



Project Report

TASK ORDER NAME: GA_Statewide_2018_B18

TASK ORDER NUMBER: 140G0218F042

CONTRACT NUMBER: G16PC00042

ATLANTIC PROJECT NUMBER: 18066 – Block 01

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SECTION 1: PROJECT OVERVIEW AND PURPOSE

1.1 Aerial LiDAR Project

1.1.1 Project Overview

USGS task order 140G0218F042 required Winter, 2018/Spring, 2019 LiDAR surveys to be collected over 32,562 square miles covering part or all of 82 counties in Georgia and 3 partial counties in South Carolina in support of the State of Georgia and the USGS 3DEP program. Aerial LiDAR data for this task order was planned, acquired, processed and produced at an aggregate nominal pulse spacing (ANPS) of ≤ 0.71 meters and in compliance with USGS National Geospatial Program LiDAR Base Specification version 1.3. The Block 01 area encompasses approximately 2,450 square miles.

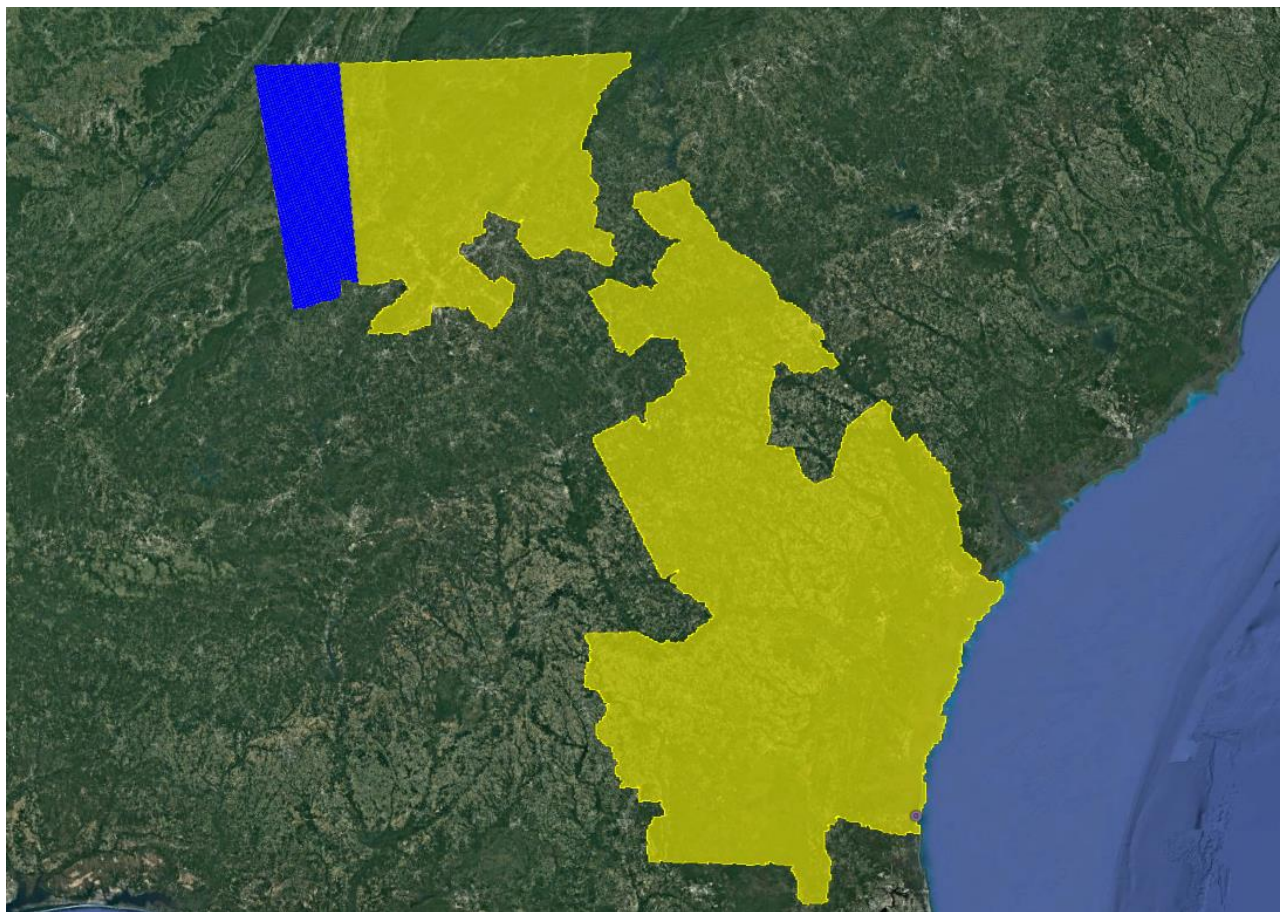


Figure 1: Aerial LiDAR Project Overview – Defined Project Area (DPA) in Yellow and Associated Areas of Interest (AOIs) in Blue

1.1.2 Project Purpose

Aerial lidar was collected to support the mapping efforts of individual counties in the State of Georgia and the USGS 3DEP program.

1.1.3 Client Contact Information

Client Contact Information	
Name of Contact	Danny Vincent
Organization	USGS, NGTOC
Position	Government Point of Contact
Telephone	573-308-3810
E-Mail Address	dvinc@usgs.gov
Mailing Address	1400 Independence Road
City	Rolla
State or Province	Missouri
Postal Code	65401

Table 1: Aerial LiDAR Client Contact Information

1.1.4 Contract Deliverables

Item	Specification/Format
Classified Point Cloud	LAS v.14, tiled delivery
Bare Earth Surface	Raster DEM, 1m cell size, hydro flattened, .img format
Breaklines	Hydro breaklines to BPA limit, .gdb format
Intensity Imagery	1m cell size, 8-bit, 256 gray scale, GeoTIFF format
Delivery Diagram	.gdb format
Metadata	Per product, FGDC compliant, .xml format
Project Report	Field work procedures, QC procedures and results, overall accuracy, .pdf format

Table 2: Aerial LiDAR Contract Deliverables

SECTION 2: FIELD OPERATIONS

2.1 Aerial LiDAR Project – Aerial Acquisition

2.1.1 Aircraft and Sensor Information

Atlantic operated a PACVX (N750VX) outfitted with an Optech Galaxy Prime LiDAR system during the collection of the project area. The specifications of this system are presented in the following table:

Parameter	Specification
Model	Galaxy Prime
Manufacturer	Optech
Performance Envelope	150 – 4700 m AGL, nominal
Absolute Horizontal Accuracy	1/10,000 x altitude
Absolute Elevation Accuracy	< 0.03 – 0.20 m RMSE from 150 – 4700 m AGL
Topographic Laser	1064-nm near-infrared
Laser Classification	Class IV
Pulse Repetition Frequency (Effective)	Programmable, 50 – 1000 kHz
Beam Divergence	0.25 mrad (1/e)
Laser Range Precision	< 0.008 m
Minimum Target Separation Distance	< 0.7 m (discrete)
Range Capture	Up to 8 range measurements, including last
Intensity Capture	Up to 8 intensity measurements, including last (12-bit)
Scan Angle (Fov)	10 – 60°
Swath Width	10 – 115% of altitude AGL
Scan Frequency	0 – 120 Hz advertised (0 – 240 scan lines/sec)
Scan Product	2000 maximum
Roll Compensation	±5° minimum
Data Storage	Internal solid-state drive (SSD)
Power Requirements	28 V; 300 W
Dimensions and Weight	Sensor: 0.34 x 0.34 x 0.25 m, 27 kg PDU: 0.42 x 0.33 x 0.10 m, 6.5 kg
Operation Temperature	0 to +35°C

Table 3: System Specifications – Galaxy Prime

2.1.2 Sensor Acquisition Information

The following table illustrates project specific system parameters for LiDAR acquisition on this project:

Parameter	Specification
System	Optech Galaxy Prime
Nominal Pulse Spacing (m)	0.6
Nominal Pulse Density (pls/m²)	2.4
Nominal Flight Height (AGL meters)	2000
Nominal Flight Speed (kts)	130
Pass Heading (°)	90
Sensor Scan Angle (°)	40
Scan Frequency (Hz)	55
Pulse Rate of Scanner (kHz)	300,000
Line Spacing (m)	1400
Central Wavelength of Sensor Laser (nm)	1064
Sensor Operated with Multiple Pulses	5
Beam Divergence (mrad)	0.25
Nominal Swath Width (m)	1674
Nominal Swath Overlap (%)	20
Scan Pattern	Triangle

Table 4: Aerial LiDAR Sensor Acquisition Parameters

2.1.3 Flight Plan Execution

Atlantic acquired 196 passes of the AOI as a series of perpendicular and/or adjacent flight-lines executed in 18 flight missions conducted between January 27, 2019 and April 21, 2019. Onboard differential Global Navigation Satellite System (GNSS) unit(s) recorded sample aircraft positions at 2 hertz (Hz) or more frequency. LiDAR data was only acquired when a minimum of six (6) satellites were in view.

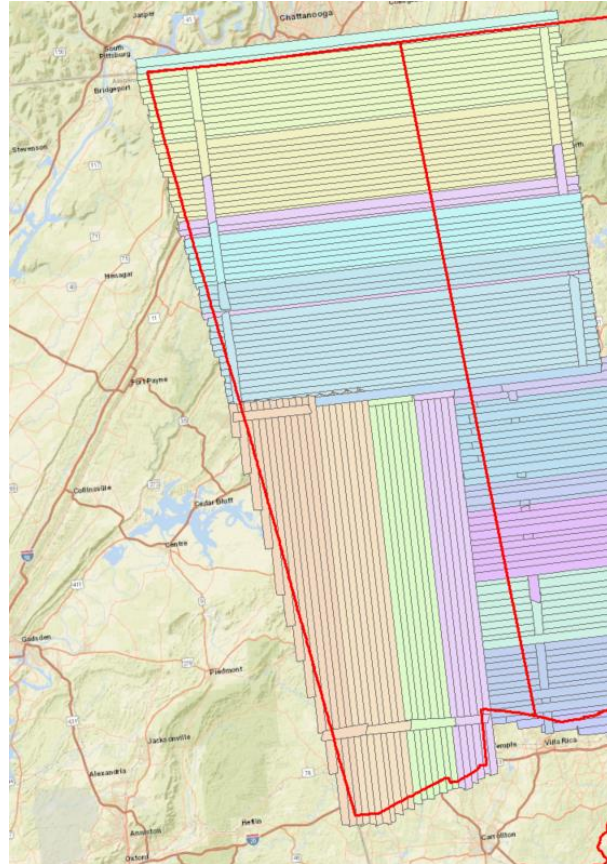


Figure 2: Orientation of Executed Flight-lines and LiDAR DPA

2.1.4 GNSS Reference Stations

Twenty-two (22) Continuously Operating Reference Stations (CORS) were used to control the LiDAR acquisition for the defined project area. The coordinates provided in below are in NAD83 (2011), Geographic Coordinate System, Ellipsoid, Meters.

Designation	Type	PID	Latitude (N)	Longitude (W)	Elevation
ALAS	CORS	ALAS	N33°40'01.20716"	W85°49'50.49161"	203.112
ALCN	CORS	ALCN	N34°09'46.97944"	W85°39'31.04922"	164.905
ALCU	CORS	ALCU	N34°10'47.53658"	W86°50'41.56001"	222.816
ALHC	CORS	ALHC	N33°31'25.44556"	W85°38'05.50127"	256.549

Designation	Type	PID	Latitude (N)	Longitude (W)	Elevation
ALHL	CORS	ALHL	N33°53'15.29819"	W86°23'52.62519"	330.735
ALLA	CORS	ALLA	N32°55'02.66212"	W85°24'01.80598"	237.158
FRKN	CORS	FRKN	N35°11'30.71108"	W83°23'41.77392"	619.545
GABN	CORS	GABN	N34°08'07.10674"	W83°46'38.52665"	277.225
GACC	CORS	GACC	N33°32'44.73008"	W82°08'01.72505"	98.582
GANW	CORS	GANW	N33°18'20.82421"	W84°46'02.50936"	259.992
GTAC	CORS	GTAC	N34°42'39.84931"	W86°39'12.31507"	193.010
NCBC	CORS	NCBC	N35°22'21.58731"	W83°30'23.39888"	564.809
NCMU	CORS	NCMU	N35°04'06.80176"	W83°57'59.38941"	474.874
NCRB	CORS	NCRB	N35°19'15.71699"	W83°47'48.71726"	605.321
P806	CORS	P806	N32°57'47.92265"	W84°13'33.05711"	215.870
TN21	CORS	TN21	N35°03'51.76165"	W85°12'25.96382"	196.277
TN22	CORS	TN22	N35°23'25.74313"	W85°22'40.99939"	206.175
TN25	CORS	TN25	N35°22'01.47346"	W86°11'20.80782"	301.315
TN26	CORS	TN26	N35°26'35.14309"	W84°37'48.36432"	256.760
TN29	CORS	TN29	N35°14'46.29843"	W84°34'06.16386"	198.193
TN34	CORS	TN34	N35°25'34.74325"	W86°42'43.90718"	229.099
ZTL4	CORS	ZTL4	N33°22'46.87792"	W84°17'48.21520"	260.690

Table 5: GNSS Reference Stations

2.2 Aerial LiDAR Project – Ground Acquisition

2.2.1 Ground Control Survey

A total of 94 ground survey points were collected in support of this project, including 23 LiDAR Control Points (LCP), 42 Non-vegetated Vertical Accuracy (NVA) and 29 Vegetated Vertical Accuracy (VVA).

Point cloud data accuracy was tested against a Triangulated Irregular Network (TIN) constructed from LiDAR points in clear and open areas. A clear and open area can be characterized with respect to topographic and ground cover variation such that a minimum of five (5) times the Nominal Pulse Spacing (NPS) exists with less than 1/3 of the RMSEZ deviation from a low-slope plane. Slopes that exceed ten (10) percent were avoided.

Each land cover type representing ten (10) percent or more of the total project area were tested and reported with a VVA. In land cover categories other than dense urban areas, the tested points did not have obstructions forty-five (45) degrees above the horizon to ensure a satisfactory TIN surface. The VVA value is provided as a target. It is understood that in areas of dense vegetation, swamps, or extremely difficult terrain, this value may be exceeded.

The NVA value is a requirement that must be met, regardless of any allowed “busts” in the VVA(s) for individual land cover types within the project. Checkpoints for each assessment (NVA and VVA) are required to be well-distributed throughout the land cover type, for the entire project area.

The following tables and figures outline the coordinate values and distribution of LCP, NVA and VVA points collected in support of this project:

ID	Easting	Northing	Elevation
LCP	1006399.156	1283007.795	221.956
LCP	981275.5623	1254954.082	363.687
LCP	997593.4479	1241622.295	417.233
LCP	984195.8752	1239792.107	343.496
LCP	1001706.641	1264470.739	402.091
LCP	975327.0807	1374198.556	217.062
LCP	959219.9051	1322155.445	236.043
LCP	976045.9821	1322256.575	218.771
LCP	961449.2186	1307017.791	191.554
LCP	945456.4774	1375636.344	484.591
LCP	949264.5886	1348185.481	245.099
LCP	973984.6594	1281989.645	207.348
LCP	973731.4975	1299154.738	182.374
LCP	992742.1394	1298995.603	188.645
LCP	990319.5311	1314169.18	182.644
LCP	983183.7312	1303131.595	195.23
LCP	997249.9142	1271465.265	255.598

ID	Easting	Northing	Elevation
LCP	974307.8288	1263708.069	278.019
LCP	984387.3118	1276877.612	264.452
LCP	973061.1071	1342147.161	279.057
LCP	960888.9413	1358936.789	272.642
LCP	986504.7916	1341516.308	277.487
LCP	991755.99	1360071.253	279.525

Table 6: LiDAR Control Point Coordinates

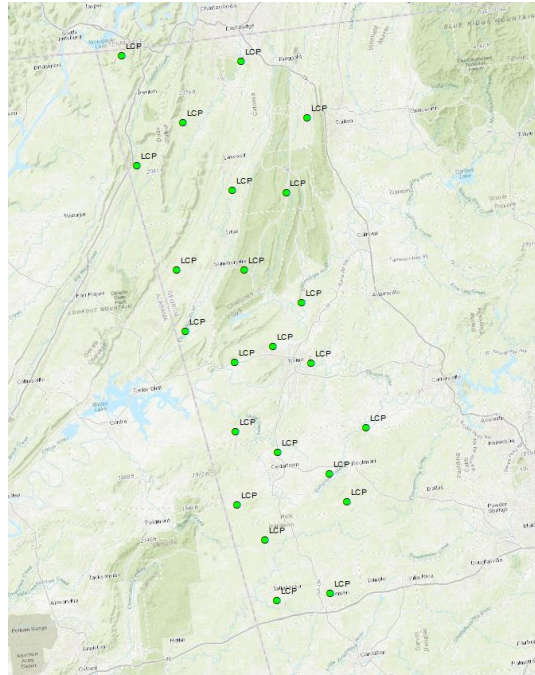


Figure 3: LiDAR Control Point Distribution

ID	Easting	Northing	Elevation
NVA	989557.1129	1252351.659	383.92
NVA	984701.7783	1236160.676	349.61
NVA	999279.8278	1257461.363	369.952
NVA	984296.6738	1240527.814	345.969
NVA	989557.1053	1252351.663	384.061
NVA	1009947.809	1272518.204	354.069
NVA	1010180.693	1256057.069	392.536
NVA	1012815.094	1256027.054	396.731
NVA	999283.9727	1263066.937	376.835
NVA	988206.6491	1371343.524	244.375
NVA	988217.2955	1371309.426	244.247

ID	Easting	Northing	Elevation
NVA	970319.3026	1377508.827	232.543
NVA	975051.9213	1375185.44	216.923
NVA	979287.6536	1365318.255	295.515
NVA	965305.619	1315246.285	199.247
NVA	972652.2831	1330854.792	208.746
NVA	971109.8124	1327780.647	214.394
NVA	964627.9512	1314459.327	192.609
NVA	949568.7048	1363827.112	218.338
NVA	947440.8731	1353213.355	246.99
NVA	948868.6721	1364124.596	231.292
NVA	984788.443	1290305.288	215.142
NVA	965586.1071	1298132.76	187.533
NVA	982196.5603	1302615.188	203.251
NVA	986513.0773	1314432.273	193.913
NVA	989630.6889	1327117.716	202.692
NVA	986338.8434	1300211.65	178.406
NVA	985822.406	1313014.424	189.79
NVA	974478.9491	1281894.06	193.662
NVA	981367.8842	1271671.022	237.021
NVA	1003294.061	1273969.373	236.562
NVA	982675.3563	1272345.278	236.923
NVA	1002216.383	1274061.365	232.826
NVA	987375.1463	1346950.826	274.352
NVA	972113.7613	1353117.638	269.794
NVA	973320.6257	1364039.8	239.091
NVA	980645.4976	1341279.573	259.152
NVA	961491.3998	1378084.416	552.39
NVA	971693.027	1348712.602	245.916
NVA	999216.0677	1314052.098	222.38
NVA	967944.3393	1308475.926	210.326

Table 7: Non-Vegetated Vertical Accuracy (NVA) Point Coordinates

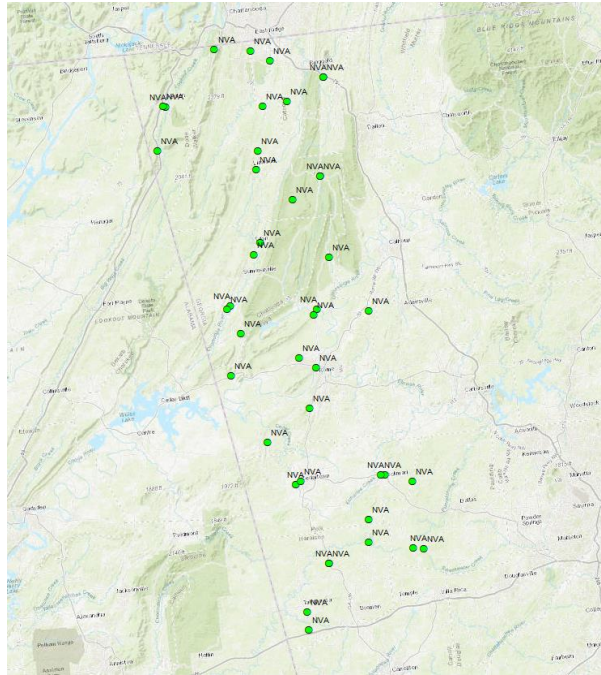


Figure 4: Non-Vegetated Vertical Accuracy (NVA) Point Distribution

ID	Easting	Northing	Elevation
VVA	991038.4648	1248921.957	379.272
VVA	981396.9327	1234144.862	353.012
VVA	976795.7589	1254468.939	391.077
VVA	989280.5862	1245624.045	332.908
VVA	1000845.043	1242581.503	416.377
VVA	999437.0178	1259997.945	350.122
VVA	1011239.929	1258636.728	380.813
VVA	999525.5214	1265011.906	378.765
VVA	982515.3417	1366362.551	242.655
VVA	977179.4543	1374989.055	229.137
VVA	970158.4802	1326620.269	205.515
VVA	968680.7664	1317812.815	211.706
VVA	983214.0867	1334109.558	234.393
VVA	956499.3952	1327112.528	503.76
VVA	948486.0498	1349837.984	242.179
VVA	947500.0806	1371288.499	455.257
VVA	948472.1364	1374795.392	283.507
VVA	975006.3615	1282858.951	220.14

ID	Easting	Northing	Elevation
VVA	984888.649	1302374.035	187.589
VVA	987056.5471	1323326.958	206.019
VVA	991332.4058	1290291.785	241.694
VVA	983149.2712	1266200.835	259.484
VVA	998267.7804	1273142.286	257.283
VVA	992197.1921	1274176.655	287.777
VVA	966253.9502	1371367.725	292.626
VVA	985738.388	1340612.483	256.381
VVA	954718.4158	1346206.46	643.928
VVA	989827.1075	1357642.386	289.863
VVA	989827.1075	1357642.386	289.863

Table 8: Vegetated Vertical Accuracy (VVA) Point Coordinates

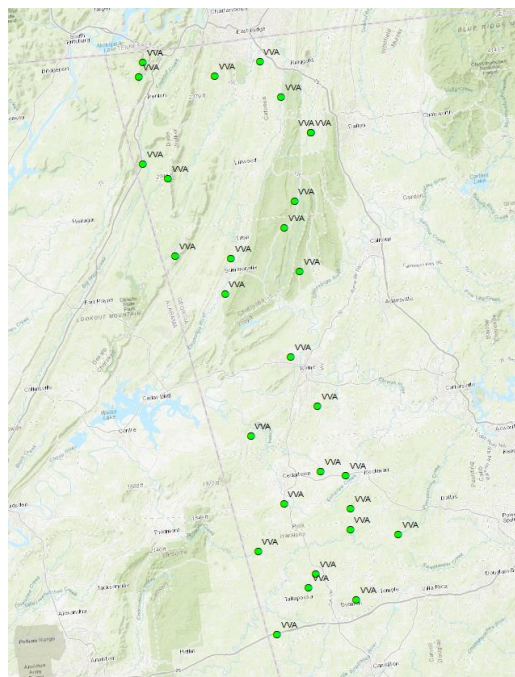


Figure 5: Vegetated Vertical Accuracy (VVA) Point Distribution

SECTION 3: DATA PRODUCTION

3.1 Aerial LiDAR Project – Calibration/Classification

3.1.1 LiDAR Point Cloud Generation

Atlantic used Leica software products to download the IPAS ABGNSS/IMU data and raw laser scan files from the airborne system. Waypoint Inertial Explorer is used to extract the raw IPAS ABGNSS/IMU data, which is further processed in combination with controlled base stations to provide the final Smoothed Best Estimate Trajectory (SBET) for each mission. The SBETs are combined with the raw laser scan files to export the LiDAR ASCII Standard (*.las) formatted swath point clouds.

3.1.2 Coordinate Reference System

Parameter	Specification
Horizontal Datum	NAD83 (NSRS2011)
Coordinate System	Albers Conic
Vertical Datum	NAVD88
Geoid Model	12B
EPSG Code	6350
Units of Reference	Meter

Table 9: Coordinate Reference System

3.1.3 LiDAR Point Cloud Statistics

Category	Value
Total Points (Nominal)	24,562,874,062
Nominal Pulse Spacing (M)	0.5022
Nominal Pulse Density (PLS/M^2)	3.9651
Total Points (Aggregate)	22,292,157,281
Aggregate Pulse Spacing (M)	0.4577
Aggregate Pulse Density (PLS/M^2)	4.7726

Table 10: LiDAR Point Cloud Statistics

3.1.4 Smooth Surface Repeatability (Interswath)

Departures from planarity of first returns within single swaths in non-vegetated areas were assessed at multiple locations with hard surface areas (parking lots or large rooftops) inside the project area. Each area was evaluated using signed difference rasters (maximum elevation – minimum elevation) at a cell size equal to 2 x ANPS, rounded to the next integer. The following figure depicts a sample of the assessment.

3.1.5 LiDAR Calibration

Using a combination of GeoCue, TerraScan and TerraMatch; overlapping swath point clouds are corrected for any orientation or linear deviations to obtain the best fit swath-to-swath calibration. Relative calibration was evaluated using advanced plane-matching analysis and parameter corrections derived. This process was repeated interactively until residual errors between overlapping swaths, across all project missions, was reduced to $\leq 2\text{cm}$. A final analysis of the calibrated lidar is preformed using a TerraMatch tie line report for an overall statistical model of the project area. Individual control point assessments for this project can be found in Section VI of this report.

Upon completion of the data calibration, a complete set of elevation difference intensity rasters (dZ Orthos) are produced. A user-defined color ramp is applied depicting the offsets between overlapping swaths based on project specifications. The dZ orthos provide an opportunity to review the data calibration in a qualitative manner. Atlantic assigns green to all offset values that fall below the required RMSDz requirement of the project. A yellow color is assigned for offsets that fall between the RMSDz value and 1.5x of that value. Finally, red values are assigned to all values that fall beyond 1.5x of the RMSDz requirements of the project.

3.1.6 LiDAR Classification

Multiple automated filtering routines are applied to the calibrated LiDAR point cloud identifying and extracting bare-earth and above ground features. GeoCue, TerraScan, and TerraModeler software was used for the initial batch processing, visual inspection and any manual editing of the LiDAR point clouds. Atlantic utilized collected breakline data to preform classification for class 9 (Water).

Code	Description
1	Processed but unclassified
2	Bare-earth ground
3	Low Vegetation (0.5 – 5 feet)
4	Medium Vegetation (5 – 20 feet)
5	High Vegetation (>20 feet)
6	Building footprints
7	Low Noise
9	Water
11	Withheld
17	Bridge Decks
18	High Noise
20	Ignored ground (breakline proximity)
21	Snow (where reliable identifiable)
22	Temporal Exclusion (typically non-favored data in intertidal zones)

Table 11: LiDAR Point Classification Codes and Descriptions

3.1.7 LiDAR Intensity Imagery

LiDAR intensity imagery was created from the final calibrated and classified lidar point cloud. Intensity images were produced from all classified points and posted to a 1-meter cell size. Intensity images were cut to match the tile index and its corresponding tile names and delivered in GeoTIFF format.

3.1.8 Hydro-line Collection/Conflation

Hydro breaklines were compiled using LiDAR intensity data and surface terrain models of the entire project area. After the collection, all delineated hydro features were validated for monotonicity and vertical variance. This procedure ensures that no points were floating above ground. Hydro-lines were then encoded into the LiDAR surface and used to hydro-enforce/flatten all significant water bodies. These final hydro-lines were then used in the production of bare Earth digital models to hydro flatten significant water bodies. This product was delivered as an ESRI geodatabase for the entire project area.

3.1.9 Bare-Earth Surface – Digital Elevation Model (DEM)

Bare earth Digital Elevation Models (DEMs) were derived using the hydro-lines and bare earth (ground) LiDAR points. All DEMs were created with a grid spacing of 1 meter. DEMs for this project were cut to match the tile index and its corresponding tile names and delivered in 32-bit floating point .img format.

SECTION 4: ACCURACY ASSESSMENT

4.1 Aerial LiDAR Project – Vertical Accuracy Assessment

4.1.1 Requirements

Per the table below, the Vertical Accuracy Assessment utilized the required parameters for Vertical Data Accuracy Class IV.

Vertical Data Accuracy Class	RMSEz in Non-Vegetated Terrain (cm)	Non-Vegetated Vertical Accuracy (NVA) at 95% Confidence Level (cm)	Vegetated Vertical Accuracy (VVA) at 95th Percentile (cm)
I	1.0	2.0	2.9
II	2.5	4.9	7.4
III	5.0	9.8	14.7
IV	10.0	19.6	29.4
V	12.5	24.5	36.8
VI	20.0	39.2	58.8
VII	33.3	65.3	98.0
VIII	66.7	130.7	196.0
IX	100.0	196.0	294.0
X	333.3	653.3	980.0

Table 12: Vertical Accuracy Standards, Source: ASPRS Positional Accuracy Standards for Digital Geospatial Data v1.0 (2014)

*The terms NVA and VVA are from the American Society for Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data v1.0 (2014). The term NVA refers to assessments in clear, open areas (which typically produce only single LiDAR returns); the term VVA refers to assessments in vegetated areas (typically characterized by multiple return LiDAR).

4.1.2 Results

An overall statistical assessment of the check points can be found in the following two tables (values provided in meters):

Broad Land Cover Type	Points (#)	RMSEz	Confidence Level (95%)	Percentile (95th)
NVA (Point Cloud)	31	0.0572	0.1121	0.1140
NVA (DEM)	31	0.0589	0.1154	0.0448
VVA (Point Cloud)	28	0.0776	0.1521	0.1393
VVA (DEM)	28	0.0677	0.1327	0.1228

Table 13: NVA/VVA Accuracies

SECTION 5: CERTIFICATION STATEMENTS

5.1 Aerial LiDAR Project

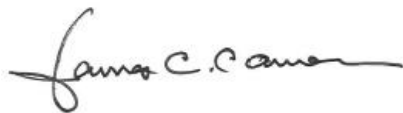
This accuracy assessment confirms that the data may be used for the intended applications stated in Section I of this document. This dataset may also be used as a topographic input for other applications, but the user should be aware that this LiDAR dataset was designed with a specific purpose and was not intended to meet specifications and/or requirements of users outside of the United States Geological Survey.

It should also be noted that LiDAR points do not represent a continuous surface model. LiDAR points are discrete measurements of the surface and any values derived within a triangle of three LiDAR points are interpolated. As such, the user should not use the resultant LiDAR dataset for vertical placement of a planimetric feature such as a headwall, building footprint or any other planimetric feature unless there is an associated LiDAR point that can be reasonably located on this structure.

Consideration should be given by the end user of this dataset to the fact that this LiDAR dataset was developed differently and separately than previous LiDAR datasets that may be available for this geographic location. It is likely that the data in this project was created using different geodetic control, a different Geoid, newer LiDAR technology and more up-to-date processing techniques. As such, any direct comparative analysis performed between this dataset and previous datasets could result in misleading or inaccurate results. Users are encouraged to proceed with caution while performing this type of comparative analysis and to completely understand the variables that make each of these datasets unique and not corollary.

It is encouraged that the user refers to the full FGDC Metadata and project reports for a complete understanding on the content of this dataset.

I, hereby, certify to the extent of my knowledge that the statements and statistics represented in this document are true and factual.



James C. Cannon, ASPRS Certified Photogrammetrist #1594

SECTION 6: CONTROL POINT ASSESSMENTS

6.1 Aerial LiDAR Project

6.1.1 Point Cloud Check Point Assessment

Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
PIED_HARALSON_TG1	991038.4648	1248921.9570	379.2720	379.2470	0.0250	VVA
PIED_HAROL_FO1	981396.9327	1234144.8620	353.0120	353.1830	0.1710	VVA
PIED_HAROL_FO2	976795.7589	1254468.9390	391.0770	391.1720	0.0950	VVA
PIED_HAROL_FO3	989280.5862	1245624.0450	332.9080	332.9760	0.0680	VVA
PIED_HAROL_FO4	1000845.0430	1242581.5030	416.3770	416.4680	0.0910	VVA
PIED_HAROL_FO5	999437.0178	1259997.9450	350.1220	350.2620	0.1400	VVA
PIED_PAULDING_FO7	1011239.9290	1258636.7280	380.8130	380.7760	0.0370	VVA
PIED_POLK_FO6	999525.5214	1265011.9060	378.7650	378.8520	0.0870	VVA
SWAPP_CATOO_FO20	982515.3417	1366362.5510	242.6550	242.7190	0.0640	VVA
SWAPP_CATOO_FO28	977179.4543	1374989.0550	229.1370	229.1590	0.0220	VVA
SWAPP_CATOOSA_OT20	988206.6491	1371343.5240	244.3750	244.4040	0.0290	NVA
SWAPP_CATOOSA_OT20_1	988217.2955	1371309.4260	244.2470	244.1920	0.0550	NVA
SWAPP_CATOOSA_OT21	970319.3026	1377508.8270	232.5430	232.5080	0.0350	NVA
SWAPP_CATOOSA_UA16	979287.6536	1365318.2550	295.5150	295.5020	0.0130	NVA
SWAPP_CHATTOOGA_BE2	967944.3393	1308475.9260	210.3260	210.2750	0.0510	NVA
SWAPP_CHATTOOGA_BR2	970158.4802	1326620.2690	205.5150	205.5070	0.0083	VVA
SWAPP_CHATTOOGA_FO10	983214.0867	1334109.5580	234.3930	234.4360	0.0430	VVA
SWAPP_CHATTOOGA_FO14	956499.3952	1327112.5280	503.7600	503.8840	0.1240	VVA
SWAPP_CHATTOOGA_FO9	968680.7664	1317812.8150	211.7060	211.7940	0.0880	VVA
SWAPP_CHATTOOGA_OT12	965305.6190	1315246.2850	199.2470	199.2840	0.0370	NVA
SWAPP_CHATTOOGA_OT13	972652.2831	1330854.7920	208.7460	208.8090	0.0630	NVA
SWAPP_CHATTOOGA_UA10	971109.8124	1327780.6470	214.3940	214.3770	0.0170	NVA
SWAPP_CHATTOOGA_UA14	964627.9512	1314459.3270	192.6090	192.6210	0.0120	NVA
SWAPP_DADE_FO18	948486.0498	1349837.9840	242.1790	242.3170	0.1380	VVA
SWAPP_DADE_FO19	947500.0806	1371288.4990	455.2570	455.2220	0.0350	VVA
SWAPP_DADE_OT25	949568.7048	1363827.1120	218.3380	218.2860	0.0520	NVA
SWAPP_DADE_TG3	948472.1364	1374795.3920	283.5070	283.5280	0.0210	VVA
SWAPP_DADE_UA12	948868.6721	1364124.5960	231.2920	231.1950	0.0970	NVA
SWAPP_DADE_UA3	947440.8731	1353213.3550	246.9900	246.8770	0.1130	NVA
SWAPP_FLOYD_BE1	999216.0677	1314052.0980	222.3800	222.4130	0.0330	NVA
SWAPP_FLOYD_FO24	991332.4058	1290291.7850	241.6940	241.7050	0.0110	VVA

Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
SWAPP_FLOYD_FO3	975006.3615	1282858.9510	220.1400	220.2150	0.0750	VVA
SWAPP_FLOYD_FO4	984888.6490	1302374.0350	187.5890	187.5720	0.0170	VVA
SWAPP_FLOYD_FO5	987056.5471	1323326.9580	206.0190	206.0090	0.0099	VVA
SWAPP_FLOYD_OT27	989630.6889	1327117.7160	202.6920	202.5480	0.1440	NVA
SWAPP_FLOYD_OT3	984788.4430	1290305.2880	215.1420	215.1350	0.0067	NVA
SWAPP_FLOYD_OT4	965586.1071	1298132.7600	187.5330	187.5190	0.0140	NVA
SWAPP_FLOYD_OT5	982196.5603	1302615.1880	203.2510	203.2670	0.0160	NVA
SWAPP_FLOYD_OT6	986513.0773	1314432.2730	193.9130	193.8830	0.0300	NVA
SWAPP_FLOYD_UA22	974478.9491	1281894.0600	193.6620	193.6290	0.0330	NVA
SWAPP_FLOYD_UA4	986338.8434	1300211.6500	178.4060	178.3780	0.0280	NVA
SWAPP_FLOYD_UA5	985822.4060	1313014.4240	189.7900	189.7480	0.0420	NVA
SWAPP_POLK_FO1	983149.2712	1266200.8350	259.4840	259.5870	0.1030	VVA
SWAPP_POLK_FO2	998267.7804	1273142.2860	257.2830	257.3140	0.0310	VVA
SWAPP_POLK_OT1	981367.8842	1271671.0220	237.0210	237.0270	0.0057	NVA
SWAPP_POLK_OT2	1003294.0610	1273969.3730	236.5620	236.5230	0.0390	NVA
SWAPP_POLK_TG1	992197.1921	1274176.6550	287.7770	287.7840	0.0066	VVA
SWAPP_POLK_UA1	982675.3563	1272345.2780	236.9230	236.8600	0.0630	NVA
SWAPP_POLK_UA2	1002216.3830	1274061.3650	232.8260	232.7110	0.1150	NVA
SWAPP_WALKER_FO15	966253.9502	1371367.7250	292.6260	292.6750	0.0490	VVA
SWAPP_WALKER_FO16	985738.3880	1340612.4830	256.3810	256.2600	0.1210	VVA
SWAPP_WALKER_FO17	954718.4158	1346206.4600	643.9280	643.9790	0.0510	VVA
SWAPP_WALKER_OT22	987375.1463	1346950.8260	274.3520	274.3660	0.0140	NVA
SWAPP_WALKER_OT23	972113.7613	1353117.6380	269.7940	269.7480	0.0460	NVA
SWAPP_WALKER_OT24	973320.6257	1364039.8000	239.0910	239.0880	0.0035	NVA
SWAPP_WALKER_OT26	980645.4976	1341279.5730	259.1520	259.2170	0.0650	NVA
SWAPP_WALKER_UA11	961491.3998	1378084.4160	552.3900	552.2950	0.0950	NVA
SWAPP_WALKER_UA13	971693.0270	1348712.6020	245.9160	245.8740	0.0420	NVA
SWAPP_WHIT_FO23	989827.1075	1357642.3860	289.8630	289.8890	0.0260	VVA

Table 14: Point Cloud Check Point Assessment

6.1.2 Digital Elevation Model (DEM) Check Point Assessment

Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
SWAPP_CATOOSA_OT20	988206.6491	1371343.5240	244.3750	244.3879	0.0129	NVA
SWAPP_CATOOSA_OT20_1	988217.2955	1371309.4260	244.2470	244.1928	-0.0542	NVA
SWAPP_CATOOSA_OT21	970319.3026	1377508.8270	232.5430	232.5123	-0.0307	NVA

Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
SWAPP_CATOOSA_UA16	979287.6536	1365318.2550	295.5150	295.5001	-0.0149	NVA
SWAPP_CHATTOOGA_BE2	967944.3393	1308475.9260	210.3260	210.2844	-0.0416	NVA
SWAPP_CHATTOOGA_OT12	965305.6190	1315246.2850	199.2470	199.2893	0.0423	NVA
SWAPP_CHATTOOGA_OT13	972652.2831	1330854.7920	208.7460	208.7932	0.0472	NVA
SWAPP_CHATTOOGA_UA10	971109.8124	1327780.6470	214.3940	214.3601	-0.0339	NVA
SWAPP_CHATTOOGA_UA14	964627.9512	1314459.3270	192.6090	192.6209	0.0119	NVA
SWAPP_DADE_OT25	949568.7048	1363827.1120	218.3380	218.2923	-0.0457	NVA
SWAPP_DADE_UA12	948868.6721	1364124.5960	231.2920	231.1970	-0.0950	NVA
SWAPP_DADE_UA3	947440.8731	1353213.3550	246.9900	246.8741	-0.1159	NVA
SWAPP_FLOYD_BE1	999216.0677	1314052.0980	222.3800	222.4115	0.0315	NVA
SWAPP_FLOYD_OT27	989630.6889	1327117.7160	202.6920	202.5396	-0.1524	NVA
SWAPP_FLOYD_OT3	984788.4430	1290305.2880	215.1420	215.1239	-0.0181	NVA
SWAPP_FLOYD_OT4	965586.1071	1298132.7600	187.5330	187.4972	-0.0358	NVA
SWAPP_FLOYD_OT5	982196.5603	1302615.1880	203.2510	203.2691	0.0181	NVA
SWAPP_FLOYD_OT6	986513.0773	1314432.2730	193.9130	193.8835	-0.0295	NVA
SWAPP_FLOYD_UA22	974478.9491	1281894.0600	193.6620	193.6480	-0.0140	NVA
SWAPP_FLOYD_UA4	986338.8434	1300211.6500	178.4060	178.3768	-0.0292	NVA
SWAPP_FLOYD_UA5	985822.4060	1313014.4240	189.7900	189.7281	-0.0619	NVA
SWAPP_POLK_OT1	981367.8842	1271671.0220	237.0210	236.9930	-0.0280	NVA
SWAPP_POLK_OT2	1003294.0610	1273969.3730	236.5620	236.5215	-0.0405	NVA
SWAPP_POLK_UA1	982675.3563	1272345.2780	236.9230	236.8575	-0.0655	NVA
SWAPP_POLK_UA2	1002216.3830	1274061.3650	232.8260	232.6936	-0.1324	NVA
SWAPP_WALKER_OT22	987375.1463	1346950.8260	274.3520	274.3610	0.0090	NVA
SWAPP_WALKER_OT23	972113.7613	1353117.6380	269.7940	274.3610	0.0090	NVA
SWAPP_WALKER_OT24	973320.6257	1364039.8000	239.0910	269.7442	-0.0498	NVA
SWAPP_WALKER_OT26	980645.4976	1341279.5730	259.1520	239.0885	-0.0025	NVA
SWAPP_WALKER_UA11	961491.3998	1378084.4160	552.3900	259.2145	0.0625	NVA
SWAPP_WALKER_UA13	971693.0270	1348712.6020	245.9160	552.2953	-0.0947	NVA

Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
PIED_HARALSON_TG1	991038.4648	1248921.9570	379.2720	379.2429	-0.0291	VVA
PIED_HAROL_FO1	981396.9327	1234144.8620	353.0120	353.1638	0.1518	VVA
PIED_HAROL_FO2	976795.7589	1254468.9390	391.0770	391.1744	0.0974	VVA
PIED_HAROL_FO3	989280.5862	1245624.0450	332.9080	332.9716	0.0636	VVA

Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
PIED_HAROL_FO4	1000845.0430	1242581.5030	416.3770	416.4497	0.0727	VVA
PIED_HAROL_FO5	999437.0178	1259997.9450	350.1220	350.2502	0.1282	VVA
PIED_PAULDING_FO7	1011239.9290	1258636.7280	380.8130	380.7757	-0.0373	VVA
PIED_POLK_FO6	999525.5214	1265011.9060	378.7650	378.8230	0.0580	VVA
SWAPP_CATOO_FO20	982515.3417	1366362.5510	242.6550	242.7105	0.0555	VVA
SWAPP_CATOO_FO28	977179.4543	1374989.0550	229.1370	229.1609	0.0239	VVA
SWAPP_CHATTOOGA_BR2	970158.4802	1326620.2690	205.5150	205.4935	-0.0215	VVA
SWAPP_CHATTOOGA_FO10	983214.0867	1334109.5580	234.3930	234.3982	0.0052	VVA
SWAPP_CHATTOOGA_FO14	956499.3952	1327112.5280	503.7600	503.8728	0.1128	VVA
SWAPP_CHATTOOGA_FO9	968680.7664	1317812.8150	211.7060	211.7912	0.0852	VVA
SWAPP_DADE_FO18	948486.0498	1349837.9840	242.1790	242.2910	0.1120	VVA
SWAPP_DADE_FO19	947500.0806	1371288.4990	455.2570	455.2365	-0.0205	VVA
SWAPP_DADE_TG3	948472.1364	1374795.3920	283.5070	283.5278	0.0208	VVA
SWAPP_FLOYD_FO24	991332.4058	1290291.7850	241.6940	241.7079	0.0139	VVA
SWAPP_FLOYD_FO3	975006.3615	1282858.9510	220.1400	220.2076	0.0676	VVA
SWAPP_FLOYD_FO4	984888.6490	1302374.0350	187.5890	187.5652	-0.0238	VVA
SWAPP_FLOYD_FO5	987056.5471	1323326.9580	206.0190	206.0031	-0.0159	VVA
SWAPP_POLK_FO1	983149.2712	1266200.8350	259.4840	259.5466	0.0626	VVA
SWAPP_POLK_FO2	998267.7804	1273142.2860	257.2830	257.3021	0.0191	VVA
SWAPP_POLK_TG1	992197.1921	1274176.6550	287.7770	287.7666	-0.0104	VVA
SWAPP_WALKER_FO15	966253.9502	1371367.7250	292.6260	292.6366	0.0106	VVA
SWAPP_WALKER_FO16	985738.3880	1340612.4830	256.3810	256.2664	-0.1146	VVA
SWAPP_WALKER_FO17	954718.4158	1346206.4600	643.9280	643.9819	0.0539	VVA
SWAPP_WHIT_FO23	989827.1075	1357642.3860	289.8630	289.8930	0.0300	VVA

Table 15: DEM Check Point Assessment