Airborne Lidar Report

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TASK ORDER NAME: LA Chenier Plain Lidar 2017 B16

Contract Number: G16PC00022
Task Number: G16PD01120

Contractor: Woolpert, Inc.
Woolpert Project # 769851

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Section 1: Overview

TASK ORDER NAME: LA Chenier Plain Lidar 2017 B16

Project: # 76985

This report contains a comprehensive outline of the LA Chenier Plain Lidar 2017 B16 Lidar task order. Processing task order for the United States Geological Survey (USGS). This task is issued under USGS Contract No. G16PC00022, Task Order No. G16PD01120. This task order requires lidar data to be acquired over approximately 2898 miles located along an area of coastal Louisiana referred to as Chenier Plain, which includes portions of Calcasieu, Cameron, Vermillion, Iberia, and St. Mary Parishes. The lidar data was acquired and processed in compliance with U.S. Geological Survey National Geospatial Program Lidar Base Specification version 1.2, 1collected at a nominal pulse spacing (NPS) of 0.7 meters. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath. This project was acquired using Leica ALS80 and ALS70 lidar sensors.

The data was collected using Leica ALS80 HP 1000 kHz Multiple Pulses in Air (MPiA) lidar systems. The ALS80 sensor collects up to four returns per pulse, as well as intensity data, for the first three returns. If a fourth return was captured, the system does not record an associated intensity value. The aerial lidar was collected at the following sensor specifications:

Table 1.1: ALS80 Specifications – WOOLPERT	
Post Spacing	0.70 m
AGL (Above Ground Level) average flying height	2,377 m
Average Ground Speed:	150 knots
Field of View (full)	40 degrees
Scan Rate	35.5 Hz
Pulse Rate	346 kHz

The data was collected using Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) lidar sensor. The ALS70 sensor collects up to four returns per pulse, as well as intensity data, for the first three returns. If a fourth return was captured, the system does not record an associated intensity value. The aerial lidar was collected at the following sensor specifications:

Table 1.2: ALS70 Specifications - ASI	
Post Spacing	0.70 m
AGL (Above Ground Level) average flying height	1,524 m
Average Ground Speed:	150 knots
Field of View (full)	50 degrees
Pulse Rate	272 kHz
Scan Rate	50 Hz

The horizontal datum used for the task order was referenced to NAD1983(2011) UTM Zone 15N, Meters. The vertical datum used for the task order was referenced to NAVD 1988, Meters, GEOID12B.

Figure 1.1: LA Chenier Plain Lidar 2017 B16 Lidar Task Order AOI

Section 2: Acquisition

The lidar data was acquired with Leica ALS80HP 1000 kHz Multiple Pulses in Air (MPiA) Lidar Sensor Systems. The ALS80 HP lidar system, developed by Leica Geosystems of Heerbrugg, Switzerland, includes the simultaneous first, intermediate and last pulse data capture module, the extended altitude range module, and the target signal intensity capture module.

The ALS80HP 1000 kHz Multiple Pulses in Air (MPiA) Lidar System has the following specifications:

Table 2.1: ALS80 HP Lidar System Specifications	
Operating Altitude	100 – 7,620 meters
Scan Angle	0 to 72° (variable)
Swath Width	0 to 1.5 X altitude (variable)
Scan Frequency	0 – 200 Hz (variable based on scan angle)
Maximum Pulse Rate	1000 kHz (Effective)
Range Resolution	Better than 1 cm
Elevation Accuracy	6 - 19 cm single shot (one standard deviation)
Horizontal Accuracy	5 – 43 cm (one standard deviation)
Number of Returns per Pulse	Unlimited
Number of Intensities	3 (first, second, third)
Intensity Digitization	8 bit intensity + 8 bit AGC (Automatic Gain Control) level
MPiA (Multiple Pulses in Air)	8 bits @ 1nsec interval @ 50kHz
Laser Beam Divergence	0.22 mrad @ $1/e^2$ (~0.15 mrad @ 1/e)
Laser Classification	Class IV laser product (FDA CFR 21)
Eye Safe Range	400m single shot depending on laser repetition rate
Roll Stabilization	Automatic adaptive, range = 75 degrees minus current FOV
Power Requirements	28 VDC @ 25A
Operating Temperature	0-40°C
Humidity	0-95% non-condensing
Supported GNSS Receivers	Ashtech Z12, Trimble 7400, Novatel Millenium

The lidar data was acquired with Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) lidar sensors system. The ALS70 lidar system, developed by Leica Geosystems of Heerbrugg, Switzerland, includes the simultaneous first, intermediate and last pulse data capture module, the extended altitude range module, and the target signal intensity capture module.

The ALS70 500 kHz Multiple Pulses in Air (MPiA) Lidar System has the following specifications:

Table 2.2: ALS 70 Lidar System Specifications	
Operating Altitude	200 – 3,500 meters
Scan Angle	0 to 75° (variable)
Swath Width	0 to 1.5 X altitude (variable)
Scan Frequency	0 – 200 Hz (variable based on scan angle)
Maximum Pulse Rate	500 kHz (Effective)
Range Resolution	Better than 1 cm
Elevation Accuracy	7 - 16 cm single shot (one standard deviation)
Horizontal Accuracy	5 – 38 cm (one standard deviation)
Number of Returns per Pulse	7 (infinite)
Number of Intensities	3 (first, second, third)
Intensity Digitization	8 bit intensity + 8 bit AGC (Automatic Gain Control) level
MPiA (Multiple Pulses in Air)	8 bits @ 1nsec interval @ 50kHz
Laser Beam Divergence	0.22 mrad @ $1/e^2$ (~0.15 mrad @ 1/e)
Laser Classification	Class IV laser product (FDA CFR 21)
Eye Safe Range	400m single shot depending on laser repetition rate
Roll Stabilization	Automatic adaptive, range = 75 degrees minus current FOV
Power Requirements	28 VDC @ 25A
Operating Temperature	0-40°C
Humidity	0-95% non-condensing
Supported GNSS Receivers	Ashtech Z12, Trimble 7400, Novatel Millenium

Prior to mobilizing to the project site, flight crews coordinated with the necessary Air Traffic Control personnel to ensure airspace access.

Crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station for the airborne GPS support.

The Lidar data was collected in thirteen (13) missions, flown as close together as the weather permitted, to ensure consistent ground conditions across the project area. An initial quality control process was performed immediately on the Lidar data to review the data coverage, airborne GPS data, and trajectory solution. Collection of lidar data took place from January 8 through March 3 of 2017.

Figure 2.1: Lidar Flight Layout, LA Chenier Plain Lidar 2017 B16

Table 2.3: Airborne Lidar Acquisition Flight Summary

Date of Mission	Lines Flown	Mission Time (UTC)
January 8, 2017	**00001-00014**	**7:17 – 10:52**
January 23, 2017	**00191-00212**	**12:20 – 15:39**
January 26, 2017	**00166-00190**	**12:25 – 16:42**
January 27, 2017_A	**00156-00165**	**9:45 - 12:56**
January 27, 2017_B	**00137-00155**	**14:38 - 18:11**
January 28, 2017	**00128-00136**	**9:34 - 11:46**
January 29, 2017_A	**00114-00127**	**10:19 - 13:15**
January 29, 2017_B	**00102-00113**	**17:37 - 19:31**
February 16, 2017	**00052-00072**	**3:33 - 8:53**
February 25, 2017_A	**00073-00084**	**9:35 - 12:48**
February 25, 2017_B	**00085-00098**	**14:34 - 16:55**
March 2, 2017	**01012-01024, 01080-01083**	**15:17 - 19:40**
March 3, 2017	**01025-01041**	**3:54 - 7:13**

Section 3: LiDAR Data Processing

Applications and Work Flow Overview

1. Resolved kinematic corrections for three subsystems: inertial measurement unit (IMU), sensor orientation information and airborne GPS data. Developed a blending post-processed aircraft position with attitude data using Kalman filtering technology or the smoothed best estimate trajectory (SBET).
Software: POSPac Software v. 5.3, IPAS Pro v.1.35., Novatel Inertial Explorer v8.60.6129
2. Calculated laser point position by associating the SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in LAS format. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift.
Software: ALS Post Processing Software v.2.75 build #25, Proprietary Software, TerraMatch v. 17, Add Leica Cloud Pro v1.2.3
3. Imported processed LAS point cloud data into the task order tiles. Resulting data were classified as ground and non-ground points with additional filters created to meet the task order classification specifications. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Based on the statistical analysis, the lidar data was then adjusted to reduce the vertical bias when compared to the survey ground control.
Software: TerraScan v. 17.
4. The LAS files were evaluated through a series of manual QA/QC steps to eliminate remaining artifacts from the ground class.
Software: TerraScan v.17.

Global Navigation Satellite System (GNSS)–Inertial Measurement Unit (IMU) Trajectory Processing

Equipment

The pilots are skilled at maintaining their planned trajectory, while holding the aircraft steady and level. If atmospheric conditions are such that the trajectory, ground speed, roll, pitch and/or heading cannot be properly maintained, the mission is aborted until suitable conditions occur.

Base stations were set by acquisition staff and were used to support the Lidar data acquisition. The GNSS base station operated during the Lidar acquisition missions is listed below:

Table 3.1: GNSS Base Station

Station (Name)	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height (L1 Phase center) (Meters)
NGS PID BK1646	30°08'23.42594"	93°13'56.51963"	-23.387
FSHS CORS	29°48'19.10328"	91°30'08.05126"	-14.438
TONY CORS	30°13'16.94747"	92°02'42.38714"	-5.491
CAMR CORS	29°47'54.57717"	93°19'30.38072"	-10.306
MCNE CORS	30°10'50.02267"	93°13'03.84330"	-8.633
KLCH Airport	30°07'32.36071"	93°13'15.73892"	-23.685

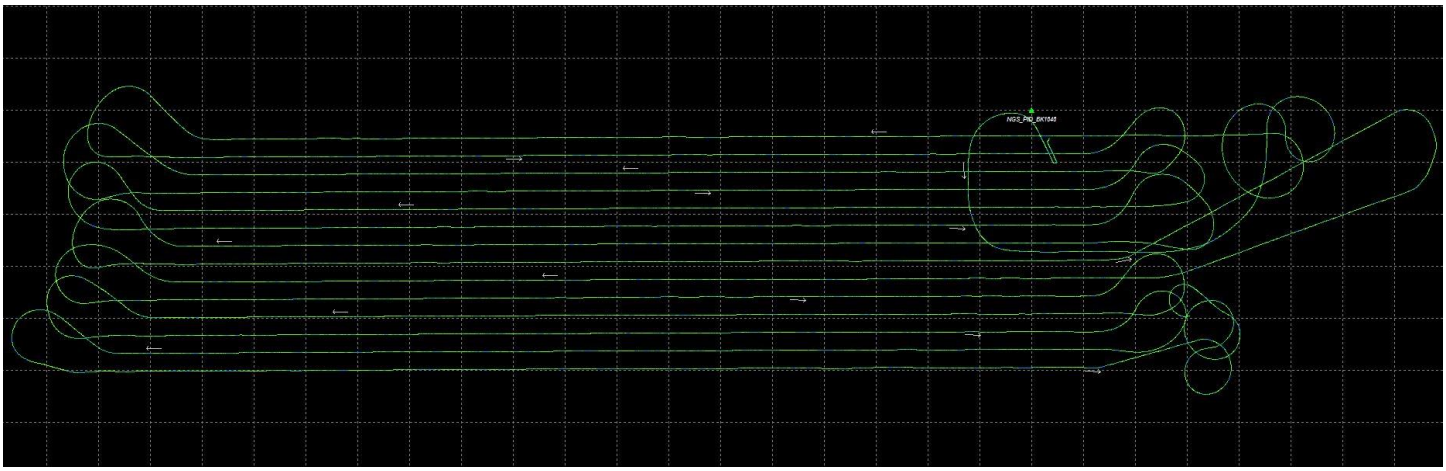
Data Processing

All airborne GNSS and IMU data was post-processed and quality controlled using Applanix MMS software. GNSS data was processed at a 1 and 2 Hz data capture rate and the IMU data was processed at 200 Hz.

Trajectory Quality

The GNSS Trajectory, along with high quality IMU data are key factors in determining the overall positional accuracy of the final sensor data. Within the trajectory processing, there are many factors that affect the overall quality, but the most indicative are the combined separation, the estimated positional accuracy, and the Positional Dilution of Precision (PDOP).

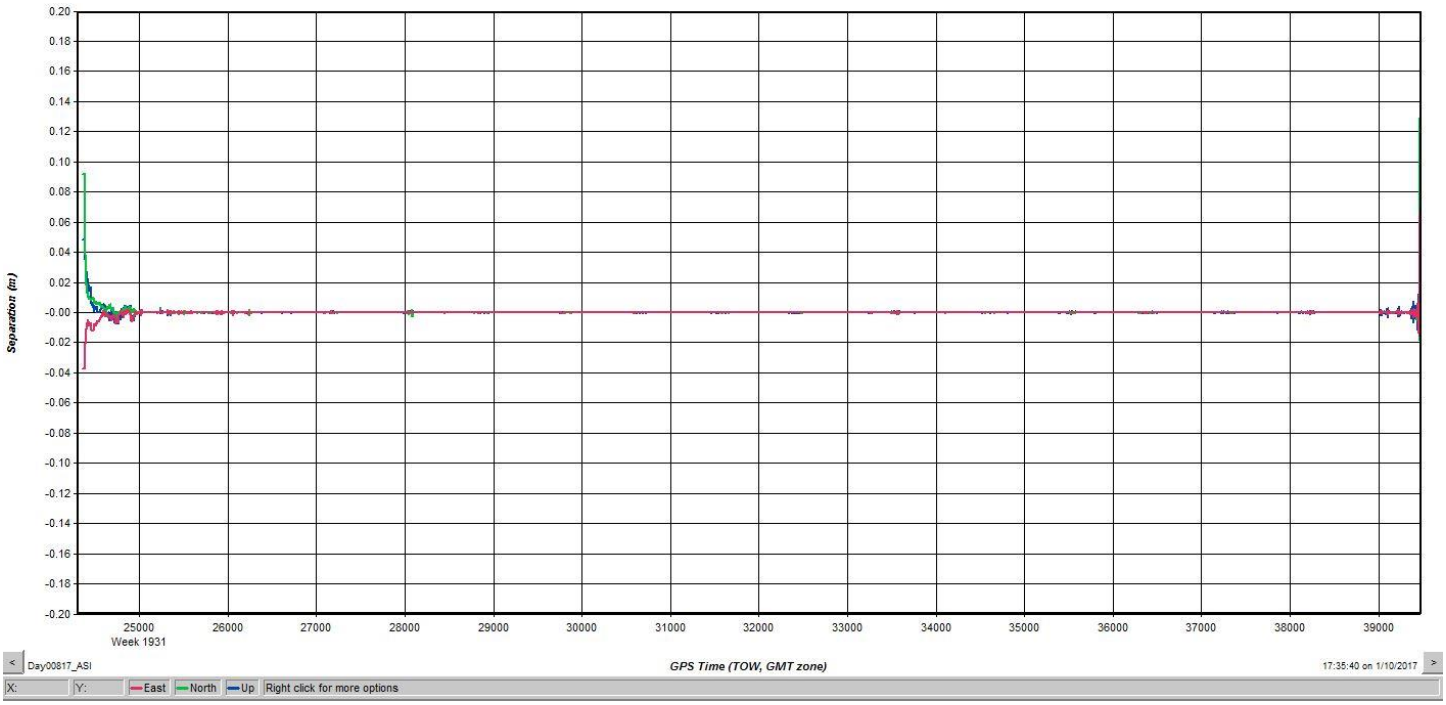
Figure 3.1: Trajectory, Day00817_ASI



Combination Separation

The Combined Separation is a measure of the difference between the forward run and the backward run solution of the trajectory. The Kalman filter is processed in both directions to remove the combined directional anomalies. In general, when these two solutions match closely, an optimally accurate reliable solution is achieved.
Woolpert's goal is to maintain a Combined Separation Difference of less than ten (10) centimeters. In most cases we achieve results below this threshold.

Figure 3.2: Combined Separation, Day00817_ASI

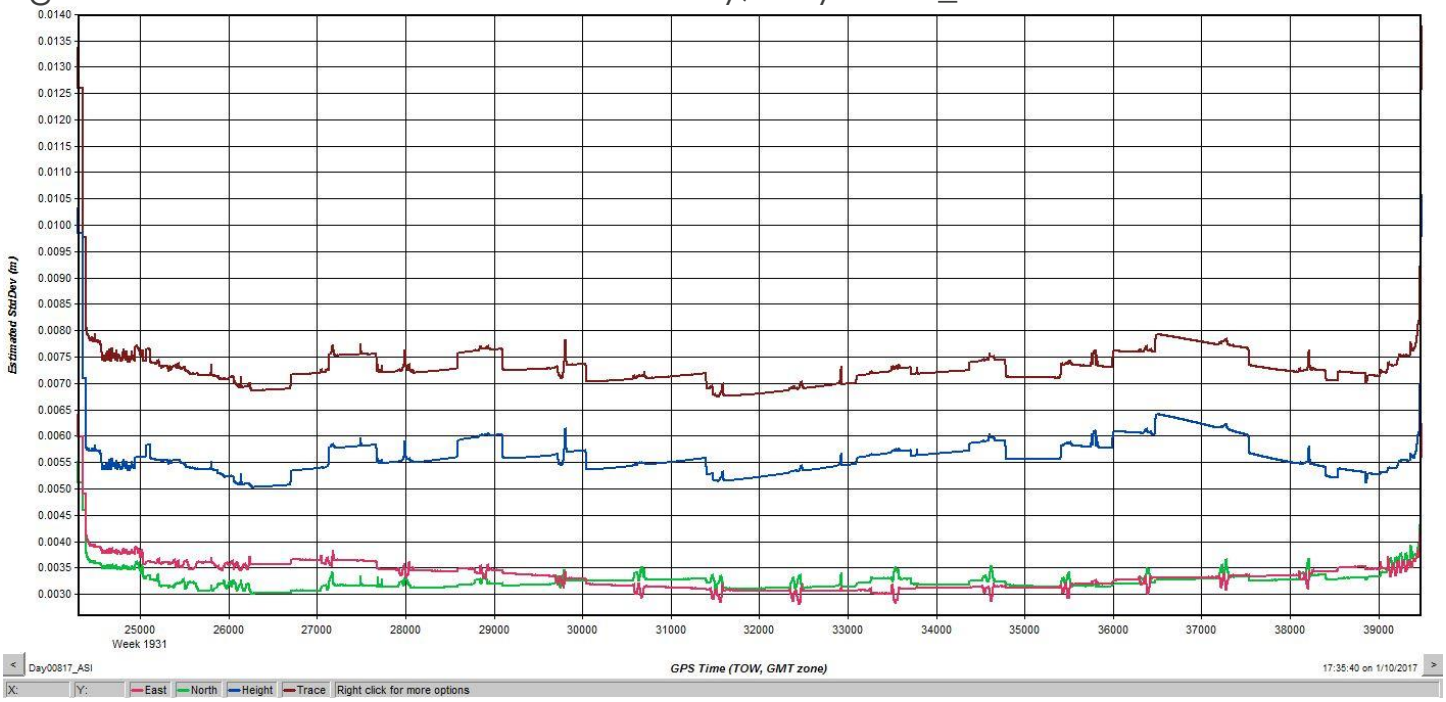


Estimated Positional Accuracy

The Estimated Positional Accuracy plots the standard deviations of the east, north, and vertical directions along a time scale of the trajectory. It illustrates loss of satellite lock issues, as well as issues arising from long baselines, noise, and/or other atmospheric interference.

Woolpert's goal is to maintain an Estimated Positional Accuracy of less than ten (10) centimeters, often achieving results well below this threshold.

Figure 3.3: Estimated Positional Accuracy, Day00817_ASI

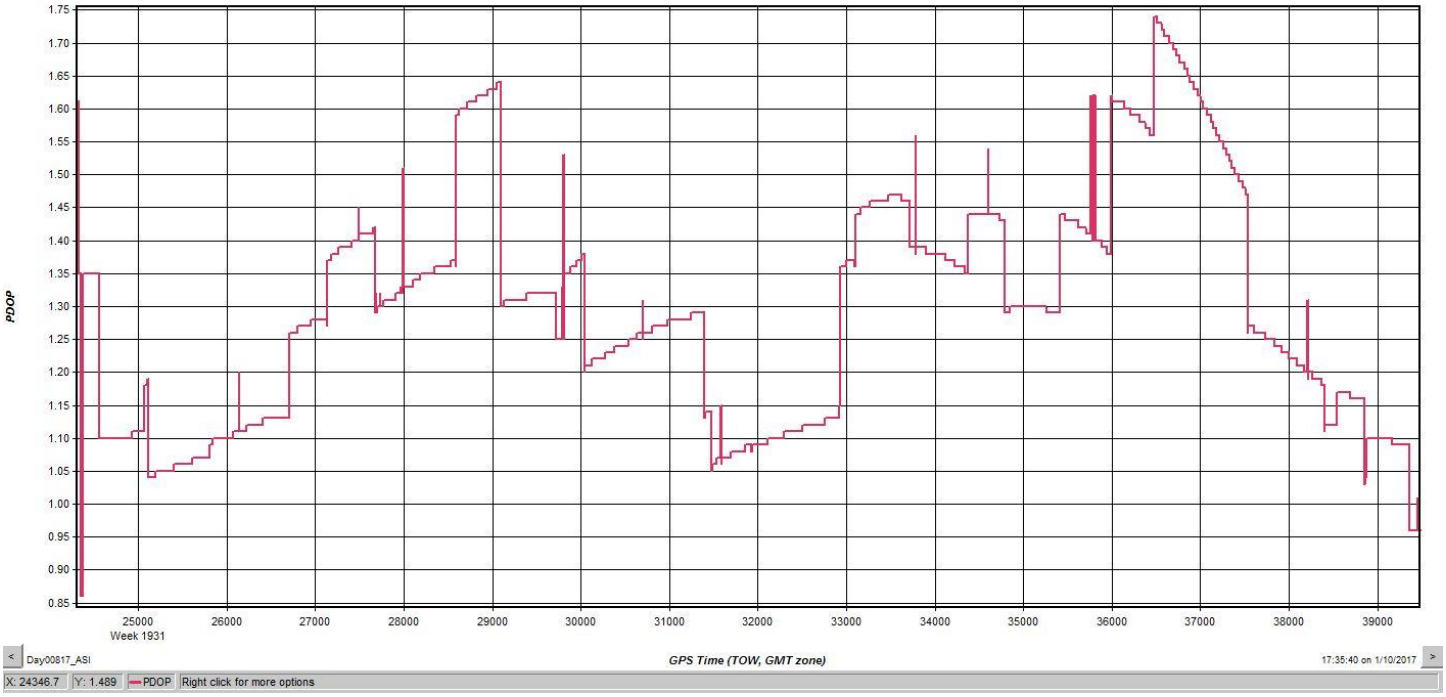


PDOP

The PDOP measures the precision of the GPS solution in regards to the geometry of the satellites acquired and used for the solution.

Woolpert's goal is to maintain an average PDOP value below 3.0. Brief periods of PDOP over 3.0 are acceptable due to the calibration and control process if other metrics are within specification.

Figure 3.4: PDOP, Day00817_ASI



LiDAR Data Processing

When the sensor calibration, data acquisition, and GPS processing phases were complete, the formal data reduction processes by Woolpert lidar specialists included:

- Processed individual flight lines to derive a raw “Point Cloud” LAS file. Matched overlapping flight lines, generated statistics for evaluation comparisons, and made the necessary adjustments to remove any residual systematic error.
- Calibrated LAS files were imported into the task order tiles and initially filtered to create a ground and non-ground class. Then additional classes were filtered as necessary to meet client specified classes.
- Once all project data was imported and classified, survey ground control data was imported and calculated for an accuracy assessment. As a QC measure, Woolpert has developed a routine to generate accuracy statistical reports by comparisons against the TIN and the DEM using surveyed ground control of higher accuracy. The lidar is adjusted accordingly to meet or exceed the vertical accuracy requirements.
- The lidar tiles were reviewed using a series of proprietary QA/QC procedures to ensure it fulfills the task order requirements. A portion of this requires a manual step to ensure anomalies have been removed from the ground class.
- The lidar LAS files are classified into the Processed, but unclassified (Class 1), Bare earth (Class 2), Vegetation (Class 3), Low Noise (Class 7), Water (Class 9), Ignored ground (Class10), Bridge Decks (Class 17), High Noise (Class 18) classifications.
- The Chenier Plain Wetland areas contain hundreds of impoundments related to aquaculture operations. These fields are flooded and contained within the impoundments on a semi-permanent basis, including during the Chenier Plain lidar acquisition timeframe. This is an understood and accepted acquisition condition. Furthermore, impoundments equal to or greater than 2 acres are treated as hydrologically flattened features within the data deliverables. Tidal Restriction: The following tide gauges were considered suitable for prediction of regional water levels within the AOI; Sabin Pass North, TX NOS (8770570), Calcasieu Pass, LA NOS (8768094), Freshwater Canal Locks, LA NOS (8766072), and Amerada Pass, LA NOS (8764227). Water levels at flight time were below -0.10 meters (mean seal level) for the Calcasieu Pass, LA tide gauge (8768094) in the west and -0.10 meters (mean seal level) for the Amerada Pass, LA tide gauge (8764227). Meteorological: Acquisition occurred during times of calm winds and only after passage of any moderate to strong high-pressure systems generating northerly winds exceeding five (5) knots. Additionally, it is noted switching of winds from WNW to ENE is a tipping point for switching from wind driven marsh drainage to marsh flooding. In this circumstance, acquisition was delayed several hours until water levels regulated. Ground Conditions: Within the extreme eastern AOI (swamp and fresh to intermediate marsh occurring northeast of Marsh Island and bordering East Cote Blanche Bay) Lidar was not acquired when the Lower Atchafalaya River stage was less than 4 feet as determined by the latest measurements taken at gauge (USGS 07381605) at Morgan City. Lidar was not acquired when regional precipitation driven flooding occurred in local rivers with significant impact to wetland impoundments located throughout the entire Chenier Plain west of Cote Blanch Bay. The following local rivers shall be monitored for flood conditions; Vermillion, Mermentau, Calcasieu, and Sabine rivers.
- FGDC Compliant metadata was developed for the task order in .xml format per product.
- The horizontal datum used for the task order was referenced to NAD83 (2011), UTM Zone 15N, Meters. The vertical datum used for the task order was referenced to NAVD 1988, Meters, GEOID12B

Section 4: Hydrologic Flattening

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

LA Chenier Plain Lidar 2017 B16 Lidar processing task order required the compilation of breaklines defining water bodies and rivers. The breaklines were used to perform the hydrologic flattening of water bodies, and gradient hydrologic flattening of double line streams and rivers. Lakes, reservoirs and ponds, at a minimum size of 2-acre or greater, were compiled as closed polygons. The closed water bodies were collected at a constant elevation. Rivers and streams, at a nominal minimum width of 30 meters (100 feet), were compiled in the direction of flow with both sides of the stream maintaining an equal gradient elevation.

LIDAR DATA REVIEW AND PROCESSING

Woolpert utilized the following steps to hydrologically flatten the water bodies and for gradient hydrologic flattening of the double line streams within the existing lidar data.

The compilation procedure included use of lidar intensity, bare earth surface model, point cloud data, and open source imagery to perform a primarily threshold-based object oriented semi-automated feature extraction to compile hydrologic features in a 2-d environment. The automated process does not provide as refined a hydrologic breakline as a manual effort, however in this type of terrain, the automated approach was the most practical. Following the compilation phase, a separate process was used to adjust the breakline data to best match the water level at the time of the lidar collection. Any ponds and/or lakes were adjusted to be at or just below the bank and to be at a constant elevation. Any streams were adjusted to be at or just below the bank and to be monotonic. Bridge breaklines were also compiled to generate an accurate DEM product. The final hydrologic and bridge breakline product was delivered in ESRI shape file format and was also used in the processing of the DEM deliverable. It is understood that due to the complexity of water features located within the Chenier Plain project area, the breakline process as described, was necessary and will likely yield accuracy that is less than typically expected of breakline features on a 3DEP lidar project.

The lakes, reservoirs and ponds, at a minimum size of 2-acre or greater and streams at a minimum size of 30 meters (100 feet) nominal width, were compiled to meet task order requirements. **Figure 4.1** illustrates an example of 30 meters (100 feet) nominal streams identified and defined with hydrologic breaklines. The breaklines defining rivers and streams, at a nominal minimum width of 30 meters (100 feet), were draped with both sides of the stream maintaining an equal gradient elevation.

All ground points were reclassified from inside the hydrologic feature polygons to water, class nine (9).

All ground points were reclassified from within a buffer along the hydrologic feature breaklines to buffered ground, class ten (10).

The lidar ground points and hydrologic feature breaklines were used to generate a new digital elevation model (DEM).

The hydrologic complexity of the Chenier Plain Lidar AOI led to expansive feature class polygons containing large, atypical amounts of vertices. Excessive vertices in a feature class can cause processing and display issues for data producers as well as end-users. To develop a hydrologic dataset with a tolerable amount of vertices per feature class, large features were cut at logical junctures. This workflow allowed preservation of the geographic extent of collected hydrologic features while maintaining an operable feature class dataset.

Figure 4.1: Example Hydrologic Breaklines

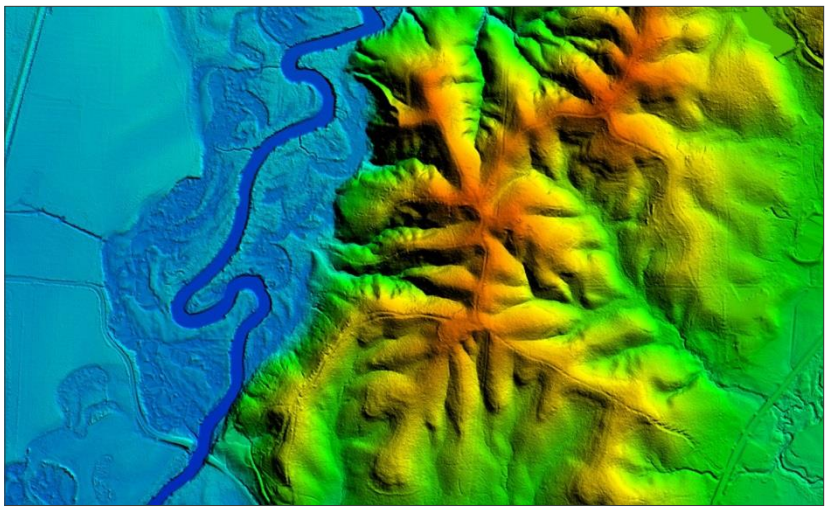


Figure 4.2 reflects a DEM generated from original lidar bare earth point data prior to the hydrologic flattening process. Note the "tinning" across the lake surface.

Figure 4.3 reflects a DEM generated from lidar with breaklines compiled to define the hydrologic features. This figure illustrates the results of adding the breaklines to hydrologically flatten the DEM data. Note the smooth appearance of the lake surface in the DEM.

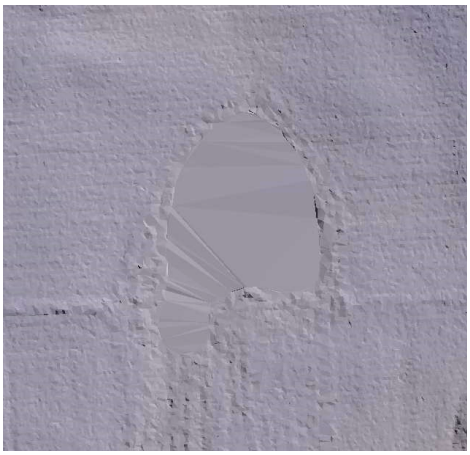


Figure 4.2

Figure 4.3

Terrascan was used to add the hydrologic breakline vertices and export the lattice models. The hydrologically flattened DEM data was provided to USGS in TIFF format.

The hydrologic breaklines compiled as part of the flattening process were provided to the USGS in ESRI GDB format. The breaklines defining the water bodies greater than 2-acre and for the gradient flattening of all rivers and streams at a nominal minimum width of 30 meters (100 feet) were provided in geodatabase as a Polygon-Z and Polyline-Z shape file, respectively.

DATA QA/QC

Initial QA/QC for this task order was performed in Global Mapper v17, by reviewing the grids and hydrologic breakline features. Additionally, ESRI software and proprietary methods were used to review the overall connectivity of the hydrologic breaklines.

Edits and corrections were addressed individually by tile. If a water body breakline needed to be adjusted to improve the flattening of the DEM data, the area was cross referenced by tile number, corrected accordingly, a new DEM file was regenerated and reviewed.

Section 5: ACCURACY ASSESSMENT

Accuracy Assessment

The vertical accuracy statistics were calculated by comparison of all lidar points to the ground surveyed QC points.

Table 5.1: Overall Vertical Accuracy Statistics		
Average error	-0.002	Meter
Minimum error	-0.149	Meter
Maximum error	0.161	Meter
Average magnitude	0.049	Meter
Root mean square	0.062	Meter
Standard deviation	0.063	Meter

Table 5.2: RAW Swath Quality Check Point Analysis NVA

Point ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	TIN Elevation (Meter)	Dz (Meter)
2001	413751.962	3293366.223	2.154	2.120	-0.034
2002	436879.148	3332326.401	1.777	1.890	0.113
2003	457054.559	3293447.806	1.286	1.200	-0.086
2004	464187.902	3331892.696	2.166	2.220	0.054
2005	477729.324	3331911.440	1.935	1.920	-0.015
2006	481983.475	3320622.225	2.338	2.310	-0.028
2007	462172.701	3317743.232	2.842	2.880	0.038
2008	536878.171	3323048.136	1.510	1.500	-0.010
2009	507999.469	3320714.345	0.208	0.140	-0.068
2010	567993.030	3301162.666	1.361	1.410	0.049
2011	581576.019	3305920.253	1.727	1.750	0.023
2012	598968.976	3319221.167	2.021	1.940	-0.081
2013	596877.778	3313921.457	2.365	2.330	-0.035
2014	600108.021	3317693.516	1.780	1.840	0.060
2014A	600103.720	3317669.335	1.961	1.920	-0.041
2015	611057.541	3316332.750	2.105	2.110	0.005
2016	628992.393	3308767.593	3.874	4.010	0.136
2017	640976.661	3305357.755	3.280	3.150	-0.130
2018	642683.043	3274542.032	1.117	1.050	-0.067
2019	640531.908	3278171.304	0.596	0.550	-0.046
2020	655665.473	3290363.275	3.083	3.030	-0.053
2021	610665.250	3288654.163	0.903	0.900	-0.003
2022	616239.478	3299792.843	2.339	2.350	0.011

2023	567165.675	3269479.281	1.579	1.740	0.161
2024	558657.577	3278348.853	0.692	0.710	0.018
2025	564371.038	3289187.641	0.864	0.940	0.076
2026	515723.382	3289479.738	0.482	0.620	0.138
2027	491281.402	3303255.078	0.800	0.800	0.000
2028	577812.831	3295078.304	1.574	1.560	-0.014
2029	644830.804	3298305.382	1.527	1.480	-0.047
2030	563594.144	3298036.094	1.692	1.690	-0.002
2031	583531.395	3299396.120	1.621	1.650	0.029
2032	605217.751	3307686.575	12.644	12.590	-0.054
2033	620711.045	3295012.833	2.470	2.430	-0.040
2034	628893.304	3298530.317	3.160	3.100	-0.060
2035	617335.506	3309039.370	1.347	1.350	0.003
2036	649455.142	3302204.664	3.702	3.700	-0.002
2037	611228.662	3313655.446	1.626	1.610	-0.016
2038	607355.566	3317587.903	2.742	2.720	-0.022
2039	605530.695	3313854.196	1.990	2.030	0.040
2040	607711.585	3312837.420	1.533	1.530	-0.003
2041	576298.322	3295548.588	0.942	1.070	0.128
2042	552826.351	3279774.321	1.085	1.030	-0.055
2043	546415.927	3280947.553	0.832	0.830	-0.002
2044	541334.609	3282369.582	1.266	1.290	0.024
2045	531362.197	3286216.238	0.815	0.730	-0.085
2046	498466.934	3293371.257	2.057	2.100	0.043
2047	474500.417	3295272.896	1.027	0.970	-0.057
2048	466806.977	3297077.904	1.161	1.150	-0.011
2049	468781.576	3300916.605	0.870	0.890	0.020
2050	437752.212	3292539.911	2.189	2.040	-0.149
2051	467681.536	3329362.677	2.927	2.980	0.053
2052	465651.383	3327228.194	1.213	1.200	-0.013
2053	470919.974	3330338.842	8.531	8.490	-0.041
2054	471609.377	3325889.005	1.152	1.240	0.088
2055	473802.620	3322128.556	3.139	3.190	0.051
2056	476001.717	3320725.336	3.031	3.030	-0.001
2057	474066.662	3317534.523	1.291	1.310	0.019
2058	483468.099	3320380.145	2.606	2.680	0.074
2059	486408.352	3320558.058	3.526	3.570	0.044
2060	489198.842	3319809.525	1.770	1.790	0.020
2061	491469.147	3318147.098	1.488	1.440	-0.048
2062	491559.866	3322932.103	4.464	4.580	0.116
2063	486337.304	3297103.742	0.968	0.880	-0.088

2064	507204.178	3291778.613	1.028	1.010	-0.018
2065	534714.257	3321455.376	2.857	2.880	0.023
2066	526724.747	3320692.719	1.817	1.880	0.063
2067	521773.239	3322886.984	2.827	2.850	0.023
2068	521376.471	3319787.915	1.374	1.380	0.006
2069	516325.702	3322714.723	0.914	0.840	-0.074
2070	510480.524	3316427.530	1.168	1.130	-0.038
2071	503680.785	3316699.602	1.076	1.080	0.004
2072	512643.145	3299875.344	0.920	0.900	-0.020
2073	509291.688	3299563.797	0.785	0.790	0.005
2074	511434.896	3299166.485	0.623	0.590	-0.033
2075	506647.593	3299799.314	0.515	0.650	0.135
2076	504217.417	3300345.210	0.931	0.840	-0.091
2077	500119.450	3301198.706	0.951	0.960	0.009
2078	500086.706	3299169.747	1.087	1.000	-0.087
2079	498930.553	3301380.413	1.249	1.310	0.061
2080	495793.318	3302134.792	0.824	0.810	-0.014
2081	493785.736	3302721.792	1.029	1.060	0.031
2082	489391.703	3301502.451	0.519	0.480	-0.039
2083	422764.748	3292929.416	1.521	1.450	-0.071
2084	429356.719	3292803.734	2.060	1.980	-0.080
2085	460121.927	3331502.801	2.544	2.440	-0.104
2086	476060.265	3328595.611	1.538	1.550	0.012
2087	479472.891	3322036.154	2.280	2.260	-0.020
2088	476058.192	3324545.806	1.685	1.600	-0.085
2089	480759.909	3313987.133	0.858	0.890	0.032
2090	643960.528	3293272.624	-0.355	-0.410	-0.055
2091	491412.590	3315822.569	1.756	1.850	0.094
2092	492321.521	3307070.404	1.301	1.360	0.059
2093	478720.661	3316263.063	1.965	1.900	-0.065

VERTICAL ACCURACY CONCLUSIONS

Raw Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.122 Meters Non-vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 0.062 x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the TIN using all lidar points against 94 NVA points.

Classified LAS Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.122 Meters Non-vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 0.062 x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the TIN using lidar ground points against 94 NVA points.

Table 5.3: NVA Check Point Analysis DEM

Point ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	DEM Elevation (Meter)	Dz (Meter)
2001	413751.962	3293366.223	2.154	2.100	-0.054
2002	436879.148	3332326.401	1.777	1.880	0.103
2003	457054.559	3293447.806	1.286	1.200	-0.086
2004	464187.902	3331892.696	2.166	2.180	0.014
2005	477729.324	3331911.440	1.935	1.920	-0.015
2006	481983.475	3320622.225	2.338	2.300	-0.038
2007	462172.701	3317743.232	2.842	2.870	0.028
2008	536878.171	3323048.136	1.510	1.450	-0.060
2009	507999.469	3320714.345	0.208	0.120	-0.088
2010	567993.030	3301162.666	1.361	1.440	0.079
2011	581576.019	3305920.253	1.727	1.750	0.023
2012	598968.976	3319221.167	2.021	1.930	-0.091
2013	596877.778	3313921.457	2.365	2.300	-0.065
2014	600108.021	3317693.516	1.780	1.810	0.030
2014A	600103.720	3317669.335	1.961	1.910	-0.051
2015	611057.541	3316332.750	2.105	2.070	-0.035
2016	628992.393	3308767.593	3.874	3.950	0.076
2017	640976.661	3305357.755	3.280	3.160	-0.120
2018	642683.043	3274542.032	1.117	1.020	-0.097
2019	640531.908	3278171.304	0.596	0.510	-0.086
2020	655665.473	3290363.275	3.083	3.020	-0.063
2021	610665.250	3288654.163	0.903	0.910	0.007
2022	616239.478	3299792.843	2.339	2.360	0.021
2023	567165.675	3269479.281	1.579	1.690	0.111
2024	558657.577	3278348.853	0.692	0.730	0.038
2025	564371.038	3289187.641	0.864	0.930	0.066
2026	515723.382	3289479.738	0.482	0.620	0.138
2027	491281.402	3303255.078	0.800	0.790	-0.010
2028	577812.831	3295078.304	1.574	1.560	-0.014
2029	644830.804	3298305.382	1.527	1.500	-0.027
2030	563594.144	3298036.094	1.692	1.710	0.018
2031	583531.395	3299396.120	1.621	1.610	-0.011
2032	605217.751	3307686.575	12.644	12.570	-0.074
2033	620711.045	3295012.833	2.470	2.370	-0.100
2034	628893.304	3298530.317	3.160	3.110	-0.050
2035	617335.506	3309039.370	1.347	1.320	-0.027
2036	649455.142	3302204.664	3.702	3.710	0.008
2037	611228.662	3313655.446	1.626	1.570	-0.056

2038	607355.566	3317587.903	2.742	2.690	-0.052
2039	605530.695	3313854.196	1.990	2.020	0.030
2040	607711.585	3312837.420	1.533	1.530	-0.003
2041	576298.322	3295548.588	0.942	1.050	0.108
2042	552826.351	3279774.321	1.085	1.030	-0.055
2043	546415.927	3280947.553	0.832	0.810	-0.022
2044	541334.609	3282369.582	1.266	1.280	0.014
2045	531362.197	3286216.238	0.815	0.680	-0.135
2046	498466.934	3293371.257	2.057	2.070	0.013
2047	474500.417	3295272.896	1.027	0.920	-0.107
2048	466806.977	3297077.904	1.161	1.150	-0.011
2049	468781.576	3300916.605	0.870	0.890	0.020
2050	437752.212	3292539.911	2.189	2.030	-0.159
2051	467681.536	3329362.677	2.927	3.020	0.093
2052	465651.383	3327228.194	1.213	1.220	0.007
2053	470919.974	3330338.842	8.531	8.470	-0.061
2054	471609.377	3325889.005	1.152	1.200	0.048
2055	473802.620	3322128.556	3.139	3.180	0.041
2056	476001.717	3320725.336	3.031	3.040	0.009
2057	474066.662	3317534.523	1.291	1.310	0.019
2058	483468.099	3320380.145	2.606	2.670	0.064
2059	486408.352	3320558.058	3.526	3.560	0.034
2060	489198.842	3319809.525	1.770	1.750	-0.020
2061	491469.147	3318147.098	1.488	1.420	-0.068
2062	491559.866	3322932.103	4.464	4.560	0.096
2063	486337.304	3297103.742	0.968	0.880	-0.088
2064	507204.178	3291778.613	1.028	0.980	-0.048
2065	534714.257	3321455.376	2.857	2.880	0.023
2066	526724.747	3320692.719	1.817	1.880	0.063
2067	521773.239	3322886.984	2.827	2.830	0.003
2068	521376.471	3319787.915	1.374	1.370	-0.004
2069	516325.702	3322714.723	0.914	0.840	-0.074
2070	510480.524	3316427.530	1.168	1.130	-0.038
2071	503680.785	3316699.602	1.076	1.100	0.024
2072	512643.145	3299875.344	0.920	0.870	-0.050
2073	509291.688	3299563.797	0.785	0.780	-0.005
2074	511434.896	3299166.485	0.623	0.590	-0.033
2075	506647.593	3299799.314	0.515	0.660	0.145
2076	504217.417	3300345.210	0.931	0.840	-0.091
2077	500119.450	3301198.706	0.951	0.950	-0.001
2078	500086.706	3299169.747	1.087	1.010	-0.077

2079	498930.553	3301380.413	1.249	1.300	0.051
2080	495793.318	3302134.792	0.824	0.810	-0.014
2081	493785.736	3302721.792	1.029	1.040	0.011
2082	489391.703	3301502.451	0.519	0.460	-0.059
2083	422764.748	3292929.416	1.521	1.470	-0.051
2084	429356.719	3292803.734	2.060	2.010	-0.050
2085	460121.927	3331502.801	2.544	2.480	-0.064
2086	476060.265	3328595.611	1.538	1.530	-0.008
2087	479472.891	3322036.154	2.280	2.270	-0.010
2088	476058.192	3324545.806	1.685	1.530	-0.155
2089	480759.909	3313987.133	0.858	0.880	0.022
2090	643960.528	3293272.624	-0.355	-0.420	-0.065
2091	491412.590	3315822.569	1.756	1.800	0.044
2092	492321.521	3307070.404	1.301	1.340	0.039
2093	478720.661	3316263.063	1.965	2.020	0.055

VERTICAL ACCURACY CONCLUSIONS

Bare-Earth DEM Non-Vegetated Vertical Accuracy (NVA) Tested 0.125 Meters Non-Vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 0.064 x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM against 94 NVA points.

Table 5.4: VVA Quality Check Point Analysis DEM

Point ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	DEM Elevation (Meter)	Dz (Meter)
3001	414023.320	3293525.282	1.027	1.010	-0.017
3002	436820.909	3332348.366	1.367	1.320	-0.047
3003	456842.661	3293468.862	1.289	1.200	-0.089
3004	464189.710	3331783.918	1.663	1.650	-0.013
3005	477727.902	3331943.174	2.114	2.090	-0.024
3006	482034.283	3320648.718	1.999	2.000	0.001
3007	462145.091	3317713.307	2.805	2.890	0.085
3008	536830.496	3323007.792	0.839	0.780	-0.059
3009	508185.664	3320650.177	0.059	0.030	-0.029
3010	568030.076	3301040.416	1.052	1.110	0.058
3011	581709.214	3305760.287	1.952	2.040	0.088
3012	598922.452	3319097.084	2.100	2.160	0.060
3013	597018.225	3313914.062	1.996	1.960	-0.036
3014	599851.471	3317784.930	0.969	1.040	0.071

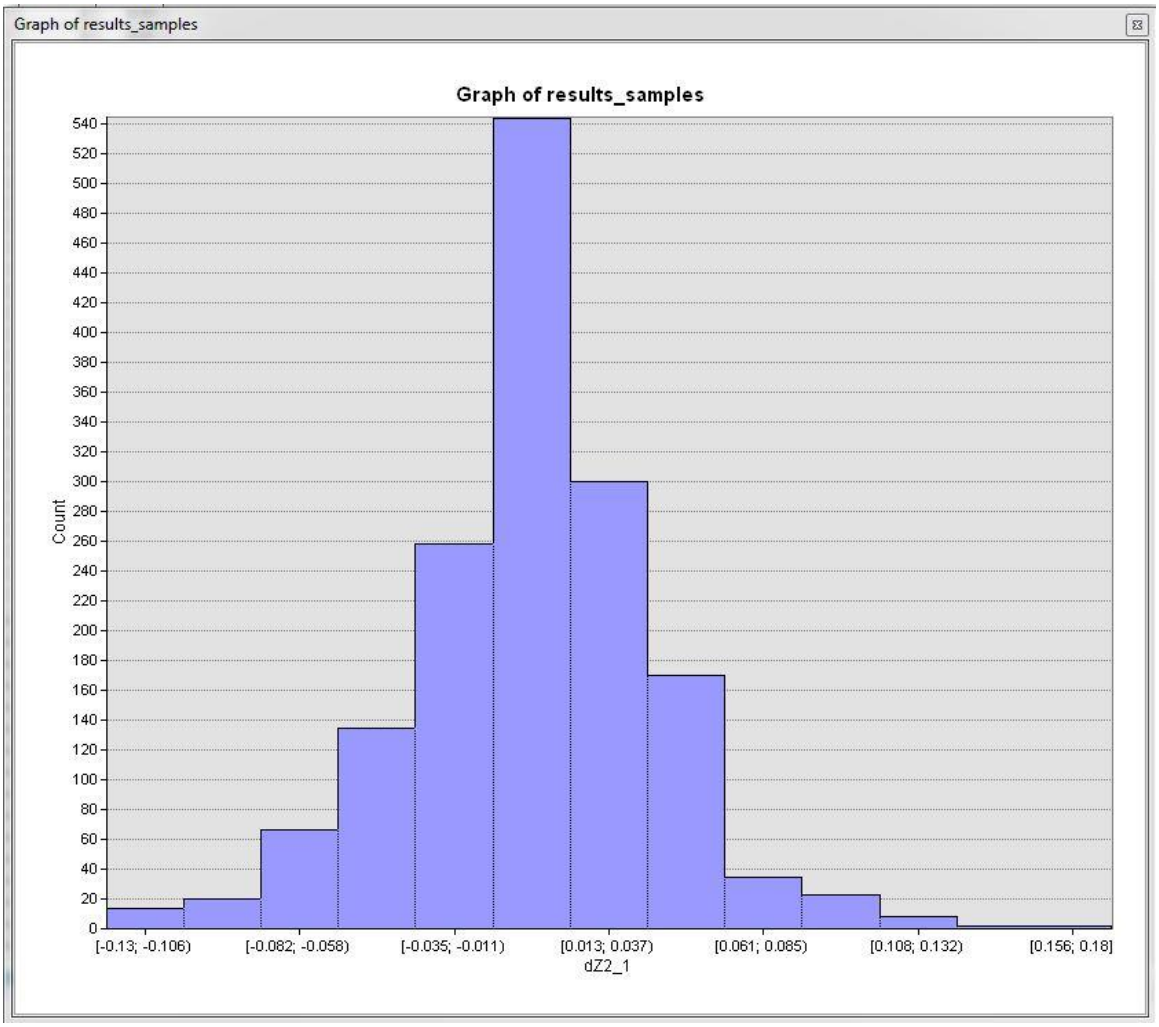
3015	611391.901	3316415.355	2.155	2.150	-0.005
3016	629296.304	3308881.652	4.246	4.450	0.204
3017	641207.889	3305333.080	3.009	2.930	-0.079
3018	641734.034	3272581.939	0.713	0.700	-0.013
3019	640841.664	3277991.599	0.827	0.810	-0.017
3020	655587.369	3290263.387	2.939	2.920	-0.019
3021	609171.419	3288118.328	0.877	0.920	0.043
3022	615485.672	3299921.981	12.941	13.020	0.079
3023	565481.051	3269503.986	1.757	1.830	0.073
3024	558371.527	3278415.355	0.672	0.790	0.118
3026	515891.087	3289331.613	0.853	0.850	-0.003
3027	490642.336	3303912.683	0.671	0.670	-0.001
3028	578633.910	3294898.475	1.543	1.580	0.037
3029	644866.084	3298261.628	1.460	1.390	-0.070
3030	563419.920	3297842.940	0.363	0.380	0.017
3030A	563469.020	3297886.681	0.348	0.400	0.052
3031	583670.900	3299524.106	1.328	1.350	0.022
3032	605535.315	3307833.326	13.433	13.450	0.017
3033	621179.122	3295219.328	1.025	0.990	-0.035
3034	628731.554	3299408.587	2.418	2.460	0.042
3035	617878.918	3309012.122	1.102	1.140	0.038
3036	649250.211	3302696.413	3.078	3.070	-0.008
3037	610599.594	3313632.122	1.504	1.470	-0.034
3038	607895.163	3316249.749	1.895	1.980	0.085
3039	605577.661	3314044.682	2.267	2.210	-0.057
3040	607724.570	3312759.039	1.372	1.480	0.108
3041	576423.684	3295500.778	0.668	0.740	0.072
3042	552954.695	3279765.401	1.505	1.540	0.035
3043	546898.350	3280895.629	2.494	2.500	0.006
3044	540703.345	3282651.742	0.498	0.610	0.112
3045	531792.570	3286209.829	1.746	1.680	-0.066
3046	498910.113	3293865.154	0.896	0.850	-0.046
3047	475246.308	3295364.616	0.938	0.900	-0.038
3048	467761.382	3296732.236	0.608	0.610	0.002
3049	468300.147	3300772.623	2.287	2.390	0.103
3050	436991.164	3292569.809	2.096	2.030	-0.066
3051	466591.440	3329589.967	1.851	1.950	0.099
3052	465173.803	3327845.769	1.183	1.270	0.087
3053	470601.666	3330373.188	3.182	3.250	0.068
3053A	470729.208	3330403.269	5.803	5.870	0.067
3054	472371.210	3325661.161	0.857	0.930	0.073

3055	474313.792	3322113.568	1.181	1.180	-0.001
3056	476322.698	3320617.793	3.075	3.170	0.095
3057	474259.640	3317453.771	1.253	1.300	0.047
3058	484425.650	3320481.976	2.673	2.690	0.017
3059	486717.646	3320993.088	3.782	3.810	0.028
3060	488414.376	3319801.639	2.250	2.230	-0.020
3061	491386.246	3318038.779	0.955	0.970	0.015
3062	491457.326	3322912.322	3.157	3.290	0.133
3063	485872.069	3297090.911	0.408	0.400	-0.008
3064	506371.097	3292021.418	1.333	1.190	-0.143
3065	534901.905	3321414.486	1.480	1.410	-0.070
3066	526686.988	3321365.672	1.564	1.530	-0.034
3067	521442.625	3322167.427	1.374	1.320	-0.054
3068	521361.395	3319899.283	0.603	0.570	-0.033
3069	516385.160	3322834.810	0.956	0.930	-0.026
3070	510170.336	3314775.180	1.137	1.090	-0.047
3071	503667.601	3317713.789	1.867	1.850	-0.017
3072	503964.199	3300409.865	0.769	0.730	-0.039
103008	536829.047	3323017.681	0.196	0.170	-0.026
103008A	536827.064	3323017.657	0.160	0.060	-0.100

VERTICAL ACCURACY CONCLUSIONS

Vegetated Vertical Accuracy (VVA) Tested 0.121 Meters at the 95th percentile reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM against 75 VVA points. VVA Errors larger than 95th percentile include:
Point 3016, Easting 629296.304, Northing 3308881.652, Z-Error 0.204 Meters
Point 3062, Easting 491457.326, Northing 3322912.322, Z-Error 0.133 Meters
Point 3064, Easting 506371.097, Northing 3292021.418, Z-Error 0.143 Meters

Figure 5.1: Lidar Relative Accuracy Histogram



RELATIVE ACCURACY ASSESSMENT AND CONCLUSION

Relative accuracy also known as "between swath" accuracy was tested through a series of well distributed flight line overlap locations. The relative accuracy for the Chenier Plain Lidar 2017 B16 measured at 0.038 Meters RMSDz.

Approved by:	Name	Signature	Date
Associate Member, Lidar Specialist Certified Photogrammetrist #1381	Qian Xiao		December 2017

Section 6: Flight Logs

Flight logs for the project are shown on the following pages:

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	81/8/2017	8	17-6739-01	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
							none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
50	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	5000	Ft		Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
1	268	7:19:28	7:30:18		17	0.7	1.2	
2	088	7:34:06	7:44:48		17	0.7	1.2	
3	268	7:48:01	7:59:01		16	0.7	1.1	
4	088	8:03:00	8:14:15		17	0.6	1.1	
5	268	8:17:51	8:29:08		17	0.6	1.1	
6	088	8:32:23	8:43:35		16	0.6	1.2	
7	268	8:47:34	8:58:35		16	0.6	1.4	
8	088	9:02:19	9:13:30		16	0.7	1.5	
9	268	9:23:37	9:34:50		18	0.6	1.3	
10	088	9:38:17	9:49:35		17	0.6	1.3	
11	268	9:52:50	10:04:27		17	0.7	1.3	
12	088	10:07:40	10:19:20		18	0.6	1.1	
13	268	10:22:33	10:34:34		19	0.6	1.2	
14	088	10:37:47	10:49:55		18	0.6	1.2	
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/23/2017	23	17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
191	166	12:21:45	12:24:03		16	0.7	1.2	
192	347	12:29:28	12:32:06		16	0.7	1.2	
193	166	12:35:12	12:37:29		16	0.7	1.2	
194	347	12:41:15	12:42:11		16	0.7	1.1	
195	290	12:51:25	12:52:33		17	0.7	1.1	
196	109	12:57:00	13:02:02		17	0.7	1.1	
197	290	13:04:30	13:10:04		16	0.7	1.2	
198	109	13:13:10	13:18:30		16	0.7	1.2	
199	290	13:23:00	13:28:15		16	0.7	1.2	
200	109	13:31:45	13:37:23		15	0.7	1.3	
201	290	13:40:43	13:48:00		15	0.7	1.3	
202	109	13:52:00	13:58:56		16	0.7	1.1	
203	290	14:02:31	14:10:15		15	0.7	1.3	
204	109	14:13:36	14:21:17		18	0.6	1	
205	290	14:25:07	14:33:01		18	0.6	1.1	
206	109	14:36:20	14:44:28		18	0.6	1.2	
207	290	14:47:40	14:55:45		18	0.6	1.2	
208	109	14:58:45	15:06:49		20	0.6	1.2	
209	290	15:09:47	15:15:43		19	0.6	1.1	
210	109	15:19:50	15:22:52		19	0.6	1.1	
211	290	15:26:10	15:27:27		20	0.6	1.1	
212	109	15:32:05	15:38:07		18	0.7	1.3	
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/26/2017	26	17-6739-01	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing / Arriving
	10	clr					none	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes X No
190	090	12:25:38	12:28:26		16	0.7	1.1	
189	270	12:31:52	12:35:12		16	0.7	1.1	
188	090	12:37:43	12:41:05		17	0.7	1	
187	270	12:45:57	12:51:11		17	0.7	1.1	
186	090	12:54:00	12:59:21		16	0.7	1.2	
185	270	13:04:20	13:09:47		16	0.7	1.2	
184	090	13:13:05	13:18:38		16	0.7	1.2	
183	270	13:22:33	13:28:21		16	0.7	1.1	
182	090	13:31:18	13:37:00		16	0.7	1.1	
181	270	13:45:45	13:51:49		16	0.7	1.2	
180	090	13:54:59	14:00:54		16	0.7	1.2	
179	270	14:05:35	14:11:47		18	0.6	1.1	
178	270	14:15:40	14:16:45		18	0.6	1.2	
177	090	14:19:45	14:21:12		18	0.6	1.2	
176	270	14:24:25	14:26:24		18	0.6	1.2	
175	090	14:30:15	14:32:09		18	0.6	1.2	
174	090	14:39:48	14:50:30		17	0.6	1.2	
173	270	14:56:10	15:07:20		19	0.6	1.1	
172	090	15:10:58	15:21:42		20	0.6	1	
171	270	15:25:25	15:36:00		17	0.7	1.3	
170	090	15:39:08	15:49:15		17	0.7	1.3	
169	270	15:53:20	16:02:51		18	0.6	1.2	
168	090	16:05:37	16:15:23		19	0.6	1.2	
167	270	16:19:40	16:28:48		20	0.6	1.1	
166	090	16:31:46	16:40:57		20	0.6	1.1	
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/27/2017	27	17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing / Arriving
	10	clr					none	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
165	090	9:48:33	10:04:41		20	0.6	1	
164	270	10:08:42	10:25:18		18	0.6	1.1	
163	090	10:28:10	10:44:16		18	0.6	1.1	
162	270	10:48:23	11:05:00		17	0.6	1.1	
161	090	11:07:45	11:23:45		15	0.7	1.5	
160	270	11:28:55	11:45:08		17	0.6	1.2	
159	090	11:48:08	12:03:30		17	0.6	1.1	
158	270	12:07:42	12:23:11		16	0.7	1.2	
157	090	12:25:54	12:40:03		16	0.7	1.2	
156	270	12:44:00	12:55:09		17	0.7	1.1	fuel stop
155	090	14:39:29	14:49:41		18	0.6	1.2	
154	270	14:53:50	15:04:04		19	0.7	1.3	
153	090	15:07:06	15:17:06		20	0.7	1.3	
152	270	15:22:44	15:32:28		17	0.7	1.3	
151	090	15:36:10	15:45:52		18	0.6	1.2	
150	270	15:49:58	15:59:45		19	0.6	1.1	
149	090	16:02:40	16:06:45		19	0.6	1.2	
148	270	16:11:25	16:15:10		20	0.6	1.1	
147	090	16:17:45	16:21:08		19	0.6	1.2	
146	270	16:24:30	16:25:29		20	0.6	1.1	
145	090	16:28:11	16:28:49		20	0.6	1.1	
144	270	16:40:25	16:42:53		19	0.6	1.1	
143	090	16:46:20	16:50:25		19	0.6	1.1	
142	270	16:53:42	16:58:31		20	0.6	1.1	
141	090	17:03:03	17:09:50		20	0.5	1	
140	270	17:13:32	17:21:47		20	0.6	1	
139	090	17:25:37	17:37:10		18	0.6	1.1	
138	270	17:40:40	17:53:39		19	0.6	1.1	
137	090	17:56:38	18:09:28		17	0.9	1.4	Smoke from fire-end of line
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/27/2017	27	17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
165	090	9:48:33	10:04:41		20	0.6	1	
164	270	10:08:42	10:25:18		18	0.6	1.1	
163	090	10:28:10	10:44:16		18	0.6	1.1	
162	270	10:48:23	11:05:00		17	0.6	1.1	
161	090	11:07:45	11:23:45		15	0.7	1.5	
160	270	11:28:55	11:45:08		17	0.6	1.2	
159	090	11:48:08	12:03:30		17	0.6	1.1	
158	270	12:07:42	12:23:11		16	0.7	1.2	
157	090	12:25:54	12:40:03		16	0.7	1.2	
156	270	12:44:00	12:55:09		17	0.7	1.1	fuel stop
155	090	14:39:29	14:49:41		18	0.6	1.2	
154	270	14:53:50	15:04:04		19	0.7	1.3	
153	090	15:07:06	15:17:06		20	0.7	1.3	
152	270	15:22:44	15:32:28		17	0.7	1.3	
151	090	15:36:10	15:45:52		18	0.6	1.2	
150	270	15:49:58	15:59:45		19	0.6	1.1	
149	090	16:02:40	16:06:45		19	0.6	1.2	
148	270	16:11:25	16:15:10		20	0.6	1.1	
147	090	16:17:45	16:21:08		19	0.6	1.2	
146	270	16:24:30	16:25:29		20	0.6	1.1	
145	090	16:28:11	16:28:49		20	0.6	1.1	
144	270	16:40:25	16:42:53		19	0.6	1.1	
143	090	16:46:20	16:50:25		19	0.6	1.1	
142	270	16:53:42	16:58:31		20	0.6	1.1	
141	090	17:03:03	17:09:50		20	0.5	1	
140	270	17:13:32	17:21:47		20	0.6	1	
139	090	17:25:37	17:37:10		18	0.6	1.1	
138	270	17:40:40	17:53:39		19	0.6	1.1	
137	090	17:56:38	18:09:28		17	0.9	1.4	Smoke from fire-end of line
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/28/2017	28	17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	6,500	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes X No
136	270	9:36:45	9:48:25		20	0.6	1	smoke-fires on eastern end of line
135	090	9:51:28	10:03:06		18	0.6	1.1	smoke-fires on eastern end of line
134	270	10:05:57	10:17:25		18	0.6	1.1	
133	090	10:20:38	10:31:30		18	0.6	1.1	
132	270	10:35:07	10:46:04		16	0.6	1.1	
131	090	10:49:11	10:59:52		16	0.7	1.2	
130	270	11:05:17	11:16:07		15	0.7	1.5	
129	090	11:19:22	11:29:47		16	0.7	1.3	
128	270	11:32:53	11:43:53		17	0.7	1.3	

↑ Times entered are Zulu / GMT ↑		Page	1	Verify S-Turns After Mission	Yes	X	No	

Additional Comments:	Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/29/2017	29	17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing / Arriving
	10	clr					none	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
127	270	10:21:41	10:32:48		18	0.6	1.1	
126	090	10:35:41	10:46:55		17	0.6	1.1	
125	270	10:50:09	10:57:04		15	0.7	1.4	
124	090	10:59:44	11:05:28		15	0.7	1.5	
123	270	11:09:37	11:15:30		16	0.7	1.3	
122	090	11:18:20	11:24:18		16	0.7	1.3	
121	270	11:27:49	11:34:28		17	0.6	1.1	
120	090	11:37:25	11:44:09		16	0.7	1.2	
119	270	11:47:44	11:57:27		16	0.7	1.2	
118	090	12:00:04	12:09:40		16	0.7	1.2	
117	270	12:14:25	12:25:25		16	0.7	1.1	
116	090	12:28:25	12:39:00		17	0.6	1	
115	270	12:43:36	12:55:40		16	0.7	1.2	
114	090	13:01:18	13:14:23		15	0.7	1.2	fuel break
113	270	17:40:02	17:53:48		18	0.7	1.1	
112	090	17:56:20	18:05:49		18	0.8	1.3	
111	270	18:09:00	18:18:46		19	0.6	1.1	
110	090	18:20:48	18:30:14		19	0.6	1.1	
109	270	18:32:47	18:42:26		19	0.6	1.1	
108	090	18:44:44	18:50:11		19	0.6	1.1	
107	270	18:53:10	18:58:37		17	0.7	1.4	
106	090	19:00:40	19:06:04		18	0.7	1.4	
105	270	19:08:27	19:13:20		18	0.7	1.4	
104	090	19:15:30	19:20:17		17	0.7	1.5	
103	270	19:22:25	19:25:30		18	0.6	1.3	
102	090	19:27:36	19:29:30		18	0.7	1.4	
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	1/29/2017	29	17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
127	270	10:21:41	10:32:48		18	0.6	1.1	
126	090	10:35:41	10:46:55		17	0.6	1.1	
125	270	10:50:09	10:57:04		15	0.7	1.4	
124	090	10:59:44	11:05:28		15	0.7	1.5	
123	270	11:09:37	11:15:30		16	0.7	1.3	
122	090	11:18:20	11:24:18		16	0.7	1.3	
121	270	11:27:49	11:34:28		17	0.6	1.1	
120	090	11:37:25	11:44:09		16	0.7	1.2	
119	270	11:47:44	11:57:27		16	0.7	1.2	
118	090	12:00:04	12:09:40		16	0.7	1.2	
117	270	12:14:25	12:25:25		16	0.7	1.1	
116	090	12:28:25	12:39:00		17	0.6	1	
115	270	12:43:36	12:55:40		16	0.7	1.2	
114	090	13:01:18	13:14:23		15	0.7	1.2	fuel break
113	270	17:40:02	17:53:48		18	0.7	1.1	
112	090	17:56:20	18:05:49		18	0.8	1.3	
111	270	18:09:00	18:18:46		19	0.6	1.1	
110	090	18:20:48	18:30:14		19	0.6	1.1	
109	270	18:32:47	18:42:26		19	0.6	1.1	
108	090	18:44:44	18:50:11		19	0.6	1.1	
107	270	18:53:10	18:58:37		17	0.7	1.4	
106	090	19:00:40	19:06:04		18	0.7	1.4	
105	270	19:08:27	19:13:20		18	0.7	1.4	
104	090	19:15:30	19:20:17		17	0.7	1.5	
103	270	19:22:25	19:25:30		18	0.6	1.3	
102	090	19:27:36	19:29:30		18	0.7	1.4	
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	2/15/2017		17-6739	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
			100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	6,500	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
52	e	3:34:25	3:36:50			0.7	1.2	
53	e	3:42:45	3:55:38			0.7	1.2	
54	w	3:58:00	4:11:00			0.7	1.1	
55	e	4:13:55	4:26:51			0.7	1.1	
56	w	4:29:39	4:42:33			0.7	1.2	
57	e	4:45:15	4:58:04			0.7	1.2	
58	w	5:00:42	5:13:40			0.7	1.3	
59	e	5:16:39	5:29:33			0.7	1.1	
60	w	5:32:18	5:45:20			0.6	1.1	
61	e	5:48:15	6:00:52			0.6	1.1	
62	w	6:03:57	6:16:34			0.7	1.5	
63	e	6:19:50	6:32:23			0.7	1.7	
64	w	6:35:25	6:48:42			0.7	1.7	
65	e	6:51:26	7:04:10			0.6	1.4	
66	w	7:06:52	7:19:55			0.6	1.2	
67	e	7:22:40	7:35:10			0.7	1.3	
68	w	7:37:45	7:50:42			0.6	1.1	
69	e	7:53:40	8:06:25			0.7	1.2	
70	w	8:08:57	8:22:06			0.7	1.1	
71	e	8:24:30	8:37:00			0.6	1.1	
72	w	8:39:35	8:52:25			0.7	1.2	
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	2/25/2017		17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
73	e	9:37:25	9:50:06		16	0.8	1.3	
74	w	9:53:20	10:05:53		16	0.8	1.5	
75	e	10:09:15	10:22:00		15	0.8	1.3	
76	e	10:25:00	10:37:30		16	0.7	1.2	
77	w	10:40:48	10:54:00		16	0.7	1.2	
78	e	10:56:53	11:09:40		15	0.7	1.1	
79	w	11:12:44	11:25:35		16	0.7	1.3	
80	e	11:30:13	11:43:53		13	0.8	1.1	
81	w	11:46:42	11:59:50		18	0.6	1.7	
82	e	12:02:50	12:16:00		17	0.6	1.2	
83	w	12:18:45	12:31:30		17	0.6	1.3	
84	e	12:34:33	12:46:38		19	0.6	1.3	
85	w	14:36:30	14:48:06		20	0.6	1.2	
86	e	14:50:40	15:00:55		20	0.6	1.1	
87	w	15:03:30	15:12:57		20	0.6	1	
88	e	15:16:00	15:25:40		19	0.6	1.1	
89	w	15:28:30	15:38:48		19	0.6	1.2	
90	e	15:41:04	15:50:06		18	0.6	1.2	
91	w	15:52:36	15:59:31		18	0.7	1.2	
92	e	16:02:15	16:08:48		19	0.6	1.3	
93	w	16:11:17	16:17:20		19	0.6	1.1	
94	e	16:19:57	16:25:45		19	0.6	1.1	
95	w	16:28:04	16:33:14		18	0.6	1.1	
96	e	16:36:05	16:40:45		18	0.6	1.1	
97	w	16:43:18	16:47:37		20	0.6	1.1	
98	e	16:50:20	16:54:20		17	0.6	1	
99	w	16:57:09	17:00:40		17	0.8	1.3	error- sc in fire mode but not receiving
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	2/25/2017		17-6739-02	1	Louisiana

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Other	N35AS				

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
Other	OTHER				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
	10	clr					none	Arriving	

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	50	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts		Ft	6,500	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
73	e	9:37:25	9:50:06		16	0.8	1.3	
74	w	9:53:20	10:05:53		16	0.8	1.5	
75	e	10:09:15	10:22:00		15	0.8	1.3	
76	e	10:25:00	10:37:30		16	0.7	1.2	
77	w	10:40:48	10:54:00		16	0.7	1.2	
78	e	10:56:53	11:09:40		15	0.7	1.1	
79	w	11:12:44	11:25:35		16	0.7	1.3	
80	e	11:30:13	11:43:53		13	0.8	1.1	
81	w	11:46:42	11:59:50		18	0.6	1.7	
82	e	12:02:50	12:16:00		17	0.6	1.2	
83	w	12:18:45	12:31:30		17	0.6	1.3	
84	e	12:34:33	12:46:38		19	0.6	1.3	
85	w	14:36:30	14:48:06		20	0.6	1.2	
86	e	14:50:40	15:00:55		20	0.6	1.1	
87	w	15:03:30	15:12:57		20	0.6	1	
88	e	15:16:00	15:25:40		19	0.6	1.1	
89	w	15:28:30	15:38:48		19	0.6	1.2	
90	e	15:41:04	15:50:06		18	0.6	1.2	
91	w	15:52:36	15:59:31		18	0.7	1.2	
92	e	16:02:15	16:08:48		19	0.6	1.3	
93	w	16:11:17	16:17:20		19	0.6	1.1	
94	e	16:19:57	16:25:45		19	0.6	1.1	
95	w	16:28:04	16:33:14		18	0.6	1.1	
96	e	16:36:05	16:40:45		18	0.6	1.1	
97	w	16:43:18	16:47:37		20	0.6	1.1	
98	e	16:50:20	16:54:20		17	0.6	1	
99	w	16:57:09	17:00:40		17	0.8	1.3	error- sc in fire mode but not receiving
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/2/2017	61	76985	2	Cheiner, LA

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
GALAMBOS	N475RC	820.0	9:18:00	15:18:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
GEBHART	OTHER	825.0	13:40:00	19:40:00	KCLH

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KLCH
040 17 G 24	10	Clear		12	-2	30.32		Arriving	KLCH

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	255	Mode		Threshold Values	
40	35.5	344	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
150	Kts	7800	Ft	7800	Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	14:48:42
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission	Yes / No
				6:41:08				Sensor 8194	
80	E	15:18:35	15:22:33	0:00:00	22	0.6	1	takeoff 1457z	
81	W	15:24:57	15:28:44	0:00:00	22	0.6	1		
82	E	15:31:14	15:34:03	0:00:00	22	0.7	1		
83	W	15:36:48	15:39:03	0:00:00	22	0.7	1	circles	
12	W	16:32:39	16:45:45	0:00:00	20	0.6	1.2		
13	E	16:47:58	17:00:30	0:00:00	20	0.6	1.2		
14	W	17:02:50	17:15:39	0:00:00	20	0.6	1.2		
15	E	17:17:58	17:30:07	0:00:00	20	0.6	1.2		
16	W	17:32:37	17:44:36	0:00:00	18	0.8	1.6		
17	E	17:46:41	17:59:00	0:00:00	18	0.8	1.6		
18	W	18:01:26	18:13:56	0:00:00	18	0.8	1.6		
19	E	18:16:05	18:28:00	0:00:00	18	0.8	1.6		
20	W	18::30:12	18:42:25	0:00:00	18	0.8	1.6		
21	E	18:44:32	18:56:40	0:00:00	17	0.8	1.2		
22	W	18:58:34	19:10:51	0:00:00	17	0.8	1.2		
23	E	19:12:54	19:25:00	0:00:00	17	0.8	1.2		
24	W	19:27:03	19:40:00	0:00:00	17	0.8	1.2		
				0:00:00					
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↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission	Yes X No

Additional Comments:	Drive #
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Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/2/2017	61	76985	2	Cheiner, LA

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
GALAMBOS	N475RC	825.0	9:55:00	3:55:00	WOOLPERT PIN

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
GEBHART	OTHER	828.8	1:13:00	7:13:00	KCLH

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
040 6	10+	Clear		11	1	30.41		Departing	KLCH
								Arriving	KLCH

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	255	Mode		Threshold Values	
40	35.5	344	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
150	Kts	7800	Ft	7800	Ft	Yes		No	X	@ NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	3:16:50
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission	Yes No
				7:52:12				Sensor 8194 - "B" Flight	
40	W	3:55:39	3:56:33	0:00:00	18	0.7	1.2	takeoff:0356z	
39	E	3:58:51	4:00:20	0:00:00	18	0.7	1.2	Tide window 9:30 pm - 2:30am	
38	W	4:03:10	4:05:13	0:00:00	18	0.7	1.2		
37	E	4:07:50	4:10:43	0:00:00	18	0.7	1.2		
36	W	4:13:55	4:18:27	0:00:00	18	0.7	1.2		
35	E	4:21:08	4:28:58	0:00:00	18	0.7	1.2		
41	E	4:32:37	4:33:24	0:00:00	18	0.7	1.2		
34	W	4:35:32	4:48:03	0:00:00	16	0.7	1.8		
33	E	4:50:25	5:05:00	0:00:00	16	0.7	1.8		
32	W	5:06:58	5:21:32	0:00:00	16	0.7	1.8		
31	E	5:23:54	5:38:39	0:00:00	16	0.7	1.8		
30	W	05::40:33	5:55:28	0:00:00	16	0.7	1.8		
29	E	5:57:45	6:12:07	0:00:00	20	0.6	1.1		
28	W	6:14:12	6:28:03	0:00:00	20	0.6	1.1		
27	E	6:30:51	6:43:51	0:00:00	20	0.6	1.1		
26	W	6:45:51	6:58:34	0:00:00	20	0.6	1.1		
25	E	7:00:53	7:13:00	0:00:00	20	0.6	1.1		
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↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission	Yes X No

Additional Comments:	Drive #
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Section 7: Final Deliverables

The final lidar deliverables are listed below.

- LAS v1.4 classified point cloud
- LAS v1.4 raw unclassified point cloud flight line strips.
- Hydro Breaklines as ESRI GDB
- Bridge Breaklines as ESRI GDB
- Digital Elevation Model in TIF format
- Digital Surface Model in TIF format
- 8-bit gray scale intensity images in TIF format
- Tile layout provided as ESRI shapefile
- Control Points provided as ESRI shapefile
- Flight Lines in ESRI Shapefile
- FGDC compliant metadata per product in XML format
- Lidar processing report in pdf format
- Survey report in pdf format