to remove without highly manual processing.

Digital Elevation Models (DEMs)

The QA procedure for the Jasper County, South Carolina, lidar determined that, overall, the DEM data were very good. The tiles chosen for review were randomly selected and represent approximately 30% of all tiles (Figure 14). If issues with a tile were discovered, the adjacent tiles were also examined. The DEM data are expected to be a highly used product and include both the lidar and break line information. Some minor issues with the DEMs were found, and they were submitted to Photo Science for review. Photo Science corrected, to the satisfaction of the QA team, the issues raised during the review.

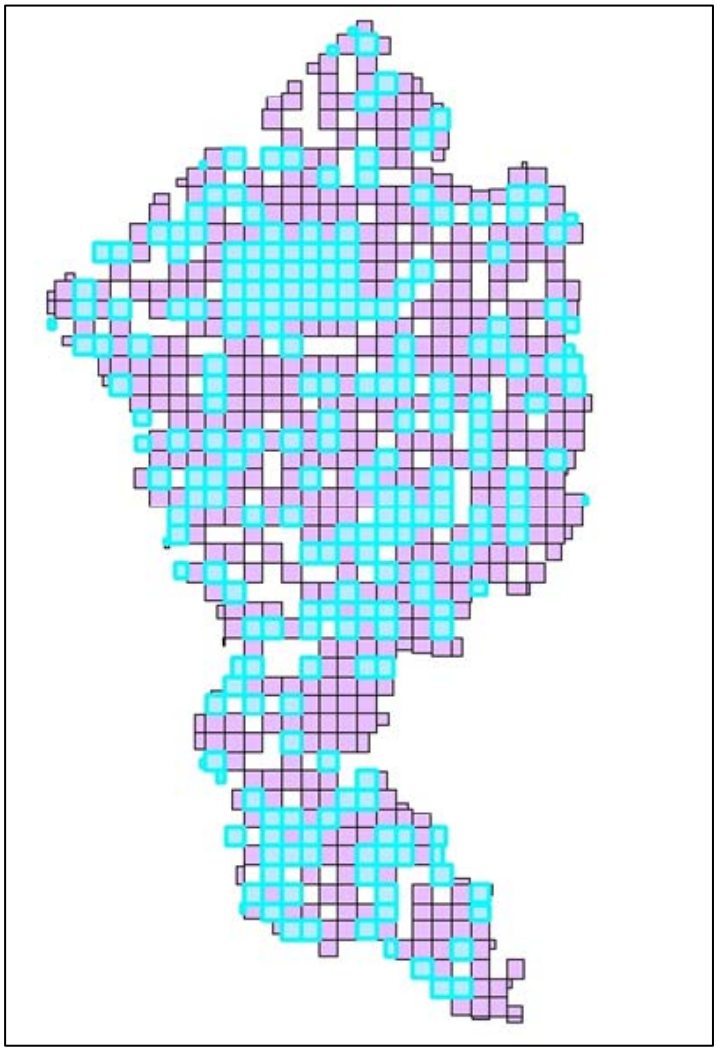


Figure 14. DEMs Reviewed (highlighted in blue)

Process

Each DEM was checked using the Global Mapper software program with the corresponding DOQQ (Digital Ortho Quarter Quad) and Google Earth images for reference. The DEM tiles were

1. checked for consistency;
2. examined for tile edge match with neighboring tiles and match of features across tiles;

3. checked for flight line match, artifacts, water boundaries, shoreline and road match, and bridge, building, and vegetation removal; and
4. reviewed visually for proper hydro-enforcing (i.e., water flowing downstream).

The tiles were reviewed initially to highlight any potential problems and then reviewed by a second reviewer to cross-check the issues. Table 4 lists the DEM files for review.

Table 6. DEM Files with Potential Issues

Tile	Region	Note	Response
489572	Coastal	A few bumps (hay bales?), upper portion of tile (Fig. 15)	Reviewed
495576	Inland	Upper right quadrant, potential artifacts? (Fig. 16)	Reviewed
498582	Inland	Bridge removed, but 4 piles still remain (Fig. 17)	Reviewed
501557	Coastal	Features not removed? 1 house, 4 trees (Fig. 18)	Reviewed
489602/489603	**Inland**	**These tile sets do not butt up together, looks like tile 602** **doesn't totally fill the area, gap of about 15 m (Fig. 19)**	**Fixed**
490602/490603	**Inland**		
492602/492603	**Inland**		
493602/493603	**Inland**		
495602/495603	**Inland**		

The biggest problem is with the five sets of inland tiles (Figure 17); they were redone by Photo Science. The other tiles were checked, but the issues were mainly small, localized artifacts, and the professional opinion indeed determined the artifacts to be ground features. The following figures are examples of the minor issues that were found. Given that about 200 tiles were checked, the list is small, which highlights the overall quality of the data set. All the issues have been addressed to the satisfaction of the QA team. The DEMs have been accepted as a very good data set.

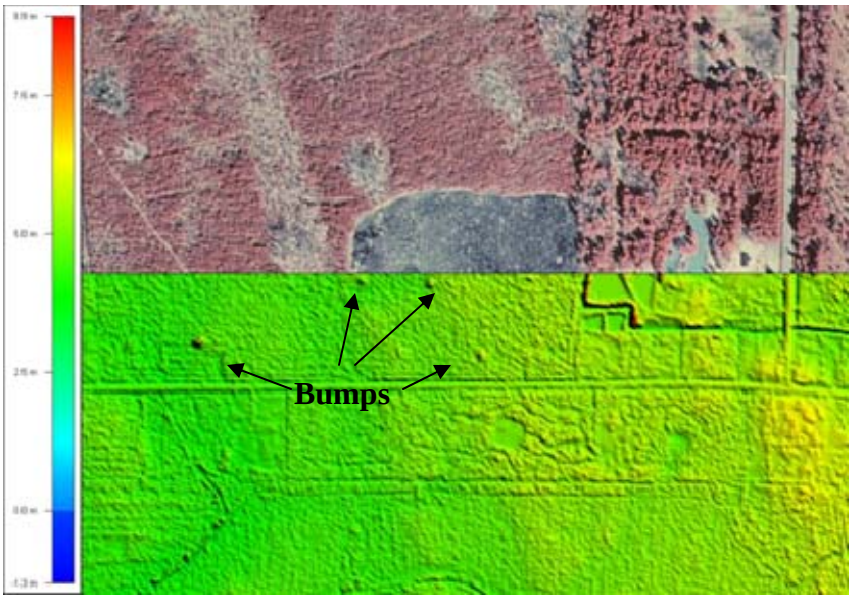


Figure 15. Slight Bumps in Flat Terrain That May Be Hay Bales or Other Non-Ground Features

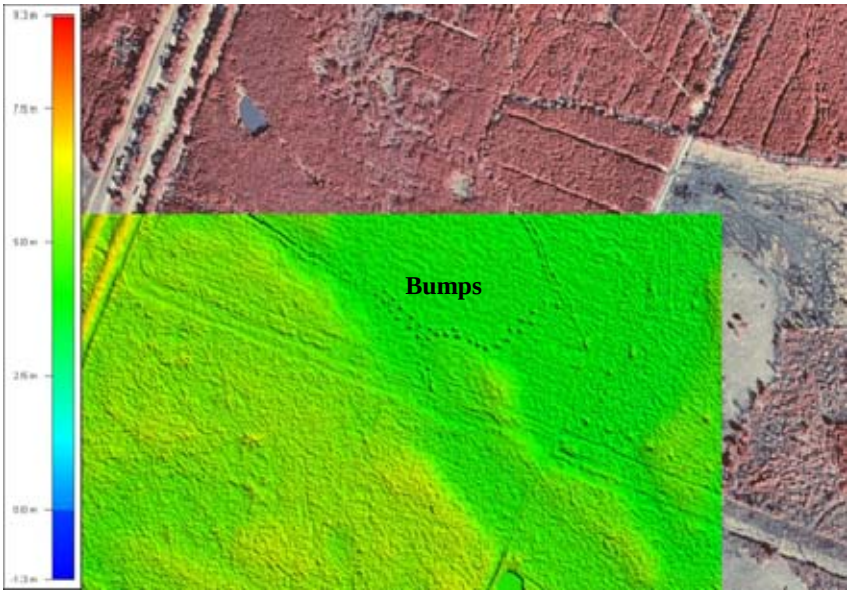


Figure 16. Unknown Features along Road

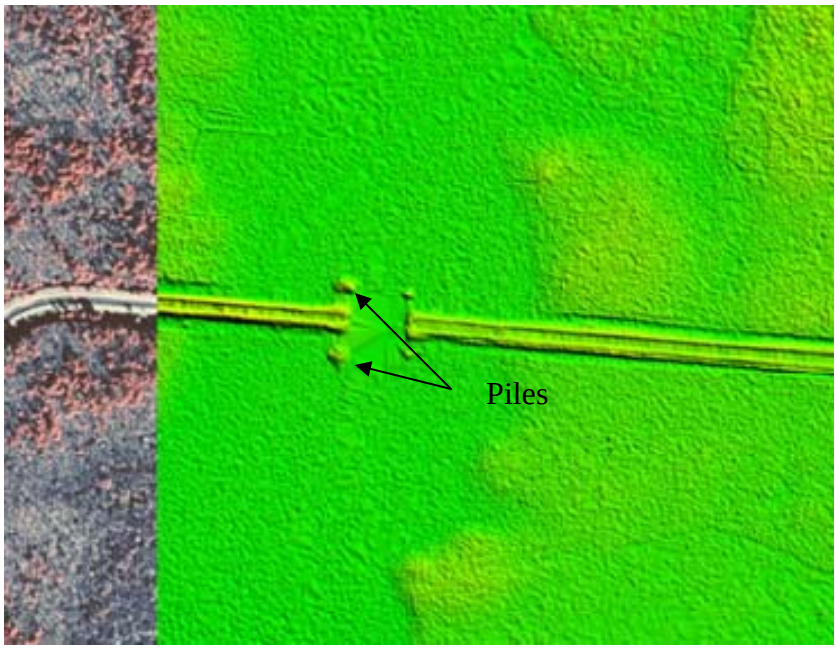


Figure 17. Piles beside Bridge Not Removed?

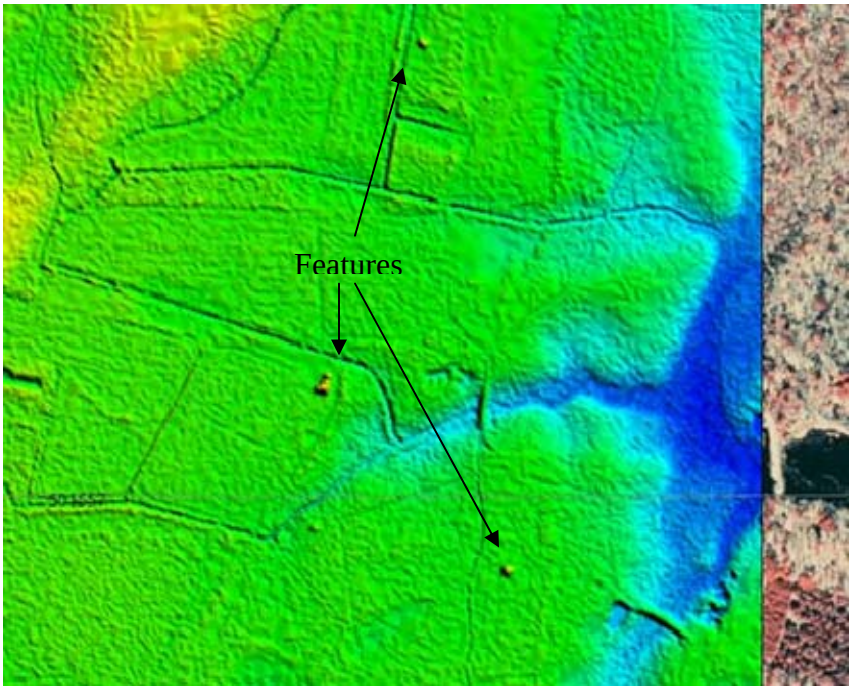


Figure 18. Incomplete Removal of Small Features Possible

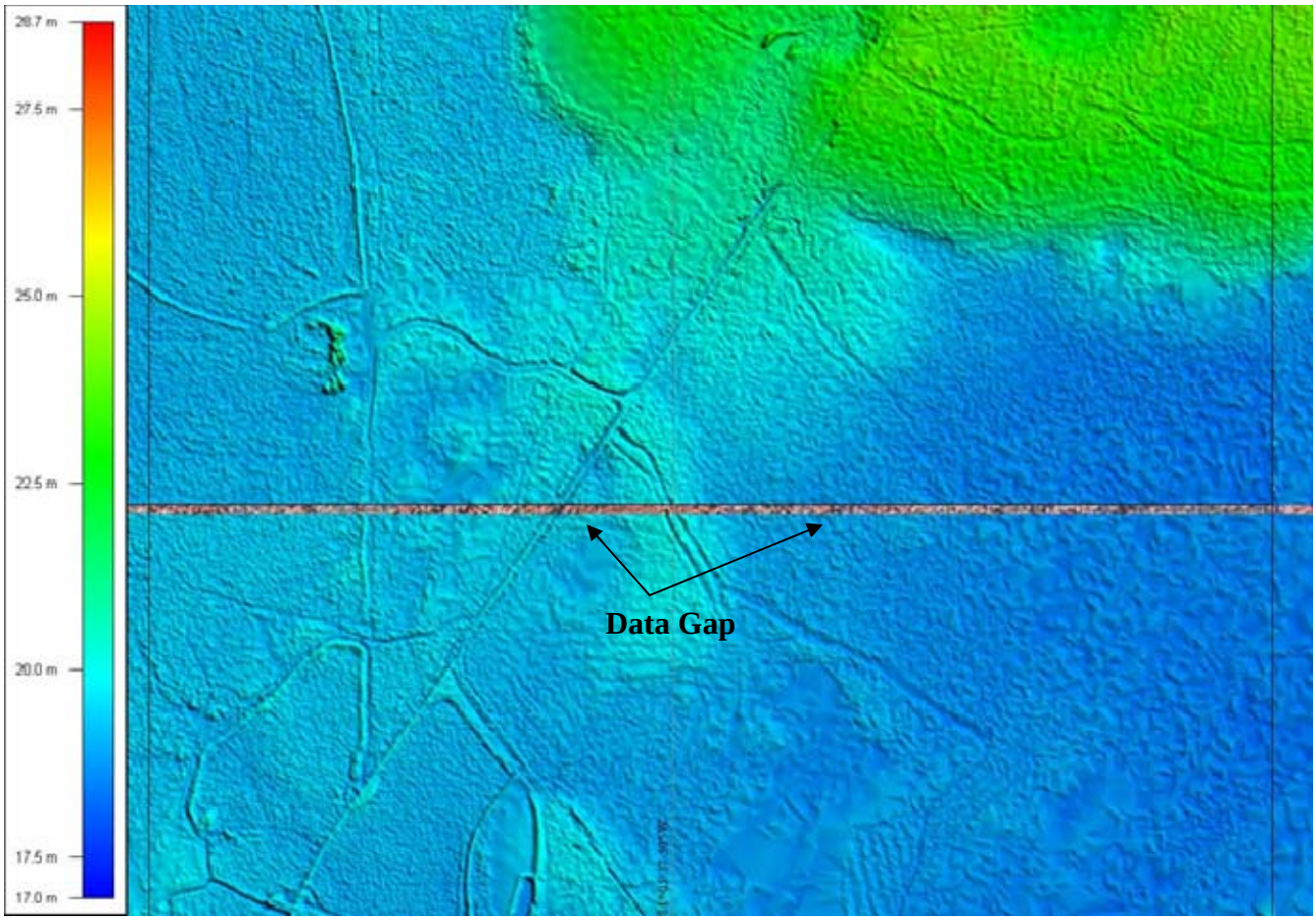
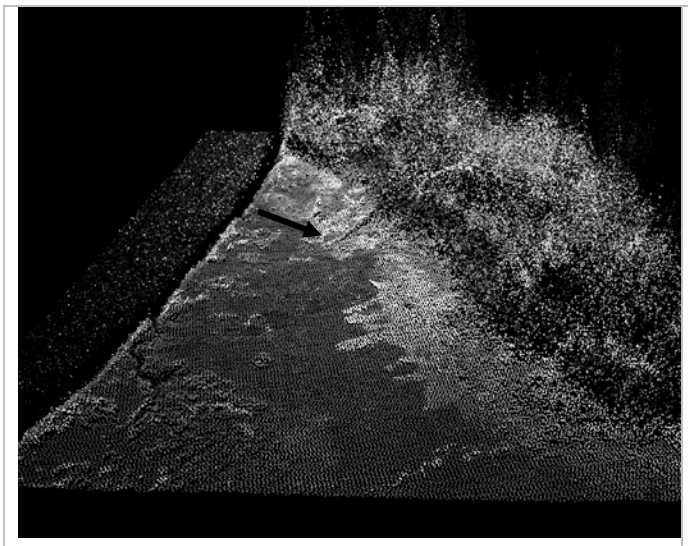


Figure 19. Example of the Gaps in Data between Several Tiles. This issue was corrected by Photo Science.

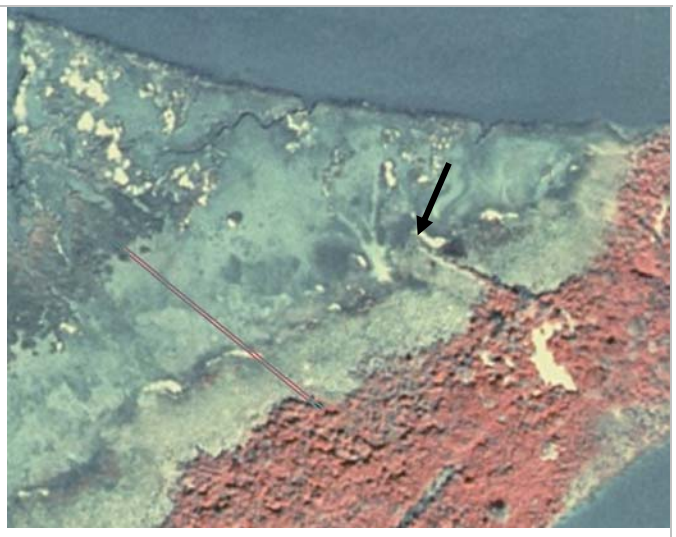
Coastal Applications

There is a significant amount of coastal marsh in Jasper County but not much sandy beach. And, in keeping with the flat terrain, there is an important premium placed on micro-topographic change; a few centimeters can make a large difference in determining the type of dominant species. Moreover, a significant amount of high marsh vegetation can be difficult to measure through.

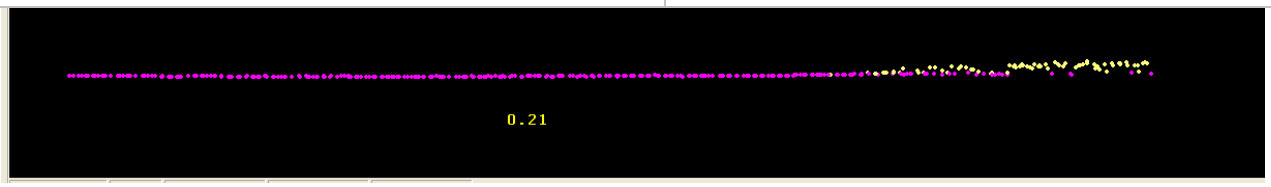
An example using these aspects of coastal habitats is presented in Figure 20. In this case, a coastal marsh with mixed habitats (Figure 20, A and B) is shown with the changes in lidar elevation (Figure 20, C). The intensity returns show the variations in vegetation or soil types and highlight the various habitats, along with the aerial image (Figure 20, B). Significantly, the marsh elevation, even when crossing different vegetation and soil types, only changes on the order of 30 cm (1 ft), which is consistent with the terrain. What is not seen are vegetative changes in elevation; that is, there is no discernable (large) change in elevation where different marsh plants and habitats intersect, which is a good indication that the ground surface is being measured and not the height of marsh vegetation.



A. 3D Intensity View of Coastal Marsh Area (arrow pointing to same feature as in B)



B. Aerial Photo of Marsh Area, with Profile (red) in Middle of Image



C. Profile (red line in B) Showing Flatness of Area with about a 20 cm Variation across the Different Habitats. Purple points are ground classified and yellow points are unclassified vegetation (not used to make DEM surface).

Figure 20. Coastal Area Examined for Lidar Use

The DEM of the same area with the aerial image overlaid (Figure 21) highlights the utility and consistency of the data, where only slight changes (1.5 ft) in elevation (across different vegetation) are consistent with the terrain. Also note that the sandy areas (whitish areas along riverbank) appear higher than the surrounding vegetated areas, which is consistent with the terrain and the apparent “side cast” of dredge material.

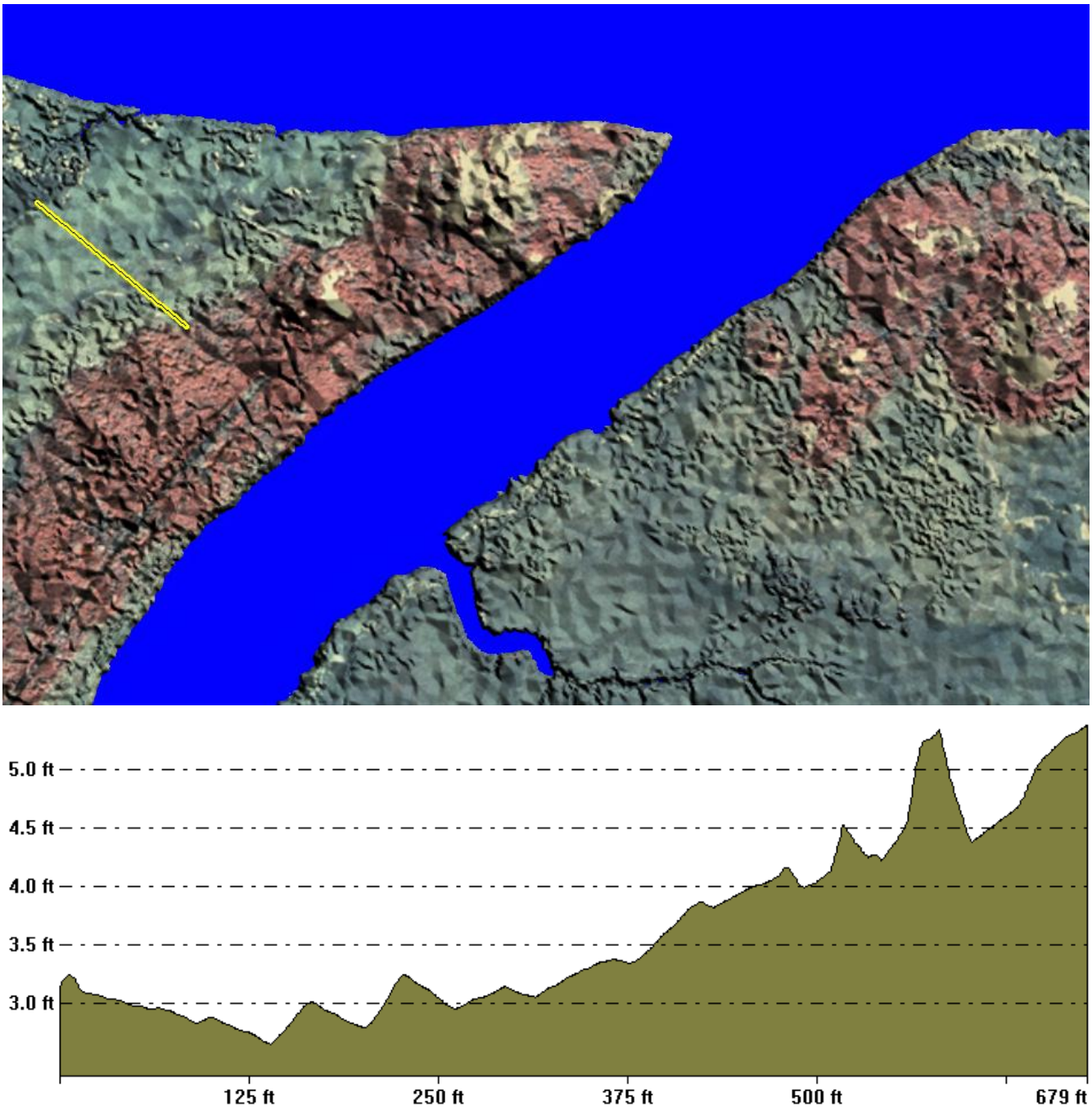


Figure 21. DEM with Image Overlay and Associated Profile in Coastal Area

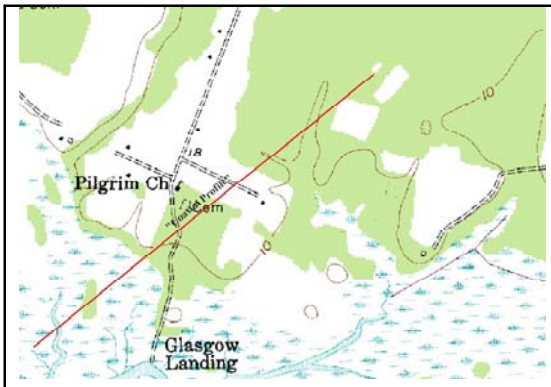
Conclusions

The data are, in all respects, of very high quality. The minor issues found either have been corrected or were deemed trivial to the performance of the data for the expected uses. The data can be used consistently over the county in applications where vertical accuracies of approximately 1 ft (30 cm) are required. Relative accuracies may be significantly higher for small areas of investigation where the

terrain is not obstructed (e.g., cultivated fields or roads). In these settings, it is likely that 1/3 ft (10 cm) changes (or less) in the terrain can be mapped with a high level of confidence.

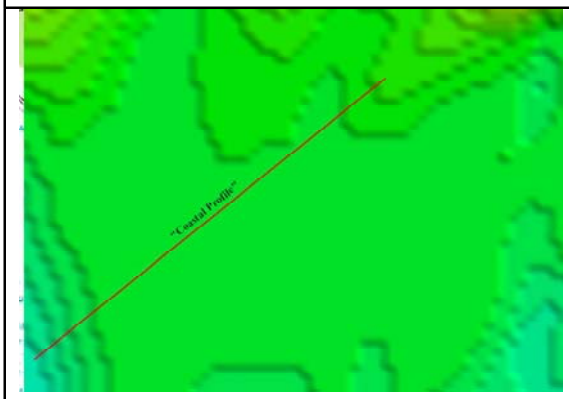
Coastal applications of the data also appear to be supported, since the data show good marsh cover penetration. Additional tests may be required to document accuracies in the marsh categories, but the general land forms appear to be correct and not overly influenced by vegetation heights.

The differences between the older data now available and the new Jasper lidar are striking. There is significantly more resolution (Figure 22, B-D) and a dramatic change in values (e.g., most places are one to two meters different than previously denoted).

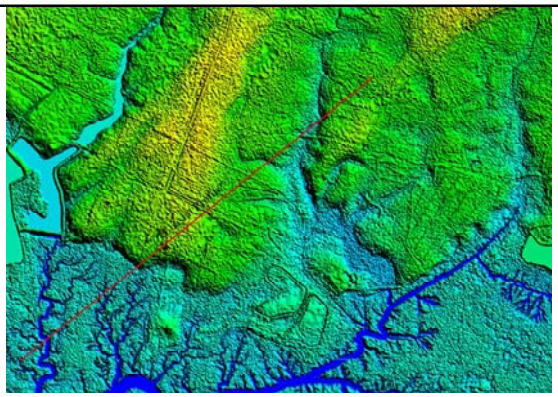


A. Coastal Location in Jasper County

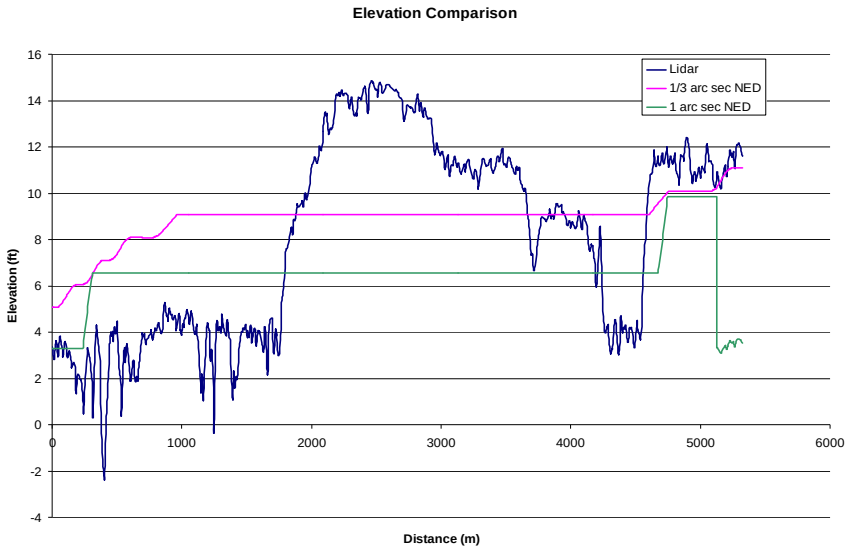
B. 30-meter National Elevation Data (NED) for the Area



C. 10-meter NED for the Area



D. Lidar Data for the Same Area (B, C, and D all have the same elevation color scale)



E. Elevations along "Coastal Profile" Shown in Figures A-D

Figure 22. New Lidar Data Compared with Existing Data

References

American Society for Photogrammetry and Remote Sensing (ASPRS). 2004. "ASPRS Guidelines: Vertical Accuracy Reporting for Lidar Data." American Society for Photogrammetry and Remote Sensing. Accessed November 2007 at *www.asprs.org/society/committees/lidar/Downloads/Vertical_Accuracy_Reporting_for_Lidar_Data.pdf*.

Federal Emergency Management Agency (FEMA). 2003. "Guidance for Aerial Mapping and Surveying." Appendix A in *Guidelines and Specifications for Flood Hazard Mapping Partners*. Federal Emergency Management Agency. Accessed November 2007 at *www.fema.gov/plan/prevent/fhm/dl_cgs.shtm*.

Federal Geographic Data Committee (FGDC). 1998. "National Standard for Spatial Data Accuracy." Part 3 of *Geospatial Positioning Accuracy Standards*. FGDC-STD-007.3-1998. Federal Geographic Data Committee. Accessed November 2007 at *www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3*.

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National Oceanic and Atmospheric Administration (NOAA), Coastal Services Center. 2006. "Statement of Work; Jasper County, South Carolina Lidar; Mod 1." November. Unpublished.

Appendices

Appendix A – Statement of Work

Appendix B – GPS Point Collection; Temporary Benchmark and Ground Control

Appendix C – Ground Control Point Collection

Appendix D – Point Data for Calculations

APPENDIX A

Coastal Services Center
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

****

STATEMENT OF WORK

Jasper County, South Carolina Lidar

July 2006

Table of Contents

List of Acronyms

ASPRS ..... American Society of Photogrammetry and Remote Sensing
CO ..... Contracting Officer
COR ..... Contracting Officer's Representative
CRS ..... Coastal Remote Sensing
CSC ..... Coastal Services Center
FGDC ..... Federal Geographic Data Committee
LIDAR ..... Light Detection and Ranging
NAD ..... North American Datum
NAVD ..... North American Vertical Datum
NGA ..... National Geo-spatial Intelligence Agency
NOAA ..... National Oceanic and Atmospheric Administration
NSSDA ..... National Standard for Spatial Data Accuracy
QA ..... Quality Assurance
QC ..... Quality Control
RMSE ..... Root Mean Square Error
SOW ..... Statement of Work

1 Overview

This Statement of Work (SOW) has been developed by the National Oceanic and Atmospheric Administration's (NOAA) Coastal Services Center (referred to as the Center) to collect and deliver topographic elevation point data derived from multiple return light detection and ranging (lidar) measurements for areas in coastal South Carolina, specifically Jasper County. Data are intended for use in coastal management decision making, including applications such as flood plain mapping. This SOW provides specific information needed by commercial contractors to respond by submitting a technical proposal, a firm fixed price cost proposal, and a timeline detailing how the required products will be produced and delivered for the geographic areas under consideration. An electronic copy of the technical proposal, cost proposal, and timeline shall be provided.

2 Background

The mission of the Center is to support the environmental, social, and economic well being of the coast by linking people, information, and technology. The data produced from this SOW are intended to support the local Coastal Zone Managers in their decision-making processes. This data will be used for flood plain mapping and other coastal management applications.

3 Requirements

The Contractor shall provide topographic elevation data for the designated areas of Figure 1 as described in this SOW. Data collection, processing, and delivery shall be accomplished in accordance with the following specifications. The contractor shall provide all necessary labor, equipment, material, software, and supplies to satisfactorily complete the SOW.

3.1 Data Coverage

The project area shall be part of Jasper County, South Carolina. This area is estimated to cover approximately 1000 km^2, but should be verified by the contractor. The county is depicted in Figure 1 for reference. An ESRI shapefile of the county will be provided, but the shapefile cannot be assumed to represent the current shoreline or exact boundaries of collection.

3.2 Data Collection and Delivery

- The Contractor shall deliver the Lidar multiple-return mass points for the specified area(s) in the LAS data format. In addition to the measured elevation value, the intensity value for each return shall be included and, at a minimum, returns shall be classified as water, bare-ground, or not bare ground according to the American Society of Photogrammetry and Remote Sensing (ASPRS) LAS format classification table. The point data type used in LAS format shall include the GPS time and the headers shall include the date of collection.

- Nominal point spacing for the Lidar mass points shall meet the FEMA flood plain mapping specifications but shall not exceed 2 meters.
- File organization of the point data is at the discretion of the contractor. Thus, it does not need to be tiled if that would prevent the accurate time stamp for the data in LAS format. However, files shall be no more than 2.0 Gigabytes in size. The file naming convention shall be documented.
- Bare-earth gridded DEM meeting or exceeding FEMA flood plain mapping specifications. Vertical datum for the gridded product shall be the North American Vertical Datum of 1988 (NAVD88).
- The Contractor shall collect and deliver all point data referenced to the North American Datum of 1983 (NAD83) and the Geodetic Reference System of 1980 (GRS80). Horizontal units shall be in UTM zone 17 meters. Vertical units shall be in meters above the GRS80 ellipsoid surface. **Note, this is a different vertical datum than the gridded DEM**.
- Lidar data accuracy determination shall employ the National Standard for Spatial Data Accuracy (NSSDA). When compared to GPS survey grade points in generally flat non-vegetated areas, at least 95% of the positions shall have an error less than or equal to 29.4 cm (equivalent to root mean square error of 15 cm if errors were normally distributed). Horizontal accuracy shall be 1 meter RMSE or better.
- Lidar data from different flight lines shall be consistent across flight lines, *i.e.*, there is no vertical offset between adjacent flightlines.
- Spatial coverage prior to vegetation editing shall be continuous in the designated geographic areas. Lidar data gaps between adjacent flight lines larger than two meters will not be acceptable.
- Data delivery shall be by removable hard drive supporting USB 2.0 standards. The hard drive(s) will not be returned by the government.
- The Contractor shall deliver the x,y,z (latitude, longitude, elevation) data from the control points used for quality control. Points shall be delivered in ASCII format on the same media used for the elevation data delivery. The control points shall be delivered with sufficient detail regarding collection to allow the Government to tie into the same survey network of control points for an independent survey.
- Delivered elevation data shall become the property of the Government and will be shared with the public. The contractor shall retain the ability to use and distribute the data as they see fit.

If the contractor believes other delivery formats and/or mechanisms will serve the government's needs in a more efficient manner, the contractor is encouraged to propose alternatives.

3.3 Classification system

The contractor shall use the point classification system endorsed by the ASPRS for the LAS format.

3.4 Records and Metadata

The contractor shall document all delivered data and data products (including options if exercised) according to Executive Order 12906 (http://www.fgdc.gov/publications/documents/geninfo/execord.html) Specifically, the contractor shall deliver for all data and data products, metadata records which detail all flight lines, flight dates and times, datums, reprojections, resampling algorithms, processing steps, field records, and any other pertinent information. The metadata records shall conform to the Content Standards for Digital Geospatial Metadata (FGDC-STD-001-1998) as published on May 1, 2000, by the Federal Geographic Data Committee (FGDC) or to any format that supersedes it as determined by the FGDC. (http://www.fgdc.gov/metadata/csdgm/). Profiles and extensions to the standard that have been endorsed by the FGDC shall be used if they are applicable to the data or data products. The metadata records shall contain any and all elements, including those that are considered optional, wherever applicable to the data or data product. The metadata record shall contain sufficient detail to ensure the data or data product can be fully understood for future use and for posterity. The metadata records shall be delivered free of errors in both content and format as determined by the metadata parser (mp) program developed by the United States Geological Survey or an equivalent. The metadata records will be subject to review and approval prior to final acceptance by the Government.

3.5 Kickoff Meetings

The contractor shall participate in a teleconference kickoff meeting with the NOAA Coastal Services Center within 30 days of contract award unless otherwise agreed upon by NOAA and the contractor. This meeting will serve as an information exchange and planning meeting for future activities such as delivery of government furnished equipment (GFE) and field trips. The contractor shall prepare an agenda for this meeting and issue meeting minutes within 7 days after the meeting.

3.6 Contractor Coordination

Communication and coordination between both the contractor and the Government is considered vital to the satisfactory accomplishment of this SOW. The Contractor shall expect periodic interaction with the Government to ensure clear understanding of the anticipated products and satisfactory progress in the delivery of products.

The contractor shall submit monthly progress reports to the Government summarizing progress made and problems encountered. After submittal of each of these reports the contractor shall schedule a conference call with the government to discuss the progress of the project and any issues that need to be addressed. The contractor shall prepare and distribute an agenda for the call and shall distribute the meeting minutes within 5 days of the conclusion of the call.

3.7 Deliverables

This section contains the complete list of deliverables associated with this project. Each deliverable must include a proposed measure of acceptability. All submitted plans shall be of sufficient detail so that the Government can verify that the contractor has a thorough understanding of the requirements of this SOW. The contractor shall also complete the attached spreadsheet with a percentage of the overall task order that each deliverable represents and the proposed due date for each deliverable. This data will be used to track performance and for approval of invoices. The contractor may propose additional deliverables/ milestones in their technical proposal if they determine they are required. The following project deliverables are required:

1 Work Plan – in some instances, the technical proposal may be accepted as the work plan. In either case, the plan shall be in Microsoft Word format and **shall** include the major milestones and deliverables shown in **Gantt chart format**.
2 Quality Control Plan – including detailed discussion of accuracy assessment methods/plan or other means of proving contract specifications have been met in Microsoft Word format.
3 Project schedule to include dates for all deliverables
4 Monthly progress report in a Microsoft Word, Excel or Project format on the 7th day of the month. In some cases a more appropriate regularly scheduled reporting timetable may be substituted contingent on agreement by all parties.
5 Final Report – The report shall summarize the project and provide the quality control evaluation showing that the project deliverables meet the contract specifications. The report shall be in Microsoft Word format.
6 FGDC-compliant metadata for all data sets per the project requirements
7 Digital elevation data sets per the requirements of section 3.2. These include:
   - Multiple-return classified mass point data in LAS format meeting the specification in section 3.
   - Bare-earth DEM meeting or exceeding FEMA flood plain mapping specifications.
   - QA/QC validation data

3.8 Product Delivery Schedule Guidance

The contractor shall propose a product delivery schedule in their technical proposal. As a guideline, the government does not expect delivery to require more than nine-months from time of contract award.

3.9 Product Delivery Addresses

The deliverables listed above shall be delivered to the COR at the following address. Technical questions shall be addressed to the Technical POC.

NOAA COR
NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, SC 29405
Attn: Dennis Hall
(843) 740-1323
Dennis.Hall@noaa.gov

NOAA Technical POC
NOAA Coastal Services Center
2234 South Hobson Avenue
Charleston, SC 29405
Attn: Kirk Waters
(843) 740-1227
Kirk.Waters@noaa.gov

4 Options

The Government reserves the right to exercise the following options. Payment would be made at a negotiated unit price and as described in the task order. Data shall be delivered 45 days after the date the Government provides the notice to proceed

Option 1.
The contractor shall collect, process, and deliver lidar data for the remainder of Jasper County, South Carolina to the same specifications as the main task order.

Option 2.
The contractor shall collect, process, and deliver lidar data for Colleton County, South Carolina to the same specifications as the main task order.

5 Figures and Maps

Jasper County Lidar Area

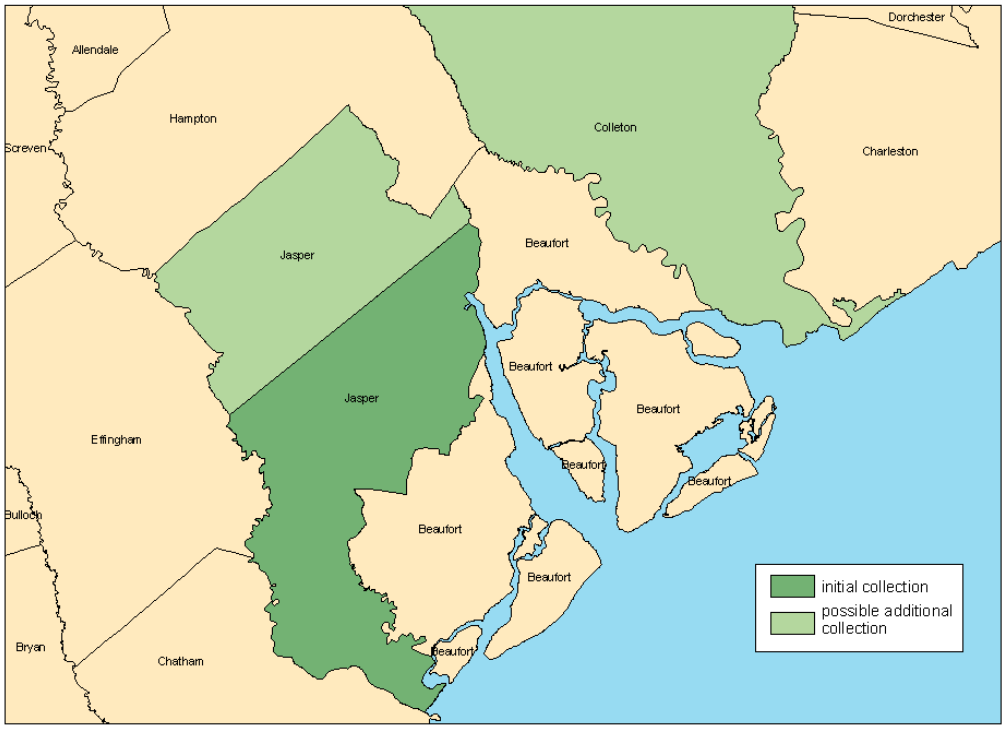


Figure 1. Map showing the area for Lidar collection covering the part of Jasper County (dark green) and the optional areas Colleton County and the remainder of Jasper County.

APPENDIX B

JASPER COUNTY GPS POINT COLLECTION

General Data Collection Information

Global Positioning System (GPS) data was collected on October 3rd, 4th and 25th in Jasper County, South Carolina by IMSG/PSGS personnel. The 3rd and 4th were spent in the south and eastern portion of the county and the 25th in the western and northern portion of the LiDAR collection area. A total of 26 locations were collected using static GPS measurements (Figure 1). Two GPS locations were used at each 'site' to allow for the use of a total station to gather check-point information in covered and uncovered areas. The check-point information at each site could then be further grouped to represent a 'scene' of a specific type of land use or setting.

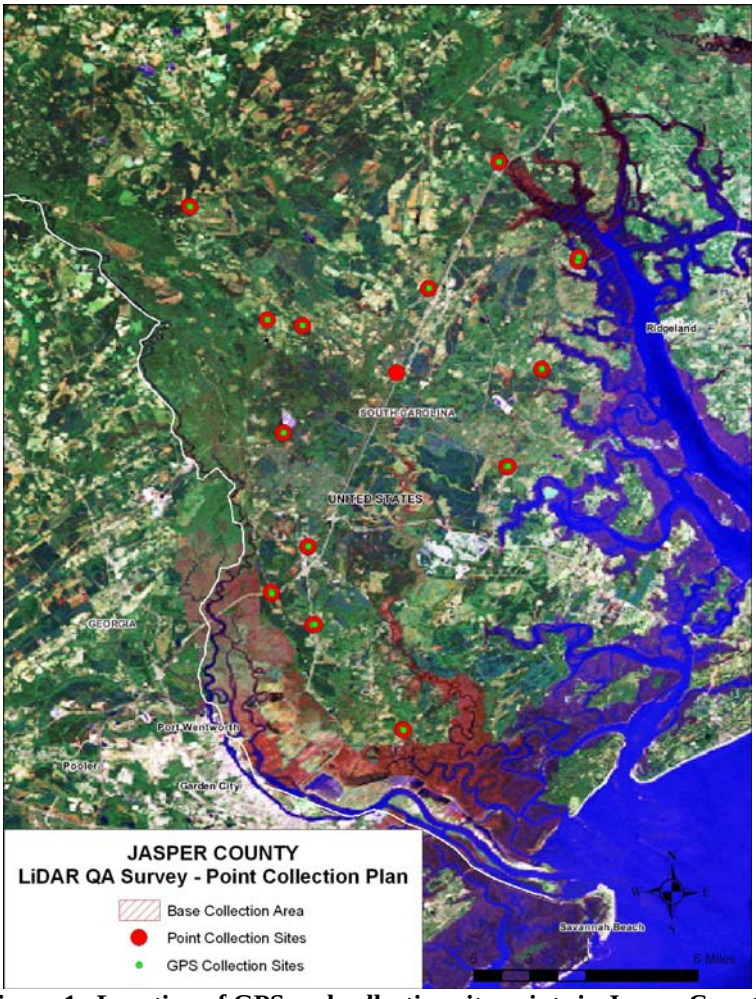


Figure 1. Location of GPS and collection site points in Jasper County

Site information is presented in Appendix B and C and includes the GPS site logs and site information such as photos. The site locations were chosen based on a uniform

distribution of points and to cover the various land cover classes as well as possible. The collection plan was submitted as 20061107_PointCollectionPlan-Q1.pdf.

Methodology

Three-dimensional coordinates were collected using three Thales dual frequency Z-Max GPS receivers in static mode. Each GPS receiver was mounted on a fixed height pole attached to a tripod. The GPS observations were collected with a data recording interval of 5 seconds and an elevation mask of 10 degrees. One GPS receiver was used as a base station at three different locations in Jasper County, while the other two GPS receivers were used as rovers and were setup at a number of acceptable locations within a 30 kilometer radius of each base station. Rover observation times ranged between 13 minutes and 7 hours depending, primarily, on the distance from the base station.

Benchmarks

Three GPS satellite suitable Benchmarks were used as references for the static GPS surveys. Two points, AE2746 and CK0962, were also used to gather ground control points; the third, AE2762, was used only as a base-station. The station sheets are provided in Appendix D. The station information is in NAD83.

GPS Data Processing

Thales' GNSS Solutions version 2.00.03 was used to post-process the data. The data were processed using the precise ephemeris. All GPS coordinates were based on the WGS 84 spatial reference system and vertical heights were referenced to the WGS 84 ellipsoid. The base station information (control) is in NAD83 and was used to make the local corrections so that the recorded GPS information in WGS84 was adjusted into NAD83.

Baselines radiating from the base stations to each static observation were calculated. Fixed solutions were obtained for all baselines. The survey height confidence intervals (at 95 percent) were between 0.001 – 0.044 meters. The survey horizontal confidence intervals (at 95 percent) were between 0.001 – 0.044 meters. Table 1 shows coordinates for each GPS point along with the survey confidence in both the x, y and z dimensions. A diagram of the survey network is shown in Figure 2 and a detailed processing report is presented in Appendix A.

Table 1. Point spread sheet from GNSS Solutions

Name	Description	Long	Lat	Ellips height	Status	Constraints	Surv_Horz_Conf	Surv_Height_Conf	Type	Warning
AE2746	Control	81° 06' 22.51834"W	32° 15' 16.91343"N	-16.85	Estimated	Horizontal & Vertical Fixed (	34.648	19.6	Control Point	No
CK0926	Control	80° 53' 48.13678"W	32° 25' 38.16833"N	-25.68	Estimated	Horizontal & Vertical Fixed (	34.648	19.6	Control Point	No
BH04		81° 04' 26.09732"W	32° 13' 45.65861"N	-26.212	Processed (static)	No constraints	0	0	Logged Point	No
BH05		81° 04' 21.27269"W	32° 13' 46.21742"N	-26.84	Processed (static)	No constraints	0	0	Logged Point	No
BH06		81° 00' 15.37883"W	32° 08' 52.91442"N	-27.22	Processed (static)	No constraints	0.001	0.001	Logged Point	No
BH07		81° 00' 13.36577"W	32° 08' 51.15094"N	-26.178	Processed (static)	No constraints	0.001	0.001	Logged Point	No
JC02		80° 52' 07.22192"W	32° 30' 42.69130"N	-27.47	Processed (static)	No constraints	0.001	0.001	Logged Point	No
JC03		80° 52' 05.04384"W	32° 30' 53.61339"N	-26.85	Processed (static)	No constraints	0.001	0.001	Logged Point	No
KS01		80° 55' 25.77221"W	32° 21' 07.56388"N	-25.455	Processed (static)	No constraints	0	0	Logged Point	No
KS02		80° 55' 21.33684"W	32° 21' 09.21505"N	-25.562	Processed (static)	No constraints	0	0	Logged Point	No
KS03		80° 59' 04.04042"W	32° 29' 27.09675"N	-10.935	Processed (static)	No constraints	0.001	0.001	Logged Point	No
KS04		80° 59' 02.02705"W	32° 29' 26.21531"N	-11.472	Processed (static)	No constraints	0.001	0.001	Logged Point	No
KS06		81° 06' 21.06634"W	32° 15' 12.56929"N	-17.274	Processed (static)	No constraints	0	0.001	Logged Point	No
KS07		81° 04' 40.59448"W	32° 17' 23.02876"N	-25.908	Processed (static)	No constraints	0	0	Logged Point	No
KS08		81° 04' 38.86582"W	32° 17' 25.15282"N	-25.873	Processed (static)	No constraints	0	0	Logged Point	No
BH03		80° 53' 47.92644"W	32° 25' 40.83731"N	-25.739	Processed (static)	No constraints	0	0	Logged Point	No
CR01		81° 05' 48.10702"W	32° 22' 43.76918"N	-23.103	Adjusted	No constraints	0.02	0.02	Logged Point	No
CR03		81° 04' 56.02946"W	32° 27' 42.86451"N	-14.715	Adjusted	No constraints	0.005	0.006	Logged Point	No
CR05		81° 10' 11.80039"W	32° 33' 16.41786"N	-12.748	Adjusted	No constraints	0.023	0.023	Logged Point	No
CR07		80° 55' 45.78760"W	32° 35' 20.27050"N	-26.385	Adjusted	No constraints	0.045	0.044	Logged Point	No
AE2762	Control	81° 06' 32.54732"W	32° 27' 58.98635"N	-15.75	Adjusted	Horizontal & Vertical Fixed (	0	0	Control Point	No
CR04		81° 04' 55.72602"W	32° 27' 42.00055"N	-14.675	Adjusted	No constraints	0.005	0.006	Logged Point	No
CR06		81° 10' 08.83953"W	32° 33' 14.37668"N	-12.617	Adjusted	No constraints	0.023	0.023	Logged Point	No
CR02		81° 05' 47.94850"W	32° 22' 42.73766"N	-23.08	Adjusted	No constraints	0.02	0.02	Logged Point	No
CR08		80° 55' 46.62181"W	32° 35' 19.59078"N	-26.255	Adjusted	No constraints	0.045	0.044	Logged Point	No

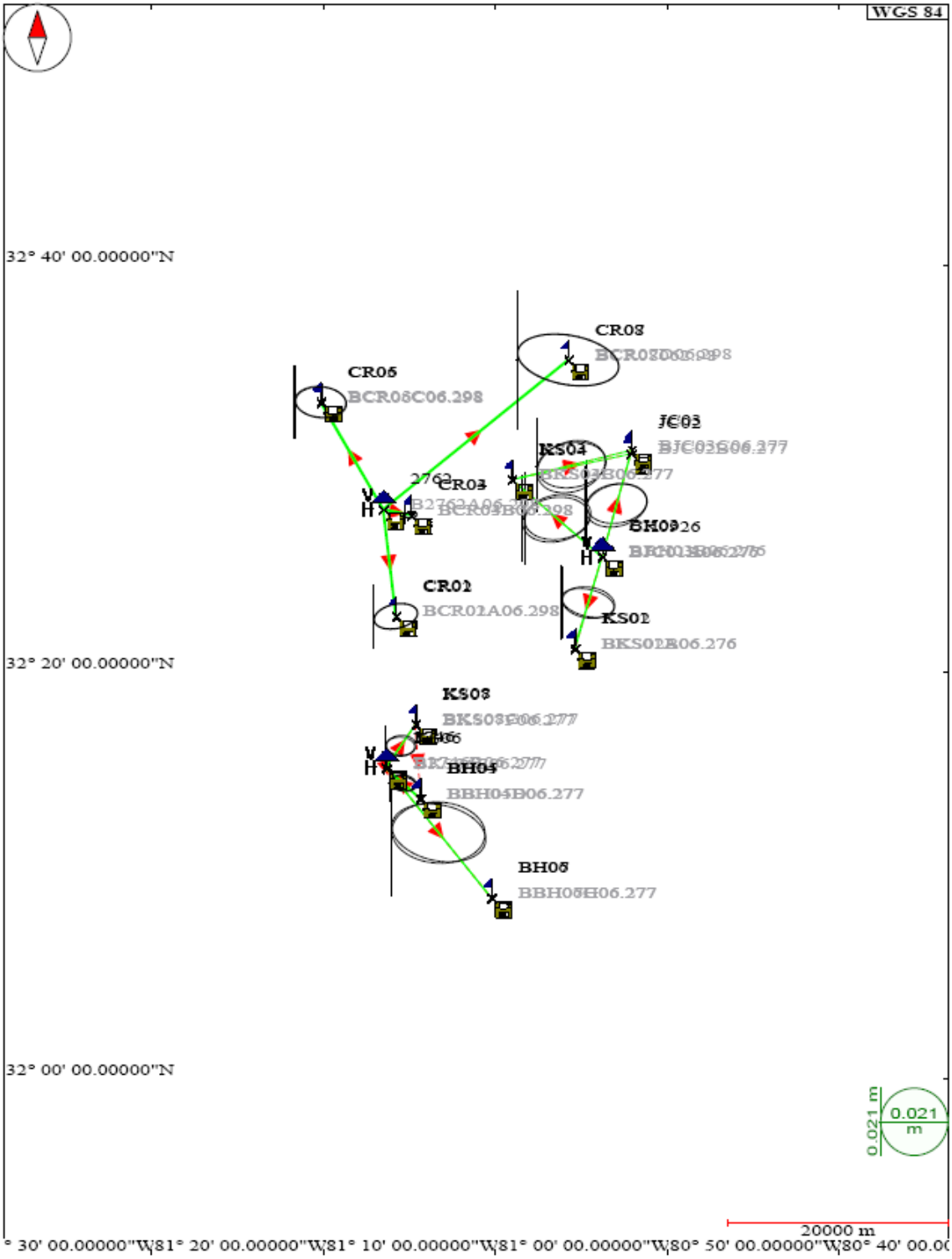


Figure 2. GPS survey diagram

Survey Point Locations – Total Station Processing

Survey points for use in LiDAR QA work include the GPS positions listed, but largely come from points taken using a Total Station. Collection of the points was overseen by Jim Harrington, the South Carolina state liaison from the National Geodetic Survey.

The ground-truthing for the Jasper LiDAR project was done by traditional survey methods and tied to geodetic control. GPS was used to establish the temporary control, unless usable existing control was available in the sample areas. NAD83 coordinates and ellipsoid heights in feet were used. Two points were set in each area as an azimuth pair. The point that saw the more versatile coverage was occupied, while the other temporary point was sighted on as the initial azimuth.

The terrestrial survey data was obtained using a Topcon GTS-700 Total station. This data was collected into laptop, and processed using NOAA/NGS ACES software. Spur traverse methods were used to position the 7-10 coverage types in each area. The elevations were established by trigonometric methods, where vertical angles and Electronic Distance Measuring Instrument distances were collected. A bi-pod with a prism was used as the target at the sample points. The height of the prism is subtracted from the computed elevation to determine the ground height.

Appendices

Appendix A - GPS Processing Report from GNSS Solutions

Appendix B - GPS Observation Logs

Appendix C - GPS Observation Sites (Site IDs, dates, photos)

Appendix D – Base-Station Benchmark Sheets

Appendix A - GPS Processing Report from GNSS Solutions

Land Survey Overview

Project Name : JasperCountyQA
Spatial Reference System : WGS 84
Time Zone : (GMT-05:00) Eastern Time (US & Canada)
Linear Units : Meters

Coordinate System Summary

Coordinate system

Name :	WGS 84
Type :	Geographic
Unit name :	Radians
Radians per unit :	1
Vertical datum :	Ellipsoid
Vertical unit :	Meters
Meters per unit :	1

Datum

Name :	WGS 84
Ellipsoid Name :	WGS 84
Semi-major Axis :	6378137.000 m
Inverse Flattening :	298.257223563
DX to WGS84 :	0.0000 m
DY to WGS84 :	0.0000 m
DY to WGS84 :	0.0000 m
RX to WGS84 :	0.000000 "
RY to WGS84 :	0.000000 "
RZ to WGS84 :	0.000000 "
ppm to WGS84 :	0.000000000000

Control Points

Name	Components		95% Error	Status
Control Error				
2746	Long	81° 06' 22.51834"W	0.000	FIXED
	Lat	32° 15' 16.91343"N	0.000	FIXED
	Ellips height	-16.850	0.000	FIXED
2762	Long	81° 06' 32.54732"W	0.000	FIXED
	Lat	32° 27' 58.98635"N	0.000	FIXED
	Ellips height	-15.750	0.000	FIXED
CK0926	Long	80° 53' 48.13678"W	0.000	FIXED
	Lat	32° 25' 38.16833"N	0.000	FIXED
	Ellips height	-25.680	0.000	FIXED

Logged Points

Name		Components	95% Error	Status
BH03	Long	80° 53' 47.92644"W	0.000	Processed (static)
	Lat	32° 25' 40.83731"N	0.000	Processed (static)
	Ellips height	-25.739	0.000	Processed (static)
BH04	Long	81° 04' 26.09732"W	0.000	Processed (static)
	Lat	32° 13' 45.65861"N	0.000	Processed (static)
	Ellips height	-26.212	0.000	Processed (static)
BH05	Long	81° 04' 21.27269"W	0.000	Processed (static)
	Lat	32° 13' 46.21742"N	0.000	Processed (static)
	Ellips height	-26.840	0.000	Processed (static)
BH06	Long	81° 00' 15.37883"W	0.000	Processed (static)
	Lat	32° 08' 52.91442"N	0.000	Processed (static)
	Ellips height	-27.220	0.001	Processed (static)
BH07	Long	81° 00' 13.36577"W	0.000	Processed (static)
	Lat	32° 08' 51.15094"N	0.000	Processed (static)
	Ellips height	-26.178	0.001	Processed (static)
CR01	Long	81° 05' 48.10702"W	0.014	Adjusted
	Lat	32° 22' 43.76918"N	0.008	Adjusted
	Ellips height	-23.103	0.020	Adjusted
CR02	Long	81° 05' 47.94850"W	0.014	Adjusted
	Lat	32° 22' 42.73766"N	0.008	Adjusted
	Ellips height	-23.080	0.020	Adjusted
CR03	Long	81° 04' 56.02946"W	0.004	Adjusted
	Lat	32° 27' 42.86451"N	0.002	Adjusted
	Ellips height	-14.715	0.006	Adjusted
CR04	Long	81° 04' 55.72602"W	0.004	Adjusted
	Lat	32° 27' 42.00055"N	0.002	Adjusted
	Ellips height	-14.675	0.006	Adjusted
CR05	Long	81° 10' 11.80039"W	0.016	Adjusted
	Lat	32° 33' 16.41786"N	0.010	Adjusted
	Ellips height	-12.748	0.023	Adjusted
CR06	Long	81° 10' 08.83953"W	0.016	Adjusted
	Lat	32° 33' 14.37668"N	0.010	Adjusted
	Ellips height	-12.617	0.023	Adjusted
CR07	Long	80° 55' 45.78760"W	0.032	Adjusted
	Lat	32° 35' 20.27050"N	0.016	Adjusted
	Ellips height	-26.385	0.044	Adjusted
CR08	Long	80° 55' 46.62181"W	0.032	Adjusted
	Lat	32° 35' 19.59078"N	0.016	Adjusted
	Ellips height	-26.255	0.044	Adjusted
JC02	Long	80° 52' 07.22192"W	0.000	Processed (static)
	Lat	32° 30' 42.69130"N	0.000	Processed (static)
	Ellips height	-27.470	0.001	Processed (static)
JC03	Long	80° 52' 05.04384"W	0.000	Processed (static)
	Lat	32° 30' 53.61339"N	0.000	Processed (static)
	Ellips height	-26.850	0.001	Processed (static)
KS01	Long	80° 55' 25.77221"W	0.000	Processed (static)
	Lat	32° 21' 07.56388"N	0.000	Processed (static)
	Ellips height	-25.455	0.000	Processed (static)

KS02	Long	80° 55' 21.33684"W	0.000	Processed (static)
	Lat	32° 21' 09.21505"N	0.000	Processed (static)
	Ellips height	-25.562	0.000	Processed (static)
KS03	Long	80° 59' 04.04042"W	0.000	Processed (static)
	Lat	32° 29' 27.09675"N	0.000	Processed (static)
	Ellips height	-10.935	0.001	Processed (static)
KS04	Long	80° 59' 02.02705"W	0.000	Processed (static)
	Lat	32° 29' 26.21531"N	0.000	Processed (static)
	Ellips height	-11.472	0.001	Processed (static)
KS06	Long	81° 06' 21.06634"W	0.000	Processed (static)
	Lat	32° 15' 12.56929"N	0.000	Processed (static)
	Ellips height	-17.274	0.001	Processed (static)
KS07	Long	81° 04' 40.59448"W	0.000	Processed (static)
	Lat	32° 17' 23.02876"N	0.000	Processed (static)
	Ellips height	-25.908	0.000	Processed (static)
KS08	Long	81° 04' 38.86582"W	0.000	Processed (static)
	Lat	32° 17' 25.15282"N	0.000	Processed (static)
	Ellips height	-25.873	0.000	Processed (static)

Files

Name	Start Time	Sampling	Epochs	Size (Kb)	Type
B2746B06.277	06/10/04 14:18	5	2475	1835	L1/L2 GPS
BBH04D06.277	06/10/04 14:29	5	275	240	L1/L2 GPS
BBH05E06.277	06/10/04 15:03	5	248	209	L1/L2 GPS
BBH06G06.277	06/10/04 16:33	5	336	221	L1/L2 GPS
BBH07H06.277	06/10/04 17:04	5	325	208	L1/L2 GPS
BJC01A06.277	06/10/04 10:07	5	1841	1520	L1/L2 GPS
BJC01B06.276	06/10/03 12:57	5	2453	1711	L1/L2 GPS
BJC02B06.277	06/10/04 11:00	5	257	257	L1/L2 GPS
BJC03C06.277	06/10/04 11:32	5	274	235	L1/L2 GPS
BKS01A06.276	06/10/03 13:58	2	1029	762	L1/L2 GPS
BKS02B06.276	06/10/03 14:55	2	933	805	L1/L2 GPS
BKS03B06.277	06/10/04 10:57	5	311	308	L1/L2 GPS
BKS04C06.277	06/10/04 11:30	5	329	285	L1/L2 GPS
BKS06E06.277	06/10/04 14:34	5	158	116	L1/L2 GPS
BKS07F06.277	06/10/04 15:24	5	258	212	L1/L2 GPS
BKS08G06.277	06/10/04 15:56	5	291	230	L1/L2 GPS
BCR01A06.298	06/10/25 10:24	5	674	652	L1/L2 GPS
BCR03B06.298	06/10/25 11:55	5	409	305	L1/L2 GPS
BCR05C06.298	06/10/25 13:43	5	390	317	L1/L2 GPS

BCR07D06.298	06/10/25 15:41	5	515	304	L1/L2 GPS
B2762A06.298	06/10/25 09:27	5	5036	4050	L1/L2 GPS
BCR04B06.298	06/10/25 11:57	5	382	282	L1/L2 GPS
BCR06C06.298	06/10/25 13:48	5	373	304	L1/L2 GPS
BCR02A06.298	06/10/25 10:36	5	555	490	L1/L2 GPS
BCR08062.98	06/10/25 15:42	5	538	335	L1/L2 GPS
BBH03B06.276	06/10/03 15:52	2	463	345	L1/L2 GPS

Observations

Site	Antenna Type	Antenna Height	Height Type	Receiver Type	Start Time	File Name
2746	ZMax GPS	2.004	Slant	Z-MAX	06/10/04 14:18:34	B2746B06.277
BH04	ZMax GPS	2.004	Slant	Z-MAX	06/10/04 14:29:50	BBH04D06.277
BH05	ZMax GPS	2.003	Slant	Z-MAX	06/10/04 15:03:50	BBH05E06.277
BH06	ZMax GPS	2.005	Slant	Z-MAX	06/10/04 16:33:35	BBH06G06.277
BH07	ZMax GPS	2.001	Slant	Z-MAX	06/10/04 17:04:35	BBH07H06.277
CK0926	ZMax GPS	2.003	Slant	Z-MAX	06/10/04 10:07:02	BJC01A06.277
CK0926	ZMax GPS	2.003	Slant	Z-MAX	06/10/03 12:57:00	BJC01B06.276
JC02	ZMax GPS	1.980	Slant	Z-MAX	06/10/04 11:00:00	BJC02B06.277
JC03	ZMax GPS	2.007	Slant	Z-MAX	06/10/04 11:32:20	BJC03C06.277
KS01	ZMax GPS	2.005	Slant	Z-MAX	06/10/03 13:58:40	BKS01A06.276
KS02	ZMax GPS	2.005	Slant	Z-MAX	06/10/03 14:55:40	BKS02B06.276
KS03	ZMax GPS	2.001	Slant	Z-MAX	06/10/04 10:57:40	BKS03B06.277
KS04	ZMax GPS	2.001	Slant	Z-MAX	06/10/04 11:30:50	BKS04C06.277
KS06	ZMax GPS	2.003	Slant	Z-MAX	06/10/04 14:34:10	BKS06E06.277
KS07	ZMax GPS	2.005	Slant	Z-MAX	06/10/04 15:24:10	BKS07F06.277
KS08	ZMax GPS	2.005	Slant	Z-MAX	06/10/04 15:56:05	BKS08G06.277
CR01	ZMax GPS	2.005	Slant	Z-MAX	06/10/25 10:24:40	BCR01A06.298
CR03	ZMax GPS	2.006	Slant	Z-MAX	06/10/25 11:55:05	BCR03B06.298
CR05	ZMax GPS	2.006	Slant	Z-MAX	06/10/25 13:43:45	BCR05C06.298
CR07	ZMax GPS	2.007	Slant	Z-MAX	06/10/25 15:41:05	BCR07D06.298
2762	ZMax GPS	2.002	Slant	Z-MAX	06/10/25 09:27:05	B2762A06.298
CR04	ZMax GPS	2.001	Slant	Z-MAX	06/10/25 11:57:45	BCR04B06.298
CR06	ZMax GPS	2.002	Slant	Z-MAX	06/10/25 13:48:30	BCR06C06.298
CR02	ZMax GPS	2.004	Slant	Z-MAX	06/10/25 10:36:35	BCR02A06.298

CR08 ZMax GPS 2.007 Slant Z-MAX 06/10/25 15:42:20 BCR08062.98
BH03 ZMax GPS 2.002 Slant Z-MAX 06/10/03 15:52:40 BBH03B06.276

Processes

Num	Reference	Reference File	Rover	Rover File	Mode
1	2762	B2762A06.298	CR03	BCR03B06.298	Static
2	2762	B2762A06.298	CR07	BCR07D06.298	Static
3	2762	B2762A06.298	CR08	BCR08062.98	Static
4	2762	B2762A06.298	CR02	BCR02A06.298	Static
5	2762	B2762A06.298	CR06	BCR06C06.298	Static
6	2762	B2762A06.298	CR01	BCR01A06.298	Static
7	2762	B2762A06.298	CR05	BCR05C06.298	Static
8	2762	B2762A06.298	CR04	BCR04B06.298	Static
9	CK0926	BJC01B06.276	KS01	BKS01A06.276	Static
10	CK0926	BJC01B06.276	BH03	BBH03B06.276	Static
11	CK0926	BJC01B06.276	KS02	BKS02B06.276	Static
12	2746	B2746B06.277	BH05	BBH05E06.277	Static
13	2746	B2746B06.277	KS07	BKS07F06.277	Static
14	2746	B2746B06.277	BH07	BBH07H06.277	Static
15	2746	B2746B06.277	BH04	BBH04D06.277	Static
16	2746	B2746B06.277	KS08	BKS08G06.277	Static
17	2746	B2746B06.277	KS06	BKS06E06.277	Static
18	2746	B2746B06.277	BH06	BBH06G06.277	Static
19	CK0926	BJC01A06.277	KS04	BKS04C06.277	Static
20	CK0926	BJC01A06.277	KS03	BKS03B06.277	Static
21	CK0926	BJC01A06.277	JC03	BJC03C06.277	Static
22	CK0926	BJC01A06.277	JC02	BJC02B06.277	Static
23	CR01	BCR01A06.298	CR02	BCR02A06.298	Static
24	CR08	BCR08062.98	CR07	BCR07D06.298	Static
25	CR03	BCR03B06.298	CR04	BCR04B06.298	Static
26	CR05	BCR05C06.298	CR06	BCR06C06.298	Static
27	KS04	BKS04C06.277	JC03	BJC03C06.277	Static
28	KS03	BKS03B06.277	JC02	BJC02B06.277	Static
29	BH04	BBH04D06.277	KS06	BKS06E06.277	Static

KS07 BKS07F06.277 BH05 BBH05E06.277 Static
30

Processed vectors

Vector Identifier	Vector Length	95% Error		Vector Components	95% Error	SV	PDOP	QA
Solution								
2746 - KS08	4791.880	0.024	X	2352.085	0.010	8	1.6	
Fixed								
06/10/04 15:56			Y	2511.325	0.010			
			Z	3335.125	0.010			
2746 - BH05	4228.426	0.021	X	3365.308	0.008	8	2.1	
Fixed								
06/10/04 15:03			Y	-972.461	0.009			
			Z	-2368.250	0.008			
2746 - KS07	4712.340	0.023	X	2312.818	0.009	8	1.9	
Fixed								
06/10/04 15:24			Y	2469.810	0.010			
			Z	3279.796	0.009			
2746 - BH04	4146.110	0.020	X	3242.024	0.008	8	1.6	
Fixed								
06/10/04 14:29			Y	-1001.656	0.008			
			Z	-2382.476	0.008			
2746 - KS06	139.104	0.002	X	48.528	0.001	7	2.0	
Fixed								
06/10/04 14:34			Y	-64.313	0.001			
			Z	-113.397	0.001			
2746 - BH06	15243.555	0.075	X	10477.288	0.030	7	1.9	
Fixed								
06/10/04 16:33			Y	-4722.853	0.031			
			Z	-10014.343	0.031			
2746 - BH07	15318.980	0.076	X	10534.050	0.030	6	2.4	
Fixed								
06/10/04 17:04			Y	-4744.024	0.031			
			Z	-10059.780	0.031			
BH04 - KS06	4028.115	0.020	X	-3193.489	0.008	7	2.0	
Fixed								
06/10/04 14:34			Y	937.333	0.008			
			Z	2269.085	0.008			
CK0926 - KS02	8635.431	0.042	X	-1704.134	0.017	8	2.2	
Fixed								
06/10/03 14:55			Y	-4767.170	0.017			
			Z	-6995.762	0.017			
CK0926 - JC02	9743.667	0.048	X	1803.710	0.019	7	2.2	
Fixed								
06/10/04 11:00			Y	5391.395	0.020			
			Z	7913.188	0.020			
CK0926 - JC03	10083.007	0.050	X	1831.222	0.020	8	2.3	
Fixed								
06/10/04 11:32			Y	5578.442	0.021			
			Z	8197.233	0.020			
CK0926 - KS03	10853.416	0.054	X	-8741.328	0.022	7	2.2	
Fixed								
06/10/04 10:57			Y	2426.168	0.022			
			Z	5958.149	0.022			

CK0926 - KS04	10795.820	0.053	X	-8687.199	0.021	8	2.3	Fixed
06/10/04 11:30			Y	2420.448	0.022			
			Z	5934.958	0.022			
CK0926 - KS01	8717.467	0.043	X	-1814.346	0.017	7	3.0	Fixed
06/10/03 13:58			Y	-4812.432	0.017			
			Z	-7038.671	0.017			
CK0926 - BH03	82.398	0.001	X	-1.557	0.000	7	2.1	Fixed
06/10/03 15:52			Y	44.450	0.000			
			Z	69.363	0.000			
KS03 - JC02	11127.108	0.055	X	10545.038	0.022	9	1.6	Fixed
06/10/04 11:00			Y	2965.224	0.022			
			Z	1955.035	0.022			
KS04 - JC03	11212.851	0.056	X	10518.422	0.022	8	2.0	Fixed
06/10/04 11:32			Y	3157.998	0.023			
			Z	2262.273	0.022			
CR01 - CR02	32.044	0.001	X	6.730	0.000	8	2.4	Fixed
06/10/25 10:36			Y	-16.189	0.000			
			Z	-26.822	0.000			
CR03 - CR04	27.768	0.001	X	10.049	0.000	6	2.9	Fixed
06/10/25 11:57			Y	-12.915	0.000			
			Z	-22.434	0.000			
CR05 - CR06	99.602	0.001	X	81.541	0.000	8	1.9	Fixed
06/10/25 13:48			Y	-21.684	0.000			
			Z	-52.928	0.000			
2762 - CR03	2569.018	0.013	X	2531.578	0.005	6	3.3	Fixed
06/10/25 11:55			Y	125.931	0.005			
			Z	-418.458	0.005			
2762 - CR04	2582.055	0.013	X	2541.625	0.005	6	3.6	Fixed
06/10/25 11:57			Y	113.003	0.005			
			Z	-440.886	0.005			
2762 - CR05	11329.845	0.056	X	-6463.645	0.022	8	1.9	Fixed
06/10/25 13:43			Y	4308.661	0.023			
			Z	8247.553	0.023			
2762 - CR01	9779.082	0.048	X	1951.329	0.019	9	2.2	Fixed
06/10/25 10:24			Y	-4957.715	0.020			
			Z	-8200.233	0.019			
2762 - CR06	11236.601	0.055	X	-6382.100	0.022	8	1.9	Fixed
06/10/25 13:48			Y	4286.970	0.023			
			Z	8194.625	0.022			
2762 - CR02	9811.121	0.048	X	1958.063	0.019	9	2.3	Fixed
06/10/25 10:36			Y	-4973.899	0.020			
			Z	-8227.054	0.019			
2762 - CR08	21641.476	0.106	X	15509.188	0.043	6	2.5	

Fixed							
06/10/25 15:42			Y	9848.614	0.043		
			Z	11437.804	0.043		
2762 - CR07	21671.548	0.106	X	15528.876	0.043	6	2.5
Fixed							
06/10/25 15:41			Y	9863.288	0.044		
			Z	11455.371	0.043		
CR08 - CR07	30.195	0.001	X	19.688	0.000	6	2.5
Fixed							
06/10/25 15:42			Y	14.674	0.000		
			Z	17.572	0.000		

Adjusted vectors

Vector Identifier	Vector Length	Length Resid.		Vector Components	Resid.	Tau Test	QA
CR01 - CR02	32.044	0.000	X	6.730	0.000		
06/10/25 10:36			Y	-16.189	0.000		
			Z	-26.822	0.000		
CR03 - CR04	27.768	0.001	X	10.048	-0.000		
06/10/25 11:57			Y	-12.916	-0.001		
			Z	-22.434	0.000		
CR05 - CR06	99.602	0.000	X	81.541	0.000		
06/10/25 13:48			Y	-21.684	-0.000		
			Z	-52.928	0.000		
2762 - CR04	2582.057	0.007	X	2541.626	0.001		
06/10/25 11:57			Y	113.009	0.006		
			Z	-440.889	-0.003		
2762 - CR05	11329.843	0.004	X	-6463.643	0.002		
06/10/25 13:43			Y	4308.657	-0.003		
			Z	8247.553	0.001		
2762 - CR01	9779.081	0.002	X	1951.331	0.001		
06/10/25 10:24			Y	-4957.713	0.002		
			Z	-8200.232	0.001		
2762 - CR06	11236.603	0.004	X	-6382.102	-0.002		
06/10/25 13:48			Y	4286.973	0.003		
			Z	8194.625	-0.001		
2762 - CR02	9811.123	0.003	X	1958.061	-0.002		
06/10/25 10:36			Y	-4973.901	-0.002		
			Z	-8227.055	-0.000		
2762 - CR08	21641.475	0.002	X	15509.188	-0.000		
06/10/25 15:42			Y	9848.614	0.000		
			Z	11437.802	-0.002		
2762 - CR07	21671.549	0.002	X	15528.876	0.000		
06/10/25 15:41			Y	9863.288	0.000		
			Z	11455.373	0.002		
2762 - CR03	2569.017	0.007	X	2531.578	-0.001		
06/10/25 11:55			Y	125.925	-0.006		
			Z	-418.455	0.003		
CR08 - CR07	30.195	0.000	X	19.688	0.000		
06/10/25 15:42			Y	14.674	0.000		
			Z	17.572	-0.000		

Appendix B - GPS Observation Logs

Station Observation Log

Site ID:	2746	**Station PID** (if any)	AE 2746
General Location:	State Rd. 34 overpass of I-95 (Hardeeville)		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	KS (JC) BH	**Session ID:**	N/A
Receiver ID:	CD...961	**Antenna ID:**	S/N 2000424121

Antenna Height	*Before Session*	*After Session*
Height (m)	2.004	2.004

Observation Time	*Start*	*End*
Scheduled		
Actual	2:20	

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☒ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

Benchmark behind guardrail on steep bank, w/ tree directly adjacent.

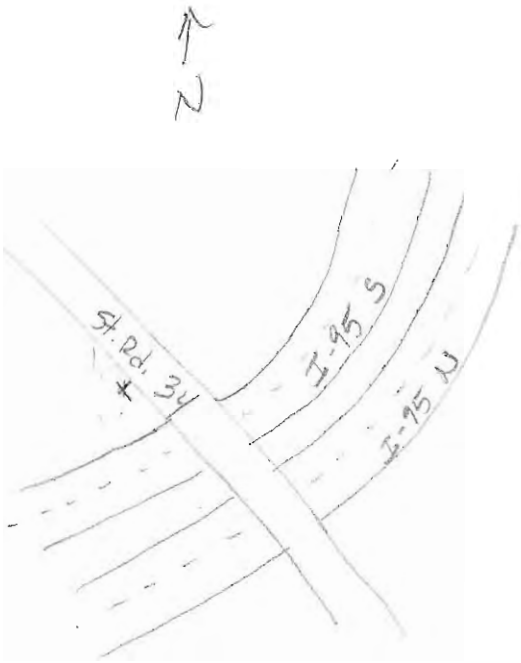
Station Location 2746

Photograph IDs of check point

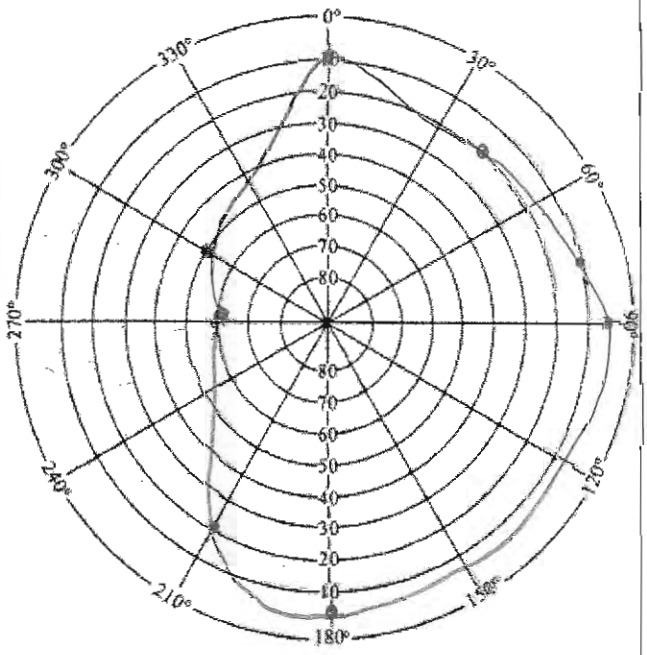
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 660
2. 661
3. 662
4. 663

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

Behind guardrail on south side of St. Rd. 34 overpass on NW end of bridge.

Directions To Reach Location:

See directions for NGS benchmark DE 2746

Station Observation Log

Site ID:	JC01	**Station PID** (if any)	CK0926
General Location:	Second Ebhaw Missionary Baptist Church		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 3 / 2006	**Day of Year:**	
Operator:	KS / (JC) / BH	**Session ID:**	N/A
Receiver ID:	Z-max #3	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.003	2.003

Observation Time	*Start*	*End*
Scheduled		
Actual	1:00 PM	

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

Overhead powerlines may cause interference.

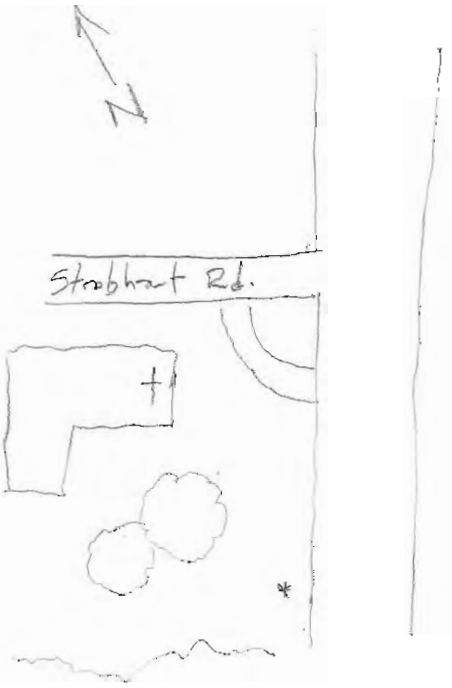
Station Location JC01

Photograph IDs of check point

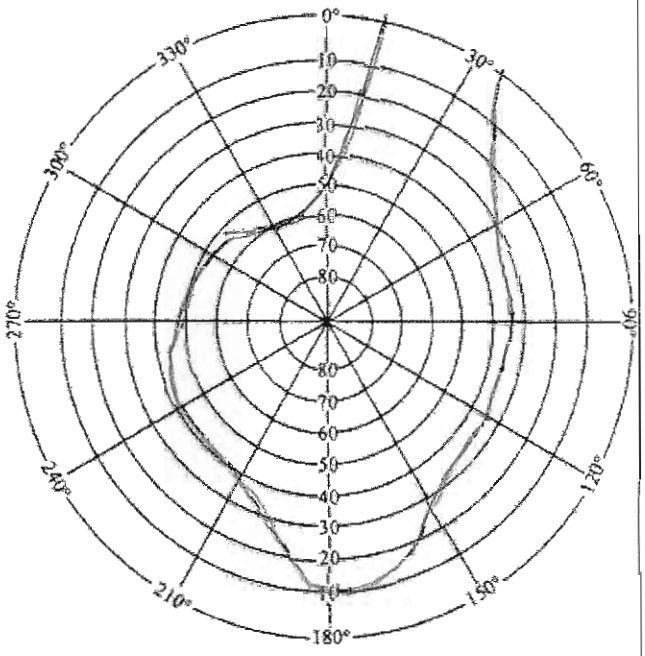
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 713 (#1000-713)
2. 714
3. 715
4. 716 → benchmark

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

SEE DESCRIPTION FOR DGS BENCHMARK CK0926

Directions To Reach Location:

Station Observation Log

Site ID:	JC02	**Station PID** (if any)	
General Location:	Deloss Island (S)		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	KS / (JC) / BH	**Session ID:**	N/A
Receiver ID:	CD... 962	**Antenna ID:**	S/N 8175

Antenna Height	*Before Session*	*After Session*
Height (m)	1.980	1.980

Observation Time	*Start*	*End*
Scheduled		
Actual	11:00	11:20

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☑ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

- Edge of road
- Potential total station pts:
  - Bare
  - Grass/crops

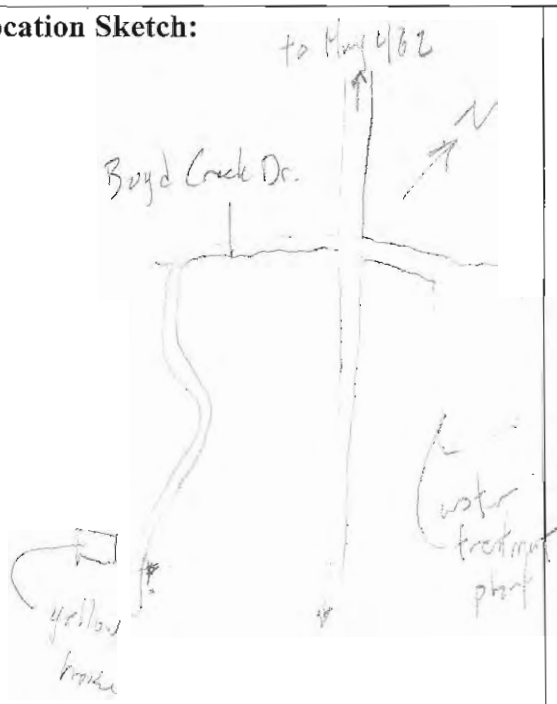
Station Location JC02

Photograph IDs of check point

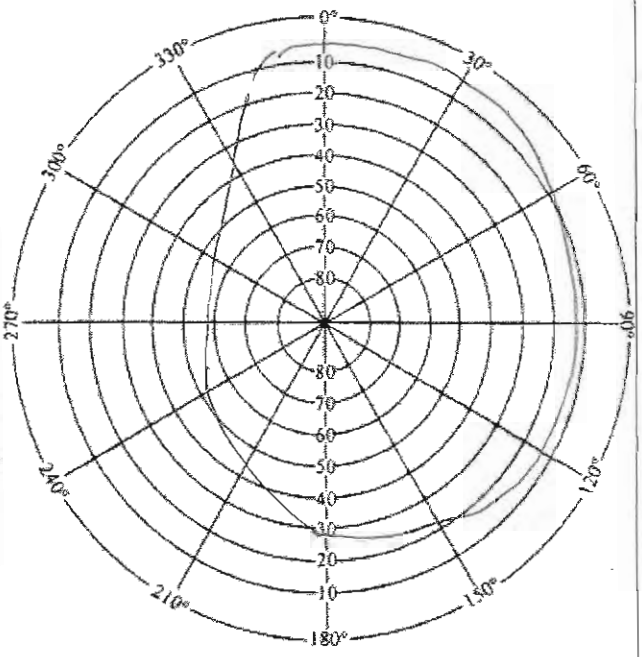
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 100-0733
2. 100-0734
3. 100-0735
4. 100-0736

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

East Edge of road, southern end of open field, between yellow house on west side of road and bird house suspended on a 3 foot tall pipe on east side of road.

Directions To Reach Location:

From Hwy 462, east to Delass Island on 5-27-19 (Crawl Island, Palm Key)

Station Observation Log

Site ID:	JC03	**Station PID** (if any)	
General Location:	Deloss Island (N)		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	KS (JC) BH	**Session ID:**	N/A
Receiver ID:	CO...962	**Antenna ID:**	S/N 8175

Antenna Height	*Before Session*	*After Session*
Height (m)	2.007	2.007

Observation Time	*Start*	*End*
Scheduled		
Actual	11:32	11:53

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

- Edge of road
- Potential total station pts:
  - Evergreen
  - Grass/Crops
  - Bare

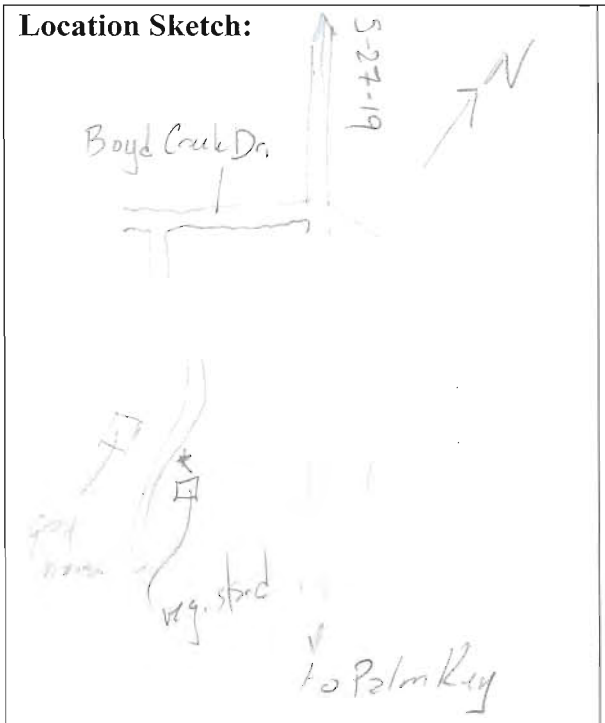
Station Location JC 03

Photograph IDs of check point

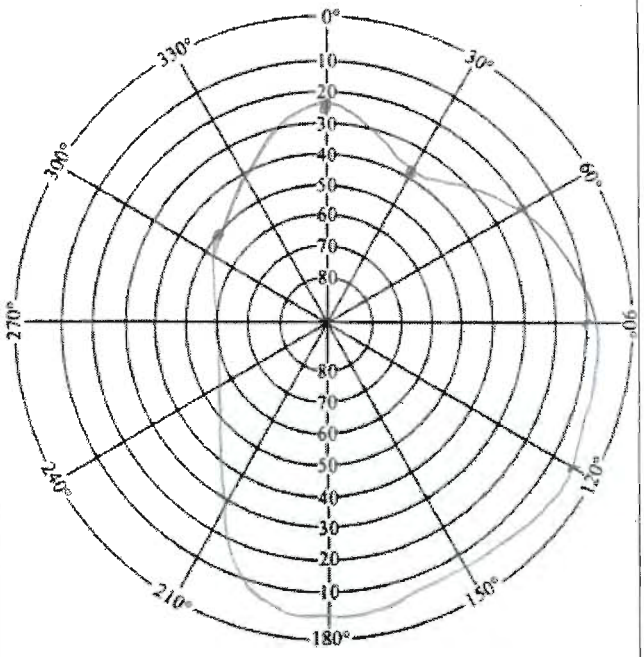
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 100-0737
2. 100-0738
3. 100-0739
4. 100-0740

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

East side of road, north end of open field, between veg. stand and gray house w/ black shutters, directly across from gray house's driveway

Directions To Reach Location:

From Hwy 462, east to Deloss Island on 5-27-19 (toward Knowles Island, Palm Key)

Station Observation Log

Site ID:	BH03	**Station PID** (if any)	
General Location:	Corner of highway 462/Strobhart Rd		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 3 / 2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	CD00012799G2	**Antenna ID:**	9715

Antenna Height	*Before Session*	*After Session*
Height (m) 2.002	2.002	

Observation Time	*Start* 3:55 PM	*End* 4:15
Scheduled		/
Actual		

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

100-150 m from Base Station

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☑ Grass/Crops
- ☐ Developed

Notes:

Power Lines to South of station

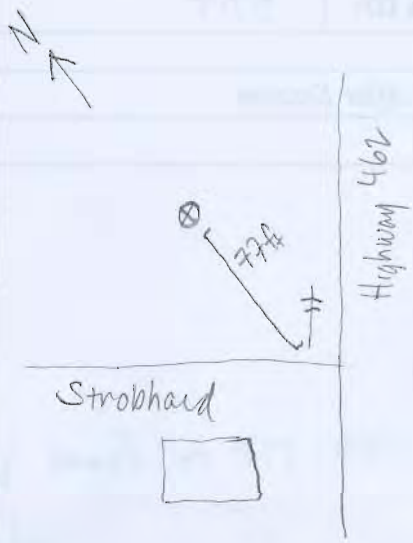
Station Location BH03

Photograph IDs of check point

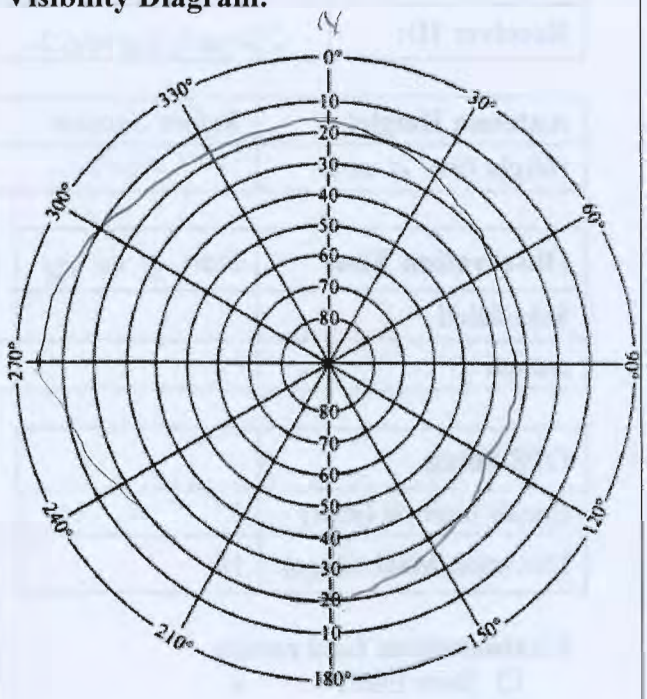
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 100 - 1632
2. 100 - 1633
3. 100 - 1634
4. 100 - 1635

Location Sketch:



Visibility Diagram:



No obstructions: ☒

General Station Location:

Directions To Reach Location:

Take Highway 462 towards Hilton Head Island. Turn @ Strobhart road and park in Second Euhaw Missionary Baptist Church. Go across Strobhart and find power pole on corner. Go 10 ft due north. In middle of field.

Station Observation Log

Site ID:	BH04	**Station PID** (if any)	
General Location:	Racetrack - (Abandoned) => old Parking Lot or field to NNW		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / (BH)	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005 m	2.005 m

Observation Time	*Start* 2:31	*End* 2:51
Scheduled		
Actual		

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes: Some Bahia Grass at site as well. Very clean skyview.

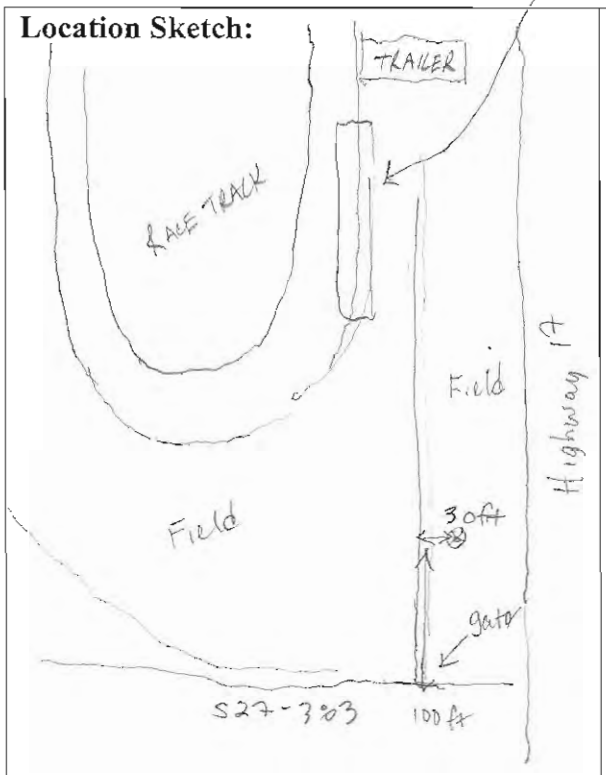
Station Location BH04

Photograph IDs of check point

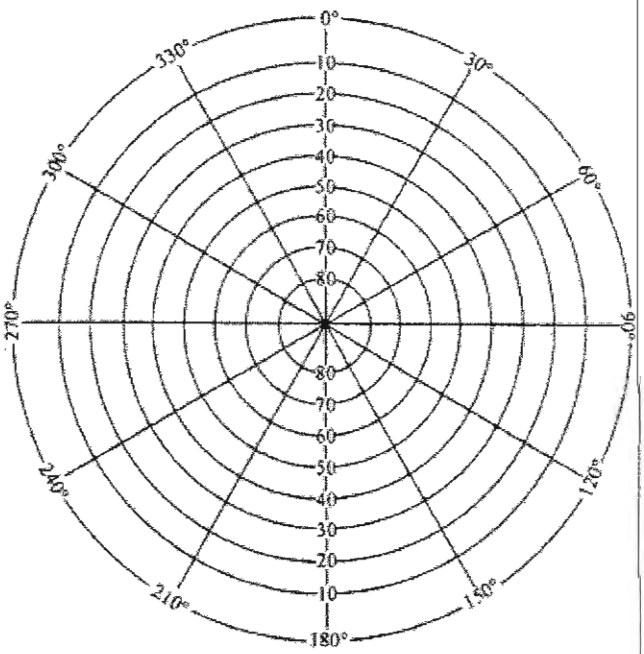
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 100 - 771
2. - 772
3. - 773
   - 774

Location Sketch:



Visibility Diagram:



No obstructions: ☒

General Station Location:

In old parking / bare field outside racetrack.

Directions To Reach Location:

Take 17 south towards Savannah. Turn left on S27 383. Take 1st right into fenced race track area. Stop approximately 100 feet after entrance. On right side 20-30 ft from right edge of road.

Station Observation Log

Site ID:	BH05	**Station PID** (if any)	
General Location:	Behind North end of abandoned race track		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / ~~BH~~	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.003 m	

Observation Time	*Start* 3:05	*End* 3:25
Scheduled		
Actual		

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☒ Grass/Crops
- ☐ Developed

Notes:

Station Location BH05

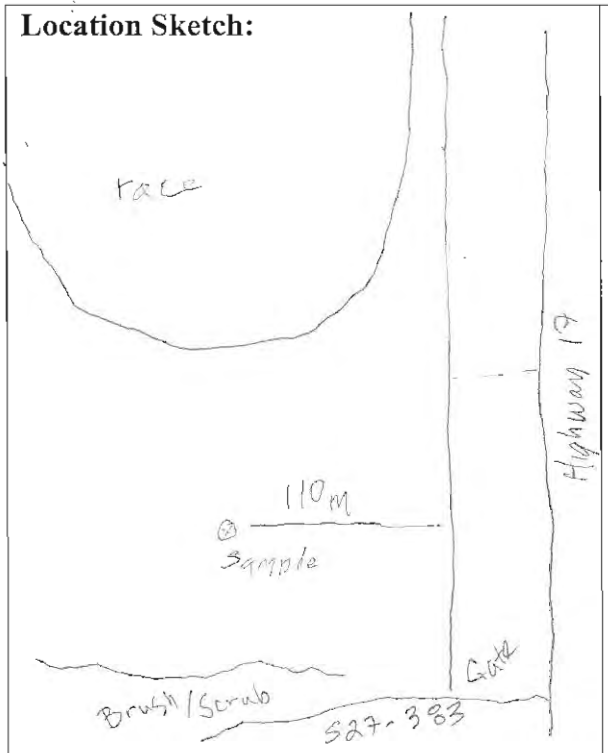
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

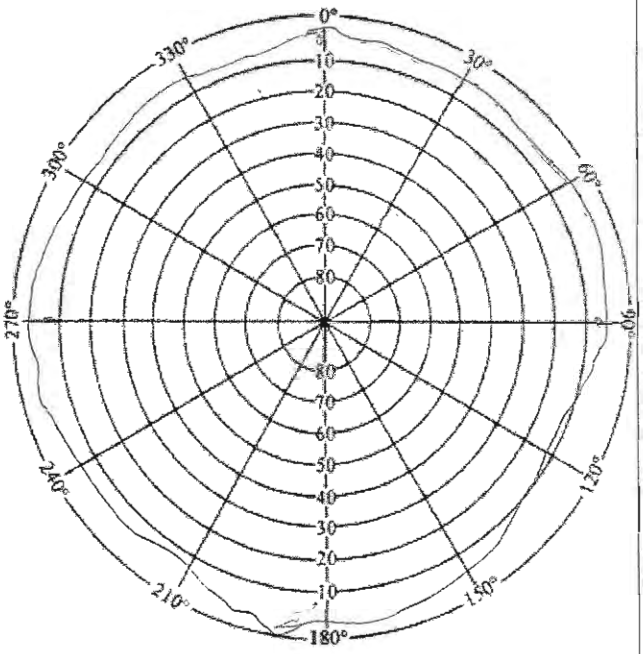
1. 100 - 745
2. 100 - 746
3. 100 - 747

100 - 748

Location Sketch:



Visibility Diagram:



No obstructions: ☐ mostly obstruction clear

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	BH06	**Station PID** (if any)	
General Location:			
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005 m	Same

Observation Time	*Start* 4:36	*End* 5:01
Scheduled		
Actual		

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes: On side of a small axis road. Other landcover categories should be accessible by total station.

Station Location BH06

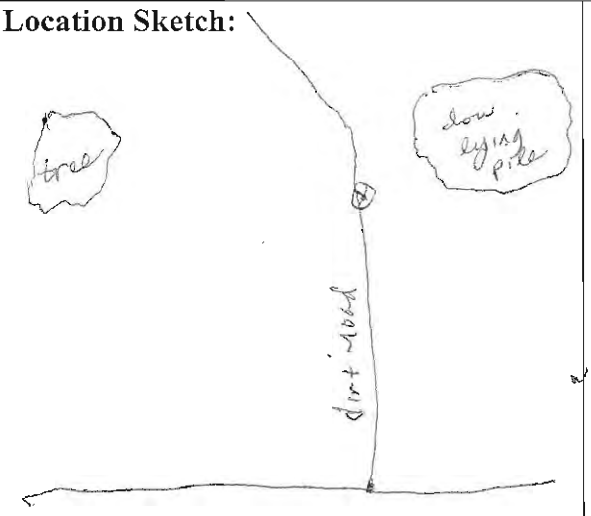
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

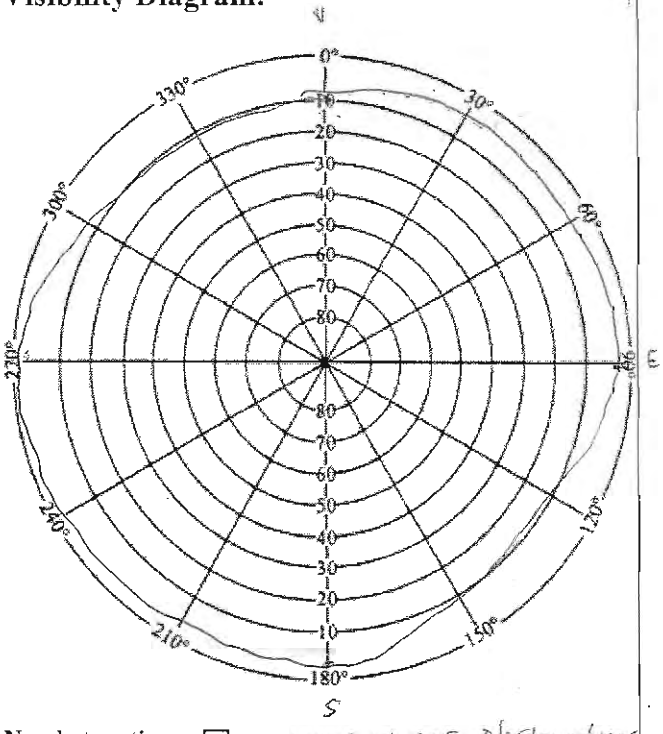
1. 100 - 749
2. 100 - 750
3. 100 - ~~750~~ 751

   100 - 752

Location Sketch:



Visibility Diagram:



No obstructions: ☐ very minor obstructions

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	PH07	**Station PID** (if any)	
General Location:			
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.001 m	Same

Observation Time	*Start*	*End*
Scheduled	5:06	5:31
Actual		

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☑ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

Bellinger Hill Rd

Station Location BH07

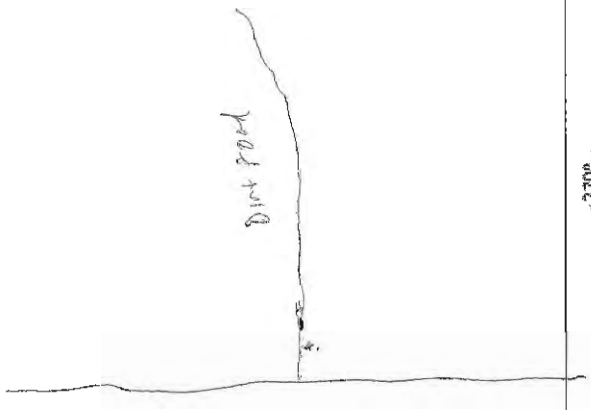
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

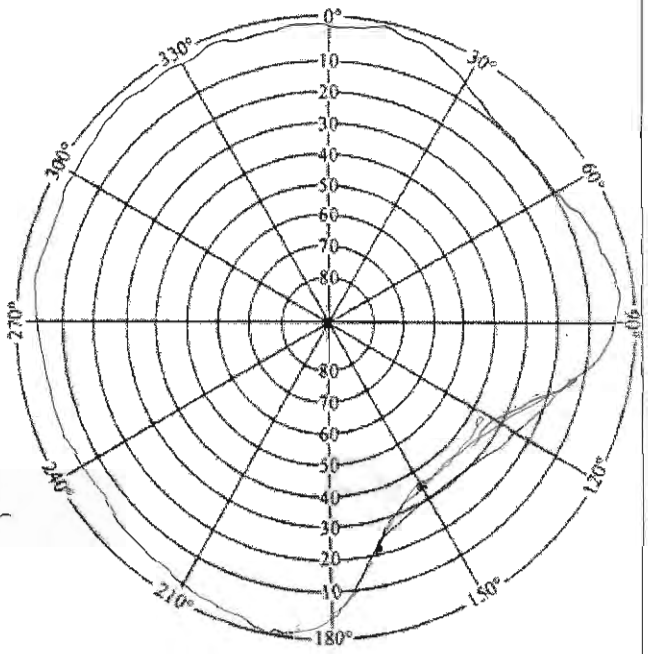
1. 100 - 753
2. 100 - 754
3. 100 - 755

100 - 756

Location Sketch:



Visibility Diagram:



No obstructions: ☒ Ignore small trees

10 ft to S/E dir. should have little impact.

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	CR01	**Station PID** (if any)	
General Location:	8 mi south of Tillman, SC		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10/25/2006	**Day of Year:**	
Operator:	(KS) / JC / BH	**Session ID:**	N/A
Receiver ID:	9901	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005	

Observation Time	*Start*	*End*
Scheduled		
Actual	10:30	

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth – GENERAL – GRASS ABOUT 2" (5 cm)
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

ON WEST SIDE OF HIGHWAY 321
NORTH SIDE OF LOGGING TRUCK ROAD

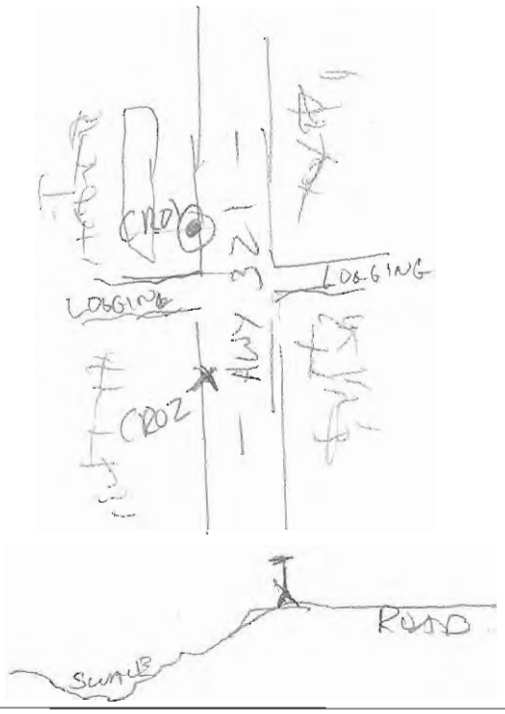
Station Location CR01

Photograph IDs of check point

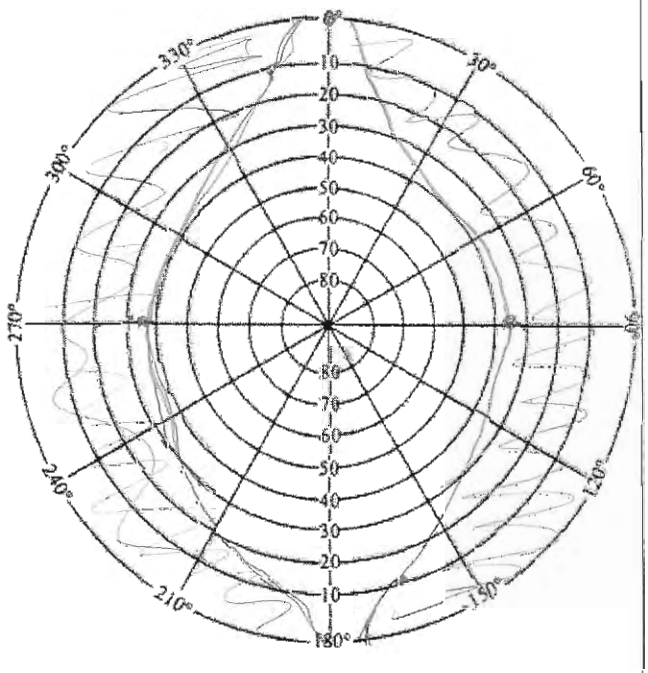
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. FROM E 0789
2. FROM N. 0790
3. FROM South 0791

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

SIDE OF HWY AT JUNCTION OF TWO LOGGING ROADS.

Directions To Reach Location:

ABOUT 8.5 mi SOUTH OF TILLMAN ON HWY 321, PAST Dairies

Station Observation Log

Site ID:	CR02	**Station PID** (if any)	
General Location:	8mi S of Tillman, SC		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10/25/2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	NOAA CSC 03	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.004	

Observation Time	*Start*	*End*
Scheduled		
Actual	10:40	

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth — General - Grass 2" (5cm)
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

On west side of Highway 321
South side of logging access road

Station Location CR02

Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

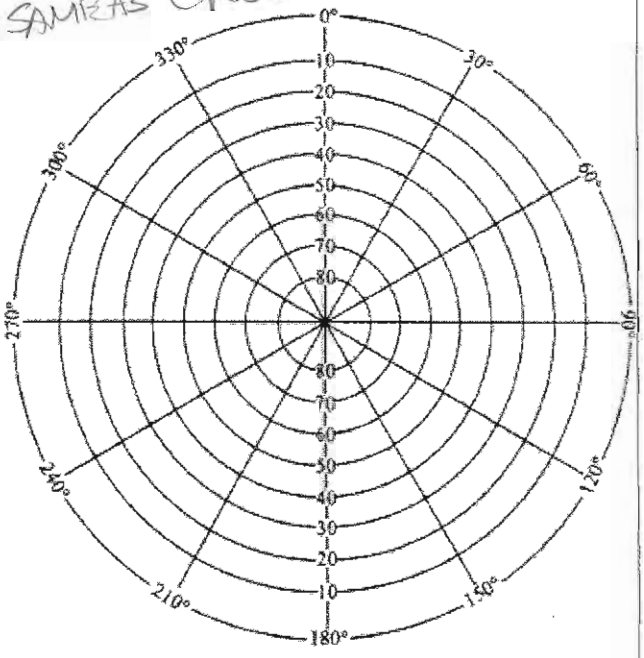
1. 0792 FROM EAST
2. 0793 FROM SOUTH
3. 0794 FROM NORTH

Location Sketch:

Same as CR01

Visibility Diagram:

SAME AS CR01



No obstructions: ☐

General Station Location: SAME AS CR01

Directions To Reach Location:

Station Observation Log

Site ID:	CR 03	**Station PID** (if any)	
General Location:	ST MATTHEW BAPTIST CHURCH		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 25 / 2006	**Day of Year:**	
Operator:	(KS) / JC / BH	**Session ID:**	N/A
Receiver ID:	9961	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.006	

Observation Time	*Start*	*End*
Scheduled		
Actual	12:00	12:30

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth ≈ 12 FT FROM EDGE OF PAVEMENT
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes: CHURCH PARKING LOT

Station Location CR03

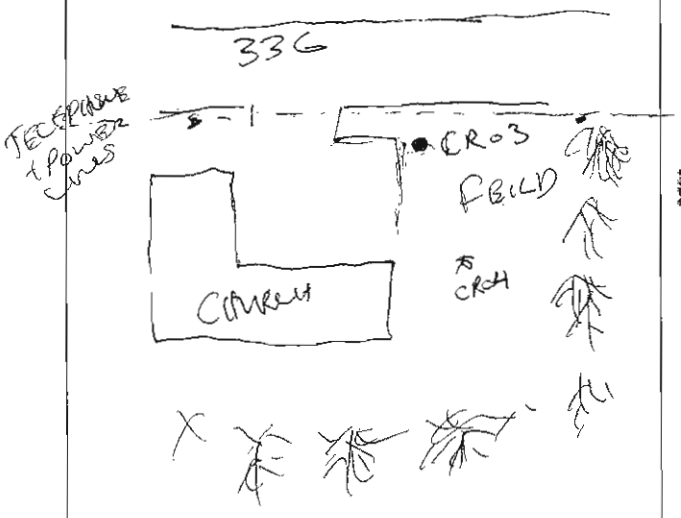
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

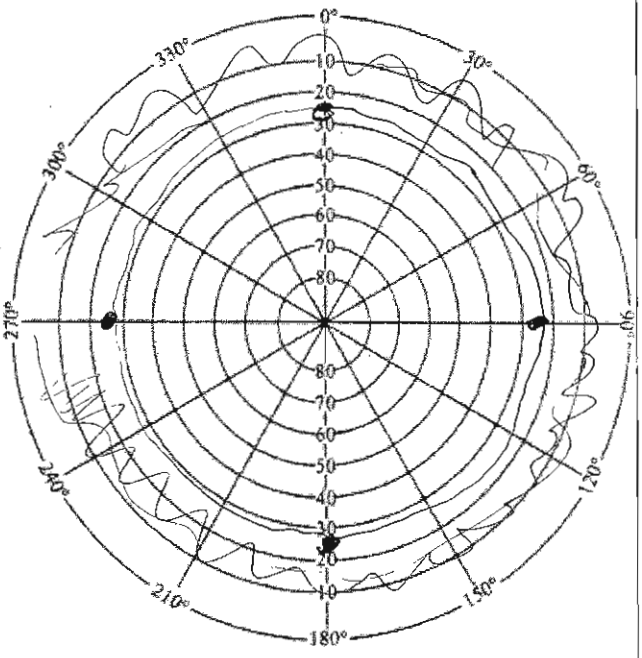
1. 0798 LOOKING NORTH
2. 0799 LOOKING SOUTH
3. 0801 LOOKING WEST

0800 NO PICTURE →

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

AT ST MATTHEW BAPTIST CHURCH
CHURCH PARKING LOT & UTILITY POST

Directions To Reach Location:

ABOUT 2 MI EAST ON 336
FROM TILLMAN, INTERSECT OF 336 & 321

Station Observation Log

Site ID:	CR04	**Station PID** (if any)	
General Location:	Vacant Lot St. Mathews Bap. Church		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10/25/2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	NOAA CSC #3	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.001	

Observation Time	*Start*	*End*
Scheduled		
Actual	12:00	13:30

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☑ Bare Earth grass 3"
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

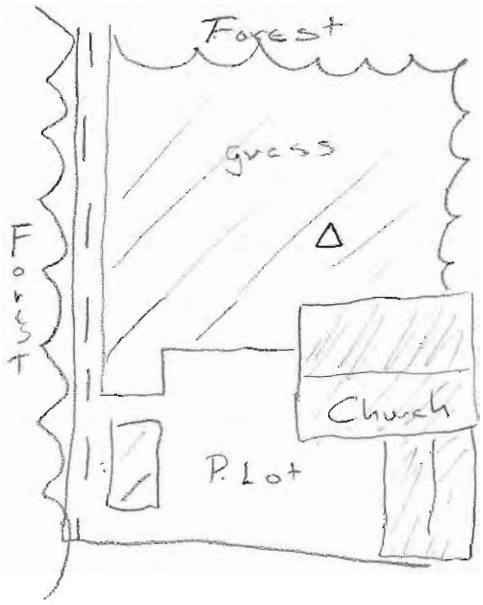
Station Location CR04

Photograph IDs of check point

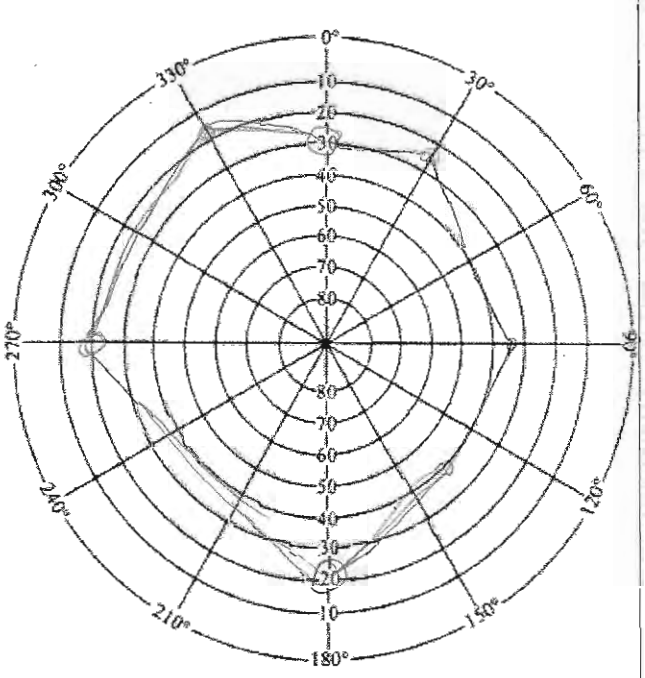
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 0795 West end of lot
2. 0796 N end of lot
3. 0797 East end of lot

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

Vacant lot adjacent to church + parking lot

Directions To Reach Location:

Same as CR03

start

Station Observation Log

Site ID:	CR05	**Station PID** (if any)	
General Location:	Parking lot area of Baptist Church near Sinclair 601 / 32		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 25 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	CSC03	**Antenna ID:**	20042427

Antenna Height	*Before Session*	*After Session*
Height (m)	~~2.007~~ 2.007	

Observation Time	*Start*	*End*
Scheduled	1:45	2:16
Actual		

GPS Setup	
Epoch Interval (secs)	5 ✓
Elevation Mask (degs)	10 ✓

Characteristic land cover:

2
- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☑ Grass/Crops manicured centipede grass
- ☐ Developed

Notes:

Station Location

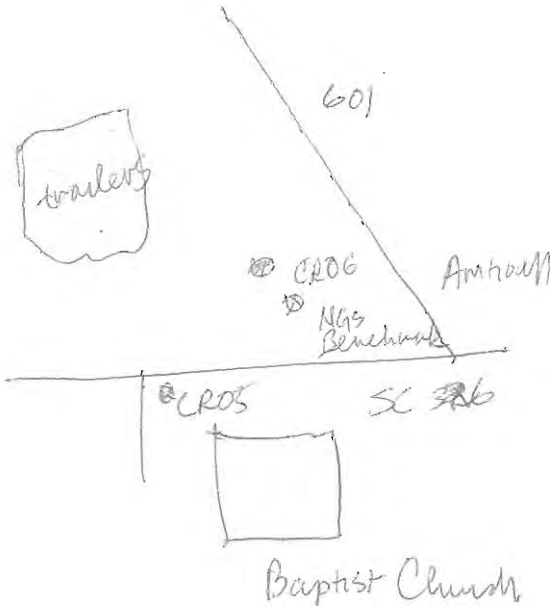
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

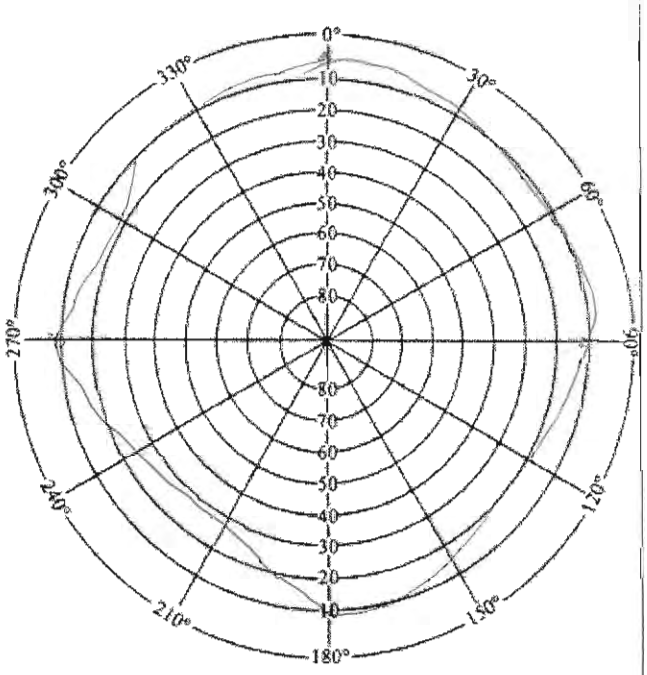
1. 609
2. 610
3. 611

4. 612

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	CR06	**Station PID** (if any)	
General Location:	At junction 326/601 Near NGS Benchmark (Antioch)		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10/25/2006	**Day of Year:**	Wednesday
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	CR206 CD00062796	**Antenna ID:**	2005078884

Antenna Height	*Before Session*	*After Session*
Height (m)	2.002	

Observation Time	*Start*	*End*
Scheduled	1:45	2:15
Actual		

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☑ Grass/Crops
- ☐ Developed

Many cuff Centipede

Notes:

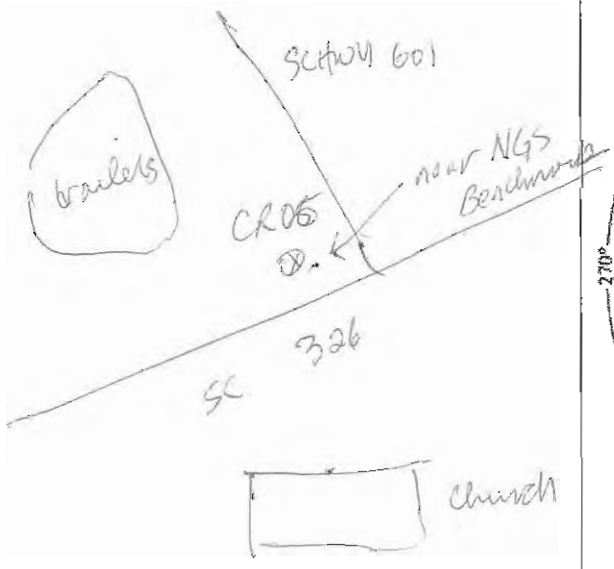
Station Location CR06

Photograph IDs of check point

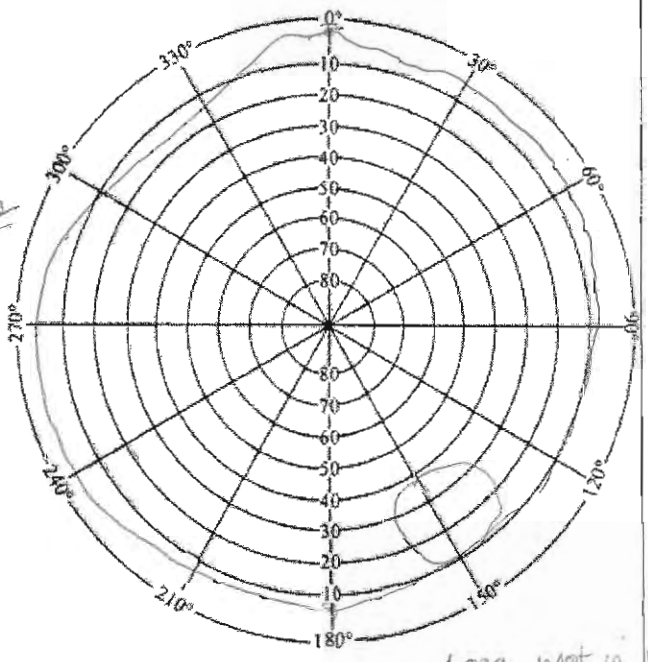
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 804
2. 806
3. 807
   806

Location Sketch:



Visibility Diagram:



trees not in requested

No obstructions: ☐

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	CR07	**Station PID** (if any)	
General Location:	At train crossing next Coosawhatchie Baptist Church.		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 25 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / (BH) CR	**Session ID:**	N/A
Receiver ID:	CD00012799 61	**Antenna ID:**	2005078884

Antenna Height	*Before Session*	*After Session*
Height (m)	2.007 m	

Observation Time	*Start*	*End*
Scheduled	3:42	
Actual		

GPS Setup	
Epoch Interval (secs)	5 ✓
Elevation Mask (degs)	10 ✓

Characteristic land cover:

1 ☐ Bare Earth
☐ Forest
  ☐ Deciduous
  ☐ Evergreen
☐ Scrub/Shrub
☒ Grass/Crops Manicured Centipede
☐ Developed

Notes:

Station Location CR07

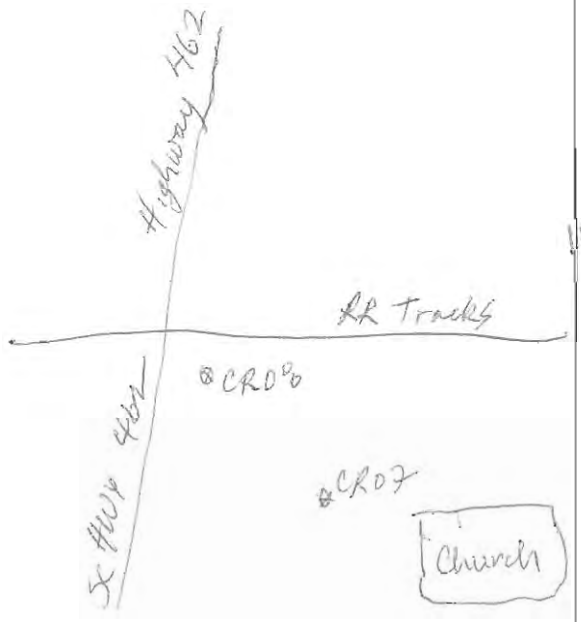
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

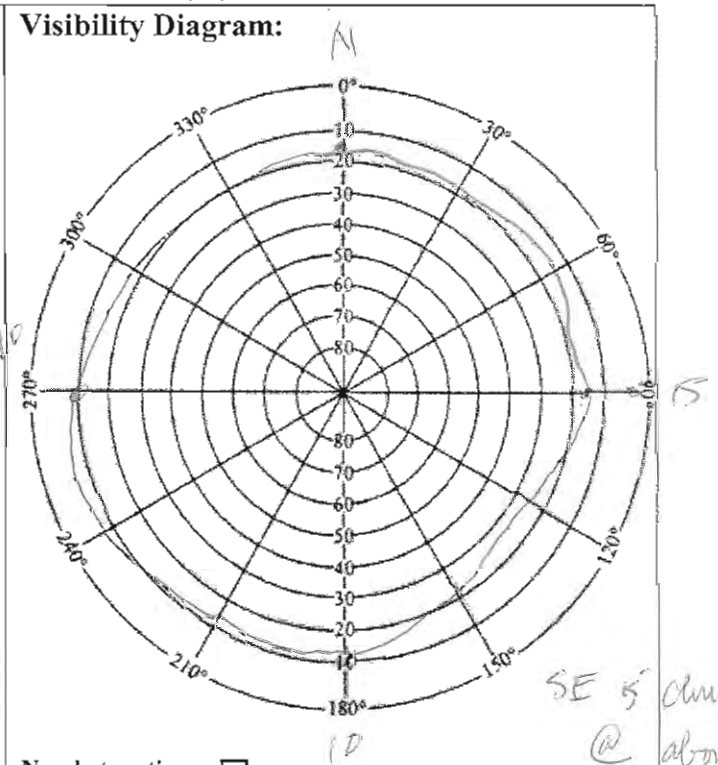
1. 817
2. 818
3. 820

4821

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

in a grass parking lot for Crossroads Baptist Church off Hwy 462 near junction with I-75.

Directions To Reach Location:

Station Observation Log

Site ID:	CR08	**Station PID** (if any)	
General Location:	At train crossing next Coosawhatchie Baptist Church on
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 25 / 2006	**Day of Year:**	Wednesday
Operator:	KS / JC / BH / CR	**Session ID:**	N/A
Receiver ID:	NOAA / CSC 3	**Antenna ID:**	2004 24121

Antenna Height	*Before Session*	*After Session*
Height (m)	2.007 m	

Observation Time	*Start* 8:43	*End*
Scheduled		
Actual		

GPS Setup	
Epoch Interval (secs)	5 ✓
Elevation Mask (degs)	10 ✓

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☑ Grass/Crops — Manicured Centipede
- ☐ Developed

Notes: 8.10 ft from Fiber Optic Cable Warning Sign

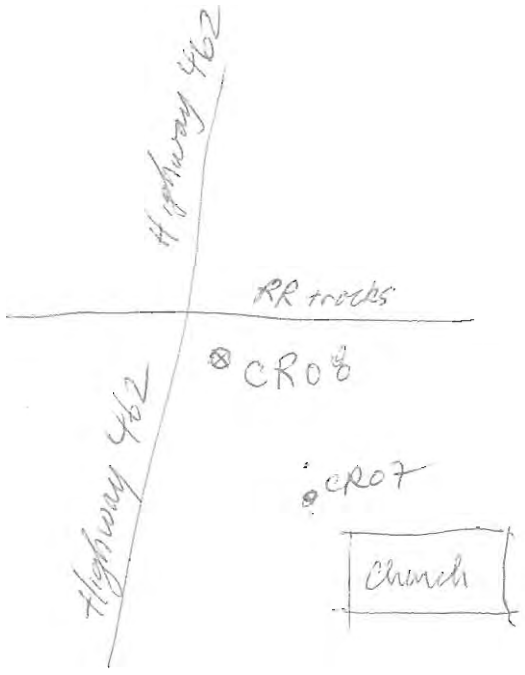
Station Location CR08

Photograph IDs of check point

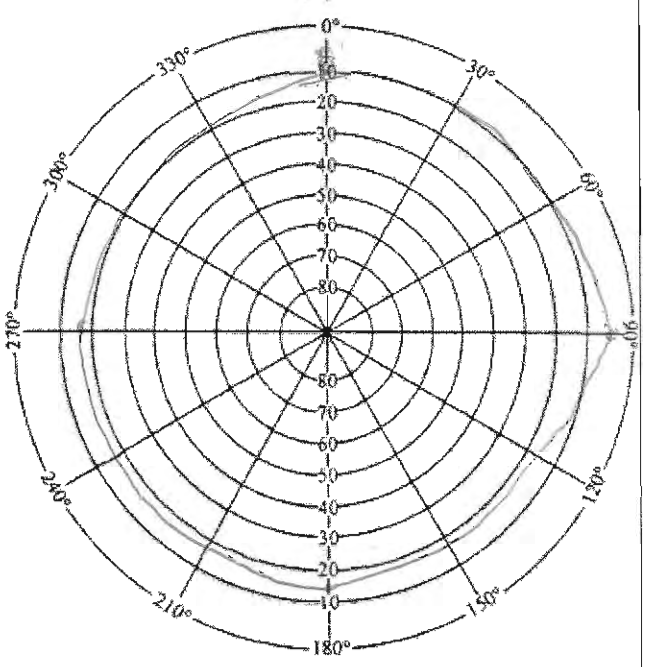
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. 813
2. 814
3. 815
4. 816

Location Sketch:



Visibility Diagram: N



No obstructions: ☐

General Station Location:

In a grass field next to Coosawhatchie Baptist Church

Directions To Reach Location:

CR01 2.005 05 2.006
CR02 2.004 06 2.002
CR03 2.006 07 2.007
CR04 2.001 08 2.007
AE2762 2.002

Station Observation Log

Site ID:	2762	**Station PID** (if any)	AE 2762
General Location:	TILMAN METHODIST CHURCH		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 25 / 2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)		

Observation Time	*Start*	*End*
Scheduled	≈ 10:00 AM	
Actual	≈ 10:00 AM	4: PM

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☒ Developed

Notes:

On sidewalk about 1FT from curb. Near telephone pole - several sets of wires overhead.

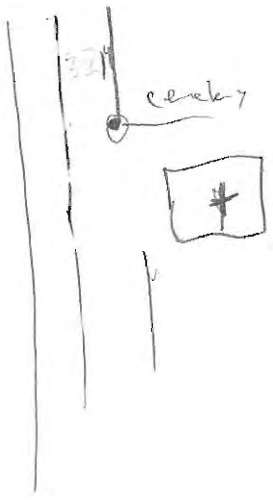
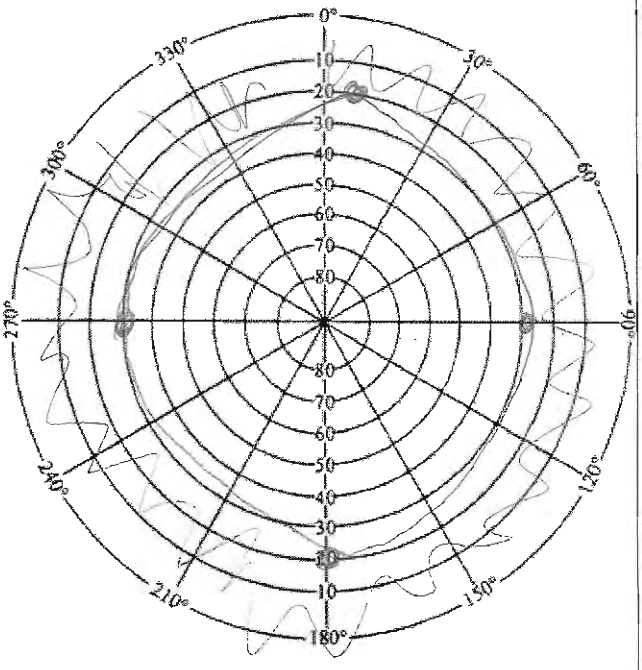
THIS IS A BASE STATION

Station Location 3762

Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

1.
2.
3.

Location Sketch:	Visibility Diagram:
	 No obstructions: ☐

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	KS01	**Station PID** (if any)	
General Location:	CORNER OF SC 171 & SC 462		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 13 / 2006	**Day of Year:**	
Operator:	(KS) / JC / BH	**Session ID:**	N/A
Receiver ID:	9961	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005	2.005

Observation Time	*Start*	*End*
Scheduled		
Actual	2:00 PM	2:33 PM

8.75 KM FROM SC01

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth/GRASS (SHORT)
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

5 M FROM EDGE OF PAVEMENT
8M FROM SLOPE UP TO SC462

POWERED FROM CAR - BATTERY DEAD?

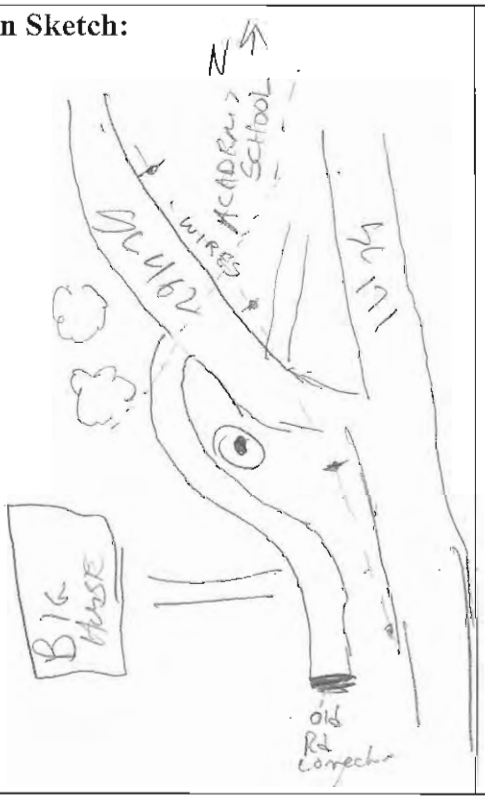
Station Location KSØ1

Photograph IDs of check point

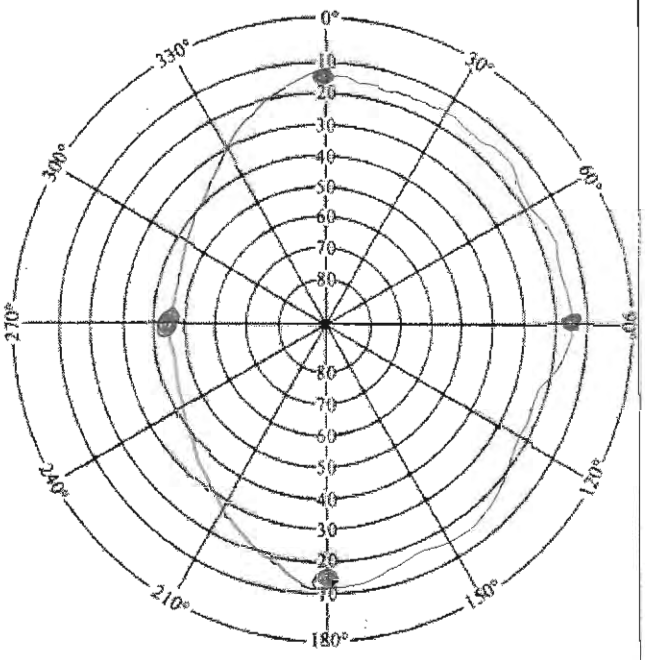
3 photos taken ~~60~~ 120 degrees apart, showing entire footprint around the check point

1. Looking N
2. " " SE
3. " " WSW

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

U IN U ROAD - Junction of two highways & PRIVATE/OLD ROAD Connector

Directions To Reach Location:

Station Observation Log

Site ID:	KS02	**Station PID** (if any)	
General Location:	ACROSS SC 462 FROM KS01, AT ACADEMY SCHOOL		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 3 / 2006	**Day of Year:**	
Operator:	(KS) / JC / BH	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005	2.005

Observation Time	*Start*	*End*
Scheduled		
Actual	2:56 PM	3:27 PM

8.75 KM FROM SC 01

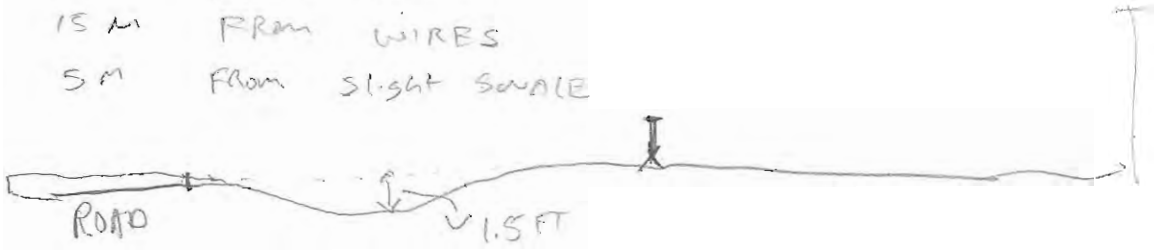
GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth / SHORT GRASS
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

15 M FROM PAVEMENT
15 M FROM WIRES
5 M FROM SIGHT GAUGE



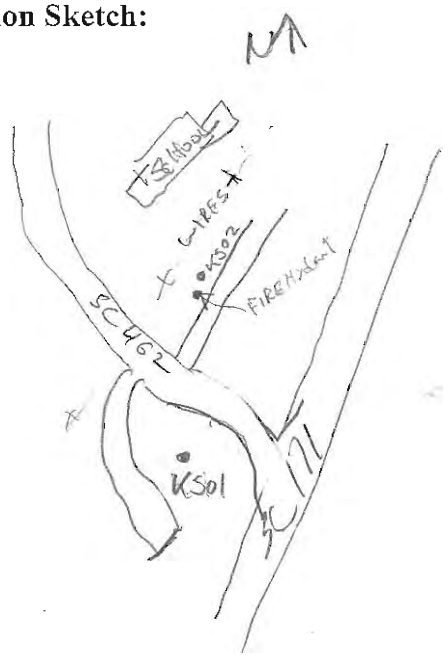
Station Location KS02

Photograph IDs of check point

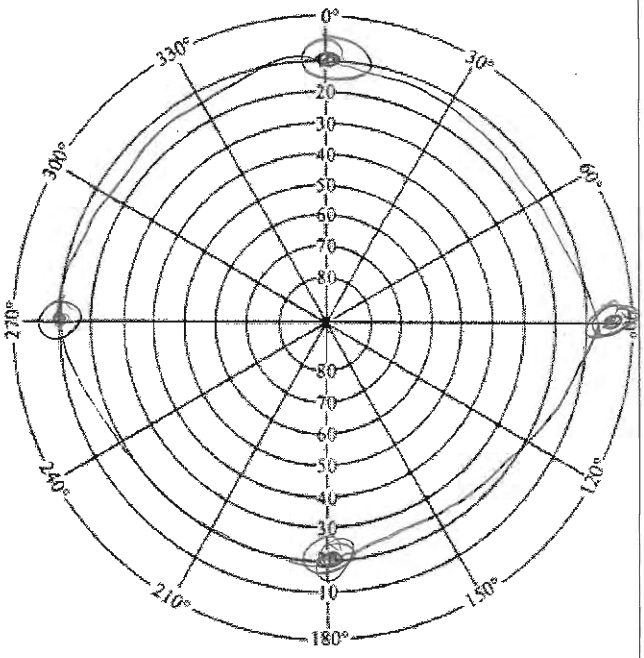
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. Looking N
2. " SE → ONE BAD PHOTO OF GROUND
3. " WSW

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

LARGE FIELD AT ACADEMY FOR EXCELLENCE SCHOOL ≈ 15 M South OF OVERHEAD WIRES. GOOD VIS IN ALL DIRECTIONS. VISIBLE FROM KS01. GRASS 2" TALL

Directions To Reach Location:

School AT JCT BETWEEN SC462 + SC171 ABOUT 10 M EAST OF FIRE HYDRANT

Station Observation Log

Site ID:	KS03	**Station PID** (if any)	
General Location:	ROAD WORK/HIGHWAY DEPT/CHURCH in Ridgeland		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	NAVAA/CSC #3	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.001	

Observation Time	*Start*	*End*
Scheduled		
Actual	10:54 AM	11:24 AM

10.8 KM TO JC01

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth/SHORT GRASS
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes: LOCATED ON VOLLEYBALL COURT AT CHURCH - VY SLIGHT INCLINE NEXT TO PARKING LOT. TALL TOWER ABOUT 150 YDS AWAY - RADIO TOWER FOR POLICE/HIGHWAY DEPT

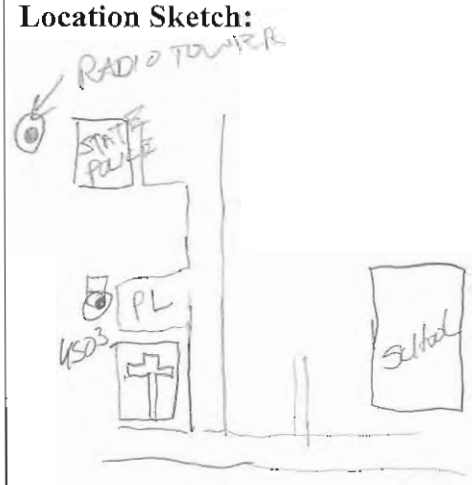
Station Location KS03

Photograph IDs of check point – PHOTOS TAKEN WITH PERSONAL CAMERA

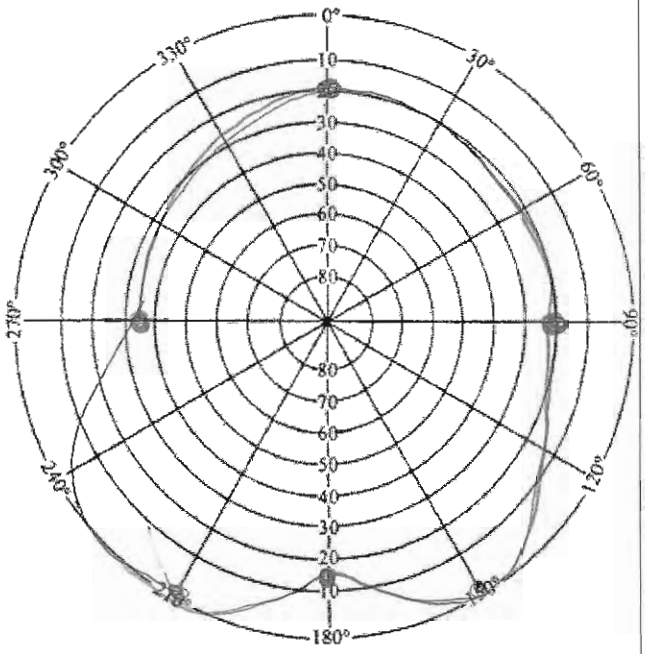
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. LOOKING N
2. " " SE
3. " " WSW

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

LOCATED BETWEEN COURCH & STATE POLICE ON WORK/BALL COURT. IN line w Southern POST + TREE – 7m WEST OF POST.

Directions To Reach Location:

IN RIDGELAND NEXT TO HIGH/MIDDLE SCHOOL – NEXT STREET (TO SCHOOL PATROL)

Station Observation Log

Site ID:	KS04	**Station PID** (if any)	
General Location:	ABOUT 50 M SE OF KS03 IN FIELD.		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	NOAA CSC#3	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.001	

Observation Time	*Start*	*End*
Scheduled		
Actual	10:31	11:59

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☐ Bare Earth
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☒ Grass/Crops UNCUT / SEMI-CUT FIELD.
- ☐ Developed

Notes: APPEARS TO BE ABOUT 1 YR WORTH OF GRASS/WEEDS

Station Location KS04

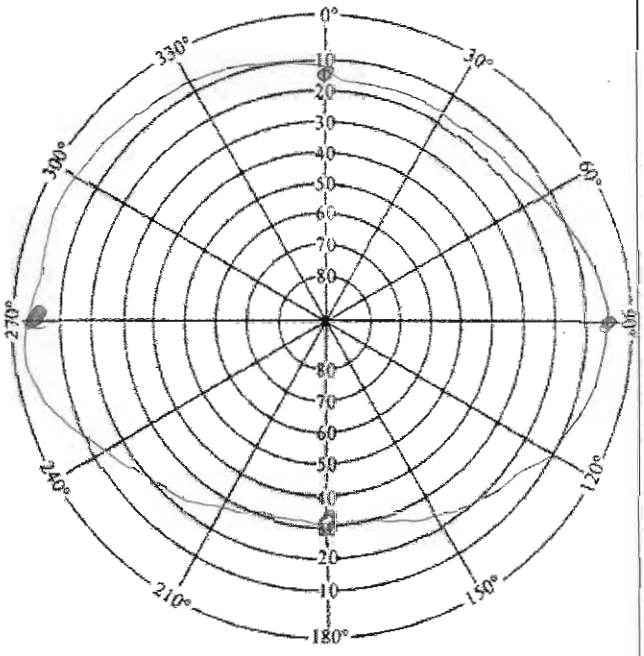
Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

1. TAKEN LOOKING NORTH
2. " " " " SE
3. " " " " WSW

Location Sketch: SEE KS03

Visibility Diagram:



No obstructions: ☐

General Station Location:

ABOUT 50 M SE OF KS03, IN UNCUT FIELD BETWEEN CHURCH + STATE POLICE. 25 M EAST OF SECOND TREE IN CHURCH PARKING LOT (IN LINE BETWEEN TREES) STOP SIGN

Directions To Reach Location:

SEE KS03

ABANDONED

Station Observation Log

Site ID:	KS05	**Station PID** (if any)	
General Location:	ABOUT 100 M S (ACROSS 95) FROM NGS BENCHMARK		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 24 2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:	NOAA CSC #03	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005	

Observation Time	*Start*	*End*
Scheduled		
Actual	2:22 PM	

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

KS05 ABANDONED
RECIEVER POINTED
WRONG DIRECTION
(SOUTH)

Characteristic land cover:

- ☒ Bare Earth – PAVEMENT
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

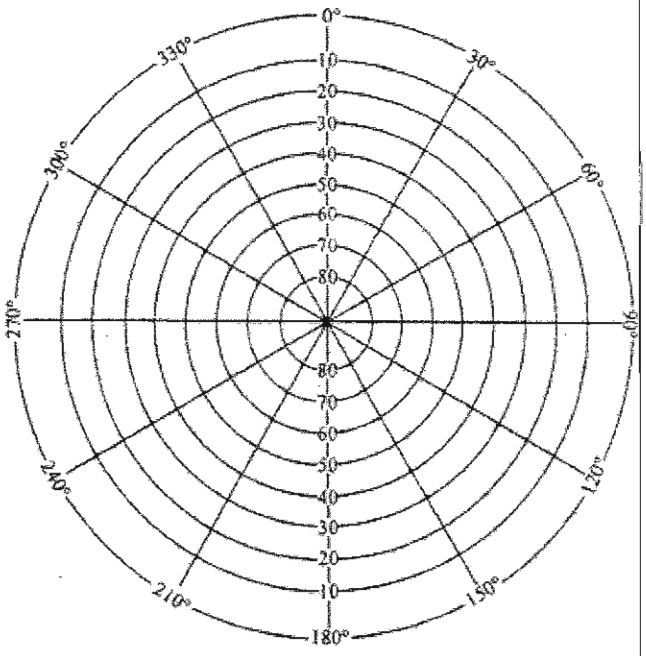
Notes: MIDDLE OF ROAD – MARKED WITH SPRAY PAINT

Station Location KS05

Photograph IDs of check point

3 photos taken 60 degrees apart, showing entire footprint around the check point

1.
2.
3.

Location Sketch:	**Visibility Diagram:**
	 No obstructions: ☐

General Station Location:

Directions To Reach Location:

Station Observation Log

Site ID:	KS06	**Station PID** (if any)	
General Location:	ABOUT 120 m SOUTH OF NGS BENCHMARK		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	/ / 2006	**Day of Year:**	
Operator:	KS / JC / BH	**Session ID:**	N/A
Receiver ID:		**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)		

Observation Time	*Start*	*End*
Scheduled		
Actual	7:32 PM	2:47 PM

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth – ASPHALT
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes: ON ROAD – SOUTH OF ORT 95

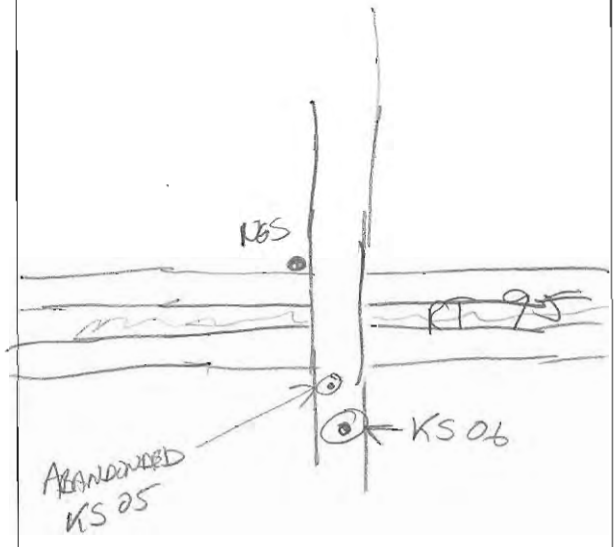
Station Location KS06

Photograph IDs of check point

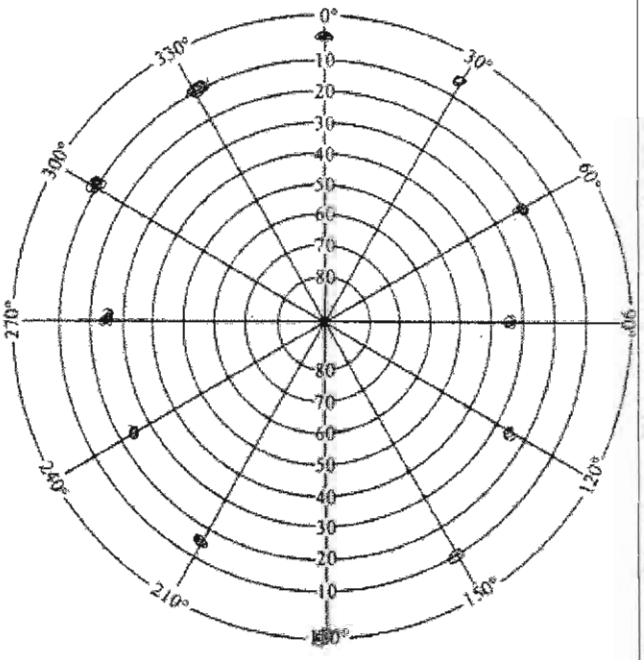
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. LOOKING NORTH
2. " " SE
3. " " WSW

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

ABOUT 120 M SOUTH OF NGS BENCHMARK - ACROSS HWY 95

Directions To Reach Location:

FOLLOW DIRECTIONS TO NGS MARKER PID AB 2745
GO 120 METRS ACROSS BRIDGE

Station Observation Log

Site ID:	KS 07	**Station PID** (if any)	
General Location:	HARDEEVILLE POST OFFICE		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	(KS) / JC / BH	**Session ID:**	N/A
Receiver ID:	NOAA CSC #3	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005	

Observation Time	*Start*	*End*
Scheduled		
Actual	3:25 PM	3:45 PM

ABOUT 5 KM FROM AE2946

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth / SHORT GRASS
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes:

ON CONCRETE PAD, SLIGHTLY LOWER THAN SURROUNDING SURFACE - ABOUT 1.5 M FROM CURB, PAD ≈ 3' BELOW GENERAL FLAT SURFACE. VIEW IS QUITE UNOBSTRUCTED

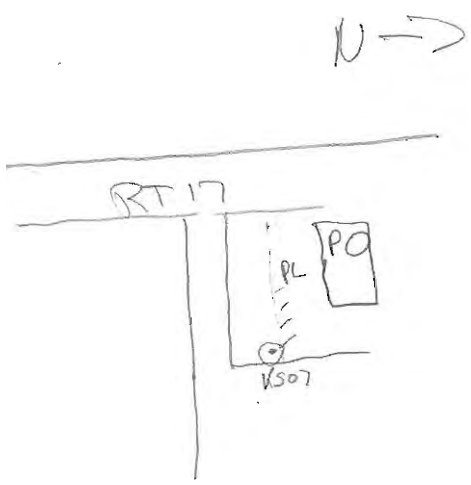
Station Location KS07

Photograph IDs of check point

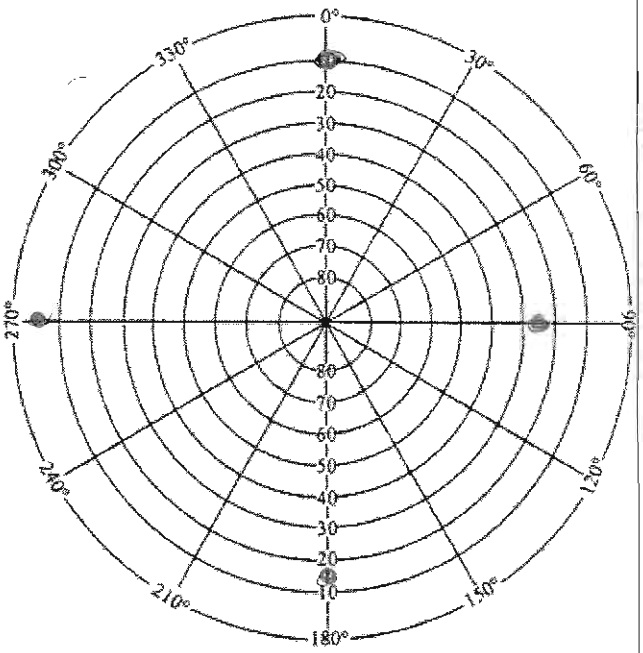
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. LOOKING N
2. " " SE
3. " " WSW

Location Sketch:



Visibility Diagram:



No obstructions: ☐ ← LOW OBSTRUCTION

General Station Location:

AT HARDEVILLE POST OFFICE - EAST END OF LOT

Directions To Reach Location:

HARDEVILLE POST OFFICE

Station Observation Log

Site ID:	KS 08	**Station PID** (if any)	
General Location:	WAREHOUSE NORTH OF HARDEEVILLE PO		
Project ID:	2006 Jasper County LiDAR ground truth survey		
Date:	10 / 4 / 2006	**Day of Year:**	
Operator:	(KS) JC / BH	**Session ID:**	N/A
Receiver ID:	NOAA CSC #3	**Antenna ID:**	

Antenna Height	*Before Session*	*After Session*
Height (m)	2.005	2.005

Observation Time	*Start*	*End*
Scheduled		
Actual	3:57 PM	4:20 PM

5 KM FROM AE 2746

GPS Setup	
Epoch Interval (secs)	5
Elevation Mask (degs)	10

Characteristic land cover:

- ☒ Bare Earth / ASPHALT
- ☐ Forest
  - ☐ Deciduous
  - ☐ Evergreen
- ☐ Scrub/Shrub
- ☐ Grass/Crops
- ☐ Developed

Notes: ON CONCRETE PAD - DISINTIGRATING - VERY SLIGHT SLOPE TO WEST.

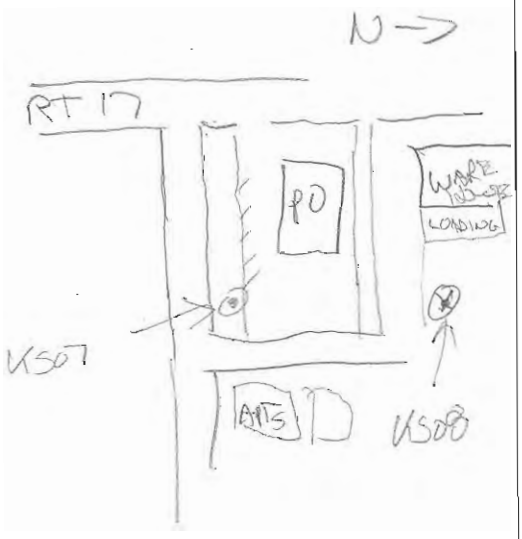
Station Location KS08

Photograph IDs of check point

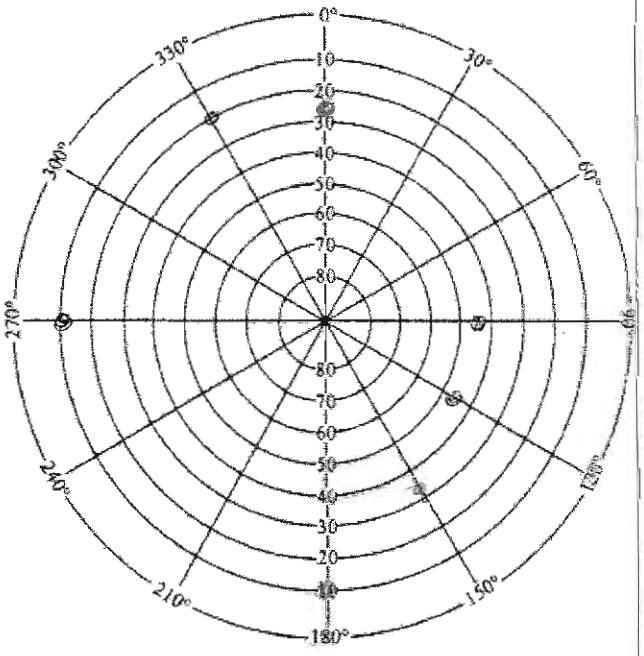
3 photos taken 60 degrees apart, showing entire footprint around the check point

1. TAKEN LOOKING NORTH
2. " " " " SE
3. " " " " WSW

Location Sketch:



Visibility Diagram:



No obstructions: ☐

General Station Location:

NEAR POST OFFICE / BACK OF POST OFFICE IN UNUSED GARAGE HOUSE LOT.

Directions To Reach Location:

70 M NORTH OF KS07

Appendix C - GPS Observation Sites

(Site IDs, dates, photos)

Sample Point ID	Latitude	Longitude	Ellipsoid Height (US survey ft)	Land-Cover	Picture ID	Sample Date
AE2746	32° 15' 16.91343"N	81° 06' 22.51834"W	-55.28	Scrub/Shrub	AE2746-1, AE2746-2, AE2746-3, AE2746-4	10/4/2006
AE2762	32° 27' 58.98635"N	81° 06' 32.54732"W	-51.67	Bare Earth	No Picture	10/25/2006
BH03	32° 25' 40.83731"N	80° 53' 47.92644"W	-84.45	Grass/Crops	BH03-1, BH03-2, BH03-3	10/3/2006
BH04	32° 13' 45.65861"N	81° 04' 26.09732"W	-86.00	Grass/Crops	BH04-1, BH04-2, BH04-3, BH04-4	10/4/2006
BH05	32° 13' 46.21742"N	81° 04' 21.27269"W	-88.06	Grass/Crops	BH05-1, BH05-2, BH05-3, BH05-4	10/4/2006
BH06	32° 08' 52.91442"N	81° 00' 15.37883"W	-89.30	Bare Earth	BH06-1, BH06-2, BH06-3, BH06-4	10/4/2006
BH07	32° 08' 51.15094"N	81° 00' 13.36577"W	-85.89	Bare Earth	BH07-1, BH07-2, BH07-3, BH07-4	10/4/2006
CK0926	32° 25' 38.16833"N	80° 53' 48.13678"W	-84.25	Bare Earth	CK0926-1, CK0926-2, CK0926-3, CK0926-4	10/3/2006
CR01	32° 22' 43.76918"N	81° 05' 48.10702"W	-75.80	Bare Earth (Short Grass)	CR01-1, CR01-2, CR01-3	10/25/2006
CR02	32° 22' 42.73766"N	81° 05' 47.94850"W	-75.72	Bare Earth (Short Grass)	CR02-1, CR02-2, CR02-3	10/25/2006
CR03	32° 27' 42.86451"N	81° 04' 56.02946"W	-48.28	Bare Earth (Short Grass)	CR03-1, CR03-2, CR03-3	10/25/2006
CR04	32° 27' 42.00055"N	81° 04' 55.72602"W	-48.15	Bare Earth (Short Grass)	CR04-1, CR04-2, CR04-3	10/25/2006
CR05	32° 33' 16.41786"N	81° 10' 11.80039"W	-41.82	Bare Earth (Short Grass)	CR05-1, CR05-2, CR05-3, CR05-4	10/25/2006
CR06	32° 33' 14.37668"N	81° 10' 08.83953"W	-41.39	Bare Earth (Short Grass)	CR06-1, CR06-2, CR06-3, CR06-4	10/25/2006
CR07	32° 35' 20.27050"N	80° 55' 45.78760"W	-86.56	Bare Earth (Short Grass)	CR07-1, CR07-2, CR07-3, CR07-4	10/25/2006
CR08	32° 35' 19.59078"N	80° 55' 46.62181"W	-86.14	Bare Earth (Short Grass)	CR08-1, CR08-2, CR08-3, CR08-4	10/25/2006
JC02	32° 30' 42.69130"N	80° 52' 07.22192"W	-90.12	Bare Earth	JC02-1, JC02-2, JC02-3, JC02-4	10/4/2006
JC03	32° 30' 53.61339"N	80° 52' 05.04384"W	-88.09	Bare Earth	JC03-1, JC03-2, JC03-3, JC03-4	10/4/2006
KS01	32° 21' 07.56388"N	80° 55' 25.77221"W	-83.51	Bare Earth (Short Grass)	KS01-1, KS01-2, KS01-3, KS01-4	10/3/2006
KS02	32° 21' 09.21505"N	80° 55' 21.33684"W	-83.86	Bare Earth (Short Grass)	KS02-1, KS02-2, KS02-3	10/3/2006
KS03	32° 29' 27.09675"N	80° 59' 04.04042"W	-35.88	Bare Earth (Short Grass)	No Picture	10/4/2006
KS04	32° 29' 26.21531"N	80° 59' 02.02705"W	-37.64	Grass/Crops (Wheat, Semi-Cut Field)	No Picture	10/4/2006
KS06	32° 15' 12.56929"N	81° 06' 21.06634"W	-56.67	Bare Earth (Pavement)	KS06-1, KS06-2, KS06-3	10/4/2006
KS07	32° 17' 23.02876"N	81° 04' 40.59448"W	-85.00	Bare Earth (Short Grass)	KS07-1, KS07-2, KS07-3	10/4/2006
KS08	32° 17' 25.15282"N	81° 04' 38.86582"W	-84.89	Bare Earth (Pavement)	KS08-1, KS08-2, KS08-3	10/4/2006

Photos in
N:\crs\projects\tcm\south_carolina\Jasper_County\Groundtruth\Groundtruth_Photos

Sample Method	Antenna Height (m)	Start Time	End Time	Elapsed Time	Receiver ID	Antenna ID
GPS/NGS Benchmark	2.004	2:20:00 PM	5:40:00 PM	3:20	CD0001279961	200424127
GPS/NGS Benchmark	2.002	9:25:00 AM	4:25:00 PM	7:00	CD0001279962	8715
GPS	2.002	3:55:00 PM	4:15:00 PM	0:20	CD0001279962	8715
GPS	2.005	2:31:00 PM	2:51:00 PM	0:20	CD0001279962	8715
GPS	2.003	3:05:00 PM	3:25:00 PM	0:20	CD0001279962	8715
GPS	2.005	4:36:00 PM	5:01:00 PM	0:25	CD0001279962	8715
GPS	2.001	5:06:00 PM	5:35:00 PM	0:29	CD0001279962	8715
GPS/NGS Benchmark	2.003	1:00:00 PM	4:30:00 PM	3:30	NOAA/CSC 3	2005078884
GPS	2.005	10:30:00 AM	10:55:00 AM	0:25	CD0001279961	200424127
GPS	2.004	10:40:00 AM	11:05:00 AM	0:25	NOAA/CSC 3	2005078884
GPS	2.006	12:00:00 PM	12:30:00 PM	0:30	CD0001279961	200424127
GPS	2.001	12:00:00 PM	12:30:00 PM	0:30	NOAA/CSC 3	2005078884
GPS	2.006	1:45:00 PM	2:16:00 PM	0:31	NOAA/CSC 3	200424127
GPS	2.002	1:45:00 PM	2:15:00 PM	0:30	CD0001279961	2005078884
GPS	2.007	3:42:00 PM	4:21:00 PM	0:39	CD0001279961	2005078884
GPS	2.007	3:43:00 PM	4:22:00 PM	0:39	NOAA/CSC 3	200424127
GPS	1.98	11:00:00 AM	11:20:00 AM	0:20	CD0001279962	8715
GPS	2.007	11:32:00 AM	11:53:00 AM	0:21	CD0001279962	8715
GPS	2.005	2:00:00 PM	2:33:00 PM	0:33	NOAA/CSC 3	2005078884
GPS	2.005	2:56:00 PM	3:27:00 PM	0:31	NOAA/CSC 3	2005078884
GPS	2.001	10:54:00 AM	11:24:00 AM	0:30	NOAA/CSC 3	2005078884
GPS	2.001	11:31:00 AM	11:59:00 AM	0:28	NOAA/CSC 3	2005078884
GPS	2	2:32:00 PM	2:47:00 PM	0:15	NOAA/CSC 3	2005078884
GPS	2.005	3:25:00 PM	3:45:00 PM	0:20	NOAA/CSC 3	2005078884
GPS	2.005	3:57:00 PM	4:20:00 PM	0:23	NOAA/CSC 3	2005078884

Appendix D – Base-Station Benchmark Sheets

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 7.42
1        National Geodetic Survey,   Retrieval Date = DECEMBER 21, 2006
 AE2746 ***********************************************************************
 AE2746  HT_MOD      -  This is a Height Modernization Survey Station.
 AE2746  DESIGNATION -  PURRYSBURG
 AE2746  PID         -  AE2746
 AE2746  STATE/COUNTY-  SC/JASPER
 AE2746  USGS QUAD   -  HARDEEVILLE (1979)
 AE2746
 AE2746                        *CURRENT SURVEY CONTROL
 AE2746  ______________________________________________________________________
 AE2746* NAD 83(2001)-  32 15 16.91343(N)    081 06 22.51834(W)     ADJUSTED
 AE2746* NAVD 88     -        14.43   (meters)      47.3    (feet)  GPS OBS
 AE2746  ______________________________________________________________________
 AE2746  X           -     834,702.781 (meters)                     COMP
 AE2746  Y           -  -5,334,110.330 (meters)                     COMP
 AE2746  Z           -   3,384,340.720 (meters)                     COMP
 AE2746  LAPLACE CORR-          -2.18  (seconds)                    DEFLEC99
 AE2746  ELLIP HEIGHT-         -16.85  (meters)          (03/13/03) GPS OBS
 AE2746  GEOID HEIGHT-         -31.27  (meters)                     GEOID03
 AE2746
 AE2746  HORZ ORDER  -  FIRST
 AE2746  ELLP ORDER  -  FOURTH    CLASS II
 AE2746
 AE2746.The horizontal coordinates were established by GPS observations
 AE2746.and adjusted by the National Geodetic Survey in March 2003..
 AE2746
 AE2746.The orthometric height was determined by GPS observations and a
 AE2746.high-resolution geoid model using precise GPS observation and
 AE2746.processing techniques.
 AE2746
 AE2746.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 AE2746
 AE2746.The Laplace correction was computed from DEFLEC99 derived deflections.
 AE2746
 AE2746.The ellipsoidal height was determined by GPS observations
 AE2746.and is referenced to NAD 83.
 AE2746
```

AE2746.The geoid height was determined by GEOID03.
AE2746
AE2746;   North   East   Units Scale Factor Converg.
AE2746;SPC SC   -   46,738.334   599,586.523   MT 1.00009539   -0 03 32.1
AE2746;SPC SC   -   153,340.99 1,967,147.39   iFT 1.00009539   -0 03 32.1
AE2746;UTM 17   - 3,568,672.585   489,991.479   MT 0.99960124   -0 03 24.1
AE2746
AE2746!   - Elev Factor x Scale Factor =   Combined Factor
AE2746!SPC SC   -   1.00000265 x   1.00009539 =   1.00009804
AE2746!UTM 17   -   1.00000265 x   0.99960124 =   0.99960388
AE2746
AE2746   SUPERSEDED SURVEY CONTROL
AE2746
AE2746 NAD 83(1986)- 32 15 16.92425(N)   081 06 22.52584(W) AD(   ) 1
AE2746 NAD 83(1995)- 32 15 16.91375(N)   081 06 22.51834(W) AD(   ) 1
AE2746 ELLIP H (12/20/99) -16.81   (m)   GP(   ) 4 1
AE2746 NAD 83(1986)- 32 15 16.92578(N)   081 06 22.52854(W) AD(   ) 1
AE2746
AE2746.Superseded values are not recommended for survey control.
AE2746.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AE2746.See file dsdata.txt to determine how the superseded data were derived.
AE2746
AE2746_U.S. NATIONAL GRID SPATIAL ADDRESS: 17SMR8999168673(NAD 83)
AE2746_MARKER: DD = SURVEY DISK
AE2746_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
AE2746_STAMPING: PURRYSBURG 1997
AE2746_MARK LOGO: SCGS
AE2746_PROJECTION: FLUSH
AE2746_MAGNETIC: M = MARKER EQUIPPED WITH BAR MAGNET
AE2746_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
AE2746+STABILITY: SURFACE MOTION
AE2746_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AE2746+SATELLITE: SATELLITE OBSERVATIONS - April 08, 2003
AE2746
AE2746 HISTORY   - Date   Condition   Report By
AE2746 HISTORY   - 1997   MONUMENTED   SCGS
AE2746 HISTORY   - 20030408 GOOD   SCGS
AE2746
AE2746   STATION DESCRIPTION
AE2746
AE2746'DESCRIBED BY SOUTH CAROLINA GEODETIC SURVEY 1997 (DDW)
AE2746'STATION IS LOCATED 2.7 MILES (4.3 KM) SOUTHWEST OF HARDEEVILLE, 17.25
AE2746'MILES (27.76 KM) SOUTHWEST OF RIDGELAND. OWNERSHIP--SCDOT, DIRECTOR
AE2746'OF PRECONSTRUCTION, P.O. BOX 191, COLUMBIA, SC 29202, PHONE
AE2746'803-737-1350. TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAY
AE2746'17 AND STATE HIGHWAY 46 (MAIN STREET) IN HARDEEVILLE, GO NORTHWEST ON
AE2746'HIGHWAY 46 FOR 0.35 MILE (0.56 KM) TO THE JUNCTION OF U.S. HIGHWAY
AE2746'321 AND STATE ROAD 31 (CHURCH STREET) AHEAD, CONTINUE ON ROAD 31 FOR
AE2746'2.15 MILES (3.46 KM) TO THE JUNCTION OF STATE ROAD 34 (PURRYSBURG

AE2746'ROAD) , TURN LEFT ON ROAD 34 FOR 0.85 MILE (1.37 KM) TO THE END OF
AE2746'PAVEMENT, CONTINUE ON ROAD 34 FOR 2.2 MILES (3.5 KM) TO THE STATION ON
AE2746'THE RIGHT NEAR THE NORTHWEST CORNER OF A BRIDGE OVER INTERSTATE 95.
AE2746'STATION IS A CONCRETE POST FLUSH WITH THE GROUND AND LEVEL WITH THE
AE2746'ROAD, 18.5 FEET (5.6 M) WEST SOUTHWEST OF THE CENTER OF ROAD 34, 21.8
AE2746'FEET (6.6 M) NORTH OF THE NORTH END OF THE BRIDGE, 3.5 FEET (1.1 M)
AE2746'NORTHWEST OF A GUARDRAIL POST WITH A SCGS REFERENCE WASHER ATTACHED,
AE2746'2.7 FEET (0.8 M) SOUTH OF A WITNESS POST. DESCRIBED BY R.W. ROBERTS.
AE2746
AE2746 STATION RECOVERY (2003)
AE2746
AE2746'RECOVERY NOTE BY SOUTH CAROLINA GEODETIC SURVEY 2003 (DDW)
AE2746'STATION IS LOCATED 2.7 MILES SOUTHWEST OF HARDEEVILLE, 17.25 MILES
AE2746'SOUTHWEST OF RIDGELAND. OWNERSHIP--SCDOT, DIRECTOR OF
AE2746'PRECONSTRUCTION, P.O. BOX 191, COLUMBIA, SC 29202, PHONE
AE2746'803-737-1350. TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAY
AE2746'17 AND STATE HIGHWAY 46 (MAIN STREET) IN HARDEEVILLE, GO NORTHWEST ON
AE2746'HIGHWAY 46 FOR 0.35 MILE TO THE JUNCTION OF U.S. HIGHWAY 321 AND
AE2746'STATE ROAD 31 (CHURCH STREET) AHEAD, CONTINUE ON ROAD 31 FOR 2.15
AE2746'MILES TO THE JUNCTION OF STATE ROAD 34 (PURRYSBURG ROAD), TURN LEFT ON
AE2746'ROAD 34 FOR 0.85 MILE TO THE END OF PAVEMENT, CONTINUE AHEAD ON THE
AE2746'GRAVEL ROAD (STATE ROAD 34) FOR 2.2 MILES TO THE STATION ON THE RIGHT
AE2746'BEHIND A GUARDRAIL NEAR THE NORTHWEST CORNER OF A BRIDGE OVER
AE2746'INTERSTATE 95. STATION IS A CONCRETE POST FLUSH WITH THE GROUND, 18.5
AE2746'FEET WEST SOUTHWEST OF THE CENTER OF ROAD 34, 21.8 FEET NORTH OF THE
AE2746'NORTH END OF THE BRIDGE, 3.5 FEET NORTHWEST OF A GUARD RAIL POST WITH
AE2746'A SCGS REFERENCE WASHER ATTACHED, 2.7 FEET SOUTH OF A WITNESS POST.
AE2746'RECOVERED BY T. HALL.
1 National Geodetic Survey, Retrieval Date = DECEMBER 21, 2006
AE2762 **
AE2762 HT_MOD   - This is a Height Modernization Survey Station.
AE2762 DESIGNATION - WINGO
AE2762 PID   - AE2762
AE2762 STATE/COUNTY- SC/JASPER
AE2762 USGS QUAD   - TILLMAN (1979)
AE2762
AE2762   *CURRENT SURVEY CONTROL
AE2762 ____
AE2762* NAD 83(2001)- 32 27 58.98635(N)   081 06 32.54732(W)   ADJUSTED
AE2762* NAVD 88   -   15.61   (meters)   51.2   (feet) GPS OBS
AE2762 ____
AE2762 X   -   832,501.647 (meters)   COMP
AE2762 Y   - -5,321,738.157 (meters)   COMP
AE2762 Z   -   3,404,170.187 (meters)   COMP
AE2762 LAPLACE CORR-   -1.86 (seconds)   DEFLEC99
AE2762 ELLIP HEIGHT-   -15.75 (meters)   (06/28/04) GPS OBS
AE2762 GEOID HEIGHT-   -31.35 (meters)   GEOID03
AE2762
AE2762 HORZ ORDER - FIRST

AE2762 ELLP ORDER - FOURTH   CLASS I
AE2762
AE2762.The horizontal coordinates were established by GPS observations
AE2762.and adjusted by the National Geodetic Survey in March 2003..
AE2762
AE2762.The orthometric height was determined by GPS observations and a
AE2762.high-resolution geoid model using precise GPS observation and
AE2762.processing techniques.
AE2762
AE2762.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AE2762
AE2762.The Laplace correction was computed from DEFLEC99 derived deflections.
AE2762
AE2762.The ellipsoidal height was determined by GPS observations
AE2762.and is referenced to NAD 83.
AE2762
AE2762.The geoid height was determined by GEOID03.
AE2762

AE2762;		North	East	Units	Scale Factor	Converg.
AE2762;SPC SC	-	70,214.456	599,348.756	MT	1.00001201	-0 03 37.6
AE2762;SPC SC	-	230,362.39	1,966,367.31	iFT	1.00001201	-0 03 37.6
AE2762;UTM 17	-	3,592,138.104	489,752.975	MT	0.99960129	-0 03 30.7

AE2762

AE2762!		Elev Factor	x	Scale Factor	=	Combined Factor
AE2762!SPC SC	-	1.00000247	x	1.00001201	=	1.00001448
AE2762!UTM 17	-	1.00000247	x	0.99960129	=	0.99960376

AE2762

AE2762:		Primary Azimuth Mark	Grid Az
AE2762:SPC SC	-	TILLMAN RESET	153 33 46.2
AE2762:UTM 17	-	TILLMAN RESET	153 33 39.3

AE2762

AE2762	PID	Reference Object	Distance	Geod. Az
AE2762				dddmmss.s
AE2762	CK6377	TILLMAN RESET	408.577 METERS	1533008.6
AE2762	AE2763	WINGO AZ MK	APPROX. 0.6 KM	3362314.2

AE2762
AE2762   SUPERSEDED SURVEY CONTROL
AE2762

AE2762					
AE2762	NAD 83(1986)-	32 27 58.99703(N)	081 06 32.55443(W)	AD( )	1
AE2762	ELLIP H (03/13/03)	-15.73 (m)		GP( )	4 2
AE2762	NAD 83(1995)-	32 27 58.98627(N)	081 06 32.54764(W)	AD( )	1
AE2762	ELLIP H (12/20/99)	-15.70 (m)		GP( )	4 1
AE2762	NAD 83(1986)-	32 27 58.99710(N)	081 06 32.55490(W)	AD( )	1

AE2762
AE2762.Superseded values are not recommended for survey control.
AE2762.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AE2762.See file dsdata.txt to determine how the superseded data were derived.

AE2762
AE2762_U.S. NATIONAL GRID SPATIAL ADDRESS: 17SMR8975392138(NAD 83)
AE2762_MARKER: DD = SURVEY DISK
AE2762_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
AE2762_STAMPING: WINGO 1997
AE2762_MARK LOGO: SCGS
AE2762_PROJECTION: FLUSH
AE2762_MAGNETIC: M = MARKER EQUIPPED WITH BAR MAGNET
AE2762_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
AE2762+STABILITY: SURFACE MOTION
AE2762_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AE2762+SATELLITE: SATELLITE OBSERVATIONS - April 14, 2003
AE2762
AE2762 HISTORY   - Date   Condition   Report By
AE2762 HISTORY   - 1997   MONUMENTED   SCGS
AE2762 HISTORY   - 20030414 GOOD   SCGS
AE2762
AE2762   STATION DESCRIPTION
AE2762
AE2762'DESCRIBED BY SOUTH CAROLINA GEODETIC SURVEY 1997 (DDW)
AE2762'STATION IS LOCATED 7.6 MILES (12.2 KM) WEST OF RIDGELAND, 12.45 MILES
AE2762'(20.04 KM) NORTH NORTHWEST OF HARDEEVILLE. OWNERSHIP--SCDOT, DIRECTOR
AE2762'OF PRECONSTRUCTION, P.O. BOX 191, COLUMBIA, SC 29202, PHONE
AE2762'803-737-1350. TO REACH THE STATION FROM THE JUNCTION OF U.S. HIGHWAY
AE2762'321, STATE HIGHWAY 336 AND STATE ROAD 119 (SAND HILLS ROAD) IN
AE2762'TILLMAN, GO NORTH NORTHWEST ON HIGHWAY 321 FOR 0.2 MILE (0.3 KM) TO
AE2762'THE STATION ON THE LEFT NEAR A POWER POLE IN FRONT OF A CHURCH
AE2762'BUILDING. STATION IS A CONCRETE POST FLUSH WITH THE GROUND AND 0.5
AE2762'FOOT (15.2 CM) ABOVE THE HIGHWAY, 26.5 FEET (8.1 M) WEST SOUTHWEST OF
AE2762'THE CENTER OF THE HIGHWAY, 1.0 FOOT (0.3 M) EAST NORTHEAST OF THE EAST
AE2762'EDGE OF A SIDEWALK, 48.8 FEET (14.9 M) SOUTHEAST OF THE SOUTHEAST
AE2762'CORNER OF A VINYL-SIDED CHURCH (TILLMAN UNITED METHODIST) , 6.2 FEET
AE2762'(1.9 M) EAST OF THE NORTHEAST CORNER OF A FENCE AROUND A CEMETERY, 7.1
AE2762'FEET (2.2 M) EAST OF A WITNESS POST BESIDE THE POWER POLE 165976/P/94
AE2762'WITH A TRANSFORMER. NOTE-STATION IS INTERVISIBLE WITH AZIMUTH MARK
AE2762'WINGO AZ MK AND HORIZONTAL STATION TILLMAN RESET. DESCRIBED BY R.W.
AE2762'ROBERTS.
AE2762
AE2762   STATION RECOVERY (2003)
AE2762
AE2762'RECOVERY NOTE BY SOUTH CAROLINA GEODETIC SURVEY 2003 (DDW)
AE2762'STATION IS LOCATED 7.6 MILES WEST OF RIDGELAND, 12.45 MILES NORTH OF
AE2762'HARDEEVILLE.   OWNERSHIP--SCDOT, DIRECTOR OF PRECONSTRUCTION, P.O. BOX
AE2762'191, COLUMBIA, SC 29202, PHONE 803-737-1350. TO REACH THE STATION
AE2762'FROM THE JUNCTION OF U.S. HIGHWAY 321, STATE HIGHWAY 336 AND STATE
AE2762'ROAD 119 (SAND HILLS ROAD) IN TILLMAN, 7.5 MILES WEST OF RIDGELAND, GO
AE2762'NORTH NORTHWEST ON HIGHWAY 321 FOR 0.2 MILE TO THE STATION ON THE
AE2762'LEFT NEAR A POWER POLE IN THE YARD OF A TILLMAN UNITED METHODIST
AE2762'CHURCH. STATION IS A CONCRETE POST FLUSH WITH THE GROUND AND LEVEL

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 AE2762'WITH THE SIDEWALK,  1.0 FOOT EAST NORTHEAST OF THE EAST EDGE OF THE
 AE2762'SIDEWALK, 1.1 FEET WEST  SOUTHWEST OF THE WEST EDGE OF THE HIGHWAY
 AE2762'CURB, 7.4 FEET EAST OF THE POWER  POLE 165976/P94, 6.1 FEET EAST OF
 AE2762'THE NORTHEAST CHAIN LINK FENCE CORNER POST OF  A SMALL CEMETERY, 7.0
 AE2762'FEET EAST OF A WITNESS POST. NOTE-STATION IS NOT INTERVISIBLE WITH
 AE2762'SURVEY STATION WINGO AZ MK. RECOVERED BY T. HALL.
1        National Geodetic Survey,   Retrieval Date = DECEMBER 21, 2006
 CK0926 ***********************************************************************
 CK0926  DESIGNATION -  F 77
 CK0926  PID         -  CK0926
 CK0926  STATE/COUNTY-  SC/JASPER
 CK0926  USGS QUAD   -  RIDGELAND (1979)
 CK0926
 CK0926                        *CURRENT SURVEY CONTROL
 CK0926 ______________________________________________________________________
 CK0926* NAD 83(2001)-  32 25 38.16833(N)    080 53 48.13678(W)     ADJUSTED
 CK0926* NAVD 88     -         5.876  (meters)      19.28   (feet)  ADJUSTED
 CK0926 ______________________________________________________________________
 CK0926  X           -     852,584.955 (meters)                     COMP
 CK0926  Y           -  -5,320,906.087 (meters)                     COMP
 CK0926  Z           -   3,400,504.273 (meters)                     COMP
 CK0926  LAPLACE CORR-          -0.81  (seconds)                    DEFLEC99
 CK0926  ELLIP HEIGHT-         -25.68  (meters)         (02/10/03) GPS OBS
 CK0926  GEOID HEIGHT-         -31.57  (meters)                    GEOID03
 CK0926  DYNAMIC HT  -           5.869 (meters)      19.26  (feet)  COMP
 CK0926  MODELED GRAV-     979,510.7   (mgal)                      NAVD 88
 CK0926
 CK0926  HORZ ORDER  -  B
 CK0926  VERT ORDER  -  FIRST     CLASS II
 CK0926  ELLP ORDER  -  FOURTH    CLASS II
 CK0926
 CK0926.The horizontal coordinates were established by GPS observations
 CK0926.and adjusted by the National Geodetic Survey in February 2003..
 CK0926
 CK0926.The orthometric height was determined by differential leveling
 CK0926.and adjusted by the National Geodetic Survey in June 1991..
 CK0926
 CK0926.The X, Y, and Z were computed from the position and the ellipsoidal ht.
 CK0926
 CK0926.The Laplace correction was computed from DEFLEC99 derived deflections.
 CK0926
 CK0926.The ellipsoidal height was determined by GPS observations
 CK0926.and is referenced to NAD 83.
 CK0926
 CK0926.The geoid height was determined by GEOID03.
 CK0926
 CK0926.The dynamic height is computed by dividing the NAVD 88
 CK0926.geopotential number by the normal gravity value computed on the
 CK0926.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
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CK0926.degrees latitude (g = 980.6199 gals.).
CK0926
CK0926.The modeled gravity was interpolated from observed gravity values.
CK0926
CK0926;                    North         East     Units Scale Factor Converg.
CK0926;SPC SC       -    65,876.052   619,315.421   MT  1.00002641   +0 03 26.2
CK0926;SPC SC       -   216,128.78  2,031,874.74   iFT  1.00002641   +0 03 26.2
CK0926;UTM  17      - 3,587,801.531   509,711.282   MT  0.99960116   +0 03 19.4
CK0926
CK0926!             -  Elev Factor  x  Scale Factor =   Combined Factor
CK0926!SPC SC       -   1.00000403  x   1.00002641  =   1.00003044
CK0926!UTM  17      -   1.00000403  x   0.99960116  =   0.99960519
CK0926
CK0926                          SUPERSEDED SURVEY CONTROL
CK0926
CK0926  NAD 83(1986)-  32 25 38.17917(N)    080 53 48.14409(W) AD(       ) 1
CK0926  NAD 83(1995)-  32 25 38.16815(N)    080 53 48.13674(W) AD(       ) B
CK0926  ELLIP H (08/25/00)  -25.65   (m)                       GP(       ) 2 2
CK0926  NAD 83(1986)-  32 25 38.17962(N)    080 53 48.14636(W) AD(       ) 1
CK0926  NAVD 88 (08/25/00)    5.88   (m)           19.3    (f) LEVELING    3
CK0926  NGVD 29 (03/21/89)    6.160  (m)           20.21   (f) ADJUSTED    1 2
CK0926
CK0926.Superseded values are not recommended for survey control.
CK0926.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
CK0926.See file dsdata.txt to determine how the superseded data were derived.
CK0926
CK0926_U.S. NATIONAL GRID SPATIAL ADDRESS: 17SNR0971187802(NAD 83)
CK0926_MARKER: DB = BENCH MARK DISK
CK0926_SETTING: 7 = SET IN TOP OF CONCRETE MONUMENT
CK0926_SP_SET: SET IN TOP OF CONCRETE MONUMENT
CK0926_STAMPING: F 77 1955
CK0926_MARK LOGO: CGS
CK0926_PROJECTION: FLUSH
CK0926_MAGNETIC: M = MARKER EQUIPPED WITH BAR MAGNET
CK0926_STABILITY: C = MAY HOLD, BUT OF TYPE COMMONLY SUBJECT TO
CK0926+STABILITY: SURFACE MOTION
CK0926_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
CK0926+SATELLITE: SATELLITE OBSERVATIONS - September 22, 2006
CK0926
CK0926  HISTORY     - Date     Condition        Report By
CK0926  HISTORY     - 1955     MONUMENTED       CGS
CK0926  HISTORY     - 1981     GOOD             SCGS
CK0926  HISTORY     - 19980304 GOOD             SCGS
CK0926  HISTORY     - 20020618 GOOD             USPSQD
CK0926  HISTORY     - 20030505 GOOD             SCGS
CK0926  HISTORY     - 20060922 GOOD             FRELAN
CK0926
CK0926                          STATION DESCRIPTION
CK0926
```

CK0926'DESCRIBED BY COAST AND GEODETIC SURVEY 1955
CK0926'12.2 MI S FROM COOSAWHATCHIE.
CK0926'ABOUT 12.15 MILES SOUTHEAST AND SOUTH ALONG STATE HIGHWAY 170
CK0926'FROM THE JUNCTION OF U.S. HIGHWAY 17 AT COOSAWHATCHIE, ABOUT 1.3
CK0926'MILES SOUTH OF OVERPASS OF HIGHWAY OVER THE SEABOARD AIR LINE
CK0926'RAILROAD, AT A CROSSROAD AND EUHAW SECOND BAPTIST CHURCH, 36.8
CK0926'FEET WEST OF CENTER LINE OF HIGHWAY, 161 FEET SOUTH OF CENTER
CK0926'LINE OF ROAD WEST, 88 1/2 FEET SOUTHEAST OF SOUTHEAST CORNER
CK0926'OF CHURCH BUILDING, 5 1/2 FEET NORTHWEST OF A TELEPHONE POLE,
CK0926'9 FEET NORTH OF A FENCE CORNER AND GATE POST, ABOUT 1 FOOT ABOVE
CK0926'LEVEL OF HIGHWAY AND SET IN THE TOP OF A CONCRETE POST PROJECTING
CK0926'3 INCHES.
CK0926
CK0926 STATION RECOVERY (1981)
CK0926
CK0926'RECOVERY NOTE BY SOUTH CAROLINA GEODETIC SURVEY 1981
CK0926'17.1 KILOMETERS (10.65 MILES) SOUTHWEST ALONG STATE HIGHWAY 462,
CK0926'FROM THE JUNCTION OF INTERSTATE HIGHWAY 95, JUST SOUTH OF
CK0926'COOSAWHATCHIE TO A BRIDGE OVER AN ABANDONED RAILROAD CROSSING
CK0926'AT THE EVHAN BAPTIST CHURCH, SET AT THE SOUTHWEST CORNER OF THE
CK0926'CHURCH YARD, BY A LEANING OAK TREE, 48.7 METERS (160.0 FEET) SOUTH
CK0926'OF THE CENTER OF THE SAND CROSSROADS, 36.6 METERS (120.0 FEET)
CK0926'SOUTHWEST OF THE FRONT SOUTHWEST CORNER OF THE CHURCH, 11.3 METERS
CK0926'(37.0 FEET) WEST OF THE CENTER OF THE HIGHWAY, 6.1 METERS (20.0 FEET)
CK0926'EAST OF AN OAK TREE THAT LEANS TOWARDS THE ROAD.
CK0926'THE MARK IS 0.33 METERS S FROM A WITNESS POST.
CK0926'THE MARK IS 1.0 M ABOVE HIGHWAY.
CK0926
CK0926 STATION RECOVERY (1998)
CK0926
CK0926'RECOVERY NOTE BY SOUTH CAROLINA GEODETIC SURVEY 1998 (DDW)
CK0926'STATION IS LOCATED 6.2 MILES (10.0 KM) SOUTHEAST OF RIDGELAND, 6.5
CK0926'MILES (10.5 KM) EAST OF SWITZERLAND. OWNERSHIP--SCDOT, DIRECTOR OF
CK0926'PRECONSTRUCTION, P.O. BOX 191, COLUMBIA, SC 29202, PHONE
CK0926'803-737-1350. TO REACH THE STATION FROM THE JUNCTION OF STATE
CK0926'HIGHWAYS 336, 462 AND U.S. HIGHWAY 278, 5.0 MILES (8.0 KM) EAST
CK0926'SOUTHEAST OF RIDGELAND, GO SOUTHWEST ON HIGHWAY 278 FOR 2.3 MILES (3.7
CK0926'KM) TO THE STATION ON THE RIGHT IN THE YARD OF THE EUHAW SECOND
CK0926'BAPTIST CHURCH IN THE SOUTHWEST ANGLE JUNCTION OF STATE ROAD 389.
CK0926'STATION IS A CONCRETE POST PROJECTING 0.2 FOOT (6.1 CM) AND 1.0 FOOT
CK0926'(0.3 M) ABOVE THE HIGHWAY, 36.9 FEET (11.2 M) WEST NORTHWEST OF THE
CK0926'CENTER OF THE HIGHWAY, 114.4 FEET (34.9 M) SOUTH SOUTHEAST OF THE
CK0926'SOUTH CORNER OF THE WING OF THE CHURCH, 59.9 FEET (18.3 M) SOUTH
CK0926'SOUTHWEST OF A TELEPHONE JUNCTION BOX RP/801/21, 171.7 FEET (52.3 M)
CK0926'SOUTH SOUTHWEST OF THE CENTER OF ROAD 389, 62.0 FEET (18.9 M) SOUTH
CK0926'SOUTHEAST OF A 3.3-FOOT PINE TREE. RECOVERED BY C.J. STONE.
CK0926
CK0926 STATION RECOVERY (2002)
CK0926

CK0926'RECOVERY NOTE BY US POWER SQUADRON 2002 (LFH)
CK0926'RECOVERED IN GOOD CONDITION.
CK0926
CK0926 STATION RECOVERY (2003)
CK0926
CK0926'RECOVERY NOTE BY SOUTH CAROLINA GEODETIC SURVEY 2003 (DDW)
CK0926'STATION IS LOCATED 6.15 MILES SOUTHEAST OF RIDGELAND.
CK0926'OWNERSHIP--SCDOT, DIRECTOR OF PRECONSTRUCTION, P.O. BOX 191,
CK0926'COLUMBIA, SC 29202, PHONE 803-737-1350. TO REACH THE STATION FROM THE
CK0926'JUNCTION OF STATE HIGHWAYS 336 AND 462 IN NEVADUN, 5.05 MILES EAST
CK0926'SOUTHEAST OF RIDGELAND, GO SOUTH SOUTHWEST ON HIGHWAY 462 FOR 2.35
CK0926'MILES TO THE STATION ON THE RIGHT IN THE YARD OF THE SECOND EUHAW
CK0926'MISSIONARY BAPTIST CHURCH IN THE SOUTHWEST ANGLE OF THE JUNCTION OF
CK0926'STATE ROAD 389. STATION IS A CONCRETE POST FLUSH WITH THE GROUND AND
CK0926'LEVEL WITH THE HIGHWAY, 36.8 FEET WEST OF THE CENTER OF THE HIGHWAY,
CK0926'59.8 FEET SOUTH SOUTHWEST OF A TELEPHONE JUNCTION BOX P/RP/801/21
CK0926'WITH A SUPPORT POST, 171.0 FEET SOUTH SOUTHWEST OF THE CENTER OF ROAD
CK0926'389, 61.8 FEET SOUTH SOUTHEAST OF A 2.8-FOOT PINE TREE, 113.9 FEET
CK0926'SOUTHEAST OF THE SOUTHEAST CORNER OF THE SOUTHWEST WING OF THE
CK0926'CHURCH. RECOVERED BY T. HALL.
CK0926
CK0926 STATION RECOVERY (2006)
CK0926
CK0926'RECOVERY NOTE BY FREELAND AND ASSOCIATES 2006 (JKS)
CK0926'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
Elapsed Time = 00:00:01

APPENDIX C

JASPER COUNTY POINT COLLECTION

General Data Collection Information

Global Positioning System (GPS) data was collected on October 3rd, 4th and 25th in Jasper County, South Carolina by IMSG/PSGS personnel (Report: LiDAR QA/QC GPS Point Collection Processing Steps: Jasper County, SC) to support additional survey data (total station collection). The 3rd and 4th were spent in the south and eastern portion of the county and the 25th in the western and northern portion of the LiDAR collection area. A total of 26 locations were collected using static GPS measurements (Figure 1). Two GPS locations were used at each 'site' to allow for the use of a total station to gather check-point information in covered and uncovered areas. The check-point information at each site could then be further grouped to represent a 'scene' of a specific type of land use or setting.

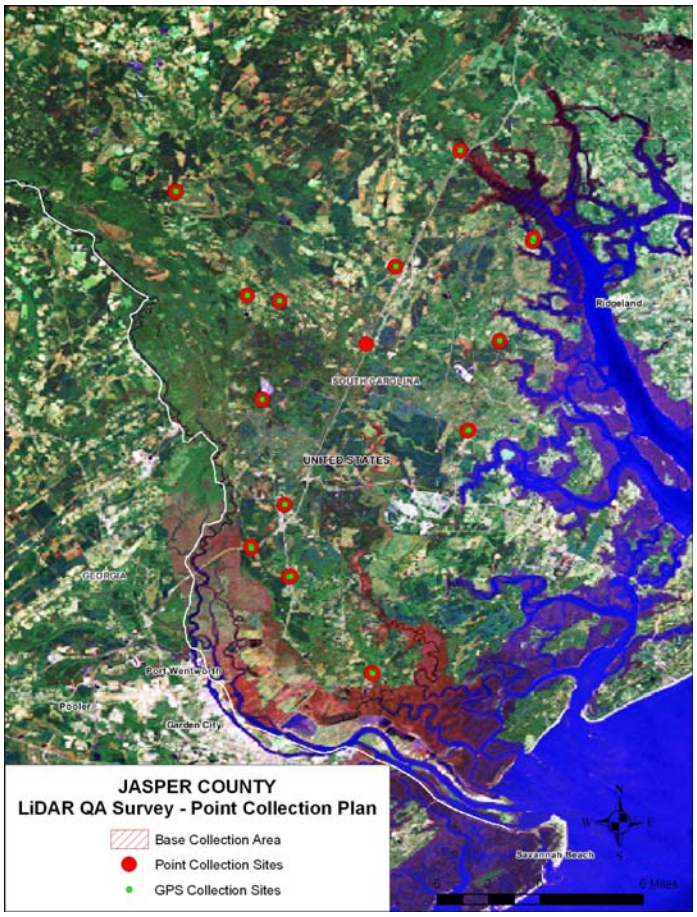

Figure 1. Location of GPS and collection site points in Jasper County

Survey Point Locations – Total Station Processing

Ground truth points for use in LiDAR QA work include the GPS positions shown in Figure 1, but largely come from points taken using a Total Station (Figure 2). Collection of the points was overseen by Jim Harrington, the South Carolina state liaison from the National Geodetic Survey (NGS).

The bulk of the ground-truth points for the Jasper LiDAR project were collected by traditional survey methods and tied to geodetic control. GPS was used to establish the temporary control, unless usable existing control was available in the sample areas. NAD83 coordinates and ellipsoid heights in feet were used. Two points were set in each area as an azimuth pair. The point that saw the more versatile coverage was occupied, while the other temporary point was sighted on as the initial azimuth. There are 13 collection areas or scenes that represent a snap-shoot of the accessible areas of Jasper County.

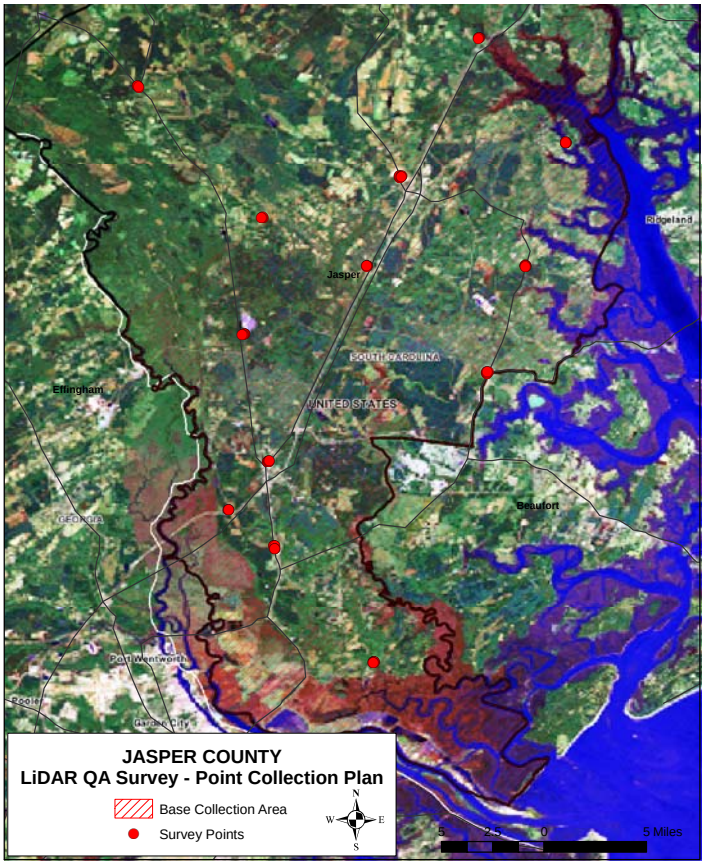

Figure 2. Survey Point Locations

The terrestrial survey data was obtained using a Topcon GTS-700 Total station. This data were collected into laptop, and processed using NOAA/NGS ACES software. Spur traverse methods were used to position the 5-10 coverage types in each area. The

elevations were established by trigonometric methods, where vertical angles and Electronic Distance Measuring Instrument distances were collected. A bi-pod with a prism was used as the target at the sample points. The height of the prism is subtracted from the computed elevation to determine the ground height. The points were collected within a distance of about 300 meters of the control points to minimize distance errors (Figure 3).

Figure 3. Example of point collection scene

QA Procedures

The GPS positions were validated and QA checked in the previous report: LiDAR QA/QC GPS Point Collection Processing Steps: Jasper County, SC. The points were checked for location and consistency by comparing the field photos and descriptions with the locations respective to the aerial imagery in ArcMap. All point data was added to an Access Database for consistency and data integrity. As the authors (Keil Schmid, Brian Hadley, and Jamie Carter) were there for each point, the information from photos was also combined with memory and field notes to highlight potential errors. Some errors were found in the point locations and point names. These were rectified by CSC and NGS using database techniques, photos and field notes.

Point Records

Appendix A provides a complete list of the data points collected for use in defining the accuracy of the Jasper County LiDAR. The points are sorted by land cover and photos of each point are located in the provided Groundtruth_Photos folder. Photographs are organized by site and point name. Elevations are provided in heights above the ellipsoid in feet.

Appendix A

Total Station Point Collection Information

Land-Cover	STATION NAME	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
Bare Earth						
	BH04A	32 13 45.96469	81 04 25.79311	-86.77	BH04A	10/6/2006
	KS01A	32 21 06.37561	80 55 25.40836	-85.30	KS01A	10/5/2006
	KS03B	32 29 27.70011	80 59 03.47782	-36.13	KS03B	10/5/2006
	KS01H	32 21 09.28858	80 55 21.36789	-83.98	KS01H	10/5/2006
	JC03C	32 30 52.33609	80 52 05.43958	-88.20	JC03C	10/5/2006
	JH01A	32 22 47.39991	81 05 39.97397	-82.35	JH01A	11/1/2006
	JC03A	32 30 53.90412	80 52 05.62968	-88.26	JC03A	10/5/2006
	JH01D	32 22 46.20676	81 05 41.90013	-81.98	JH01D	11/1/2006
	KS01D	32 21 05.97379	80 55 26.12556	-85.68	KS01D	10/5/2006
	CK0926J	32 25 38.25691	80 53 48.51850	-83.70	CK0926J	10/5/2006
	CR03A	32 27 42.77360	81 04 55.47987	-48.17	CR03A	11/1/2006
	CR05E	32 33 14.42234	81 10 10.46411	-37.99	CR05E	11/1/2006
	KS03N	32 29 27.36292	80 59 04.60077	-36.34	KS03N	10/5/2006
	KS03A	32 29 27.38618	80 59 04.14313	-36.03	KS03A	10/5/2006
	KS03G	32 29 28.26312	80 59 00.56600	-38.54	KS03G	10/5/2006
Bare Earth (Below Power Lines)						
	CK0926A	32 25 38.45193	80 53 48.13885	-84.51	CK0926A	10/5/2006
Bare Earth (Grass)						
	KS07A	32 17 22.78072	81 04 40.71345	-84.69	KS07A	10/6/2006
Bare Earth (Gravel)						
	CK0926B	32 25 39.16208	80 53 48.13041	-83.99	CK0926B	10/5/2006
Bare Earth (Medium Grass)						
	FB6	32 25 38.92694	81 00 31.17003	-56.86	No Picture	10/5/2006
Bare Earth (Sand)						
	BH07A	32 08 51.20271	81 00 13.61091	-86.65	BH07A	10/6/2006
	BH04G	32 13 47.02420	81 04 24.21149	-87.33	BH04G	10/6/2006
Bare Earth (Sand, Grass)						
	FB1	32 25 39.02400	81 00 30.47753	-57.36	FB1	10/5/2006
Bare Earth (Short Grass)						
	KS07H	32 17 22.77083	81 04 39.28294	-84.94	KS07H	10/6/2006
Built-Up						

Land-Cover	STATION NAME	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
	CR07D	32 35 19.00764	80 55 46.37616	-86.01	CR07D	11/1/2006
	AE2746E	32 15 18.48954	81 06 22.68818	-60.02	AE2746E	11/1/2006
	CR03D	32 27 42.57042	81 04 56.87636	-47.72	CR03D	11/1/2006
	KS03I	32 29 26.66259	80 58 59.65622	-38.81	KS03I	10/5/2006
	KS03L	32 29 25.70749	80 59 06.35960	-32.94	KS03L	10/5/2006
	AE2746A	32 15 17.62702	81 06 22.47051	-56.74	AE2746A	11/1/2006
	JH01H	32 22 43.77739	81 05 47.74860	-75.33	JH01H	11/1/2006
	KS03H	32 29 27.26270	80 59 00.01731	-37.58	KS03H	10/5/2006
Built-Up (Church)						
	CK0926C	32 25 39.43770	80 53 48.24941	-83.27	CK0926C	10/5/2006
Built-Up (Concrete)						
	BH04H	32 13 40.52556	81 04 24.29804	-86.01	BH04H	10/6/2006
	BH04I	32 13 40.50160	81 04 24.53913	-87.19	BH04I	10/6/2006
	BH04J	32 13 40.45849	81 04 24.96928	-87.45	BH04J	10/6/2006
Built-Up (Concrete, Tree)						
	KS07I	32 17 23.85698	81 04 38.86519	-84.94	KS07I	10/6/2006
Built-Up (Parking Lot, Buildings)						
	KS07E	32 17 22.24472	81 04 42.68146	-84.37	KS07E	10/6/2006
Built-Up (Road Center)						
	JC03B	32 30 53.18767	80 52 05.39376	-87.79	JC03B	10/5/2006
Built-Up (Road)						
	FB5	32 25 38.55464	81 00 30.63754	-57.22	FB5	10/5/2006
	KS01J	32 21 08.78948	80 55 24.13444	-83.88	KS01J	10/5/2006
	KS01E	32 21 08.13867	80 55 26.10942	-82.46	KS01E	10/5/2006
	BH07F	32 08 51.07856	81 00 11.90320	-84.52	BH07F	10/6/2006
	JC03H	32 30 54.35601	80 52 04.75664	-87.89	JC03H	10/5/2006
	BH04B	32 13 46.39443	81 04 25.56639	-87.29	BH04B	10/6/2006
Built-Up (Sidewalk next to Apartment)						
	KS07G	32 17 22.14495	81 04 39.36748	-84.49	KS07G	10/6/2006
Coniferous Forest						
	JC03E	32 30 52.79584	80 52 03.20507	-88.22	JC03E	10/5/2006
	JC03F	32 30 53.25095	80 52 03.47200	-88.40	JC03F	10/5/2006
	FB2	32 25 39.08056	81 00 29.86573	-58.18	FB2	10/5/2006
	FB3	32 25 39.90007	81 00 29.73960	-56.76	FB3	10/5/2006

Land-Cover	STATION NAME	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
	KS03K	32 29 24.36545	80 59 05.39254	-36.14	KS03K	10/5/2006
Coniferous Forest (45 - 50 ft)						
	BH04F	32 13 47.34953	81 04 27.00962	-86.66	BH04F	10/6/2006
Coniferous Forest (Dense)						
	CK0926F	32 25 39.19940	80 53 46.72298	-84.48	CK0926F	10/5/2006
Coniferous Forest (Mixed)						
	CK0926G	32 25 38.61553	80 53 46.92207	-84.00	CK0926G	10/5/2006
Deciduous Forest						
	KS03F	32 29 29.77620	80 59 01.13475	-38.34	KS03F	10/5/2006
	CR07E	32 35 17.65799	80 55 46.99428	-83.40	CR07E	11/1/2006
	CR07C	32 35 21.02359	80 55 46.44924	-89.37	CR07C	11/1/2006
	CR05A	32 33 16.50309	81 10 12.62861	-39.85	CR05A	11/1/2006
	CR03E	32 27 42.59196	81 04 58.40724	-48.28	CR03E	11/1/2006
	CR03C	32 27 43.97836	81 04 55.42413	-49.77	CR03C	11/1/2006
Deciduous Forest (Light Cover)						
	BH07E	32 08 51.96899	81 00 11.47278	-85.08	BH07E	10/6/2006
Deciduous Forest (Live Oak)						
	KS03E	32 29 29.35547	80 59 02.03715	-37.51	KS03E	10/5/2006
Deciduous Forest (Low, Mixed)						
	KS03M	32 29 27.07525	80 59 05.13892	-36.33	KS03M	10/5/2006
Deciduous Forest (Mixed)						
	CK0926H	32 25 37.70178	80 53 46.85539	-86.00	CK0926H	10/5/2006
Deciduous Forest (Sparse Cover)						
	BH07H	32 08 49.22593	81 00 15.66209	-85.88	BH07H	10/6/2006
Forest						
	JH01G	32 22 44.47600	81 05 45.27276	-83.02	JH01G	11/1/2006
	AE2746D	32 15 18.60655	81 06 22.50848	-60.97	AE2746D	11/1/2006
	CR05D	32 33 13.80676	81 10 10.18000	-38.02	CR05D	11/1/2006
	JH01F	32 22 44.13494	81 05 44.20270	-83.11	JH01F	11/1/2006
Forest (Mixed)						
	KS07F	32 17 20.02727	81 04 40.28313	-86.58	KS07F	10/6/2006
	KS01F	32 21 09.08772	80 55 26.44483	-83.79	KS01F	10/5/2006
	KS07C	32 17 20.55614	81 04 41.71098	-86.11	KS07C	10/6/2006
	KS01C	32 21 05.31471	80 55 25.54320	-85.29	KS01C	10/5/2006

Land-Cover	STATION NAME	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
Grass/Crops						
	JH01E	32 22 45.55952	81 05 43.23086	-84.05	JH01E	11/1/2006
	AE2746C	32 15 18.11134	81 06 22.38289	-59.07	AE2746C	11/1/2006
	AE2746B	32 15 17.81166	81 06 22.76669	-57.51	AE2746B	11/1/2006
	BH07G	32 08 49.83880	81 00 12.84605	-85.05	BH07G	10/6/2006
	JC03D	32 30 51.79765	80 52 05.23731	-88.01	JC03D	10/5/2006
	JC03G	32 30 53.24280	80 52 04.17498	-88.33	JC03G	10/5/2006
Grass/Crops (Long Grass)						
	BH07C	32 08 51.80025	81 00 14.12759	-88.06	BH07C	10/6/2006
Grass/Crops (Weeds)						
	CK0926E	32 25 41.66603	80 53 47.71858	-84.40	CK0926E	10/5/2006
	KS03J	32 29 26.42996	80 59 00.75852	-37.52	KS03J	10/5/2006
	CR05C	32 33 17.19483	81 10 13.19546	-42.03	CR05C	11/1/2006
	CK0926D	32 25 40.83816	80 53 47.67089	-84.50	CK0926D	10/5/2006
	KS03D	32 29 28.02228	80 59 02.01331	-37.40	KS03D	10/5/2006
	KS07B	32 17 21.87900	81 04 41.60524	-85.10	KS07B	10/6/2006
	KS03C	32 29 27.95205	80 59 02.89727	-37.01	KS03C	10/5/2006
Scrub/Shrub						
	FB4	32 25 38.00222	81 00 30.78445	-60.12	FB4	10/5/2006
	CK0926I	32 25 37.03431	80 53 47.33093	-86.79	CK0926I	10/5/2006
	KS01G	32 21 09.44700	80 55 25.50358	-83.28	KS01G	10/5/2006
	CR07B	32 35 21.14166	80 55 44.31434	-90.03	CR07B	11/1/2006
	KS01I	32 21 07.74133	80 55 23.90047	-84.54	KS01I	10/5/2006
	JH01C	32 22 46.95284	81 05 41.09730	-83.96	JH01C	11/1/2006
	JH01B	32 22 47.35700	81 05 40.40646	-83.42	JH01B	11/1/2006
	CR07A	32 35 21.08295	80 55 45.01346	-88.47	CR07A	11/1/2006
	JC03J	32 30 53.47550	80 52 05.63651	-88.30	JC03J	10/5/2006
	CR03B	32 27 42.93659	81 04 54.07764	-48.02	CR03B	11/1/2006
	CR05B	32 33 17.06828	81 10 13.16788	-41.52	CR05B	11/1/2006
	KS07D	32 17 21.06534	81 04 42.88781	-84.38	KS07D	10/6/2006
Scrub/Shrub (3/4 ft)						
	BH04C	32 13 48.02028	81 04 25.90792	-86.26	BH04C	10/6/2006
	BH04D	32 13 48.07793	81 04 26.30723	-86.46	BH04D	10/6/2006
Scrub/Shrub (5 ft)						
	BH04E	32 13 47.68654	81 04 26.97887	-86.47	BH04E	10/6/2006

Land-Cover	STATION NAME	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
Scrub/Shrub (Close Proximity to a Ditch)						
	JC03I	32 30 54.06629	80 52 05.12401	-87.96	JC03I	10/5/2006
Scrub/Shrub (Light Cover)						
	BH07I	32 08 50.53096	81 00 14.61003	-85.62	BH07I	10/6/2006
Scrub/Shrub (Low with Woody Floor)						
	BH07D	32 08 51.69467	81 00 12.29719	-85.52	BH07D	10/6/2006
Scrub/Shrub (Low)						
	BH07B	32 08 51.15850	81 00 14.34279	-86.19	BH07B	10/6/2006
Scrub/Shrub (Pine, New-Growth, Dense)						
	CK0926K	32 25 38.01473	80 53 48.57020	-84.05	CK0926K	10/5/2006
Weeds/Brush/Scrub						
	KS01B	32 21 05.46565	80 55 24.98147	-85.40	KS01B	10/5/2006

GPS Point Collection Information

Land-Cover	STATION	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
Bare Earth						
	BH06	32 08 52.91440	81 00 15.37880	-89.30	BH06-1, BH06-2, BH06-3, BH06-4	10/4/2006
	BH07	32 08 51.15090	81 00 13.36580	-85.89	BH07-1, BH07-2, BH07-3, BH07-4	10/4/2006
	CK0926	32 25 38.16830	80 53 48.13680	-84.25	CK0926-1, CK0926-2, CK0926-3, CK0926-4	10/3/2006
	JC03	32 30 53.61340	80 52 05.04380	-88.09	JC03-1, JC03-2, JC03-3, JC03-4	10/4/2006
	JC02	32 30 42.69130	80 52 07.22190	-90.12	JC02-1, JC02-2, JC02-3, JC02-4	10/4/2006
Bare Earth (Pavement)						
	KS08	32 17 25.15280	81 04 38.86580	-84.89	KS08-1, KS08-2, KS08-3	10/4/2006
	KS06	32 15 12.56930	81 06 21.06630	-56.67	KS06-1, KS06-2, KS06-3	10/4/2006
Bare Earth (Short Grass)						
	CR08	32 35 19.59080	80 55 46.62180	-86.14	CR08-1, CR08-2, CR08-3, CR08-4	0/25/2006
	CR01	32 22 43.76910	81 05 48.10700	-75.80	CR01-1, CR01-2, CR01-3	0/25/2006
	CR02	32 22 42.73770	81 05 47.94850	-75.72	CR02-1, CR02-2, CR02-3	0/25/2006
	CR03	32 27 42.86450	81 04 56.02950	-48.28	CR03-1, CR03-2, CR03-3	0/25/2006
	CR04	32 27 42.00060	81 04 55.72600	-48.15	CR04-1, CR04-2, CR04-3	0/25/2006
	CR05	32 33 16.41790	81 10 11.80040	-41.82	CR05-1, CR05-2, CR05-3, CR05-4	0/25/2006

Land-Cover	STATION	LATITUDE	LONGITUDE	ELEVATION	Picture ID	Date
	CR07	32 35 20.27050	80 55 45.78760	-86.56	CR07-1, CR07-2, CR07-3, CR07-4	0/25/2006
	KS01	32 21 07.56390	80 55 25.77220	-83.51	KS01-1, KS01-2, KS01-3, KS01-4	10/3/2006
	KS02	32 21 09.21500	80 55 21.33680	-83.86	KS02-1, KS02-2, KS02-3	10/3/2006
	KS03	32 29 27.09680	80 59 04.04040	-35.88	No Picture	10/4/2006
	KS07	32 17 23.02880	81 04 40.59450	-85.00	KS07-1, KS07-2, KS07-3	10/4/2006
	CR06	32 33 14.37670	81 10 08.83950	-41.39	CR06-1, CR06-2, CR06-3, CR06-4	0/25/2006
Grass/Crops						
	BH03	32 25 40.83730	80 53 47.92640	-84.45	BH03-1, BH03-2, BH03-3	10/3/2006
	BH05	32 13 46.21740	81 04 21.27270	-88.06	BH05-1, BH05-2, BH05-3, BH05-4	10/4/2006
	BH04	32 13 45.65860	81 04 26.09730	-86.00	BH04-1, BH04-2, BH04-3, BH04-4	10/4/2006
Grass/Crops (Wheat, Semi-Cut Field)						
	KS04	32 29 26.21530	80 59 02.02700	-37.64	No Picture	10/4/2006
Scrub/Shrub						
	SWITZERLAND	32 25 41.18440	81 00 29.00975	-55.48	FB-General-Site	10/4/2006
	FEREBEEVILL	32 25 38.61302	81 00 31.37465	-57.32	FB-General-Site	10/4/2006

APPENDIX D

Name	land use	picture	date	type	Elev_ft	Elev_m	error	Lidar	catagory	absolute
CR03A	Bare Earth	CR03A	11/1/2006 0:00:00	Tot_Sta	-48.169998	-14.6822154	-0.1201432	-14.8023586	BareEarth	0.12014324
CR07	Bare Earth (Short Grass)	CR07-1, CR07-2,	10/25/2006 0:00:00	GPS	-86.559998	-26.3834874	-0.1072715	-26.4907589	BareEarth	0.10727151
CR08	Bare Earth (Short Grass)	CR08-1, CR08-2,	10/25/2006 0:00:00	GPS	-86.139999	-26.2554717	-0.1035810	-26.3590527	BareEarth	0.10358096
CK0926	Bare Earth	CK0926-1, CK092	10/3/2006 0:00:00	GPS/NGS Be	-84.250000	-25.6794000	-0.0896849	-25.76908	BareEarth	0.08968493
KS07A	Bare Earth (Grass)	KS07A	10/6/2006 0:00:00	Tot_Sta	-84.690002	-25.8135126	-0.0881006	-25.90161	BareEarth	0.08810063
KS07	Bare Earth (Short Grass)	KS07-1, KS07-2, I	10/4/2006 0:00:00	GPS	-85.000000	-25.9080000	-0.0816851	-25.98969	BareEarth	0.08168506
CK0926J	Bare Earth	CK0926J	10/5/2006 0:00:00	Tot_Sta	-83.699997	-25.5117591	-0.0793111	-25.59107	BareEarth	0.07931109
CR03	Bare Earth (Short Grass)	CR03-1, CR03-2,	10/25/2006 0:00:00	GPS	-48.279999	-14.7157437	-0.0739282	-14.7896719	BareEarth	0.0739282
KS02	Bare Earth (Short Grass)	KS02-1, KS02-2, I	10/3/2006 0:00:00	GPS	-83.860001	-25.5605283	-0.0655722	-25.62610	BareEarth	0.06557224
KS01H	Bare Earth	KS01H	10/5/2006 0:00:00	Tot_Sta	-83.980003	-25.5971049	-0.0589753	-25.65608	BareEarth	0.05897533
KS07H	Bare Earth (Short Grass)	KS07H	10/6/2006 0:00:00	Tot_Sta	-84.940002	-25.8897126	-0.0588004	-25.94851	BareEarth	0.05880042
KS01D	Bare Earth	KS01D	10/5/2006 0:00:00	Tot_Sta	-85.680000	-26.1152640	-0.0550260	-26.17029	BareEarth	0.05502599
CK0926A	Bare Earth (Below Power Lines)	CK0926A	10/5/2006 0:00:00	Tot_Sta	-84.510002	-25.7586486	-0.0547345	-25.81338	BareEarth	0.05473449
CR04	Bare Earth (Short Grass)	CR04-1, CR04-2,	10/25/2006 0:00:00	GPS	-48.150002	-14.6761206	-0.0547172	-14.7308378	BareEarth	0.05471721
KS01A	Bare Earth	KS01A	10/5/2006 0:00:00	Tot_Sta	-85.300003	-25.9994409	-0.0525687	-26.05201	BareEarth	0.05256867
KS01	Bare Earth (Short Grass)	KS01-1, KS01-2, I	10/3/2006 0:00:00	GPS	-83.510002	-25.4538486	-0.0515854	-25.50543	BareEarth	0.05158543
JH01D	Bare Earth	JH01D	11/1/2006 0:00:00	Tot_Sta	-81.980003	-24.9875049	-0.0473652	-25.03487	BareEarth	0.04736523
JC03	Bare Earth	JC03-1, JC03-2, J	10/4/2006 0:00:00	GPS	-88.089996	-26.8498308	-0.0456866	-26.89552	BareEarth	0.04568657
JC03A	Bare Earth	JC03A	10/5/2006 0:00:00	Tot_Sta	-88.260002	-26.9016486	-0.0393132	-26.94096	BareEarth	0.03931323
KS06	Bare Earth (Pavement)	KS06-1, KS06-2, I	10/4/2006 0:00:00	GPS	-56.669998	-17.2730154	-0.0309015	-17.30392	BareEarth	0.03090154
KS08	Bare Earth (Pavement)	KS08-1, KS08-2, I	10/4/2006 0:00:00	GPS	-84.889999	-25.8744717	-0.0296821	-25.90415	BareEarth	0.02968213
JC02	Bare Earth	JC02-1, JC02-2, J	10/4/2006 0:00:00	GPS	-90.120003	-27.4685769	-0.0262523	-27.49483	BareEarth	0.02625226
JH01A	Bare Earth	JH01A	11/1/2006 0:00:00	Tot_Sta	-82.349998	-25.1002794	-0.0239901	-25.12427	BareEarth	0.0239901
JC03C	Bare Earth	JC03C	10/5/2006 0:00:00	Tot_Sta	-88.199997	-26.8833591	-0.0232037	-26.90656	BareEarth	0.02320372
KS03B	Bare Earth	KS03B	10/5/2006 0:00:00	Tot_Sta	-36.130001	-11.0124243	-0.0228922	-11.03532	BareEarth	0.02289216
KS03	Bare Earth (Short Grass)	No Picture	10/4/2006 0:00:00	GPS	-35.880001	-10.9362243	-0.0180070	-10.95423	BareEarth	0.01800696
BH04A	Bare Earth	BH04A	10/6/2006 0:00:00	Tot_Sta	-86.769997	-26.4474951	-0.0092100	-26.45671	BareEarth	0.00921001
KS03N	Bare Earth	KS03N	10/5/2006 0:00:00	Tot_Sta	-36.340000	-11.0764320	-0.0076363	-11.08407	BareEarth	0.0076363
CK0926B	Bare Earth (Gravel)	CK0926B	10/5/2006 0:00:00	Tot_Sta	-83.989998	-25.6001514	0.0026763	-25.59748	BareEarth	0.00267634
KS03G	Bare Earth	KS03G	10/5/2006 0:00:00	Tot_Sta	-38.540001	-11.7469923	0.0035469	-11.74345	BareEarth	0.00354691
CR02	Bare Earth (Short Grass)	CR02-1, CR02-2,	10/25/2006 0:00:00	GPS	-75.720001	-23.0794563	0.0068435	-23.07261	BareEarth	0.00684354
BH07	Bare Earth	BH07-1, BH07-2,	10/4/2006 0:00:00	GPS	-85.889999	-26.1792717	0.0125332	-26.16674	BareEarth	0.01253319
BH04G	Bare Earth (Sand)	BH04G	10/6/2006 0:00:00	Tot_Sta	-87.330002	-26.6181846	0.0163818	-26.60180	BareEarth	0.01638178
BH06	Bare Earth	BH06-1, BH06-2,	10/4/2006 0:00:00	GPS	-89.300003	-27.2186409	0.0274044	-27.19124	BareEarth	0.02740442
FB6	Bare Earth (Medium Grass)	No Picture	10/5/2006 0:00:00	Tot_Sta	-56.860001	-17.3309283	0.0280642	-17.30286	BareEarth	0.02806423
KS03A	Bare Earth	KS03A	10/5/2006 0:00:00	Tot_Sta	-36.029999	-10.9819437	0.0345179	-10.94743	BareEarth	0.03451785
FB1	Bare Earth (Sand, Grass)	FB1	10/5/2006 0:00:00	Tot_Sta	-57.360001	-17.4833283	0.0372529	-17.44608	BareEarth	0.03725287
CR05E	Bare Earth	CR05E	11/1/2006 0:00:00	Tot_Sta	-37.990002	-11.5793526	0.0419819	-11.5373707	BareEarth	0.04198193
CR01	Bare Earth (Short Grass)	CR01-1, CR01-2,	10/25/2006 0:00:00	GPS	-75.800003	-23.1038409	0.0456878	-23.05815	BareEarth	0.04568776
BH07A	Bare Earth (Sand)	BH07A	10/6/2006 0:00:00	Tot_Sta	-86.650002	-26.4109206	0.0496745	-26.36125	BareEarth	0.0496745
CR06	Bare Earth (Short Grass)	CR06-1, CR06-2,	10/25/2006 0:00:00	GPS	-41.389999	-12.6156717	0.0981851	-12.5174866	BareEarth	0.09818512
CR05	Bare Earth (Short Grass)	CR05-1, CR05-2,	10/25/2006 0:00:00	GPS	-41.820000	-12.7467360	0.1826348	-12.5641012	BareEarth	0.18263478
CR03D	Built-Up	CR03D	11/1/2006 0:00:00	Tot_Sta	-47.720001	-14.5450563	-0.1171799	-14.6622362	BuiltUp	0.11717991
AE2746E	Built-Up	AE2746E	11/1/2006 0:00:00	Tot_Sta	-60.020000	-18.2940960	-0.0958710	-18.38997	BuiltUp	0.09587096
JC03H	Built-Up (Road)	JC03H	10/5/2006 0:00:00	Tot_Sta	-87.889999	-26.7888717	-0.0650483	-26.85392	BuiltUp	0.06504829
AE2746A	Built-Up	AE2746A	11/1/2006 0:00:00	Tot_Sta	-56.740002	-17.2943526	-0.0587606	-17.35311	BuiltUp	0.05876056
KS07E	Built-Up (Parking Lot, Buildings)	KS07E	10/6/2006 0:00:00	Tot_Sta	-84.370003	-25.7159769	-0.0587042	-25.77468	BuiltUp	0.05870418
KS07G	Built-Up (Sidewalk next to Apartment)	KS07G	10/6/2006 0:00:00	Tot_Sta	-84.489998	-25.7525514	-0.0438697	-25.79642	BuiltUp	0.04386966
BH07F	Built-Up (Road)	BH07F	10/6/2006 0:00:00	Tot_Sta	-84.519997	-25.7616951	-0.0430782	-25.80477	BuiltUp	0.04307825
KS07I	Built-Up (Concrete, Tree)	KS07I	10/6/2006 0:00:00	Tot_Sta	-84.940002	-25.8897126	-0.0306499	-25.92036	BuiltUp	0.03064986
CK0926C	Built-Up (Church)	CK0926C	10/5/2006 0:00:00	Tot_Sta	-83.269997	-25.3806951	-0.0060427	-25.38674	BuiltUp	0.00604274
BH04B	Built-Up (Road)	BH04B	10/6/2006 0:00:00	Tot_Sta	-87.290001	-26.6059923	0.0069342	-26.59906	BuiltUp	0.00693415
CR07D	Built-Up	CR07D	11/1/2006 0:00:00	Tot_Sta	-86.010002	-26.2158486	0.0138127	-26.2020359	BuiltUp	0.01381271
BH04I	Built-Up (Concrete)	BH04I	10/6/2006 0:00:00	Tot_Sta	-87.190002	-26.5755126	0.0227859	-26.55273	BuiltUp	0.02278586
BH04J	Built-Up (Concrete)	BH04J	10/6/2006 0:00:00	Tot_Sta	-87.449997	-26.6547591	0.0269038	-26.62786	BuiltUp	0.02690378
FB5	Built-Up (Road)	FB5	10/5/2006 0:00:00	Tot_Sta	-57.220001	-17.4406563	0.0378052	-17.40285	BuiltUp	0.0378052

JH01H	Built-Up	JH01H	11/1/2006 0:00:00	Tot_Sta	-75.330002	-22.9605846	0.0501804	-22.91040	BuiltUp	0.0501804
KS01J	Built-Up (Road)	KS01J	10/5/2006 0:00:00	Tot_Sta	-83.879997	-25.5666231	0.0633596	-25.50326	BuiltUp	0.06335961
BH04H	Built-Up (Concrete)	BH04H	10/6/2006 0:00:00	Tot_Sta	-86.010002	-26.2158486	0.0654580	-26.15039	BuiltUp	0.06545798
KS01E	Built-Up (Road)	KS01E	10/5/2006 0:00:00	Tot_Sta	-82.459999	-25.1338077	0.0677085	-25.06610	BuiltUp	0.06770853
JC03B	Built-Up (Road Center)	JC03B	10/5/2006 0:00:00	Tot_Sta	-87.790001	-26.7583923	0.0844745	-26.67392	BuiltUp	0.08447453
KS03H	Built-Up	KS03H	10/5/2006 0:00:00	Tot_Sta	-37.580002	-11.4543846	0.0850485	-11.36934	BuiltUp	0.08504848
KS03L	Built-Up	KS03L	10/5/2006 0:00:00	Tot_Sta	-32.939999	-10.0401117	0.0858299	-9.95428	BuiltUp	0.08582989
KS03I	Built-Up	KS03I	10/5/2006 0:00:00	Tot_Sta	-38.810001	-11.8292883	0.1751621	-11.65413	BuiltUp	0.17516214
CR03C	Deciduous Forest	CR03C	11/1/2006 0:00:00	Tot_Sta	-49.770000	-15.1698960	-0.0905229	-15.2604189	Forest	0.09052289
CR03E	Deciduous Forest	CR03E	11/1/2006 0:00:00	Tot_Sta	-48.279999	-14.7157437	-0.0573409	-14.7730846	Forest	0.05734095
CR07E	Deciduous Forest	CR07E	11/1/2006 0:00:00	Tot_Sta	-83.400002	-25.4203206	-0.0186671	-25.4389877	Forest	0.01866712
CK0926G	Coniferous Forest (Mixed)	CK0926G	10/5/2006 0:00:00	Tot_Sta	-84.000000	-25.6032000	0.0386877	-25.56451	Forest	0.03868775
CR05A	Deciduous Forest	CR05A	11/1/2006 0:00:00	Tot_Sta	-39.849998	-12.1462794	0.0695458	-12.0767336	Forest	0.0695458
CR05D	Forest	CR05D	11/1/2006 0:00:00	Tot_Sta	-38.020000	-11.5884960	0.0732439	-11.5152521	Forest	0.07324389
KS03F	Deciduous Forest	KS03F	10/5/2006 0:00:00	Tot_Sta	-38.340000	-11.6860320	0.0845878	-11.60144	Forest	0.08458776
BH07H	Deciduous Forest (Sparse Cover)	BH07H	10/6/2006 0:00:00	Tot_Sta	-85.879997	-26.1762231	0.0892480	-26.08698	Forest	0.08924799
JC03F	Coniferous Forest	JC03F	10/5/2006 0:00:00	Tot_Sta	-88.400002	-26.9443206	0.1249751	-26.81935	Forest	0.12497514
CR07C	Deciduous Forest	CR07C	11/1/2006 0:00:00	Tot_Sta	-89.370003	-27.2399769	0.1337643	-27.1062126	Forest	0.1337643
KS01C	Forest (Mixed)	KS01C	10/5/2006 0:00:00	Tot_Sta	-85.290001	-25.9963923	0.1393920	-25.85700	Forest	0.13939195
JH01G	Forest	JH01G	11/1/2006 0:00:00	Tot_Sta	-83.019997	-25.3044951	0.1426833	-25.16181	Forest	0.14268326
BH07E	Deciduous Forest (Light Cover)	BH07E	10/6/2006 0:00:00	Tot_Sta	-85.080002	-25.9323846	0.1592370	-25.77315	Forest	0.15923703
CK0926F	Coniferous Forest (Dense)	CK0926F	10/5/2006 0:00:00	Tot_Sta	-84.480003	-25.7495049	0.1800393	-25.56947	Forest	0.18003928
KS07C	Forest (Mixed)	KS07C	10/6/2006 0:00:00	Tot_Sta	-86.110001	-26.2463283	0.1895084	-26.05682	Forest	0.18950839
JC03E	Coniferous Forest	JC03E	10/5/2006 0:00:00	Tot_Sta	-88.220001	-26.8894563	0.2025419	-26.68691	Forest	0.20254186
KS01F	Forest (Mixed)	KS01F	10/5/2006 0:00:00	Tot_Sta	-83.790001	-25.5391923	0.2061845	-25.33301	Forest	0.20618449
KS03M	Deciduous Forest (Low, Mixed)	KS03M	10/5/2006 0:00:00	Tot_Sta	-36.330002	-11.0733846	0.2093910	-10.86399	Forest	0.20939096
KS03K	Coniferous Forest	KS03K	10/5/2006 0:00:00	Tot_Sta	-36.139999	-11.0154717	0.2134821	-10.80199	Forest	0.21348214
KS03E	Deciduous Forest (Live Oak)	KS03E	10/5/2006 0:00:00	Tot_Sta	-37.509998	-11.4330474	0.2230311	-11.21002	Forest	0.22303114
FB2	Coniferous Forest	FB2	10/5/2006 0:00:00	Tot_Sta	-58.180000	-17.7332640	0.2414351	-17.49183	Forest	0.24143508
FB3	Coniferous Forest	FB3	10/5/2006 0:00:00	Tot_Sta	-56.759998	-17.3004474	0.2726058	-17.02784	Forest	0.27260582
CK0926H	Deciduous Forest (Mixed)	CK0926H	10/5/2006 0:00:00	Tot_Sta	-86.000000	-26.2128000	0.2769327	-25.93587	Forest	0.27693269
BH04F	Coniferous Forest (45 - 50 ft)	BH04F	10/6/2006 0:00:00	Tot_Sta	-86.660004	-26.4139692	0.2910768	-26.12289	Forest	0.29107684
KS07F	Forest (Mixed)	KS07F	10/6/2006 0:00:00	Tot_Sta	-86.580002	-26.3895846	0.3117076	-26.07788	Forest	0.31170756
JH01F	Forest	JH01F	11/1/2006 0:00:00	Tot_Sta	-83.110001	-25.3319283	0.3835736	-24.94835	Forest	0.38357358
CK0926D	Grass/Crops (Weeds)	CK0926D	10/5/2006 0:00:00	Tot_Sta	-84.500000	-25.7556000	-0.0832157	-25.83882	Grass-Crops	0.08321569
BH03	Grass/Crops	BH03-1, BH03-2,	10/3/2006 0:00:00	GPS	-84.449997	-25.7403591	-0.0697586	-25.81012	Grass-Crops	0.06975864
CK0926E	Grass/Crops (Weeds)	CK0926E	10/5/2006 0:00:00	Tot_Sta	-84.400002	-25.7251206	-0.0696048	-25.79473	Grass-Crops	0.06960481
AE2746C	Grass/Crops	AE2746C	11/1/2006 0:00:00	Tot_Sta	-59.070000	-18.0045360	-0.0591485	-18.06368	Grass-Crops	0.05914846
BH04	Grass/Crops	BH04-1, BH04-2,	10/4/2006 0:00:00	GPS	-86.000000	-26.2128000	-0.0283270	-26.24113	Grass-Crops	0.02832701
JC03G	Grass/Crops	JC03G	10/5/2006 0:00:00	Tot_Sta	-88.330002	-26.9229846	0.0055366	-26.91745	Grass-Crops	0.00553657
KS07B	Grass/Crops (Weeds)	KS07B	10/6/2006 0:00:00	Tot_Sta	-85.099998	-25.9384794	0.0151052	-25.92337	Grass-Crops	0.01510521
AE2746B	Grass/Crops	AE2746B	11/1/2006 0:00:00	Tot_Sta	-57.509998	-17.5290474	0.0208324	-17.50821	Grass-Crops	0.02083244
KS04	Grass/Crops (Wheat, Semi-Cut Field)	No Picture	10/4/2006 0:00:00	GPS	-37.639999	-11.4726717	0.0211994	-11.45147	Grass-Crops	0.02119941
BH05	Grass/Crops	BH05-1, BH05-2,	10/4/2006 0:00:00	GPS	-88.059998	-26.8406874	0.0371081	-26.80358	Grass-Crops	0.03710806
JC03D	Grass/Crops	JC03D	10/5/2006 0:00:00	Tot_Sta	-88.010002	-26.8254486	0.0606628	-26.76479	Grass-Crops	0.06066284
CR05C	Grass/Crops (Weeds)	CR05C	11/1/2006 0:00:00	Tot_Sta	-42.029999	-12.8107437	0.0801605	-12.7305832	Grass-Crops	0.0801605
KS03D	Grass/Crops (Weeds)	KS03D	10/5/2006 0:00:00	Tot_Sta	-37.400002	-11.3995206	0.0857894	-11.31373	Grass-Crops	0.08578942
BH07G	Grass/Crops	BH07G	10/6/2006 0:00:00	Tot_Sta	-85.050003	-25.9232409	0.0955336	-25.82771	Grass-Crops	0.09553362
KS03J	Grass/Crops (Weeds)	KS03J	10/5/2006 0:00:00	Tot_Sta	-37.520000	-11.4360960	0.1238840	-11.31221	Grass-Crops	0.12388401
KS03C	Grass/Crops (Weeds)	KS03C	10/5/2006 0:00:00	Tot_Sta	-37.009998	-11.2806474	0.1240159	-11.15663	Grass-Crops	0.12401592
BH07C	Grass/Crops (Long Grass)	BH07C	10/6/2006 0:00:00	Tot_Sta	-88.059998	-26.8406874	0.1813418	-26.65935	Grass-Crops	0.18134176
KS01B	Weeds/Brush/Scrub	KS01B	10/5/2006 0:00:00	Tot_Sta	-85.400002	-26.0299206	0.1820011	-25.84792	Grass-Crops	0.18200115
JH01E	Grass/Crops	JH01E	11/1/2006 0:00:00	Tot_Sta	-84.050003	-25.6184409	0.3720057	-25.24644	Grass-Crops	0.37200575
CR07B	Scrub/Shrub	CR07B	11/1/2006 0:00:00	Tot_Sta	-90.029999	-27.4411437	-0.0880197	-27.5291634	Scrub-Shrub	0.08801967
FEREBEEVILLE	Scrub/Shrub	FB-General-Site	10/4/2006 0:00:00	NGS Benchm	-57.320000	-17.4711360	-0.0185967	-17.48973	Scrub-Shrub	0.01859674
CR07A	Scrub/Shrub	CR07A	11/1/2006 0:00:00	Tot_Sta	-88.470001	-26.9656563	-0.0029449	-26.9686012	Scrub-Shrub	0.00294492
BH07B	Scrub/Shrub (Low)	BH07B	10/6/2006 0:00:00	Tot_Sta	-86.190002	-26.2707126	0.0073459	-26.26337	Scrub-Shrub	0.00734591
KS01G	Scrub/Shrub	KS01G	10/5/2006 0:00:00	Tot_Sta	-83.279999	-25.3837437	0.0490708	-25.33467	Scrub-Shrub	0.04907077

CR03B	Scrub/Shrub	CR03B	11/1/2006 0:00:00	Tot_Sta	-48.020000	-14.6364960	0.0521530	-14.5843430	Scrub-Shrub	0.05215304
JC03I	Scrub/Shrub (Close Proximity to a Ditch	JC03I	10/5/2006 0:00:00	Tot_Sta	-87.959999	-26.8102077	0.0634960	-26.74671	Scrub-Shrub	0.06349596
BH04C	Scrub/Shrub (3/4 ft)	BH04C	10/6/2006 0:00:00	Tot_Sta	-86.260002	-26.2920486	0.1236889	-26.16836	Scrub-Shrub	0.12368885
CR05B	Scrub/Shrub	CR05B	11/1/2006 0:00:00	Tot_Sta	-41.520000	-12.6552960	0.1294562	-12.5258398	Scrub-Shrub	0.12945619
BH07D	Scrub/Shrub (Low with Woody Floor)	BH07D	10/6/2006 0:00:00	Tot_Sta	-85.519997	-26.0664951	0.1325294	-25.93397	Scrub-Shrub	0.1325294
JC03J	Scrub/Shrub	JC03J	10/5/2006 0:00:00	Tot_Sta	-88.300003	-26.9138409	0.1435067	-26.77033	Scrub-Shrub	0.14350667
BH07I	Scrub/Shrub (Light Cover)	BH07I	10/6/2006 0:00:00	Tot_Sta	-85.620003	-26.0969769	0.1472413	-25.94974	Scrub-Shrub	0.14724127
KS07D	Scrub/Shrub	KS07D	10/6/2006 0:00:00	Tot_Sta	-84.379997	-25.7190231	0.1521972	-25.56683	Scrub-Shrub	0.15219722
KS01I	Scrub/Shrub	KS01I	10/5/2006 0:00:00	Tot_Sta	-84.540001	-25.7677923	0.1549249	-25.61287	Scrub-Shrub	0.15492495
JH01B	Scrub/Shrub	JH01B	11/1/2006 0:00:00	Tot_Sta	-83.419998	-25.4264154	0.1628427	-25.26357	Scrub-Shrub	0.1628427
FB4	Scrub/Shrub	FB4	10/5/2006 0:00:00	Tot_Sta	-60.119999	-18.3245757	0.1847117	-18.13986	Scrub-Shrub	0.18471173
CK0926K	Scrub/Shrub (Pine, New-Growth, Dense	CK0926K	10/5/2006 0:00:00	Tot_Sta	-84.050003	-25.6184409	0.1965316	-25.42191	Scrub-Shrub	0.19653158
JH01C	Scrub/Shrub	JH01C	11/1/2006 0:00:00	Tot_Sta	-83.959999	-25.5910077	0.2824693	-25.30854	Scrub-Shrub	0.28246926
CK0926I	Scrub/Shrub	CK0926I	10/5/2006 0:00:00	Tot_Sta	-86.790001	-26.4535923	0.3083115	-26.14528	Scrub-Shrub	0.30831147
BH04E	Scrub/Shrub (5 ft)	BH04E	10/6/2006 0:00:00	Tot_Sta	-86.470001	-26.3560563	0.3177148	-26.03834	Scrub-Shrub	0.31771478
BH04D	Scrub/Shrub (3/4 ft)	BH04D	10/6/2006 0:00:00	Tot_Sta	-86.459999	-26.3530077	0.3646444	-25.98836	Scrub-Shrub	0.36464443

100 Percent of Totals	RMSE (m)	Mean (m)	Median (m)	Skew	Std Dev (m)	# of Points	Min (m)	Max (m)	95th Percentile (m)	Accuracyz (m)
Total	0.130	0.06	0.04	0.78	0.12	130	-0.12	0.38	**0.29**	0.25
Open Terrain	0.062	-0.02	-0.03	1.09	0.06	42	-0.12	0.18	0.11	**0.12**
Weeds/Crop	0.123	0.06	0.04	1.18	0.11	19	-0.08	0.37	0.20	0.24
Scrub	0.178	0.14	0.14	0.17	0.12	21	-0.09	0.36	0.32	0.35
Forest	0.193	0.16	0.17	-0.35	0.11	26	-0.09	0.38	0.31	0.38
Built-up	0.071	0.01	0.02	0.15	0.07	22	-0.12	0.18	0.12	0.14

Questionable points

Name	land use	picture	date	type	Elev_ft	Elev_m	error	Lidar	catagory	absolute	Reason
AE2746D	Forest	AE2746D	11/1/2006 0:00:00	Tot_Sta	-60.970001	-18.5836563	-0.2622433	-18.84590	Forest	0.26224328	high slopes