

Tishomingo, Mississippi 2016 QL2 LiDAR Project Report



USGS Contract # G16PC00016
Requisition # 0040260521
Task Order # G16PD00327

Submitted: November 14, 2016

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- Appendix B: Survey Report

1. Summary / Scope

1.1. Summary

This report contains a summary of the Tishomingo, Mississippi 2016 QL2 LiDAR acquisition task order, issued by USGS National Geospatial Technical Operations Center (NGTOC) under their Geospatial Product and Services Contract on February 29, 2016. The task order yielded a project area covering approximately 3,825 square miles over two project areas in Mississippi. The intent of this document is only to provide specific validation information for the data acquisition/ collection work completed as specified in the task order.

1.2. Scope

Aerial topographic LiDAR was acquired using state of the art technology along with the necessary surveyed ground control points (GCPs) and airborne GPS and inertial navigation systems. The aerial data collection was designed with the following specifications listed in Table 1 below.

Table 1. Originally Planned LiDAR Specifications

Average Point Density	Flight Altitude (AGL)	Field of View	Minimum Side Overlap	RMSEz
≥ 2 pts / m ²	2,000 m	40°	30%	≤ 10 cm

1.3. Coverage

The LiDAR project boundary covers approximately 3,825 square miles. The northern AOI measures approximately 2,318 square miles and fully or partly covers the following counties: Bentown, Itawamba, Lee, Lowndes, Marshall, Monroe, Prentiss, Tippah, Tishomingo, and Union. The southern AOI measures approximately 1,507 square miles and with full or partial coverage of the following counties: Forrest, Green, Lamar, and Perry. Project extents are shown in Figure 1 and Figure 2. A buffer of 100 meters was created to meet task order specifications.

1.4. Duration

LiDAR data was acquired from January 17, 2016 to February 11, 2016 in twenty-six total lifts. See “Section: 2.5. Time Period” for more details.

1.5. Issues

There were no issues to report with this project.

1.6. Deliverables

The following products were produced and delivered:

- Raw LiDAR point cloud data, swaths, in LAS 1.4 format
- Classified LiDAR point cloud data, tiled, in LAS 1.4 format
- 1-meter/2.5-foot hydro-flattened bear earth raster DEMs, tiled, in ERDAS .IMG format
- Continuous hydro-flattened breaklines, in Esri file geodatabase format
- 1-meter/2.5-foot intensity images, tiled, in GeoTIFF format
- 1-foot continuous contours, in Esri file geodatabase format
- Calibration control and QC checkpoints, in Esri shapefile format
- Processing boundary, in Esri shapefile format
- Tile Index, in Esri shapefile format
- Accuracy Assessment, in Excel format
- Project-, deliverable-, and lift-level metadata, in .XML format

All geospatial deliverables for the northern AOI were produced in NAD83 (2011) UTM Zone 16N, meters; NAVD88 (Geoid 12B), meters. Tiled deliverables have a tile size of 1,500 meters x 1,500 meters.

All geospatial deliverables for the southern AOI were produced in NAD83 (2011) State Plane Mississippi East Zone, US survey feet; NAVD88 (Geoid 12B), US survey feet. Tiled deliverables have a tile size of 5,000 feet x 5,000 feet.

Figure 1. Project Boundary - Northern AOI

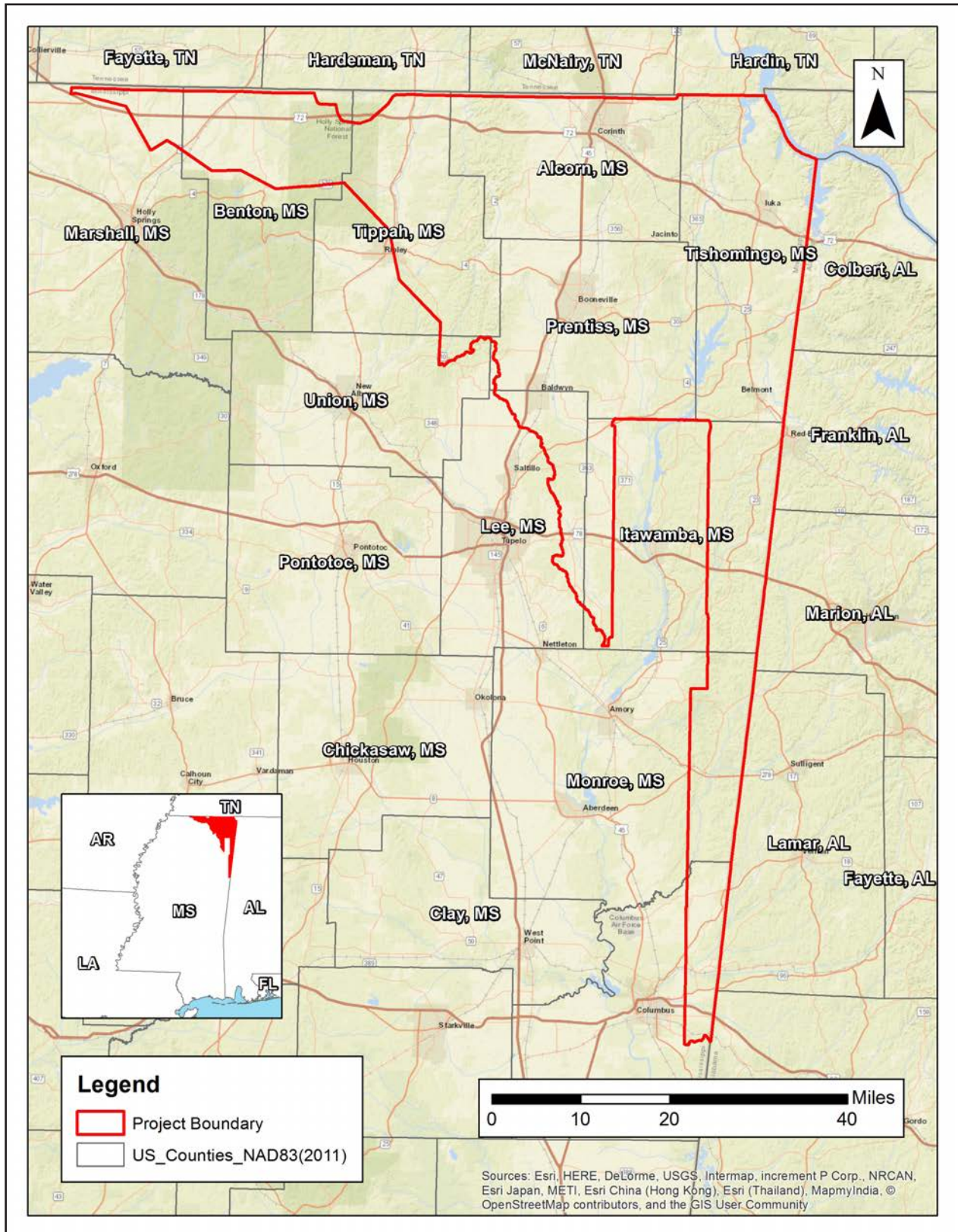
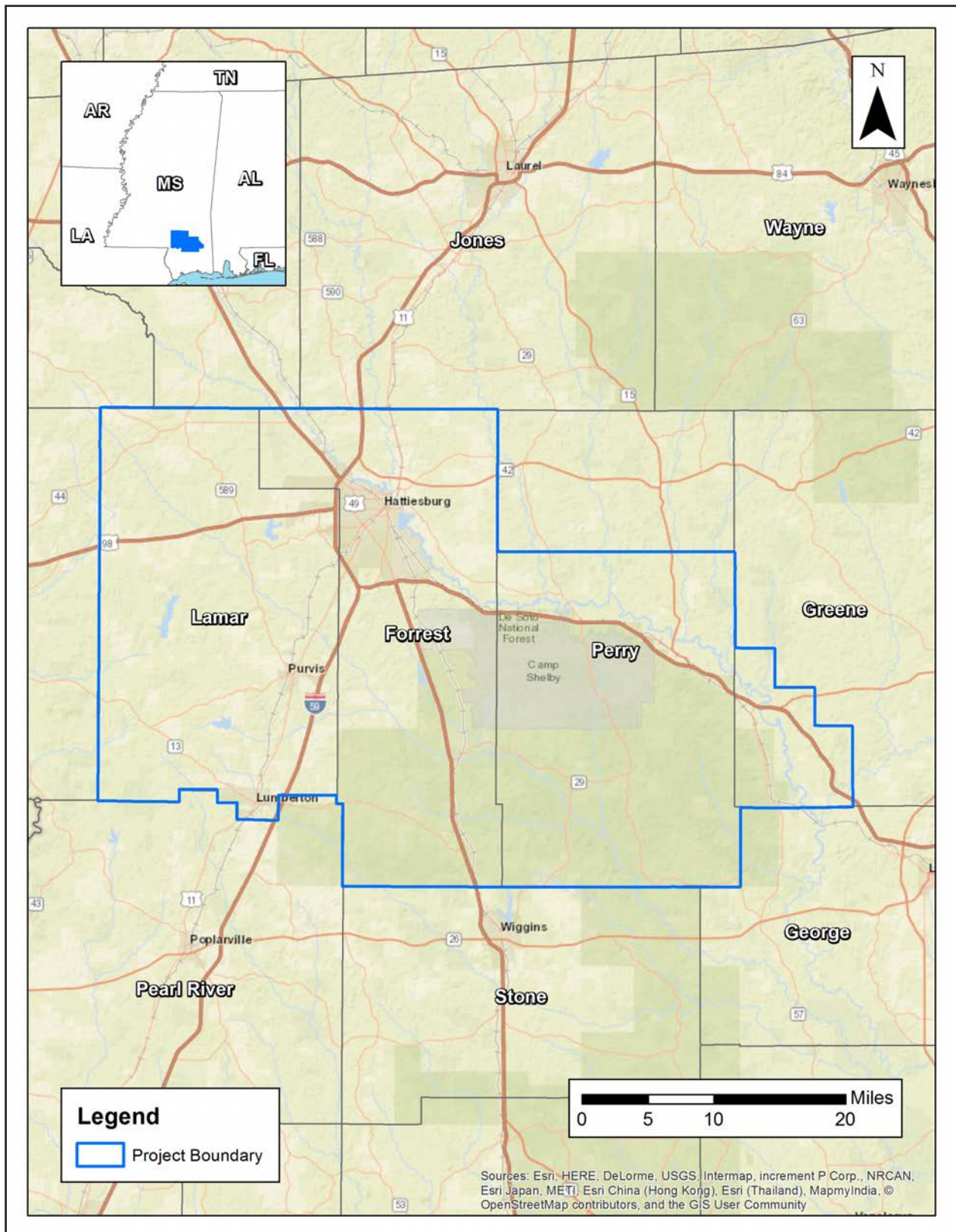


Figure 2. Project Boundary - Southern AOI



2. Planning / Equipment

2.1. Flight Planning

Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount / type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity. Please note that certain values in the table below are listed as “Variable” due to the various flight plans used, as described in “Section: 1.5. Issues” of this document.

Detailed project flight planning calculations were performed for the project using Leica MissionPro planning software.

The entire target area was comprised of 249 planned flight lines measuring approximately 7,620.54 total flight line miles (Figure 3).

2.2. LiDAR Sensor

Quantum Spatial and Woolpert Inc. utilized Leica ALS 70 and Leica ALS 80 LiDAR sensors (Figure 5), serial numbers 7178 and 8227, for this project.

The Leica ALS 70 system is capable of collecting data at a maximum frequency of 500 kHz, which affords elevation data collection of up to 500,000 points per second. The system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to 4 returns per outgoing pulse from the laser and these come in the form of 1st, 2nd, 3rd and last returns. The intensity of the returns is also captured during aerial acquisition.

The Leica ALS 80 system is capable of collecting data at a maximum frequency of 1,000 kHz. The system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to 6 returns per outgoing pulse from the laser. The intensity of the returns is also captured during aerial acquisition.

A brief summary of the aerial acquisition parameters for the project are shown in the LiDAR System Specifications in Table 2.

Figure 3. Planned Flight Lines - Northern AOI

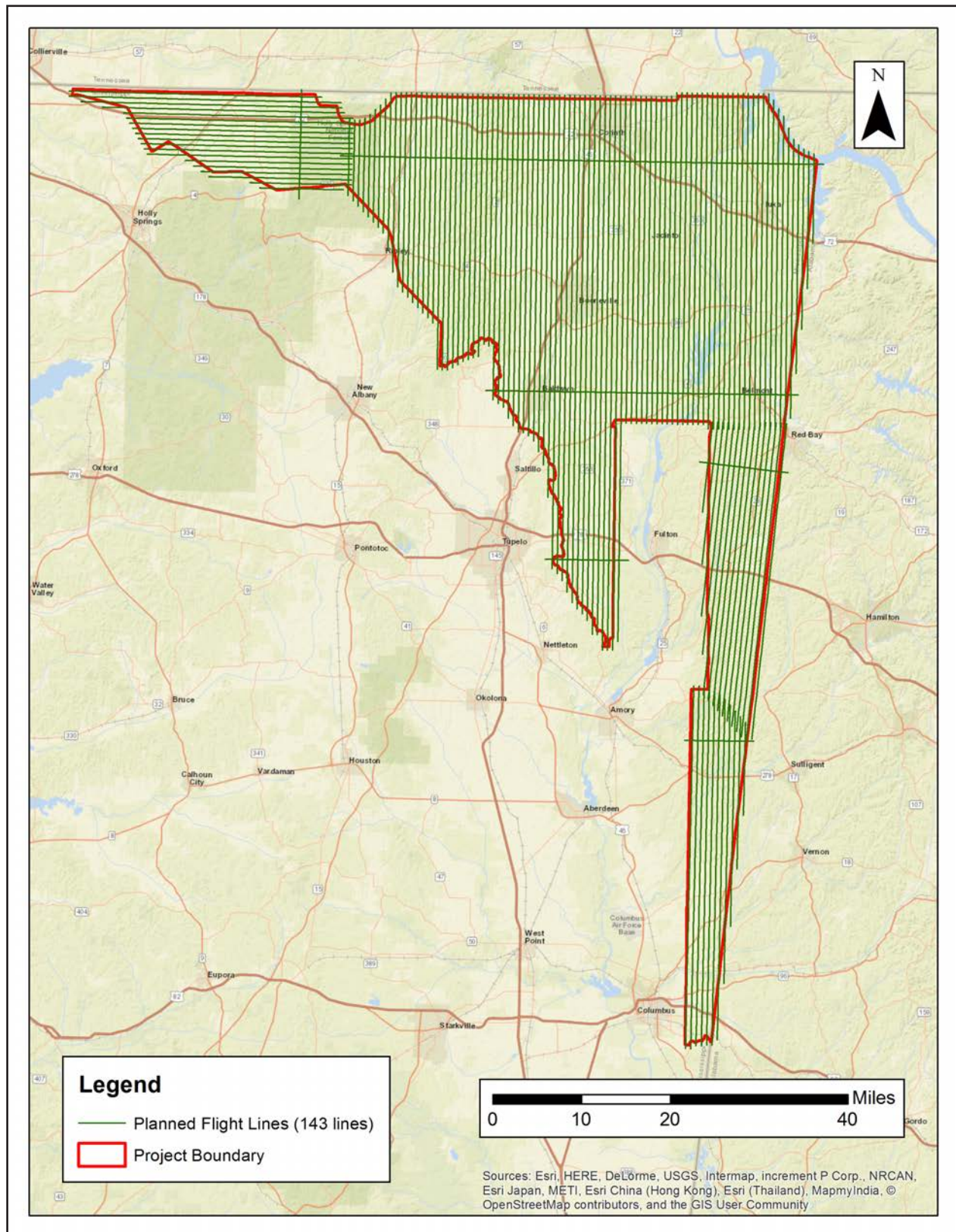


Figure 4. Planned Flight Lines - Southern AOI

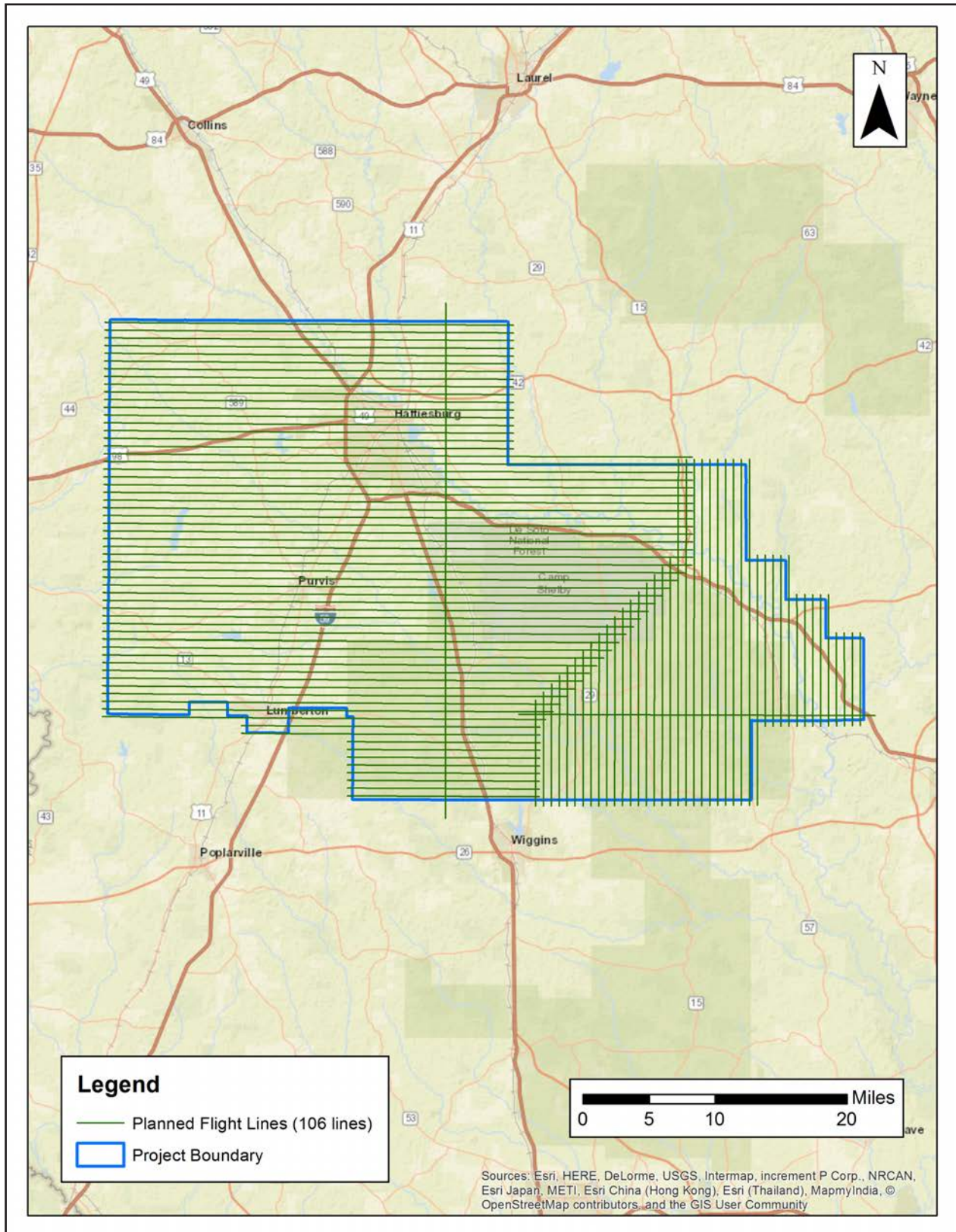


Table 2. Sensor Specifications

		7178	8227
Terrain and Aircraft Scanner	Flying Height	1,874 - 2,000 m	1,887 - 2,000 m
	Recommended Ground Speed	170 kts	170 kts
Scanner	Field of View	140°	140°
	Scan Rate Setting Used	39.0 Hz	53.4 Hz
Laser	Laser Pulse Rate Used	271.0 kHz	273.0 kHz
	Multi Pulse in Air Mode	Enabled	Enabled
Coverage	Full Swath Width	1,455.88 m	1,455.88 m
	Line Spacing	1,218.83 m	1,120.64 m
Point Spacing and Density	Maximum Point Spacing Along Track	1.24 m	0.91 m
	Maximum Point Spacing Along Track	1.64 m	1.12 m
	Average Point Density	2.14 pts / m ²	2.13 pts / m ²

Figure 5. Leica ALS 70 (left) and ALS 80 (right) LiDAR Sensors


2.3. Aircraft

All flights for the project were accomplished through the use of customized planes. Plane type and tail numbers are listed below.

- Piper Navajo (twin-piston), Tail Number: N22GE
- Cessna Caravan (single-turboprop), Tail Number: N208NR

These aircraft provided an ideal, stable aerial base for LiDAR and orthoimagery acquisition. These aerial platforms has relatively fast cruise speeds which are beneficial for project mobilization / demobilization while maintaining relatively slow stall speeds which proved ideal for collection of high-density, consistent data posting using state-of-the-art Leica LiDAR systems. Some of Quantum Spatial's operating aircraft can be seen in Figure 6 below.

Figure 6. Some of Quantum Spatial's Planes



2.4. Base Station Information

GPS base stations were utilized during all phases of flight (Table 3). The base station locations were verified using NGS OPUS service and subsequent surveys. Base station locations are depicted in Figure 7 and Figure 8. Data sheets, graphical depiction of base station locations or log sheets used during station occupation are available in Appendix A.

Table 3. Base Station Locations

Coordinates are in WGS84.

Base Station	Longitude	Latitude	Ellipsoid Height (m)
AA6293	89° 15' 36.5046"	31° 16' 15.89598"	18.557
MSPK	89° 8' 35.9375"	30° 46' 44.7959"	24.378
MSHT	89° 20' 10.62689"	31° 19' 39.14035"	65.906
MSBV	88° 33' 51.48409"	34° 39' 56.46132"	129.908
Carol_Cone, 80360, 80350	88° 45' 58.13669"	34° 15' 52.68896"	79.621
TN43	88° 36' 14.10605"	35° 13' 42.85124"	122.382
MSFL	88° 24' 54.96918"	34° 16' 36.54047"	77.233
MSPE	88° 39' 30.10859"	33° 47' 52.33113"	76.64
ALFA	87° 49' 45.5093"	33° 41' 6.74504"	90.5
MSCR	88° 32' 52.86984"	34° 54' 23.32034"	111.754
MSLU	88° 35' 21.86861"	30° 55' 30.50481"	60.489
MSHS	89° 27' 12.69644"	34° 44' 36.29706"	154.573

Figure 7. Base Station Locations - North AOI

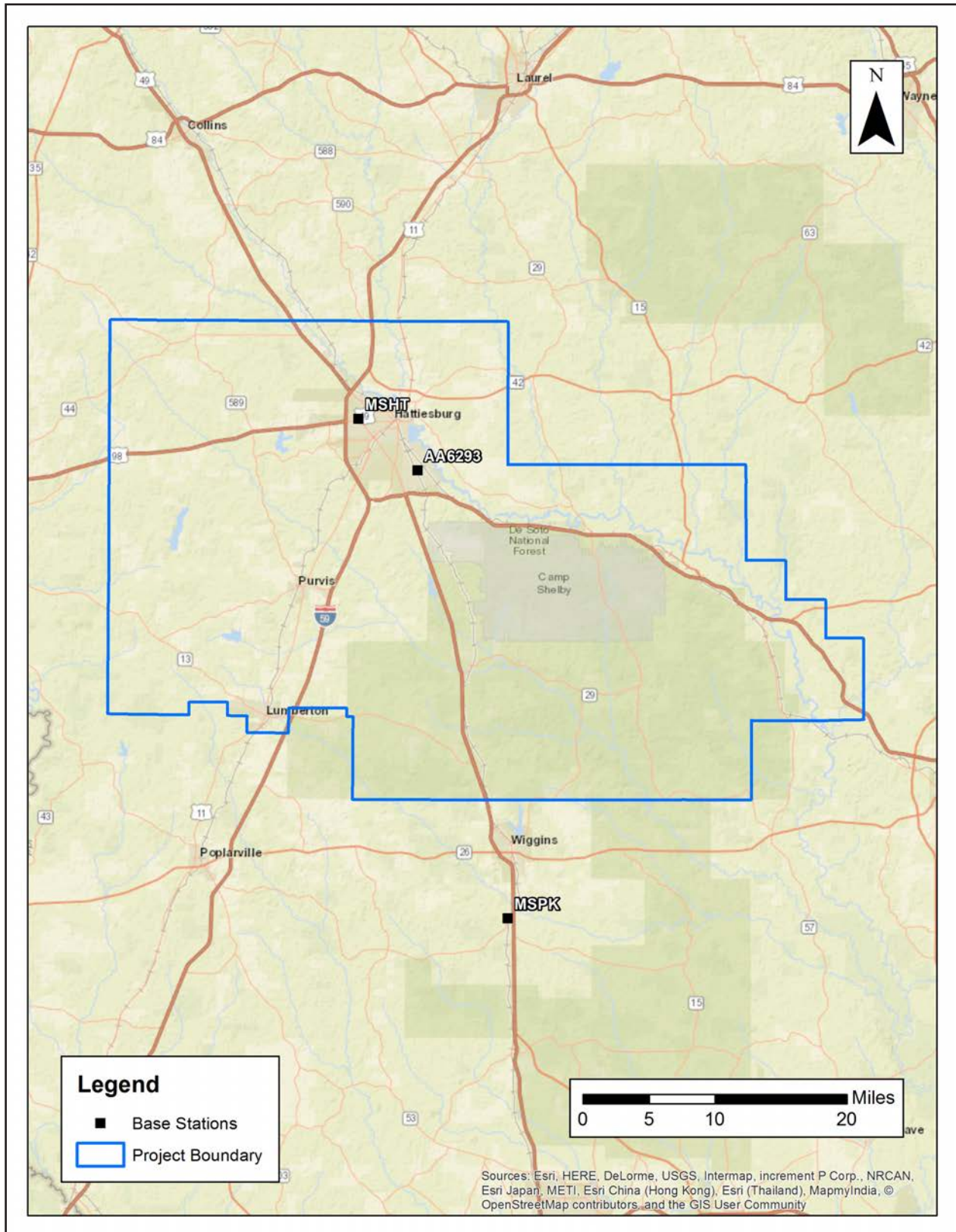
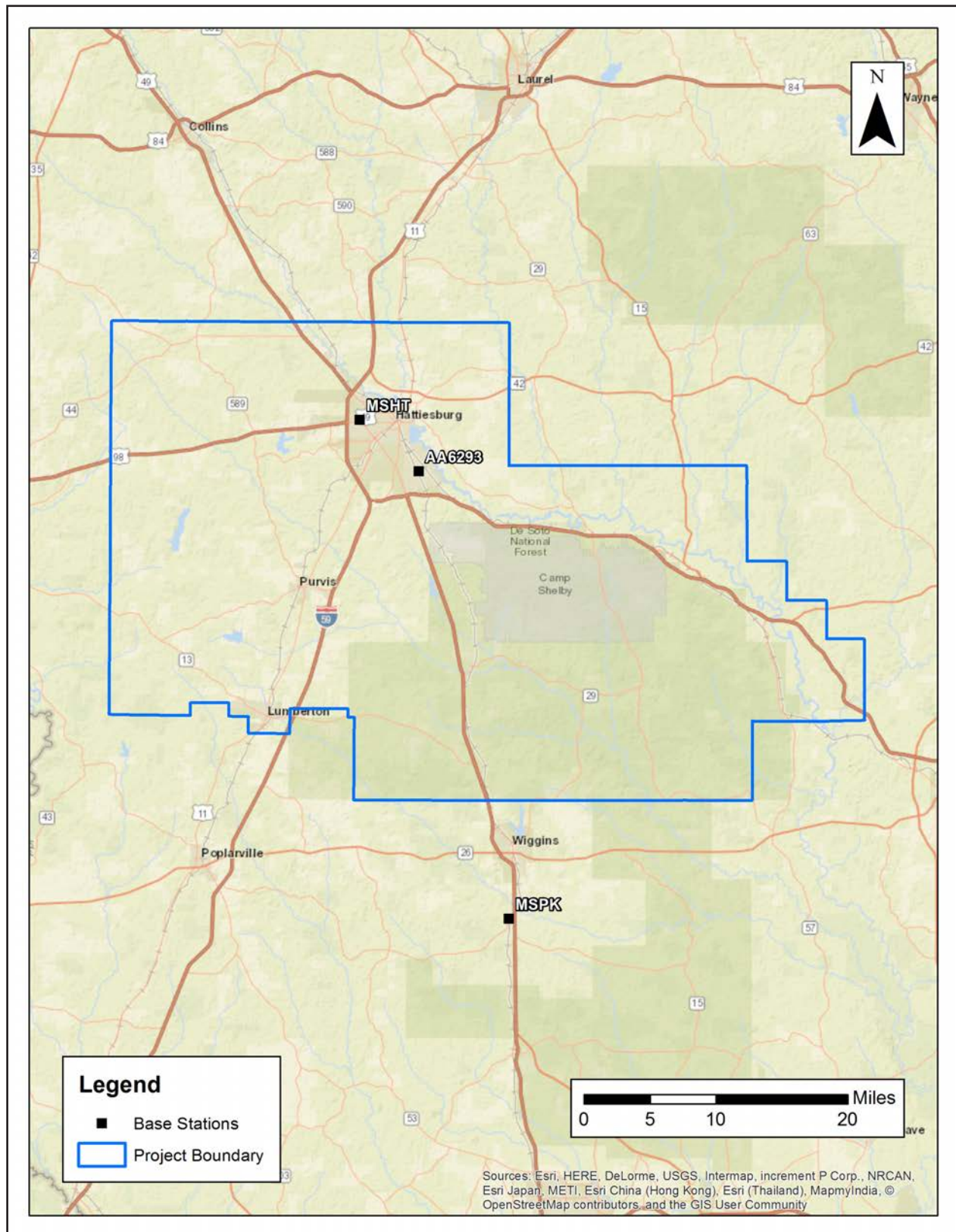


Figure 8. Base Station Locations - South AOI



2.5. Time Period

Project specific flights were conducted over two months. Twenty-six sorties, or aircraft lifts were completed. Accomplished sorties are listed below.

North AOI

- Jan 17, 2016-A
(N22GE, SN7178)
- Jan 17, 2016-B
(N22GE, SN7178)
- Jan 18, 2016-A
(N22GE, SN7178)
- Jan 18, 2016-B
(N22GE, SN7178)
- Jan 24, 2016-A
(N22GE, SN7178)
- Jan 24, 2016-B
(N22GE, SN7178)
- Jan 28, 2016-A
(N22GE, SN7178)
- Jan 30, 2016-A
(N22GE, SN7178)
- Feb 4, 2016-B
(N22GE, SN7178)
- Feb 5, 2016-A
(N22GE, SN7178)
- Feb 5, 2016-B
(N22GE, SN7178)
- Feb 6, 2016-A
(N22GE, SN7178)
- Feb 6, 2016-B
(N22GE, SN7178)
- Feb 7, 2016-A
(N22GE, SN7178)
- Feb 7, 2016-B
(N22GE, SN7178)
- Feb 11, 2016-A
(N22GE, SN7178)
- Feb 11, 2016-B
(N22GE, SN7178)

South AOI

- Jan 19, 2016-A
(N22GE, SN7178)
- Jan 27, 2016-A
(N208NR, SN8227)
- Jan 28, 2016-A
(N208NR, SN8227)
- Jan 28, 2016-B
(N208NR, SN8227)
- Jan 29, 2016-A
(N208NR, SN8227)
- Feb 3, 2016-A
(N208NR, SN8227)
- Feb 4, 2016-A
(N208NR, SN8227)
- Feb 4, 2016-B
(N208NR, SN8227)
- Feb 4, 2016-C
(N208NR, SN8227)

3. Processing Summary

3.1. Flight Logs

Flight logs were completed by LIDAR sensor technicians for each mission during acquisition. These logs depict a variety of information, including:

- Job / Project #
- Flight Date / Lift Number
- FOV (Field of View)
- Scan Rate (HZ)
- Pulse Rate Frequency (Hz)
- Ground Speed
- Altitude
- Base Station
- PDOP avoidance times
- Flight Line #
- Flight Line Start and Stop Times
- Flight Line Altitude (AMSL)
- Heading
- Speed
- Returns
- Crab

Notes: (Visibility, winds, ride, weather, temperature, dew point, pressure, etc). Project specific flight logs for each sortie are available in [Appendix A](#).

3.2. LiDAR Processing

Inertial Explorer software was used for post-processing of airborne GPS and inertial data (IMU), which is critical to the positioning and orientation of the LiDAR sensor during all flights. Inertial Explorer combines aircraft raw trajectory data with stationary GPS base station data yielding a “Smoothed Best Estimate Trajectory (SBET) necessary for additional post processing software to develop the resulting geo-referenced point cloud from the LiDAR missions.

During the sensor trajectory processing (combining GPS & IMU datasets) certain statistical graphs and tables are generated within the Inertial Explorer processing environment which are commonly used as indicators of processing stability and accuracy. This data for analysis include: Max horizontal / vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory. All relevant graphs produced in the Inertial Explorer processing environment for each sortie during the project mobilization are available in Appendix A.

The generated point cloud is the mathematical three dimensional composite of all returns from all laser pulses as determined from the aerial mission. Laser point data are imported into TerraScan and a manual calibration is performed to assess the system offsets for pitch, roll, heading and scale. At this point this data is ready for analysis, classification, and filtering to generate a bare earth surface model in which the above-ground features are removed from the data set. Point clouds were created using the Leica CloudPro software. GeoCue distributive processing software was used in the creation of some files needed in downstream processing, as well as in the tiling of the dataset into more manageable file sizes. TerraScan and TerraModeler software packages were then used for the automated data classification, manual cleanup, and bare earth generation. Project specific macros were developed to classify the ground and remove side overlap between parallel flight lines.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper was used as a final check of the bare earth dataset. GeoCue was used to create the deliverable industry-standard LAS files for both the All Point Cloud Data and the Bare Earth. In-house software was then used to perform final statistical analysis of the classes in the LAS files.

3.3. LAS Classification Scheme

The classification classes are determined by the USGS Version 1.2 specifications and are an industry standard for the classification of LIDAR point clouds. All data starts the process as Class 1 (Unclassified), and then through automated classification routines, the classifications are determined using TerraScan macro processing.

The classes used in the dataset are as follows and have the following descriptions:

- Class 1 – Processed, but Unclassified – These points would be the catch all for points that do not fit any of the other deliverable classes. This would cover features such as vegetation, cars, etc.
- Class 2 – Bare earth ground – This is the bare earth surface
- Class 7 – Low Noise – Low points, manually identified below the surface that could be noise points in point cloud.
- Class 9 – In-land Water – Points found inside of inland lake/ponds
- Class 10 – Ignored Ground – Points found to be close to breakline features. Points are moved to this class from the Class 2 dataset. This class is ignored during the DEM creation process in order to provide smooth transition between the ground surface and hydro flattened surface.
- Class 17 – Bridge Decks – Points falling on bridge decks.
- Class 18 – High Noise – High points, manually identified above the surface that could be noise points in point cloud.

3.4. Classified LAS Processing

The bare earth surface is then manually reviewed to ensure correct classification on the Class 2 (Ground) points. After the bare-earth surface is finalized, it is then used to generate all hydro-breaklines through heads-up digitization.

All ground (ASPRS Class 2) LiDAR data inside of the Lake Pond and Double Line Drain hydro flattening breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 3 feet was also used around each hydro-flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 10). All Lake Pond Island and Double Line Drain Island features were checked to ensure that the ground (ASPRS Class 2) points were reclassified to the correct classification after the automated classification was completed. All bridge decks were classified to Class 17.

All overlap data was processed through automated functionality provided by TerraScan to classify the overlapping flight line data to approved classes by USGS. The overlap data was identified using the Overlap Flag, per LAS 1.4 specifications.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper was used as a final check of the bare earth dataset. GeoCue was then used to create the deliverable industry-standard LAS files for both the All Point Cloud Data and the Bare Earth. Quantum Spatial proprietary software was used to perform final statistical analysis of the classes in the LAS files, on a per tile level to verify

final classification metrics and full LAS header information.

3.5. Hydro-Flattened Breakline Creation

Class 2 LiDAR was used to create a bare earth surface model. The surface model was then used to heads-up digitize 2D breaklines of inland streams and rivers with a 100-foot nominal width and Inland Ponds and Lakes of 2 acres or greater surface area.

Elevation values were assigned to all Inland Ponds and Lakes, Inland Pond and Lake Islands, Inland Stream and River Islands, using TerraModeler functionality.

Elevation values were assigned to all Inland streams and rivers using Quantum Spatial proprietary software.

All ground (ASPRS Class 2) LiDAR data inside of the collected inland breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 3 feet was also used around each hydro-flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 10).

The breakline files were then translated to Esri file-geodatabase format using Esri conversion tools.

3.6. Hydro-Flattened Raster DEM Creation

Class 2 LiDAR in conjunction with the hydro breaklines were used to create a 1-meter/2.5-foot raster DEM. Using automated scripting routines within ArcMap, an ERDAS Imagine .IMG file was created for each tile. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

3.7. Intensity Image Creation

GeoCue software was used to create the deliverable intensity images with a 1-meter/2.5-foot cell size. All overlap classes were ignored during this process. This helps to ensure a more aesthetically pleasing image.

The GeoCue software was then used to verify full project coverage as well. TIF/TWF files were then provided as the deliverable for this dataset requirement.

3.8. Contour Creation

Using automated scripting routines within ArcMap, a terrain surface was created using the ground (ASPRS Class 2) LiDAR data as well as the hydro-flattened breaklines. This surface was then used to generate the final 1-foot contour dataset in Esri file geodatabase format.

4. Project Coverage Verification

Coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 9.

Figure 9. Flightline Swath LAS File Coverage - Northern AOI

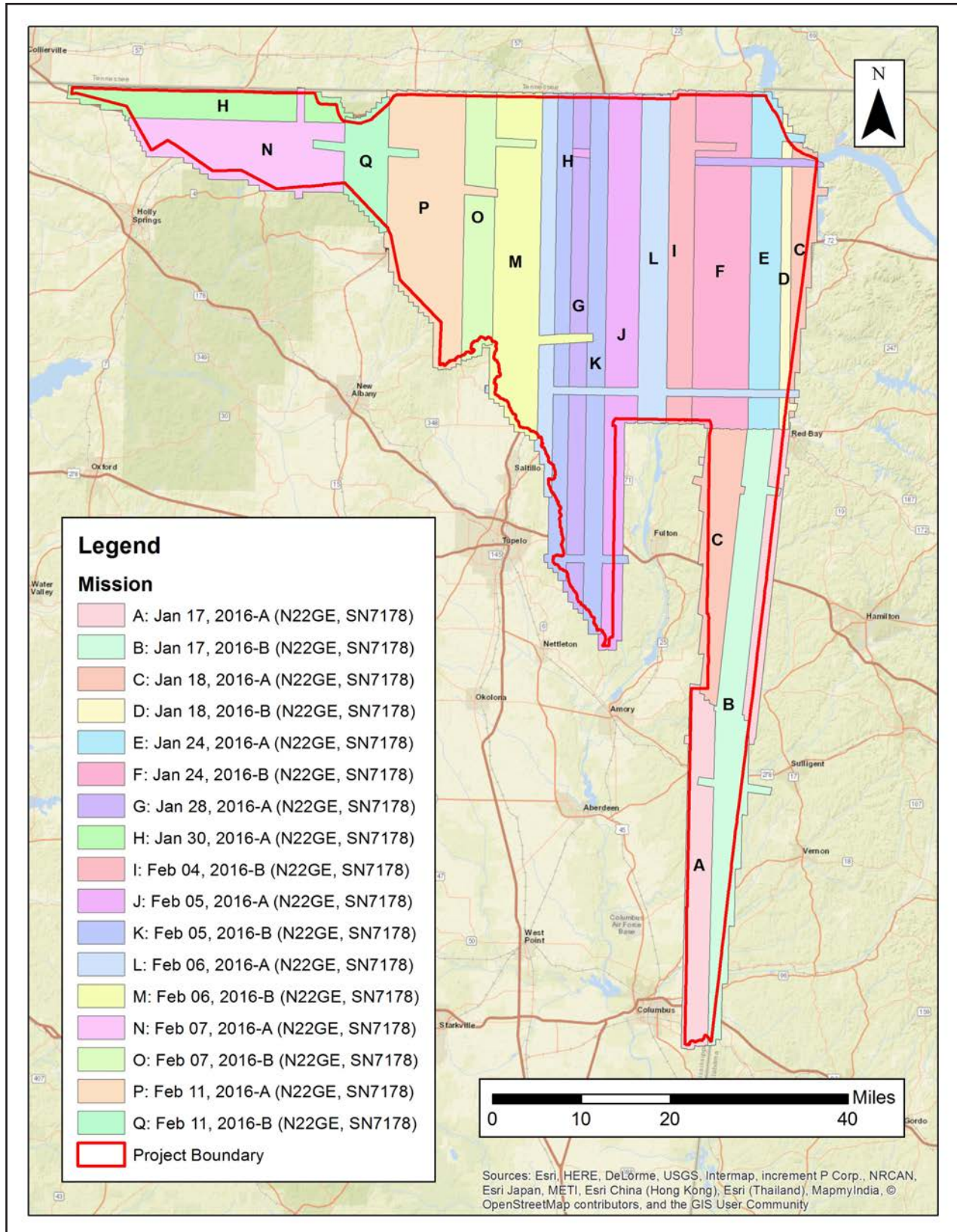
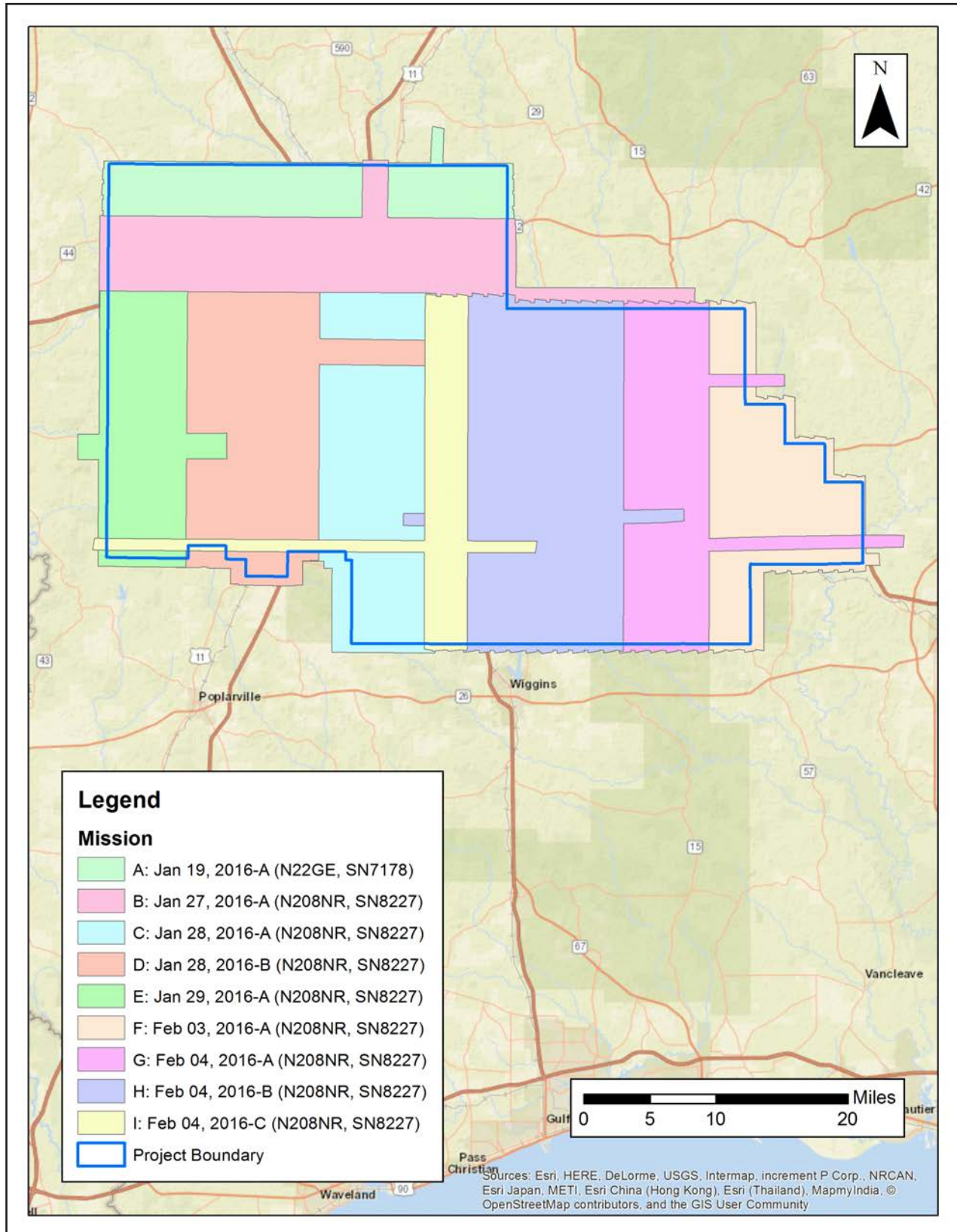


Figure 10. Flightline Swath LAS File Coverage - Southern AOI



5. Ground Control and Check Point Collection

Quantum Spatial completed a field survey of 97 (59 in the North AOI, 38 in the South AOI) ground control (calibration) points along with 174 blind QA points in Vegetated and Non-Vegetated land cover classifications (total of 271 points) as an independent test of the accuracy of this project.

A combination of precise GPS surveying methods, including static and RTK observations were used to establish the 3D position of ground calibration points and QA points for the point classes above. GPS was not an appropriate methodology for surveying in the forested areas during the leaf-on conditions for the actual field survey (which was accomplished after the LiDAR acquisition). Therefore the 3D positions for the forested points were acquired using a GPS-derived offset point located out in the open near the forested area, and using precise offset surveying techniques to derive the 3D position of the forested point from the open control point. The explicit goal for these surveys was to develop 3D positions that were three times greater than the accuracy requirement for the elevation surface. In this case of the blind QA points the goal was a positional accuracy of 5 cm in terms of the RMSE.

For more information, see the Survey Report in Appendix B.

The required accuracy testing was performed on the LiDAR dataset (both the LiDAR point cloud and derived DEM's) according to the USGS LiDAR Base Specification Version 1.2 (2014). In this document, horizontal coordinates for ground control and QA points for all LiDAR classes for the North AOI are reported in NAD83 (2011) UTM Zone 16N, meters; NAVD88 (Geoid 12B), meters. Coordinate values for the South AOI are reported in NAD83 (2011) State Plane Mississippi East, US survey feet; NAVD88 (GEOID12B), US survey feet.

5.1. Calibration Control Point Testing

Figure 11 and Figure 12 show the location of each bare earth calibration point for the project area. Table 4 and Table 5 depict the Control Report for the LiDAR bare earth calibration points, as computed in TerraScan as a quality assurance check. Note that these results of the surface calibration are not an independent assessment of the accuracy of these project deliverables, but the statistical results do provide additional feedback as to the overall quality of the elevation surface.

5.2. Point Cloud Testing

The project specifications require that only Non-Vegetated Vertical Accuracy (NVA) be computed for raw lidar point cloud swath files. The required accuracy (ACCz) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the "bare earth" and "urban" land cover classes. The NVA was tested with 56 checkpoints in the North AOI and 42 checkpoints in the South AOI, all located in bare earth and urban (non-vegetated) areas. These check points were not used in the calibration or post processing of the lidar point cloud data. The checkpoints were distributed throughout the project area and were surveyed using

GPS techniques. See survey report for additional survey methodologies.

Elevations from the unclassified lidar surface were measured for the x,y location of each check point. Elevations interpolated from the lidar surface were then compared to the elevation values of the surveyed control points. AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using $RMSE(z) \times 1.9600$ as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASRPS Guidelines. See Figure 13, Figure 14 and Table 6, Table 7.

5.3. Digital Elevation Model (DEM) Testing

The project specifications require the accuracy (ACCz) of the derived DEM be calculated and reported in two ways:

1. The required NVA is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the “bare earth” and “urban” land cover classes. This is a required accuracy. The NVA was tested with 56 checkpoints in the North AOI and 42 checkpoints in the South AOI, all located in bare earth and urban (non-vegetated) areas. See Figure 15, Figure 16 and Table 8, Table 9.

2. Vegetated Vertical Accuracy (VVA): VVA shall be reported for “forested”, “shrubs”, and “tall weeds” land cover classes. The target VVA is: 29.4 cm at the 95th percentile, derived according to ASPRS Guidelines, Vertical Accuracy Reporting for Lidar Data, i.e., based on the 95th percentile error in all vegetated land cover classes combined. This is a target accuracy. The VVA was tested with 40 checkpoints in the North AOI and 35 checkpoints in the South AOI, all located in forested, shrubs, and tall weeds (vegetated) areas. The checkpoints were distributed throughout the project area and were surveyed using GPS techniques. See Figure 17, Figure 18 and Table 10, Table 11.

See survey report for additional survey methodologies. AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using $RMSE(z) \times 1.9600$ as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASRPS Guidelines.

Figure 11. Calibration Control Point Locations - North AOI

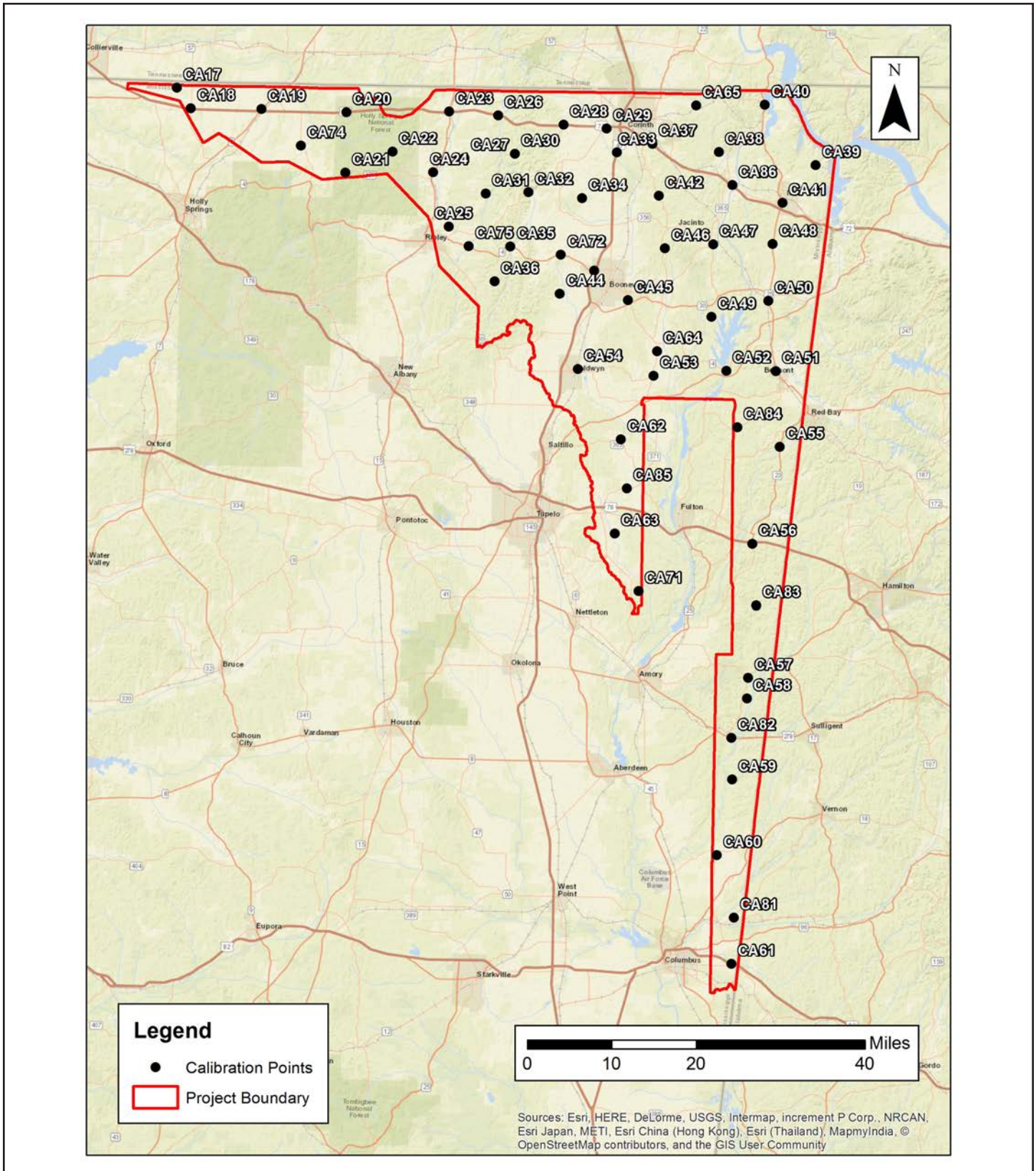


Table 4. Calibration Control Point Report - North AOI

Units = Meters

Number	Easting	Northing	Known Z	Laser Z	Dz
CA17	274334.3	3873930.97	142.88	142.92	0.04
CA18	276967.45	3869963.24	172.69	172.78	0.09
CA19	290402.06	3869849.77	139.32	139.27	-0.04
CA20	306586.5	3869231.97	170.11	170.04	-0.07
CA21	306444.48	3857739.84	203.1	203	-0.1
CA22	315396.45	3861706.74	167.93	167.96	0.03
CA23	326179.5	3869344.15	149.86	149.87	0.01
CA24	323169.75	3857771.58	141.18	141.14	-0.04
CA25	326091.84	3847407.99	166.77	166.75	-0.02
CA26	335534.87	3868657.56	158.94	158.98	0.04
CA27	329114.17	3860485.92	171.71	171.76	0.05
CA28	347995.2	3866843.65	129.93	129.98	0.05
CA29	356212.04	3866152.02	127.78	127.75	-0.03
CA30	338698.49	3861338.5	177.11	177.15	0.04
CA31	333167.33	3853707.95	171	171.06	0.06
CA32	341315.13	3854001.01	129.14	129.16	0.02
CA33	358180.57	3861609.85	126.73	126.74	0.01
CA34	351545.78	3852844.29	163.14	163.21	0.07
CA35	337868.96	3843643.24	140.24	140.26	0.02
CA36	334855.69	3836970.35	202.74	202.8	0.06
CA37	364935.84	3863182.39	141.79	141.82	0.03
CA38	377585.45	3861674.31	147.61	147.64	0.03
CA39	396051.21	3859173.47	163.08	163.09	0.01
CA40	386359.61	3870668.79	150.2	150.23	0.03
CA41	389711.07	3851969.26	175.57	175.58	0.01
CA42	366137.86	3853352.54	137.87	137.89	0.02
CA43	353838.7	3839037.51	158.98	158.92	-0.06
CA44	347271.83	3834658.42	132.42	132.44	0.02
CA45	360268.15	3833379.97	157.32	157.29	-0.03
CA46	367337.07	3843264.01	166.8	166.86	0.06
CA47	376485.26	3844020.16	156.092	156.11	0.02
CA48	387856.29	3844127.62	176.438	176.41	-0.03

Number	Easting	Northing	Known Z	Laser Z	Dz
CA49	376149.88	3830210.74	149.979	149.96	-0.02
CA50	387008.02	3833261.93	157.908	157.83	-0.08
CA51	388408.45	3819866.29	174.419	174.4	-0.02
CA52	378996	3819933.84	114.885	114.84	-0.05
CA53	365148.53	3818988.33	113.28	113.28	0
CA54	350704.68	3820294.76	104.96	104.97	0.01
CA55	389182.507	3805462.06	129.483	*	*
CA56	383954.686	3786917.86	106.911	106.94	0.03
CA57	383163.149	3761453.7	95.469	95.5	0.03
CA58	382946.357	3757520.49	89.792	89.8	0.01
CA59	380084.97	3742096.68	84.552	84.58	0.03
CA60	377214.138	3727675.5	102.512	102.51	0
CA61	379939.579	3706964.59	94.764	94.7	-0.06
CA62	358909.545	3806855.19	108.225	108.17	-0.05
CA63	357742.93	3788881.75	94.456	94.45	-0.01
CA64	365790.72	3823661.63	110.155	110.16	0
CA65	373250.485	3870505.55	149.971	150.01	0.04
CA71	362285.075	3777925.68	105.05	105.08	0.03
CA72	347470.546	3842050.83	173.771	173.74	-0.03
CA74	297925.089	3862893.5	163.253	163.17	-0.08
CA75	329930.238	3843706.92	143.461	143.52	0.06
CA81	380424.571	3715769.64	80.555	80.52	-0.04
CA82	379956.356	3750005.08	82.774	82.81	0.04
CA83	384712.522	3775203.3	115.069	115.05	-0.02
CA84	381097.955	3809162.44	150.188	150.22	0.03
CA85	360084.186	3797489.14	91.886	91.82	-0.07
CA86	380150.175	3855321.52	137.489	137.51	0.02
Average Dz		0.00 m			
Minimum Dz		-0.104 m			
Maximum Dz		0.094 m			
Root Mean Square		0.043 m			
Std. Deviation		0.043 m			

*Point CA55 fell on an area of drastic change and was removed from the final accuracy calculation.

Figure 12. Calibration Control Point Locations - South AOI

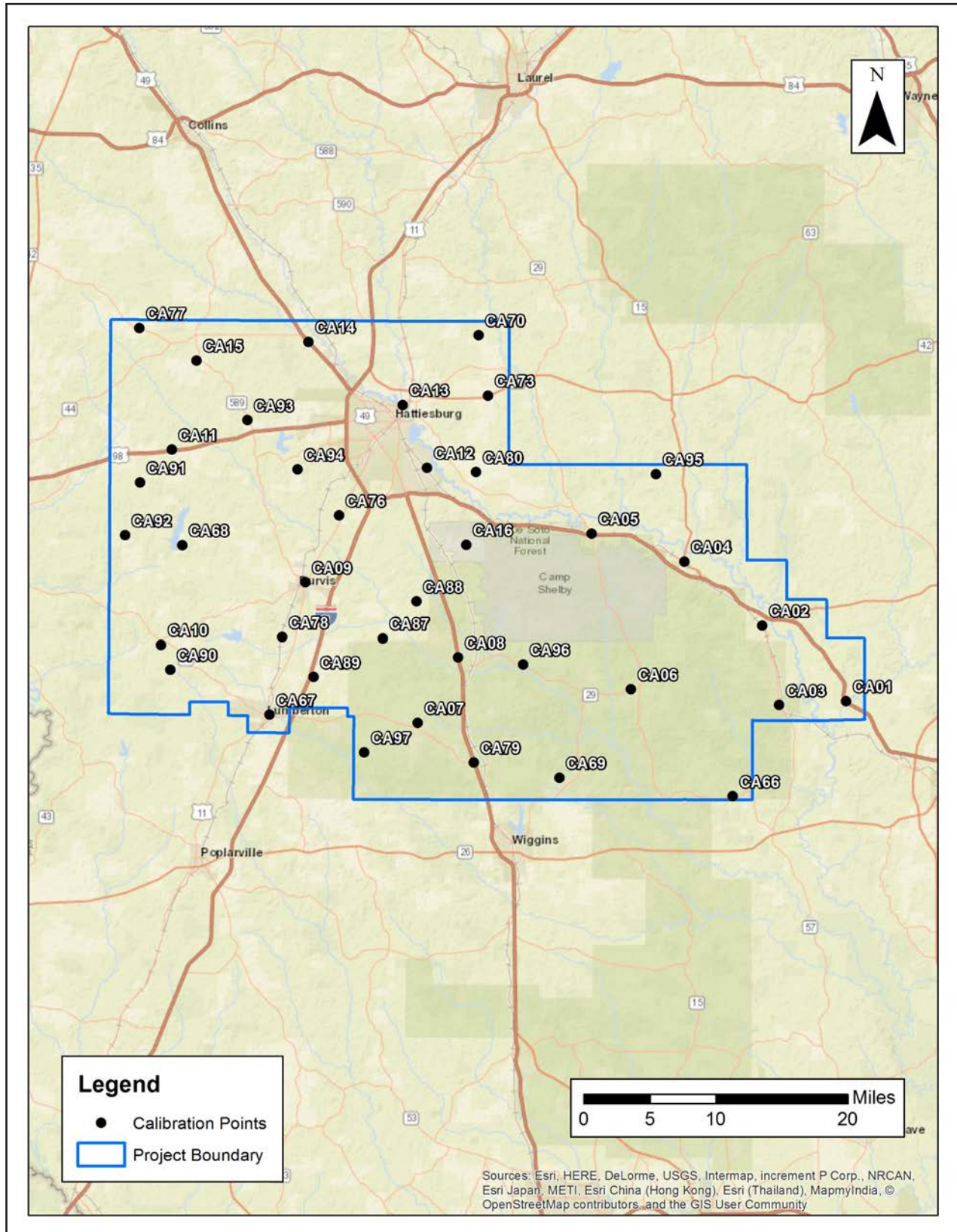


Table 5. Calibration Control Point Report - South AOI

Units = US Survey Feet

Number	Easting	Northing	Known Z	Laser Z	Dz
CA01	1021912.38	552070.27	96.5	96.68	0.18
CA02	988389.92	582115.07	77.24	77.34	0.1
CA03	995095.52	550534.81	103.3	103.35	0.05
CA04	957206.29	607755.49	93.63	93.66	0.03
CA05	920151.43	618974.01	106.71	106.69	-0.02
CA06	935896.32	556881.26	276.3	276.42	0.12
CA07	850615.73	543433.01	322.98	323.02	0.04
CA08	866746.86	569523.83	200.47	200.39	-0.08
CA09	805636.33	599412.83	359.25	359.3	0.05
CA10	748001.54	574532.22	403.51	403.63	0.12
CA11	752267.33	652551.91	412.78	412.83	0.05
CA12	854347.55	645238.87	142.3	142.09	-0.21
CA13	844548.12	670419.12	149.91	150.03	0.12
CA14	806920.13	695711.31	213.12	212.82	-0.3
CA15	762125.09	688194.92	363.27	363.05	-0.22
CA16	869932.14	614452.08	275.74	275.64	-0.1
CA66	976571.25	514030.91	208.88	208.94	0.06
CA67	791324.9	546640.51	271.57	271.59	0.02
CA68	756451.64	614286.09	353.52	353.49	-0.03
CA69	907205.77	521387.75	270.6	270.48	-0.12
CA70	874867.93	698379.19	234.5	234.52	0.02
CA73	878714.67	674147.52	254.5	254.67	0.17
CA76	819109.04	626183.55	365.07	365.15	0.08
CA77	739333.82	701192.93	418.69	418.8	0.11
CA78	796410.56	577577.36	320.3	320.36	0.06
CA79	872992.91	527541.73	314.11	314.11	0
CA80	873921.04	643557.43	159.55	159.33	-0.22
CA87	836626.64	577098.55	323.54	323.49	-0.05
CA88	850067.18	591830.07	294.55	294.47	-0.08
CA89	808958.75	561735.88	332.88	332.92	0.04
CA90	751660.51	564634.2	384.77	384.68	-0.09
CA91	739502.15	639368.78	322.55	322.57	0.02

Number	Easting	Northing	Known Z	Laser Z	Dz
CA92	733586.42	618259.54	381.44	381.35	-0.09
CA93	782501	664343.84	351.13	351.27	0.14
CA94	802520.61	644616.84	408.76	408.86	0.1
CA95	945858.56	642708.33	233.18	233.05	-0.13
CA96	892721.64	566703.26	136.7	136.83	0.13
CA97	829200.52	531578.87	267.59	267.45	-0.14
Average Dz		0.00 ft			
Minimum Dz		-0.300 ft			
Maximum Dz		0.180 ft			
Root Mean Square		0.117 ft			
Std. Deviation		0.119 ft			

Figure 13. QC Checkpoint Locations - Raw NVA - North AOI

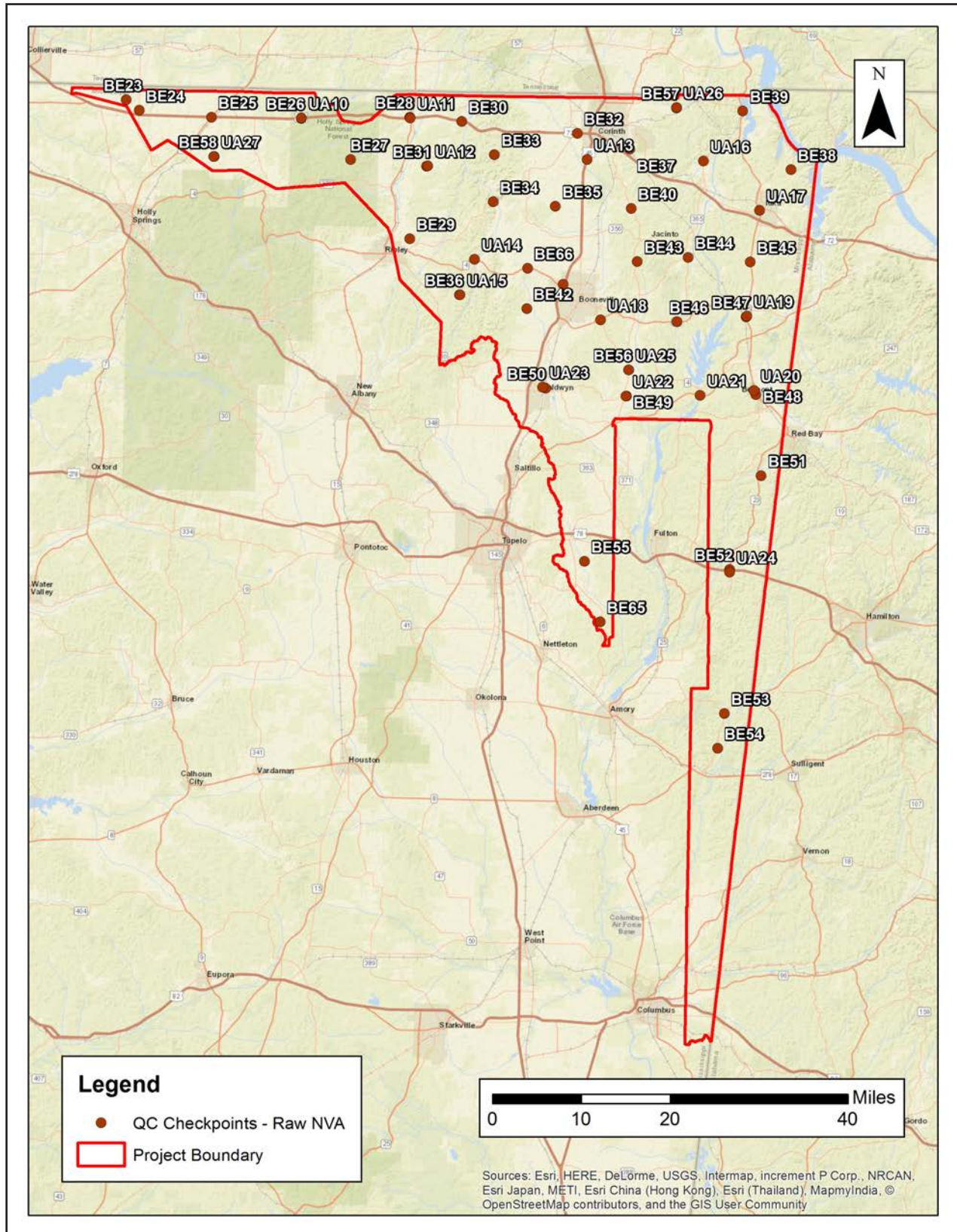


Table 6. QC Checkpoint Report - Raw NVA - North AOI

Units = Meters

Number	Easting	Northing	Known Z	Laser Z	Dz
BE23	274769.44	3872552.88	130.92	130.88	-0.04
BE24	277123.74	3870653.28	161.23	161.16	-0.07
BE25	290219.86	3869392.71	135.7	135.61	-0.09
BE26	306496.59	3869186.85	172.69	172.62	-0.07
BE27	315391.28	3861736.67	167.1	167.15	0.06
BE28	326148.08	3869347.62	149.16	149.23	0.07
BE29	326088.31	3847335.73	166.64	166.68	0.04
BE30	335532.53	3868638.72	159.26	159.31	0.05
BE31	329145.73	3860483.25	171.57	171.64	0.07
BE32	356473.31	3866460.4	125.86	125.81	-0.05
BE33	341459.84	3862623.41	192.05	192.1	0.05
BE34	341237.19	3854083.95	130.59	130.64	0.05
BE35	352488.32	3853270.38	162.31	162.33	0.02
BE36	335157.35	3837223.17	205.75	205.82	0.07
BE37	365974.32	3863606.19	162.32	162.34	0.02
BE38	395130.21	3859911.5	189.24	189.31	0.07
BE39	386427.66	3870549.23	150.79	150.79	0
BE40	366216.61	3852833.77	134.7	134.72	0.02
BE41	353916.69	3839099.14	159.94	159.94	0
BE42	347299.21	3834692.72	131.6	131.61	0.01
BE43	367326.62	3843243.97	166.74	166.76	0.02
BE44	376494.59	3844007.75	155.91	155.89	-0.02
BE45	387747.99	3843151.98	179.17	179.16	-0.01
BE46	374507.28	3832303.32	116.06	116.02	-0.04
BE47	387026.82	3833231.92	158.22	158.14	-0.08
BE48	388791.8	3819132.14	179.85	179.85	0
BE49	365360.72	3818874.75	115.91	115.93	0.02
BE50	350688.33	3820278.74	105.03	105.09	0.06
BE51	389756.5	3804408.85	141.11	141.13	0.03
BE52	384016.12	3787383.71	116.19	116.28	0.09
BE53	383071.47	3761420.23	93.58	93.6	0.02
BE54	381851.61	3755119.98	94.55	94.59	0.04

Number	Easting	Northing	Known Z	Laser Z	Dz
BE55	357729.9	3788886.86	94.29	94.32	0.03
BE56	365754.63	3823619.84	110.62	110.62	0.01
BE57	374389.92	3871085.92	148.36	148.39	0.03
BE58	290696.98	3862230.35	189.16	189.05	-0.1
BE65	360593.31	3777937.18	84.12	84.12	0
BE66	347471.23	3842004.46	172.76	172.76	0
UA10	306493.37	3869247.2	171.39	171.31	-0.08
UA11	326175.27	3869267.9	147.62	147.67	0.05
UA12	329386.53	3860536.01	171.04	171.08	0.04
UA13	358204.72	3861732.12	127.3	127.31	0.01
UA14	337854.6	3843639.19	141.01	141.03	0.03
UA15	335205.798	3837201.225	207.298	207.36	0.06
UA16	379282.562	3861424.332	135.925	135.91	-0.02
UA17	389419.276	3852512.516	179.199	179.21	0.01
UA18	360647.671	3832629.075	154.854	154.87	0.02
UA19	387143.769	3833327.716	156.38	156.42	0.04
UA20	388423.283	3819835.006	175.742	175.79	0.05
UA21	378700.119	3818998.089	104.405	104.42	0.02
UA22	365256.528	3818834.735	118.1	118.18	0.08
UA23	350143.268	3820438.402	108.774	108.79	0.02
UA24	384031.196	3786929.909	108.407	108.46	0.05
UA25	365740.393	3823608.706	110.59	110.59	0
UA26	374400.902	3871105.575	148.165	148.2	0.03
UA27	290642.97	3862279.034	190.177	190.04	-0.14
Average Dz		0.01 m			
Minimum Dz		-0.137 m			
Maximum Dz		0.091 m			
Root Mean Square		0.050 m			
95% Confidence Level		0.098 m			

Figure 14. QC Checkpoint Locations - Raw NVA - South AOI

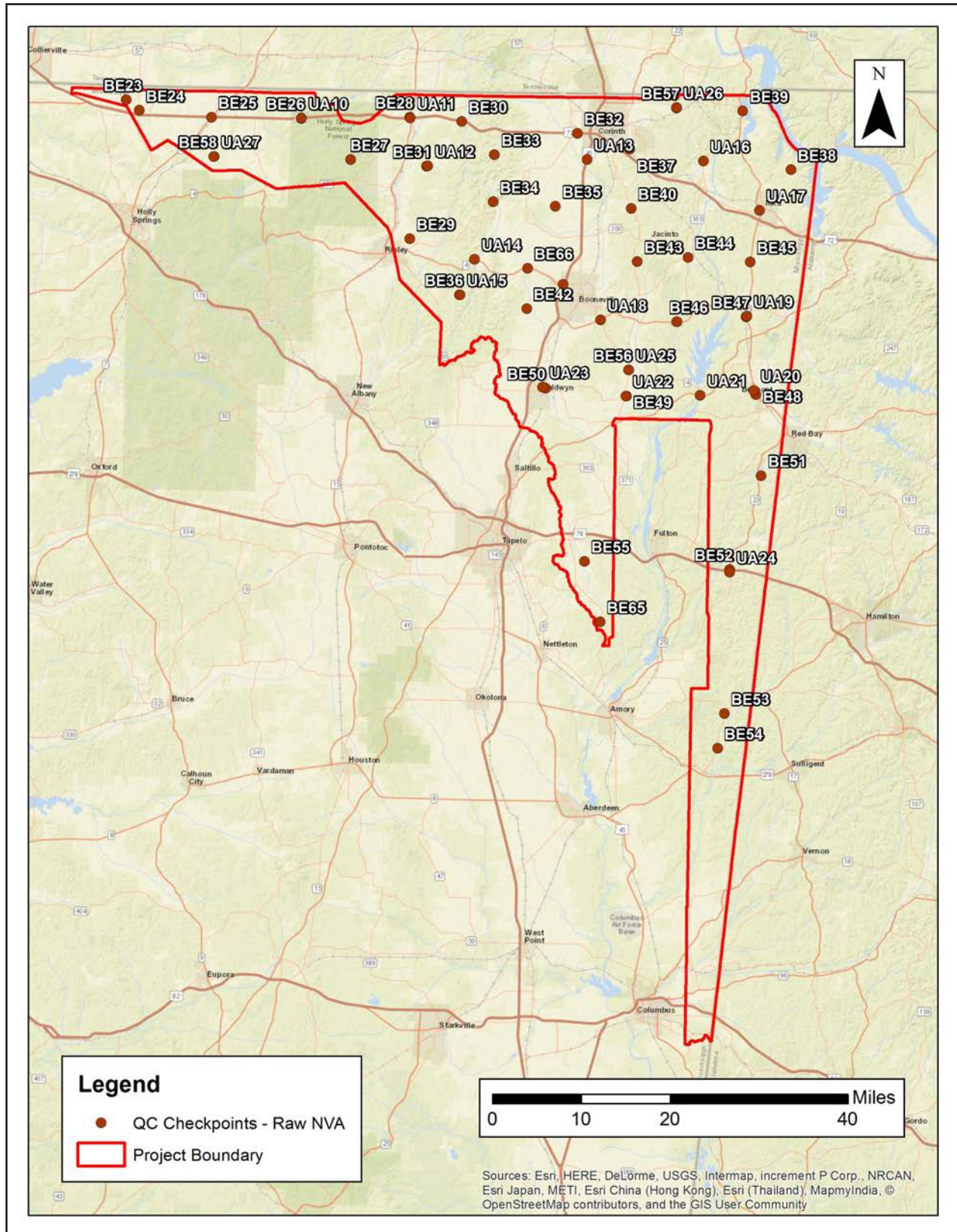


Table 7. QC Checkpoint Report - Raw NVA - South AOI

Units = US Survey Feet

Number	Easting	Northing	Known Z	Laser Z	Dz
BE01	1020723.65	552655.38	125.47	125.6	0.13
BE02	988375.58	582309.26	77.87	77.95	0.08
BE03	995421.26	550457.37	96.5	96.49	-0.01
BE04	956785.29	609248.06	90.84	90.78	-0.06
BE05	923471.88	618721.79	145.36	145.42	0.06
BE06	936068.48	556673.57	274.16	274.27	0.11
BE07	849823.48	543454.05	301.93	301.92	-0.01
BE08	867239.21	569560.6	211.34	211.24	-0.1
BE09	805698.92	599467.25	355.8	351.88	*
BE10	747697.66	574670.08	406.65	406.72	0.07
BE11	751681.57	652095.53	409.09	409.11	0.02
BE12	752760.79	653469.05	406.36	406.54	0.18
BE13	746361	573082.31	391.62	391.62	0
BE14	854996.65	645261.96	142.07	142.07	0
BE15	844960.21	668075.65	139.59	139.7	0.11
BE16	841005.6	668941.15	143.33	143.52	0.19
BE17	807371.72	695611.78	207.44	207.34	-0.1
BE18	803604.5	698469.53	231.24	231.45	0.21
BE19	762175.46	688185.91	362.86	362.71	-0.15
BE20	763133.13	689705.02	359.88	359.76	-0.12
BE21	850877.39	541144.55	304.96	304.96	0
BE22	869912.26	613853.41	279.37	279.28	-0.09
BE59	976537.13	514043.3	207.84	208.11	0.27
BE60	791314.98	547003.93	267.95	268.01	0.06
BE61	756908.88	615436.21	330.31	330.15	-0.16
BE62	907211.81	521336.75	269.44	269.37	-0.07
BE63	980449.58	635866.89	152.54	153.01	0.47
BE64	874675.77	698842.41	234.34	234.49	0.15
BE67	878636.13	673783.54	260.52	260.64	0.12
UA01	1021803.1	551898.18	96.14	96.31	0.17
UA02	988915.66	581998.89	77.46	77.49	0.03
UA03	999359.84	544856.84	81.89	81.84	-0.05

Number	Easting	Northing	Known Z	Laser Z	Dz
UA04	957232.14	607208.2	93.4	93.39	-0.01
UA05	921240.43	619603.76	110.06	110.02	-0.04
UA06	850701.04	543365.86	325.56	325.63	0.07
UA07	866525.65	569554.1	200.99	200.96	-0.03
UA08	844723.67	668143.52	139.26	139.45	0.19
UA09	807247.63	695826.29	206.66	206.56	-0.1
UA28	976572.58	514014.95	208.53	208.69	0.16
UA29	791460.13	546597.34	267.92	267.92	0
UA30	756584.59	614555.61	344.41	344.48	0.07
UA31	907222.8	521356.61	270.59	270.45	-0.14
UA32	981503.18	635967.06	177.27	177.74	0.47
Average Dz		0.05 ft			
Minimum Dz		-0.160 ft			
Maximum Dz		0.470 ft			
Root Mean Square		0.151 ft			
95% Confidence Level		0.296 ft			

***Point BE09 fell on an area of drastic change and was removed from the final accuracy calculation.**

Figure 15. QC Checkpoint Locations - NVA - North AOI

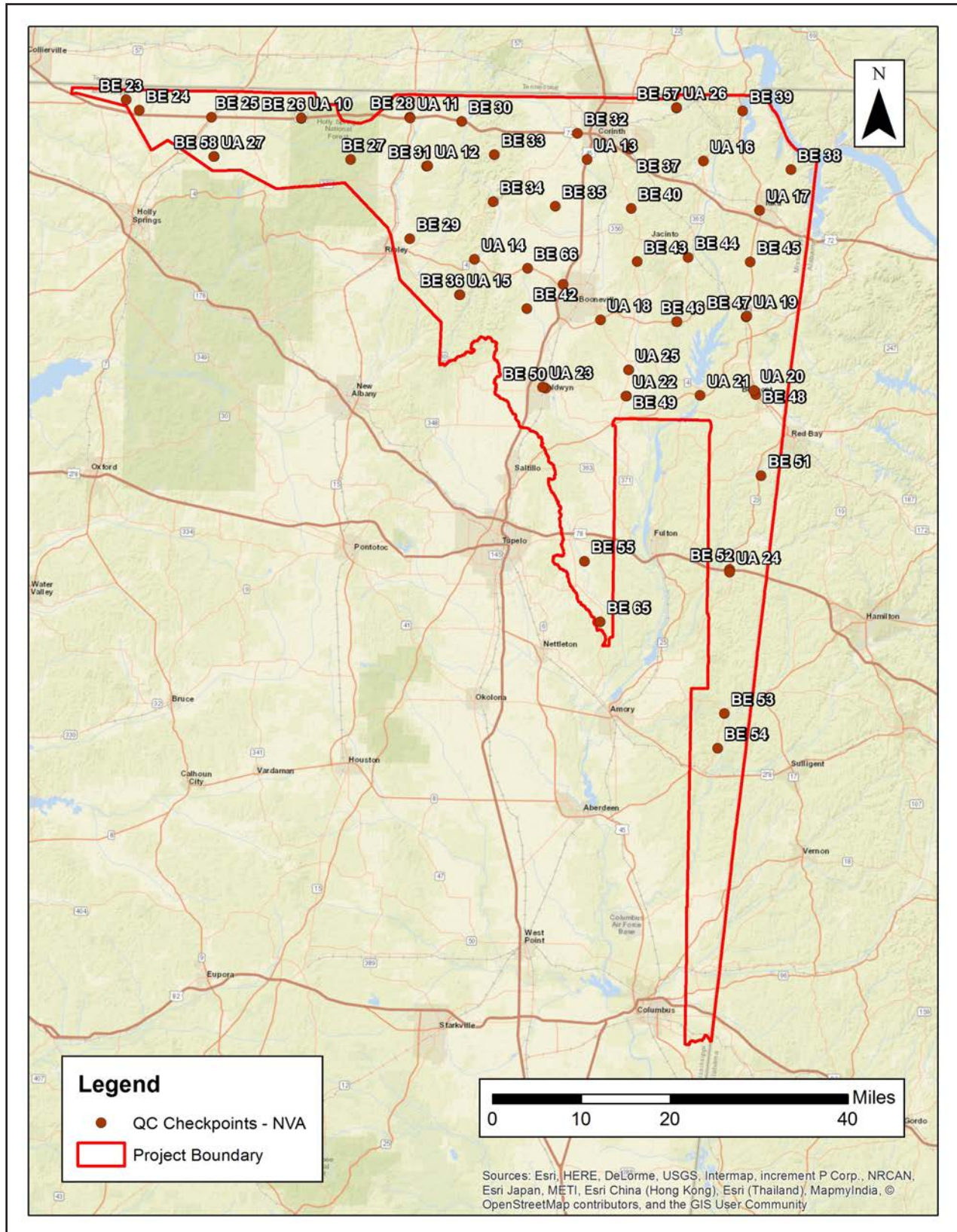


Table 8. QC Checkpoint Report - NVA - North AOI

Units = Meters

Number	Easting	Northing	Known Z	Laser Z	Dz
BE 23	274769.442	3872552.882	130.917	130.9	-0.02
BE 24	277123.738	3870653.276	161.23	161.16	-0.07
BE 25	290219.864	3869392.707	135.696	135.6	-0.1
BE 26	306496.587	3869186.845	172.693	172.62	-0.08
BE 27	315391.278	3861736.666	167.095	167.17	0.08
BE 28	326148.08	3869347.615	149.157	149.24	0.09
BE 29	326088.312	3847335.733	166.644	166.67	0.03
BE 30	335532.533	3868638.717	159.262	159.32	0.06
BE 31	329145.734	3860483.251	171.572	171.61	0.04
BE 32	356473.313	3866460.396	125.861	125.81	-0.06
BE 33	341459.84	3862623.414	192.047	192.09	0.04
BE 34	341237.189	3854083.947	130.591	130.61	0.02
BE 35	352488.321	3853270.379	162.313	162.34	0.03
BE 36	335157.348	3837223.172	205.754	205.82	0.07
BE 37	365974.324	3863606.192	162.32	162.35	0.03
BE 38	395130.213	3859911.5	189.238	189.32	0.08
BE 39	386427.663	3870549.23	150.794	150.79	0
BE 40	366216.607	3852833.77	134.699	134.71	0.01
BE 41	353916.689	3839099.135	159.938	159.94	0.01
BE 42	347299.207	3834692.723	131.603	131.62	0.02
BE 43	367326.619	3843243.969	166.736	166.75	0.02
BE 44	376494.592	3844007.749	155.907	155.9	-0.01
BE 45	387747.994	3843151.983	179.171	179.16	-0.01
BE 46	374507.278	3832303.318	116.06	116.03	-0.03
BE 47	387026.816	3833231.924	158.219	158.15	-0.07
BE 48	388791.803	3819132.138	179.846	179.86	0.02
BE 49	365360.719	3818874.747	115.913	115.94	0.02
BE 50	350688.334	3820278.738	105.027	105.09	0.07
BE 51	389756.501	3804408.851	141.105	141.15	0.04
BE 52	384016.122	3787383.714	116.189	116.29	0.1
BE 53	383071.465	3761420.229	93.575	93.59	0.01
BE 54	381851.607	3755119.983	94.553	94.59	0.03

Number	Easting	Northing	Known Z	Laser Z	Dz
BE 55	357729.901	3788886.856	94.292	94.27	-0.02
BE 56	365754.625	3823619.835	110.615	110.6	-0.02
BE 57	374389.921	3871085.921	148.359	148.38	0.02
BE 58	290696.98	3862230.349	189.155	189.06	-0.1
BE 65	360593.306	3777937.175	84.119	84.12	0
BE 66	347471.228	3842004.455	172.755	172.76	0
UA 10	306493.368	3869247.202	171.393	171.35	-0.05
UA 11	326175.272	3869267.903	147.622	147.67	0.05
UA 12	329386.534	3860536.009	171.044	171.08	0.04
UA 13	358204.717	3861732.123	127.299	127.32	0.02
UA 14	337854.6	3843639.193	141.005	141.03	0.03
UA 15	335205.798	3837201.225	207.298	207.36	0.06
UA 16	379282.562	3861424.332	135.925	135.93	0
UA 17	389419.276	3852512.516	179.199	179.21	0.01
UA 18	360647.671	3832629.075	154.854	154.87	0.02
UA 19	387143.769	3833327.716	156.38	156.41	0.03
UA 20	388423.283	3819835.006	175.742	175.78	0.04
UA 21	378700.119	3818998.089	104.405	104.43	0.02
UA 22	365256.528	3818834.735	118.1	118.18	0.08
UA 23	350143.268	3820438.402	108.774	108.79	0.01
UA 24	384031.196	3786929.909	108.407	108.45	0.04
UA 25	365740.393	3823608.706	110.59	110.62	0.03
UA 26	374400.902	3871105.575	148.165	148.22	0.06
UA 27	290642.97	3862279.034	190.177	190.06	-0.12
Average Dz		0.01 m			
Minimum Dz		-0.121 m			
Maximum Dz		0.099 m			
Root Mean Square		0.049 m			
95% Confidence Level		0.096 m			

Figure 16. QC Checkpoint Locations - NVA - South AOI

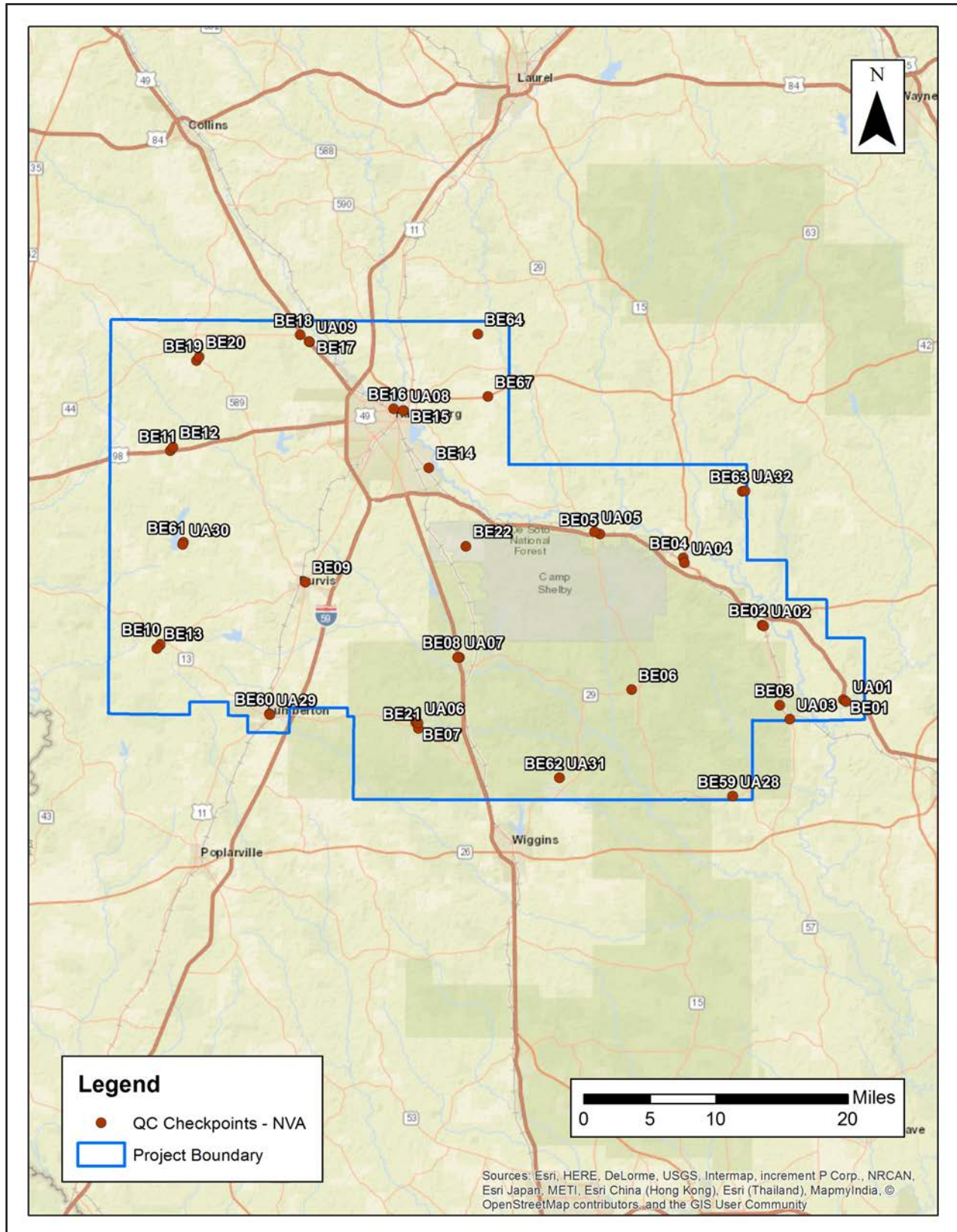


Table 9. QC Checkpoint Report - NVA - South AOI

Units = US Survey Feet

Number	Easting	Northing	Known Z	Laser Z	Dz
BE01	1020723.65	552655.38	125.47	125.60	0.13
BE02	988375.58	582309.26	77.87	77.95	0.08
BE03	995421.26	550457.37	96.5	96.47	-0.03
BE04	956785.29	609248.06	90.84	90.78	-0.06
BE05	923471.88	618721.79	145.36	145.42	0.06
BE06	936068.48	556673.57	274.16	274.23	0.07
BE07	849823.48	543454.05	301.93	301.93	0.00
BE08	867239.21	569560.6	211.34	211.27	-0.07
BE09	805698.92	599467.25	355.8	351.89	*
BE10	747697.66	574670.08	406.65	406.71	0.06
BE11	751681.57	652095.53	409.09	409.09	0.00
BE12	752760.79	653469.05	406.36	406.53	0.17
BE13	746361	573082.31	391.62	391.63	0.01
BE14	854996.65	645261.96	142.07	142.01	-0.06
BE15	844960.21	668075.65	139.59	139.70	0.11
BE16	841005.6	668941.15	143.33	143.52	0.19
BE17	807371.72	695611.78	207.44	207.37	-0.07
BE18	803604.5	698469.53	231.24	231.43	0.19
BE19	762175.46	688185.91	362.86	362.72	-0.14
BE20	763133.13	689705.02	359.88	359.75	-0.13
BE21	850877.39	541144.55	304.96	304.99	0.03
BE22	869912.26	613853.41	279.37	279.28	-0.09
BE59	976537.13	514043.3	207.84	208.13	0.29
BE60	791314.98	547003.93	267.95	268.01	0.06
BE61	756908.88	615436.21	330.31	330.15	-0.16
BE62	907211.81	521336.75	269.44	269.37	-0.07
BE63	980449.58	635866.89	152.54	153.01	0.47
BE64	874675.77	698842.41	234.34	234.53	0.19
BE67	878636.13	673783.54	260.52	260.60	0.08
UA01	1021803.1	551898.18	96.14	96.32	0.18
UA02	988915.66	581998.89	77.46	77.50	0.04
UA03	999359.84	544856.84	81.89	81.83	-0.06

Number	Easting	Northing	Known Z	Laser Z	Dz
UA04	957232.14	607208.2	93.4	93.40	0.00
UA05	921240.43	619603.76	110.06	110.02	-0.04
UA06	850701.04	543365.86	325.56	325.63	0.07
UA07	866525.65	569554.1	200.99	200.96	-0.03
UA08	844723.67	668143.52	139.26	139.45	0.19
UA09	807247.63	695826.29	206.66	206.59	-0.07
UA28	976572.58	514014.95	208.53	208.69	0.16
UA29	791460.13	546597.34	267.92	267.92	0.00
UA30	756584.59	614555.61	344.41	344.47	0.06
UA31	907222.8	521356.61	270.59	270.45	-0.14
UA32	981503.18	635967.06	177.27	177.77	0.50
Average Dz		0.05 ft			
Minimum Dz		-0.158 ft			
Maximum Dz		0.498 ft			
Root Mean Square		0.152 ft			
95% Confidence Level		0.298 ft			

*Point BE09 fell on an area of drastic change and was removed from the final accuracy calculation.

Figure 17. QC Checkpoint Locations - VVA - North AOI

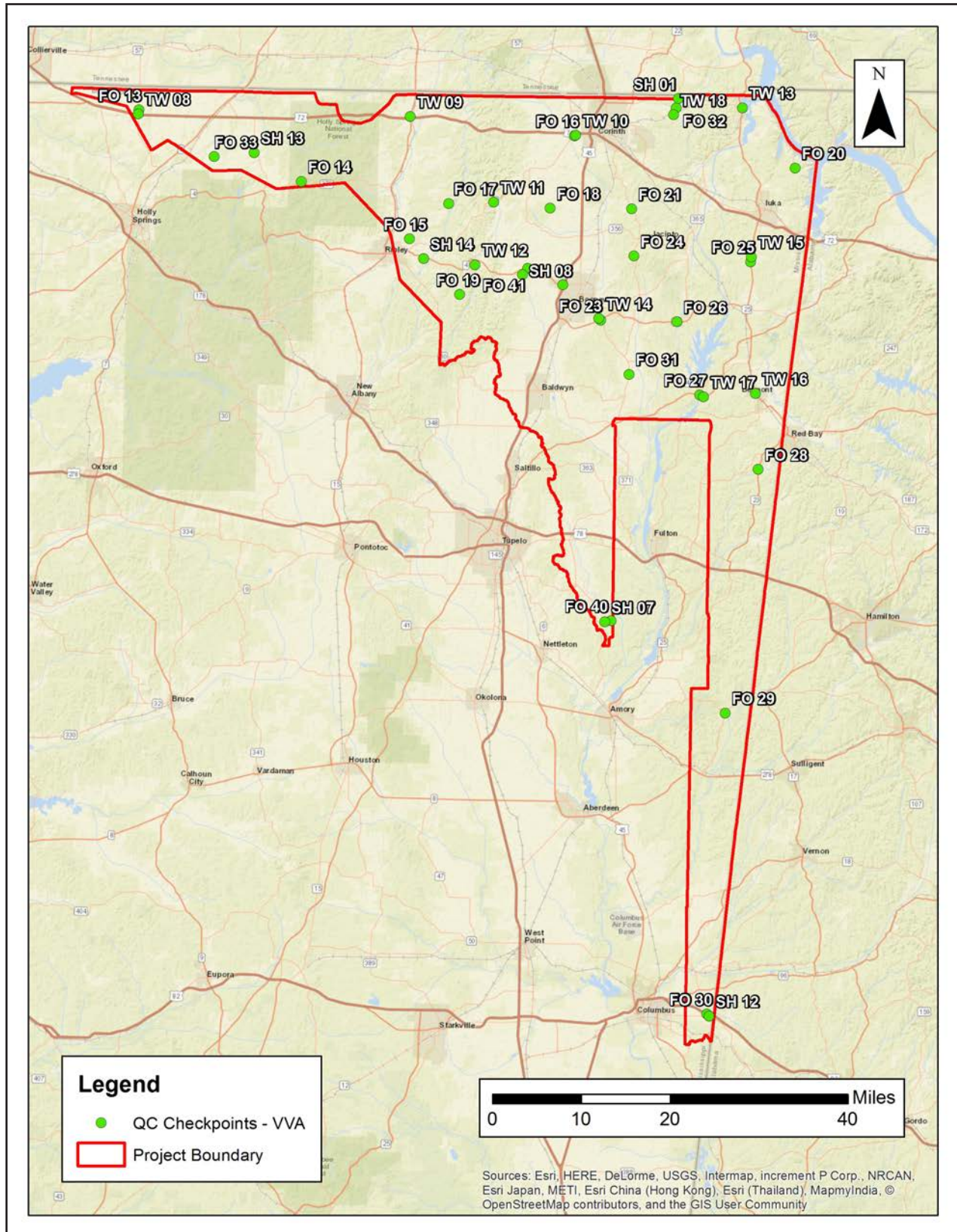


Table 10. QC Checkpoint Report - VVA - North AOI

Units = Meters

Number	Easting	Northing	Known Z	Laser Z	Dz
FO 13	277110.666	3870699.884	160.188	160.23	0.05
FO 14	306464.341	3857745.756	202.19	202.21	0.02
FO 15	326063.159	3847329.915	165.819	165.92	0.1
FO 16	355940.403	3865990.296	120.328	120.4	0.07
FO 17	333190.303	3853737.42	172.054	172.14	0.09
FO 18	351550.178	3852882.865	161.874	162.07	0.2
FO 19	335156.729	3837236.239	205.597	205.8	0.2
FO 20	395915.246	3860170.489	194.728	194.88	0.16
FO 21	366257.071	3852768.994	134.357	134.47	0.11
FO 22	353832.003	3839016.6	159.048	159.07	0.02
FO 23	360684.595	3832562.121	153.238	153.35	0.11
FO 24	366671.486	3844222.615	179.472	179.57	0.1
FO 25	387825.502	3843184.774	178.536	178.63	0.1
FO 26	374481.105	3832314.395	115.703	115.81	0.11
FO 27	378627.175	3819043.87	103.624	103.73	0.11
FO 28	389201.728	3805558.289	128.076	128.28	0.2
FO 29	383192.173	3761500.665	92.642	92.75	0.11
FO 30	379873.027	3706934.757	91.639	91.76	0.12
FO 31	365785.884	3822786.904	104.93	105.11	0.18
FO 32	374351.827	3871088.911	149.402	149.37	-0.03
FO 33	290713.106	3862252.85	188.922	188.84	-0.08
FO 40	362561.226	3778120.164	106.457	106.51	0.05
FO 41	347426.519	3841991.635	173.963	174.06	0.1
SH 01	374731.538	3872740.473	139.364	139.63	0.27
SH 07	361415.016	3777913.987	87.83	87.96	0.13
SH 08	346521.957	3840866.698	172.483	172.76	0.27
SH 12	380304.144	3706545.799	96.974	96.99	0.02
SH 13	297948.248	3862968.902	162.503	162.71	0.21
SH 14	328595.098	3843770.748	165.444	165.85	0.4
TW 08	276930.961	3870010.106	172.267	172.33	0.06
TW 09	326168.597	3869541.701	154.758	154.88	0.12
TW 10	356144.612	3866118.576	123.754	123.88	0.13

Number	Easting	Northing	Known Z	Laser Z	Dz
TW 11	341300.528	3854010.886	128.929	129.01	0.09
TW 12	337914.547	3842632.172	143.29	143.44	0.15
TW 13	386305.696	3871069.282	144.45	144.59	0.14
TW 14	360357.411	3832924.949	155.547	155.74	0.19
TW 15	387935.103	3844047.418	176.453	176.57	0.12
TW 16	388682.914	3819295.069	177.993	178.32	0.33
TW 17	379296.229	3818702.963	111.329	111.46	0.13
TW 18	373841.895	3869815.018	127.604	127.68	0.07
Average Dz		0.13 m			
Minimum Dz		-0.079 m			
Maximum Dz		0.404 m			
Root Mean Square		0.154 m			
95th Percentile		0.273 m			

Figure 18. QC Checkpoint Locations - VVA - South AOI

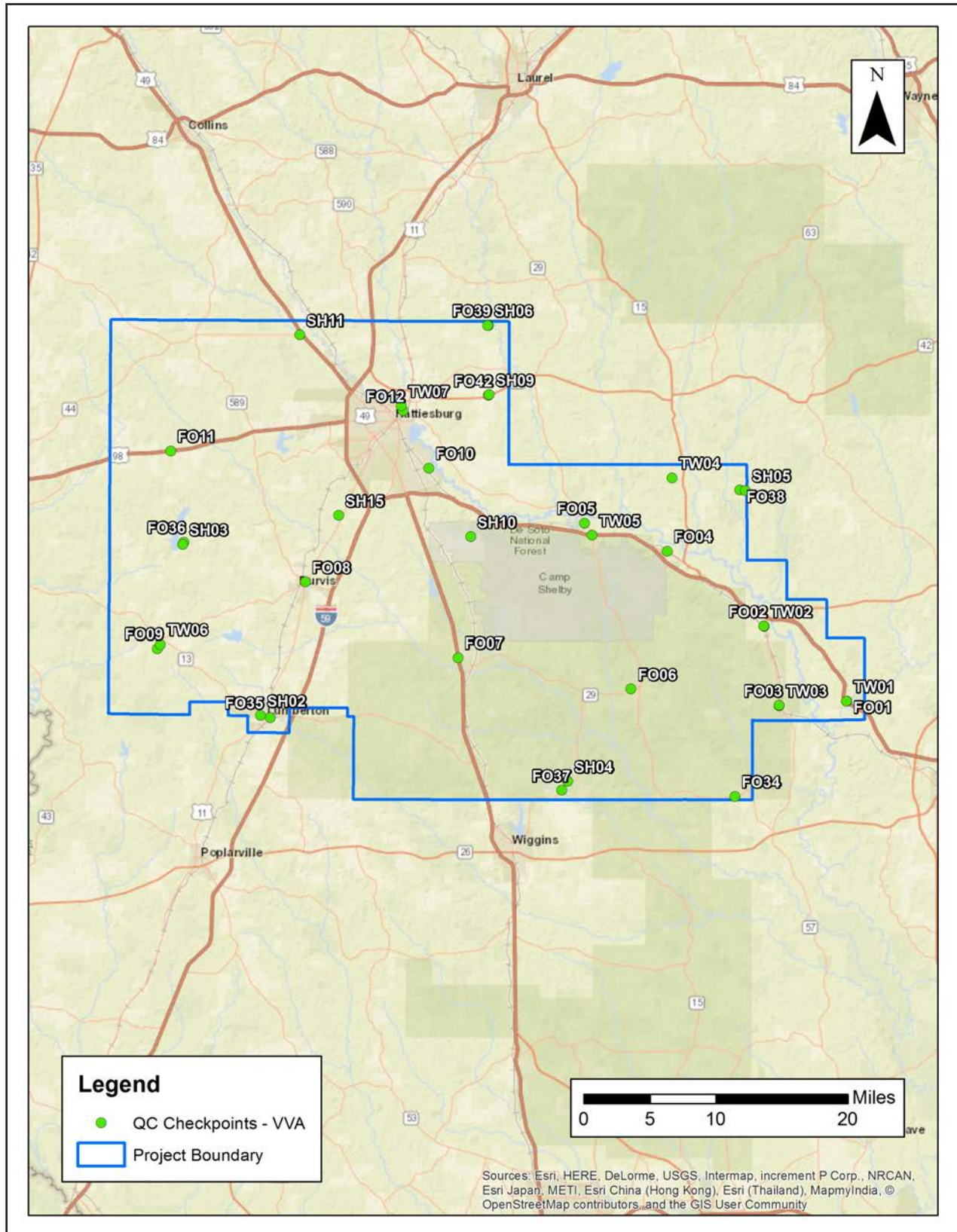


Table 11. QC Checkpoint Report - VVA - South AOI

Units = US Survey Feet

Number	Easting	Northing	Known Z	Laser Z	Dz
FO01	1022084.6	552109.88	93.26	93.49	0.23
FO02	989087.06	581842.73	75.66	76	0.34
FO03	995032.44	550251.85	103.35	103.68	0.33
FO04	950282.69	611888.17	89	89.42	0.42
FO05	917280.51	623099.15	100.1	100.1	0
FO06	935861.62	556979.4	277.83	278.21	0.38
FO07	866743.41	569466.33	198.52	198.82	0.3
FO08	805673.87	599610.41	335.46	335.78	0.32
FO09	746514.1	573060.19	388.06	388.31	0.25
FO10	855000.61	645123.69	140.72	140.82	0.1
FO11	751774.59	652014.67	410.57	410.51	-0.06
FO12	844666.3	668051.8	140.58	140.7	0.12
FO34	977363.79	513928.1	205.5	205.86	0.36
FO35	791672.84	545515.99	244.77	244.72	-0.05
FO36	757043.67	615474.45	335.7	335.61	-0.09
FO37	908145.25	516432.23	211.08	211.34	0.26
FO38	979344.05	636404.45	135.2	135.42	0.22
FO39	878834.34	702298.51	162.59	162.71	0.12
FO42	878783.31	674235.47	251.32	251.56	0.24
SH02	787697.26	546309.17	273.22	273.4596863	0.24
SH03	756571	614589.49	342.78	343.1473389	0.37
SH04	910485.45	520012.16	251.13	251.3981476	0.27
SH05	981554.62	636119.45	176.4	177.1319427	0.73
SH06	878546.39	702299.68	167.95	168.2539063	0.30
SH09	879133.09	674497.61	252.16	252.4000397	0.24
SH10	871744.53	617642.11	279.71	279.8129272	0.10
SH11	803479.79	698485.4	229.72	230.2270203	0.51
SH15	819009.71	626227.1	371.25	371.686615	0.44
TW01	1022014.01	552085.68	96.16	96.36569214	0.21
TW02	988974.52	581926.36	75.72	76.07260895	0.35
TW03	995075.05	550361.96	102.33	102.7205734	0.39
TW04	952341.54	641199.9	216.31	216.6544342	0.34

Number	Easting	Northing	Known Z	Laser Z	Dz
TW05	920243	618272.08	108.08	108.3671112	0.29
TW06	747578.86	574657.9	407.38	407.8106995	0.43
TW07	843973.1	670052.92	151.58	151.8869629	0.31
Average Dz		0.27 ft			
Minimum Dz		-0.090 ft			
Maximum Dz		0.732 ft			
Root Mean Square		0.312 ft			
95% Confidence Level		0.458 ft			