Airborne LiDAR Report

MESA COUNTY CO QL2 LIDAR

Contract Number: G10PC00057
Task Number: G15PD00937

Contractor: Woolpert, Inc.
Woolpert Project # 75927

October 2016

Airborne LiDAR Report

UNITED STATES GEOLOGICAL SURVEY

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Section 1: Overview

TASK ORDER NAME: Mesa County CO QL2 Lidar

Project: # 75927

This report contains a comprehensive outline of the Mesa County CO QL2 Lidar Processing task order for the United States Geological Survey (USGS). This task is issued under USGS Contract No. G10PC00057, Task Order No. G15PD00937. This task order requires lidar data to be acquired portions of Mesa County, Colorado (approximately 3,341 square miles). The lidar was collected and processed to meet a maximum Nominal Post Spacing (NPS) of 0.7 meters with a point density of 2 points per square meter. In addition to the QL2 collection, an area of approximately 6 square miles within the main AOI will be collected at QL1. The nominal pulse spacing (NPS) will be .35 meters with a point density of 8 points per square meter. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.

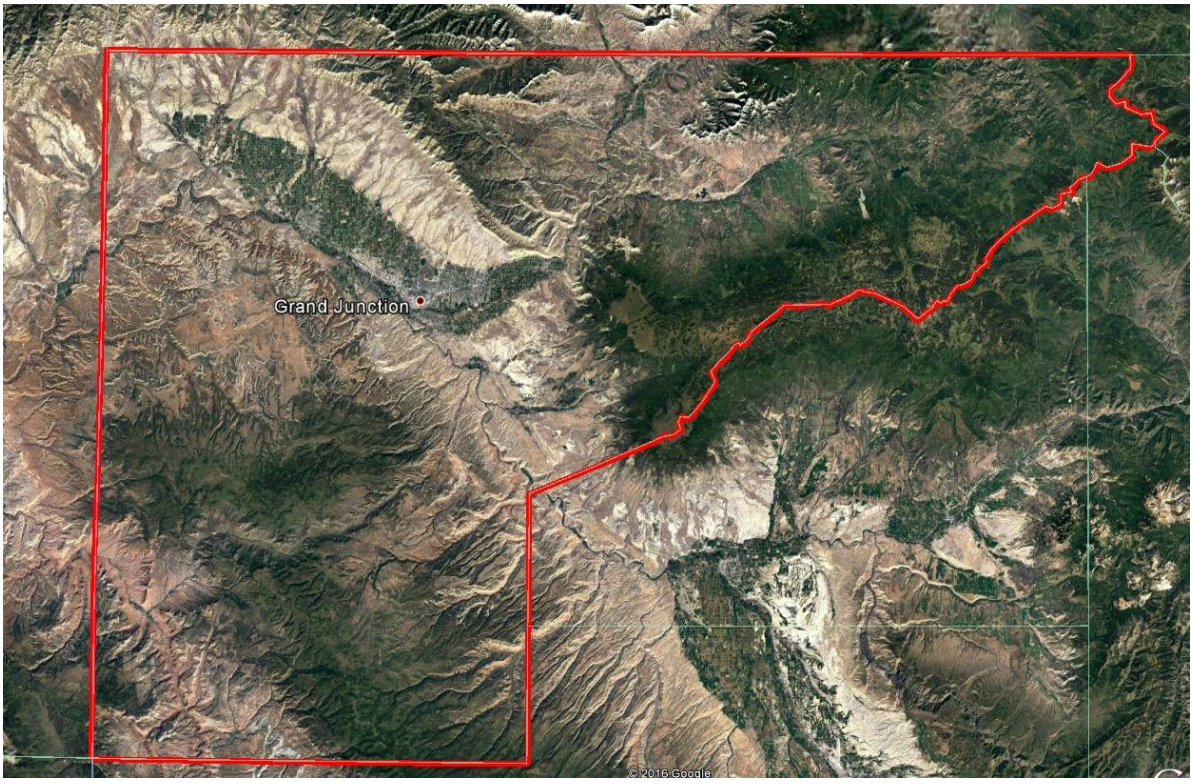
The data was collected using two Leica ALS80 HP 1000 kHz Multiple Pulses in Air (MPiA) lidar systems on board Woolpert aircraft. The ALS80 sensor collects up to four returns per pulse, as well as intensity data, for the first three returns. If a fourth return was captured, the system does not record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

Table 1.1: ALS80 Specifications	MesaCo_QL1	MesaCo_QL2
Post Spacing	0.35 m	0.7 m
AGL (Above Ground Level) average flying height	1,524 m	1,981 m
Average Ground Speed:	130 knots	150 knots
Field of View (full)	20 degrees	40 degrees
Pulse Rate	343 kHz	272 kHz
Scan Rate	66.2 Hz	51 Hz
Side Lap	25%	25%

The majority of QL2 project area is in NAD83 HARN UTM Zone 12N, SV Feet. A portion of the project falls within NAD83 HARN UTM Zone 13N, SV Feet. Data was calibrated and processed in NAD83 HARN UTM Zone 12N and later reprojected to NAD83 HARN UTM Zone 13N for product generation. Accuracies were reported on the data as it existed in UTM12N. Control Coordinates are being provided in NAD83 HARN, UTM12 and UTM13.
Part of this task order consists of approximately 6 square miles of data collected at USGS QL1 specification provided in NAD83 HARN UTM Zone 13N, SV Feet. The vertical datum used for the project was referenced to NAVD 1988, SV Feet, GEOID12B.

Figure 1.1: Mesa County QL1 Area Lidar Task Order AOI

Figure 1.2: Mesa County QL2 Area Lidar Task Order AOI



Section 2: Acquisition

The lidar data was acquired with a Leica ALS80HP 1000 kHz Multiple Pulses in Air (MPiA) Lidar Sensor System. 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

Prior to mobilizing to the project site, Woolpert 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 thirty two (32) mission, 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.

Figure 2.1: LiDAR Flight Layout, Mesa County QL1 Area Lidar

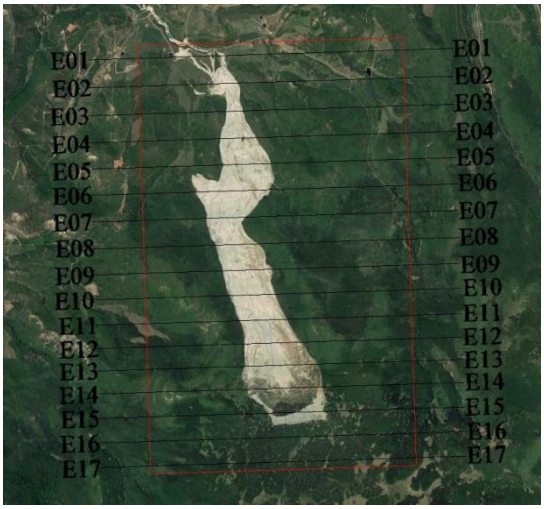


Figure 2.2: LiDAR Flight Layout, Mesa County QL2 Area Lidar

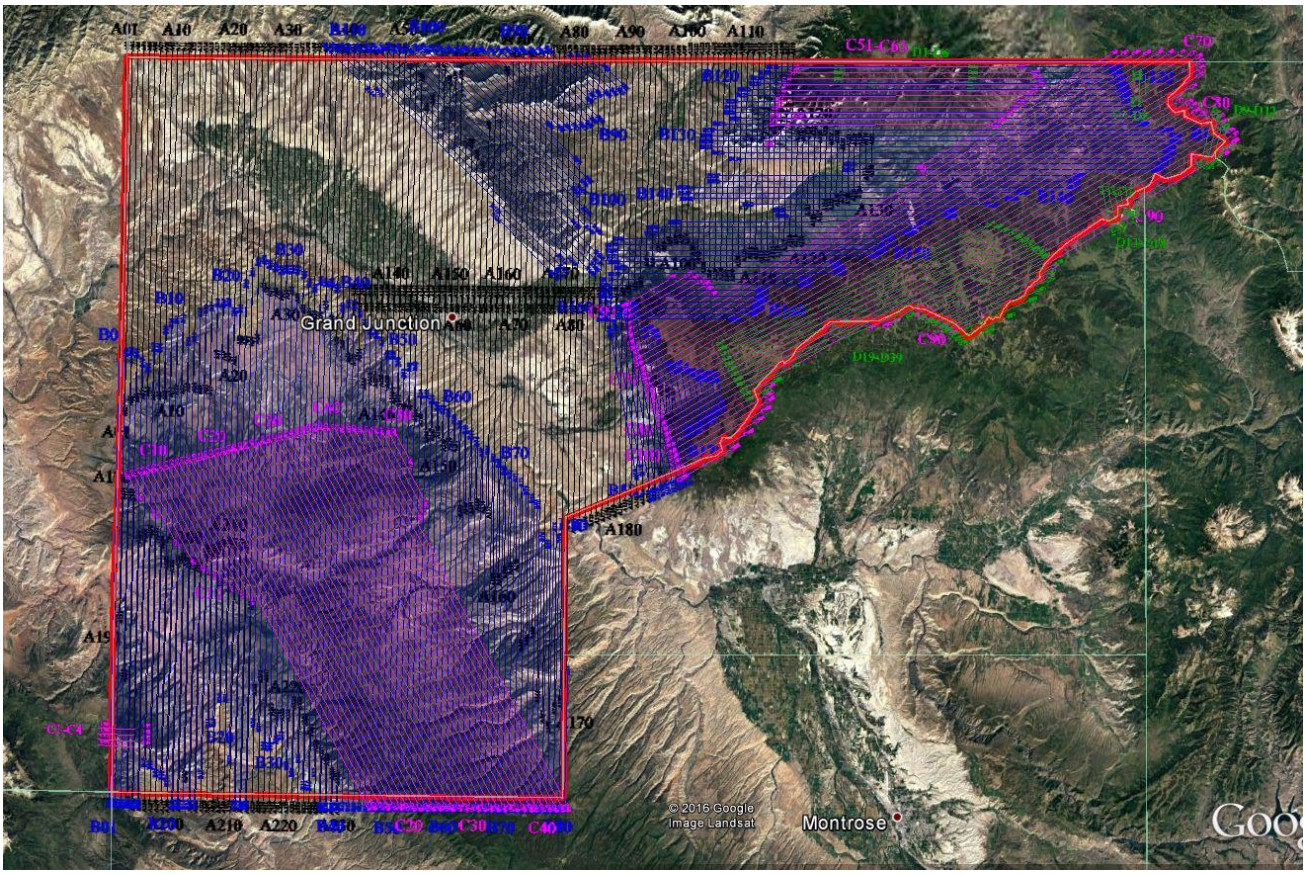


Table 2.2: Airborne Lidar Acquisition Flight Summary

Date of Mission	Lines Flown	Mission Time (UTC) Wheels Up/ Wheels Down
November 1, 2015- SH7234	E1-E17, D01-D09	19:30 - 22:45
November 2, 2015- SH7234_A and B	D13-D30, D37-D39	15:30 - 20:50
November 12, 2016-SH8170	A01-A02, A26-A41	18:20 - 22:25
November 13, 2016-SH8170_A and B	A42-A80	15:30 - 23:25
November 15, 2016-SH8170	A10-A25	15:15 – 19:00
November 20, 2016-SH8170	A01-A10	17:30 -20:40
March 12, 2016-SH8170	A07-A10,A133-A152,A229,A230	15:20 – 19:20
March 13, 2016-SH8170	A153-A181,A186,A187	15:00 – 21:25
March 15, 2016-SH8170	A182-A189,A209-A228	18:30 – 22:19
March 16, 2016-SH8170	A86-A89,A190-A208	17:10 – 21:52
March 17, 2016-SH8170	B80-B88,B106-B116,B176-B180	15:45 – 20:10
May 18, 2016-SH8191	81-132	15:01 - 21:40
May 19, 2016-SH8191	104-105	14:52 – 16:09
May 20, 2016-SH8191	79,98-105	14:30 - 17:00
May 21, 2016-SH8191	82-97,117-126	14:45 – 19:00
May 22, 2016-SH8191	59-78	14:46 - 19:25
May 23, 2016-SH8191	1-22	14:59 – 21:00
May 26, 2016-SH8191	58,163-176	15:17 - 18:33
May 28, 2016-SH8191	23-30,104,105,112,113,115	15:05 – 19:03
May 29, 2016-SH8191	31-36	15:25 - 17:40
May 30, 2016-SH8191	36-53	14:13 - 19:29
May 31, 2016-SH8191	1-10,49,50,54-59,77	14:45 - 19:00
June 1, 2016-SH8191	11-14,30-49,114	14:30 - 21:30
June 2, 2016-SH8191	58-65,93	15:30 - 17:50
July 13, 2016-SH8194_A and B	D22,D30-D39,C51-C57,C94-C99,C66-C73	14:00 - 20:25
July 14, 2016-SH8194	C74-C92,C100-C106	13:42 - 19:50
July 15, 2016-SH8194	C2,C3,C8-C10,C15-C29,C40,C42-C45,C50,B34,B35,B51	14:00 - 20:01
July 16, 2016-SH8194	B127-B148	13:57 – 18:48
July 17, 2016-SH8194	B149-B165	13:45-16:13

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. 16.01., 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.16.01.
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.16.01.

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

Equipment

Flight navigation during the lidar data acquisition mission is performed using IGI CCNS (Computer Controlled Navigation System). 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.

A base-station unit was mobilized for each acquisition mission where a CORS station was not utilized. Each base-station setup consisted of one Trimble 4000 – 5000 series dual frequency receiver, one Trimble Compact L1/L2 dual frequency antenna, one 2-meter fixed-height tripod, and essential battery power and cabling. Ground planes were used on the base-station antennas. Data was collected at 1 or 2 Hz.

The GNSS base station and CORS stations operated during the Lidar acquisition missions is listed below:

Table 3.1: GNSS/CORS Base Station

Station (Name)	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height (L1 Phase center) (Meters)
KGJT Airport Base	39°07'14.21302"	108°31'17.11156"	1457.493
KGJT Airport Base-2	39°07'14.21920"	108°31'17.09770"	1457.494
KGJT Airport Base-3	39°07'14.22556"	108°31'17.08630"	1457.505
MC07 CORS	39°19'03.97978"	108°12'46.31175"	1489.105
MC01 CORS	39°05'28.39211"	108°31'41.26976"	1438.099
MC04 CORS	38°41'02.97516"	108°58'25.82372"	1401.747
MC02 CORS	39°00'52.89775"	108°29'24.11236"	1491.353

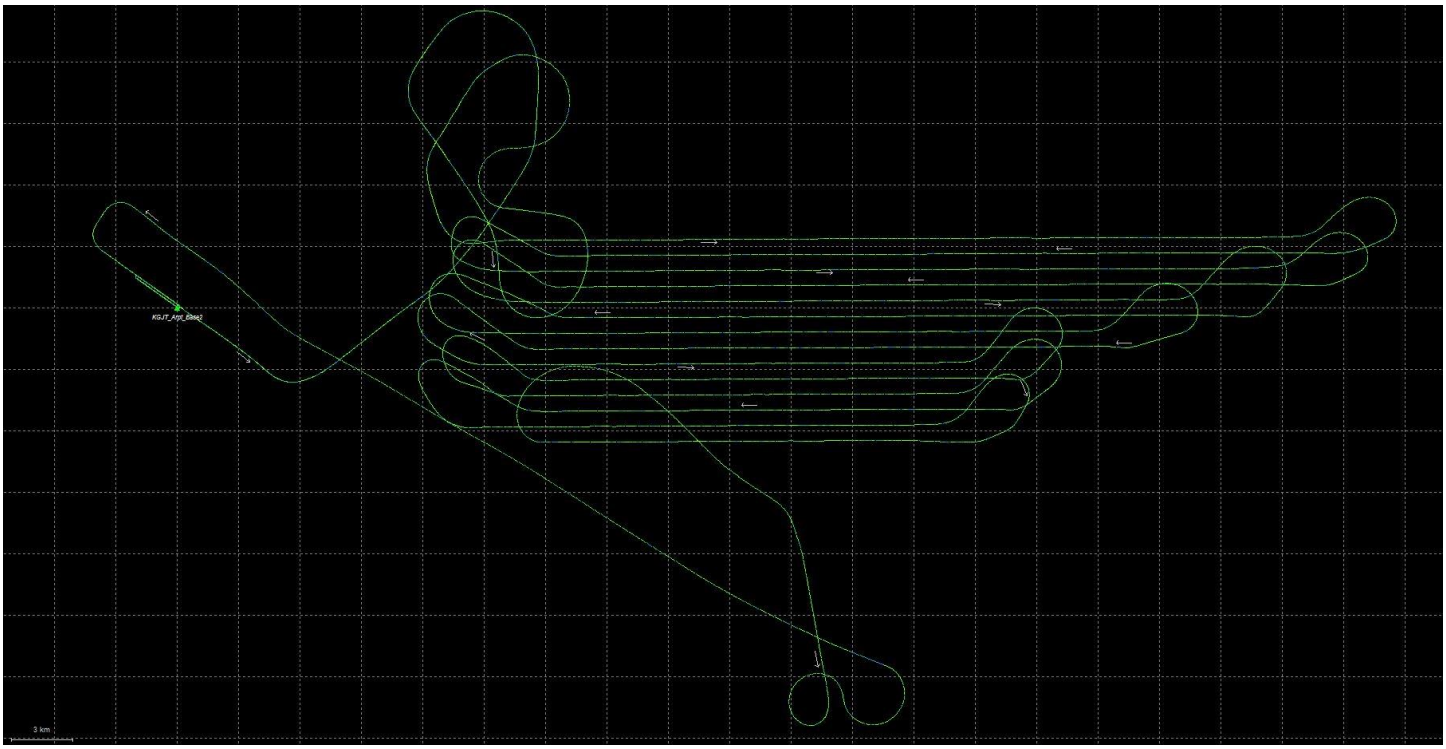
Data Processing

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, Day19916_SH8194

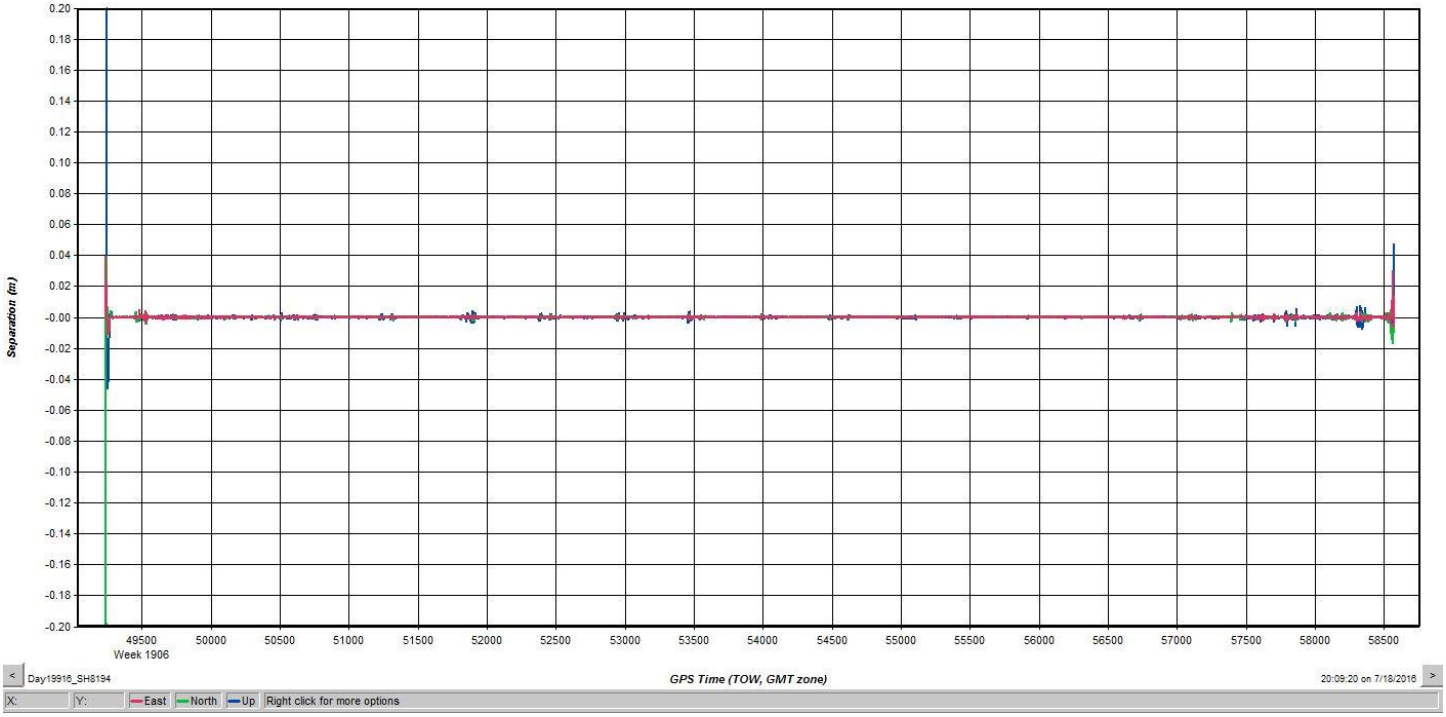


Combination Separation

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, Day19916_SH8194

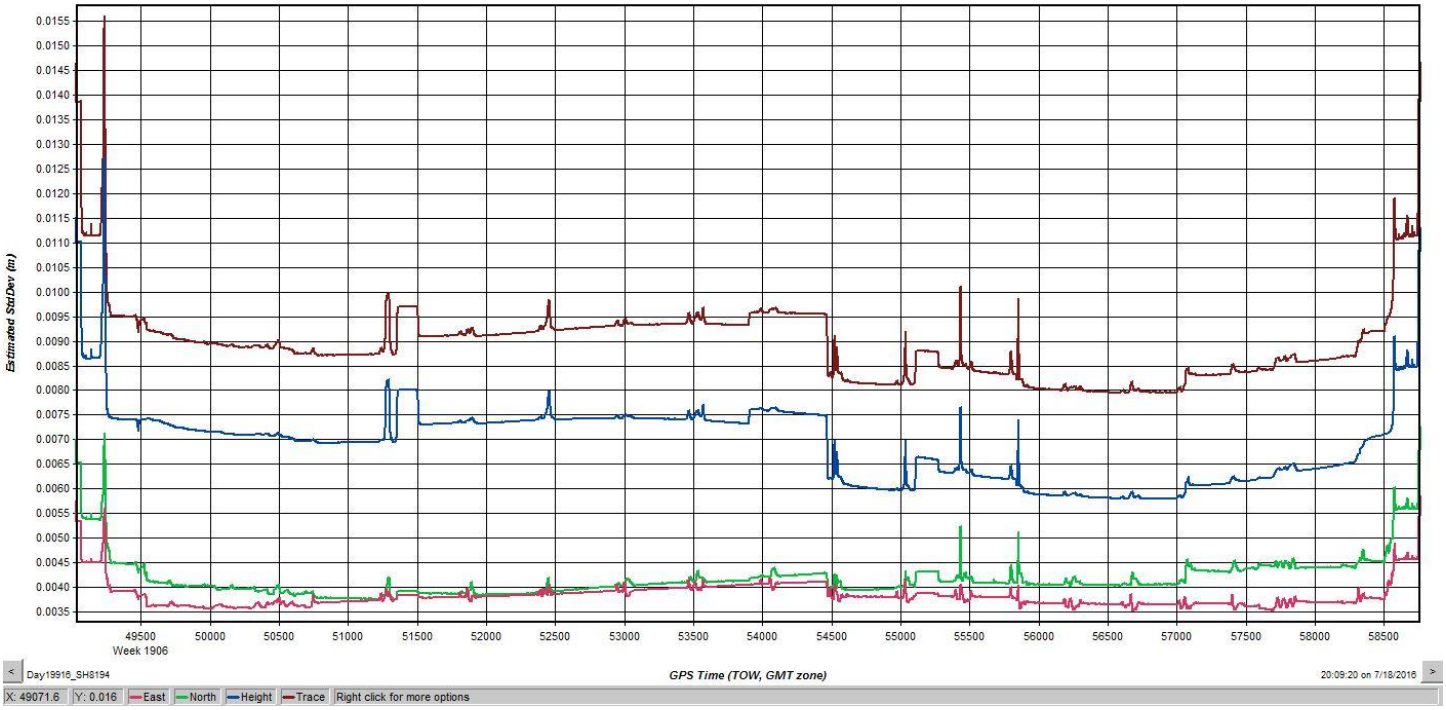


Estimated Positional Accuracy

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, Day19916_SH8194

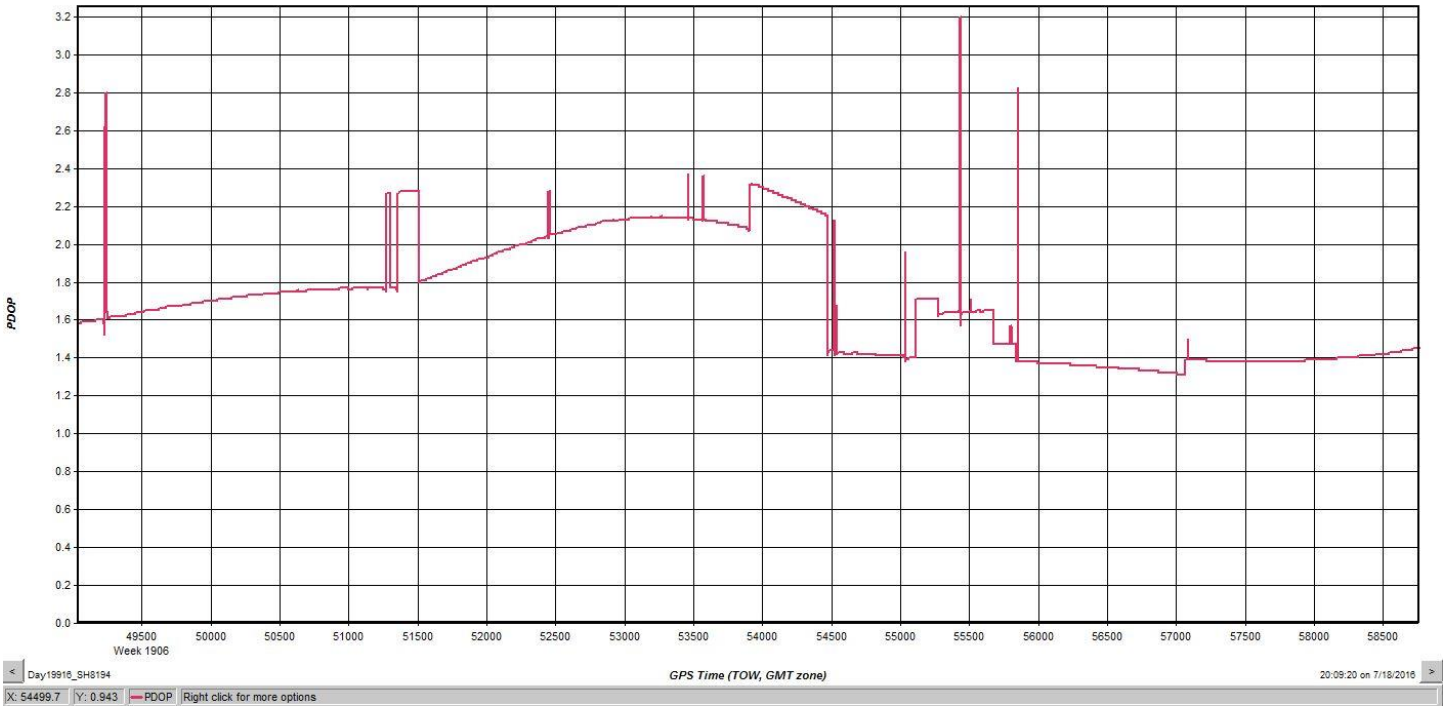


PDOP

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, Day19916_SH8194



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 Default (Class 1), Ground (Class 2), Low noise (Class 7), Water (Class 9), Ignored ground (Class 10), Bridge Decks (Class 17), High Noise (Class 18) classifications.
- FGDC Compliant metadata was developed for the task order in .xml format per product.

Section 4: Hydrologic Flattening

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

Mesa County CO QL2 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.

1. Woolpert used the newly acquired lidar data to manually draw the hydrologic features in a 2D environment using the lidar intensity and bare earth surface. Open Source imagery was used as reference when necessary.
2. Woolpert utilizes an integrated software approach to combine the lidar data and 2D breaklines. This process “drapes” the 2D breaklines onto the 3D lidar surface model to assign an elevation. A monotonic process is performed to ensure the streams are consistently flowing in a gradient manner. A secondary step within the program verifies an equally matching elevation of both stream edges. The breaklines that characterize the closed water bodies are draped onto the 3D lidar surface and assigned a constant elevation at or just below ground elevation.
3. 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.
4. All ground points were reclassified from inside the hydrologic feature polygons to water, class nine (9).
5. All ground points were reclassified from within a buffer along the hydrologic feature breaklines to buffered ground, class ten (10).
6. The lidar ground points and hydrologic feature breaklines were used to generate a new digital elevation model (DEM).

Figure 4.1: Example Hydrologic Breaklines

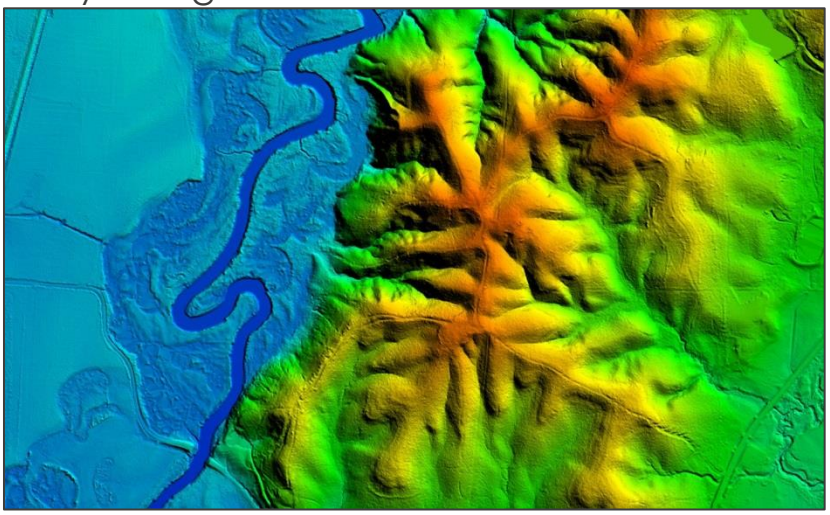


Figure 4.2 reflects a DEM generated from original lidar bare earth point data prior to the hydrologic flattening process. Note the "tinning" across the lake surface.

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 ERDAS .IMG format.

The hydrologic breaklines compiled as part of the flattening process were provided to the USGS as an ESRI Shapefile 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 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 v15, 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

Final Vertical Accuracy Assessment

The vertical accuracy statistics were calculated by comparison of the LiDAR bare earth points to the ground surveyed QA/QC points.

Table 5.1: Overall Vertical Accuracy Statistics		
Average error	+0.001	Feet
Minimum error	-0.390	Feet
Maximum error	+0.396	Feet
Average magnitude	0.087	Feet
Root mean square	0.111	Feet
Standard deviation	0.112	Feet

Table 5.2: RAW Swath Quality Check Point Analysis NVA

Point ID	Easting (Feet)	Northing (Feet)	Elevation (Feet)	TIN Elevation (Feet)	Dz (Feet)
2001	2243540.716	13991734.828	4718.101	4718.130	0.029
2002	2232113.580	14018839.767	4659.403	4659.470	0.067
2002A	2233386.540	14016933.971	4665.926	4666.110	0.184
2003	2218807.029	14053747.598	4621.047	4620.850	-0.197
2004	2281371.710	14082966.457	6771.755	6771.700	-0.055
2004A	2284543.994	14085707.425	6778.907	6779.090	0.183
2004B	2284559.545	14085694.243	6777.644	6778.040	0.396
2004C	2281330.080	14082915.354	6772.677	6772.630	-0.047
2005	2331559.900	14114805.251	6617.608	6617.790	0.182
2005A	2331556.062	14114783.575	6617.930	6618.030	0.100
2005C	2332861.322	14115714.859	6553.799	6553.690	-0.109
2006	2406012.553	14121226.177	5272.368	5272.370	0.002
2006A	2405982.983	14121256.469	5269.819	5269.870	0.051
2007	2197525.907	14150056.952	6445.925	6445.800	-0.125
2007A	2197499.539	14150058.911	6445.174	6445.080	-0.094
2008	2242006.303	14165998.010	6505.335	6505.280	-0.055
2008A	2242030.595	14166033.262	6505.958	6505.880	-0.078
2009	2282160.324	14170968.347	6869.110	6869.090	-0.020
2009A	2282164.809	14170905.664	6869.924	6869.870	-0.054
2010	2192577.721	14238858.838	4765.893	4765.780	-0.113
2010A	2192629.230	14238855.869	4768.160	4768.170	0.010
2011	2225498.649	14251415.178	4762.061	4761.990	-0.071
2011A	2225508.577	14251371.874	4761.762	4761.650	-0.112
2012	2192177.820	14295408.574	5245.249	5245.330	0.081
2012A	2192175.790	14295439.778	5246.564	5246.700	0.136
2013	2211952.590	14297416.336	4922.083	4922.160	0.077

2013A	2211967.623	14297375.887	4922.530	4922.500	-0.030
2014	2257299.025	14298121.981	4937.654	4937.670	0.016
2014A	2257316.040	14298139.094	4937.133	4937.070	-0.063
2015	2259167.296	14268283.835	4771.309	4771.440	0.131
2015A	2259135.518	14268283.537	4770.765	4770.880	0.115
2016	2282828.958	14226945.257	4502.557	4502.790	0.233
2016A	2282801.445	14226927.619	4499.715	4499.940	0.225
2017	2289968.632	14291015.043	5359.510	5359.560	0.050
2017A	2289967.667	14291067.927	5361.426	5361.410	-0.016
2018	2308662.948	14257813.515	4916.155	4916.140	-0.015
2018A	2308690.212	14257799.604	4916.253	4916.160	-0.093
2019	2332421.542	14214192.323	4721.398	4721.360	-0.038
2019A	2332424.456	14214166.411	4721.017	4721.020	0.003
2020	2365709.442	14168795.796	4666.897	4666.980	0.083
2020A	2365727.791	14168784.848	4666.936	4667.170	0.234
2021	2423703.696	14172388.115	7244.838	7244.780	-0.058
2021A	2423678.086	14172436.665	7241.462	7241.340	-0.122
2022	2389348.249	14212656.059	4716.414	4716.410	-0.004
2022A	2389401.350	14212674.288	4716.474	4716.510	0.036
2023	2413014.085	14240144.416	4835.751	4835.960	0.209
2024	2418758.479	14272773.429	4855.351	4855.390	0.039
2024A	2418722.607	14272796.477	4855.368	4855.460	0.092
2025	2366811.474	14279310.099	6070.158	6070.240	0.082
2025A	2366774.971	14279325.152	6069.850	6069.750	-0.100
2026	2377106.141	14305279.949	5826.550	5826.640	0.090
2027	2438295.392	14304702.106	4975.656	4975.640	-0.016
2027A	2438240.370	14304683.723	4975.321	4975.350	0.029
2028	2465675.515	14306058.081	5960.441	5960.480	0.039
2028A	2465633.884	14306015.049	5960.205	5960.230	0.025
2029	2450440.322	14245107.950	5174.796	5174.830	0.034
2029A	2450399.820	14245071.067	5174.465	5174.650	0.185
2029B	2452703.556	14266852.293	6050.303	6050.350	0.047
2029C	2452788.700	14266848.930	6057.370	6057.440	0.070
2030	2451611.537	14202156.048	8047.894	8047.980	0.086
2030A	2451626.570	14202200.920	8045.630	8045.740	0.110
2031	2479088.703	14186629.635	10732.643	10732.700	0.057
2031A	2479142.998	14186629.379	10733.154	10733.220	0.066
2032	2504299.348	14214250.495	9815.715	9815.690	-0.025
2032A	2504225.057	14214223.081	9805.738	9805.740	0.002
2033	2502563.961	14265385.862	6169.194	6169.300	0.106
2033A	2502637.990	14265392.670	6171.569	6171.670	0.101
2034	2524107.045	14273986.153	6869.760	6869.860	0.100
2034A	2524135.086	14274042.075	6870.334	6870.380	0.046
2035	2548297.791	14240405.817	8892.121	8892.070	-0.051
2035A	2548343.384	14240304.912	8891.406	8891.310	-0.096

2036	2557032.616	14256069.516	8131.404	8131.170	-0.234
2036A	2557025.923	14256130.687	8129.708	8129.560	-0.148
2037	2552794.333	14277146.862	7223.873	7223.930	0.057
2037A	2552693.205	14277246.813	7222.505	7222.530	0.025
2038	2566949.587	14285144.002	7475.982	7475.890	-0.092
2038A	2567004.738	14285164.730	7471.022	7470.900	-0.122
2039	2588725.065	14310986.142	6886.085	6886.110	0.025
2039A	2588742.890	14311045.016	6883.569	6883.600	0.031
2040	2580590.446	14299403.888	7943.459	7943.420	-0.039
2040A	2580546.656	14299477.185	7941.401	7941.380	-0.021
2041	2576896.391	14271018.964	7813.154	7813.180	0.026
2041A	2576925.519	14270985.073	7814.377	7814.460	0.083
2042	2624135.316	14282853.471	7855.194	7855.070	-0.124
2042A	2623983.919	14282894.121	7848.455	7848.330	-0.125
2043	2616173.534	14291218.698	7612.632	7612.480	-0.152
2043A	2616383.445	14291183.740	7607.134	7607.050	-0.084
2044	2606540.233	14304084.528	7067.453	7067.360	-0.093
2044A	2606590.499	14303944.453	7077.043	7076.980	-0.063
2045	2627110.874	14297569.974	9405.368	9405.200	-0.168
2045A	2627299.663	14297529.125	9401.740	9401.540	-0.200
2046	2217627.664	14150387.677	6831.535	6831.500	-0.035
2046A	2217662.527	14150387.529	6832.808	6832.720	-0.088
2047	2269269.966	14165847.990	6743.376	6743.350	-0.026
2047A	2269299.756	14165879.388	6742.513	6742.520	0.007
2048	2281614.033	14130671.676	8738.778	8738.960	0.182
2048A	2281570.988	14130709.452	8737.804	8737.860	0.056
2049	2250867.470	14114647.469	9072.170	9072.170	0.000
2049A	2250916.407	14114637.312	9071.662	9071.530	-0.132
2050	2230441.261	14133171.802	8086.857	8086.770	-0.087
2050A	2230421.271	14133224.319	8084.652	8084.560	-0.092
2051	2239750.685	14117974.671	9073.663	9073.530	-0.133
2051A	2239819.303	14117984.231	9076.068	9075.940	-0.128
2052	2201730.557	14074782.585	4536.562	4536.680	0.118
2052A	2201703.707	14074796.588	4537.094	4537.300	0.206
2053	2193616.059	14214491.449	4605.690	4605.590	-0.100
2054	2251201.944	14202733.350	6797.250	6796.860	-0.390
2054A	2251201.341	14202741.348	6796.801	6796.650	-0.151
2055	2350784.039	14133720.991	5974.434	5974.430	-0.004
2055A	2350773.222	14133744.180	5972.924	5972.950	0.026
2056	2340424.240	14275101.371	7060.268	7060.390	0.122
2056A	2340421.110	14275136.991	7059.838	7059.940	0.102
2057	2322102.426	14291886.521	7226.190	7226.200	0.010
2057A	2322080.484	14291802.194	7232.800	7232.810	0.010
2058	2350330.890	14253034.509	6957.965	6957.940	-0.025
2058A	2350369.020	14252992.649	6956.098	6956.230	0.132

2059	2434117.566	14268354.222	5282.050	5282.030	-0.020
2059A	2434111.333	14268304.436	5283.628	5283.670	0.042
2060	2465557.526	14201032.543	9330.450	9330.490	0.040
2060A	2465587.251	14201015.686	9334.420	9334.540	0.120
2061	2426663.906	14160265.308	6036.520	6036.400	-0.120
2062	2353887.608	14094978.660	7233.729	7233.710	-0.019
2063	2318252.870	14048994.297	8292.972	8292.920	-0.052
2064	2336361.187	14030991.275	8670.823	8670.590	-0.233
2065	2293964.037	14016268.772	8509.550	8509.510	-0.040
2066	2259896.081	14037364.051	6486.060	6485.930	-0.130
2067	2340503.987	14233160.667	5015.466	5015.410	-0.056
2067A	2340521.530	14233194.496	5016.745	5016.790	0.045
2068	2383043.548	14261883.451	6539.734	6539.860	0.126
2068A	2383067.822	14261923.733	6537.247	6537.250	0.003
2069	2453162.256	14287133.935	5667.935	5668.010	0.075
2069A	2453204.700	14287178.893	5671.084	5670.920	-0.164
2070	2508994.185	14232011.667	8129.695	8129.530	-0.165
2070A	2509045.379	14231955.821	8135.961	8135.880	-0.081
2071	2524839.366	14244685.946	7630.283	7630.290	0.007
2071A	2524944.015	14244595.900	7641.107	7640.960	-0.147
2072	2513661.652	14249028.966	6789.626	6789.650	0.024
2072A	2513728.398	14249054.379	6784.750	6784.820	0.070
2073	2543569.486	14260769.720	8009.639	8009.600	-0.039
2073A	2543574.985	14260656.492	8007.130	8007.060	-0.070
2074	2292237.820	14132350.948	8608.346	8608.400	0.054
2075	2335136.294	14187524.243	4643.672	4643.780	0.108
2075A	2335130.159	14187466.713	4644.118	4644.210	0.092
2076	2312454.118	14183376.686	5056.158	5056.110	-0.048
2076A	2312468.669	14183314.678	5056.735	5056.740	0.005
2077	2275978.801	14192647.920	6857.726	6857.580	-0.146
2078	2276154.650	14002538.330	5844.106	5844.060	-0.046
2079	2451334.084	14235250.381	5672.039	5672.250	0.211
2079A	2451288.126	14235248.445	5672.525	5672.610	0.085
2080	2451839.594	14217297.379	6652.749	6652.780	0.031
2080A	2451843.079	14217252.697	6652.152	6652.150	-0.002
2081	2398149.984	14207254.758	4963.563	4963.620	0.057
2081A	2398145.256	14207202.625	4966.056	4966.030	-0.026
2082	2381291.248	14149032.309	4843.842	4843.820	-0.022
2082A	2381305.838	14149018.733	4844.278	4844.190	-0.088
2083	2364535.989	14209639.002	4781.152	4781.100	-0.052
2083A	2364555.632	14209670.406	4781.506	4781.460	-0.046
2084	2501778.500	14283825.756	7148.270	7148.220	-0.050
2084A	2501763.966	14283895.946	7154.671	7154.710	0.039
2085	2533272.082	14291094.256	7996.332	7996.130	-0.202
2085A	2533254.185	14291167.100	7996.798	7996.690	-0.108

2086	2601703.310	14238724.209	9021.406	9021.760	0.354
2086A	2601692.648	14238787.155	9020.290	9020.400	0.110
2087	2597646.566	14253920.777	8505.761	8505.960	0.199
2087A	2597643.423	14254021.334	8503.310	8503.500	0.190
2088	2594753.836	14265746.662	8247.490	8247.550	0.060
2088A	2594775.152	14265653.004	8248.793	8248.880	0.087
2089	2583203.013	14266340.096	8173.547	8173.340	-0.207
2089A	2583198.971	14266344.249	8173.133	8172.950	-0.183
2090	2477528.861	14248412.445	5549.228	5549.240	0.012
2090A	2477556.774	14248469.508	5548.752	5548.840	0.088
2091	2477901.363	14261071.865	5892.026	5892.140	0.114
2091A	2477859.490	14261104.457	5891.819	5891.950	0.131
2093	2420039.720	14293712.771	5055.912	5055.980	0.068
2093A	2420103.204	14293723.903	5056.187	5056.100	-0.087
2094	2411348.028	14284091.645	5023.724	5023.720	-0.004
2094A	2411327.441	14284128.334	5022.916	5022.930	0.014
2095	2392477.226	14279763.471	5495.140	5495.040	-0.100
2095A	2392430.038	14279743.406	5495.481	5495.390	-0.091
2096	2390271.384	14173816.216	5037.316	5037.340	0.024
2096A	2390216.125	14173811.655	5036.191	5036.200	0.009
2097	2319404.298	14163763.726	5914.135	5914.050	-0.085
2097A	2319396.710	14163807.594	5911.494	5911.420	-0.074
2098	2440718.396	14220464.607	6693.674	6693.760	0.086
2098A	2440677.674	14220486.342	6693.855	6693.940	0.085
2099	2247631.889	14089039.548	6232.366	6232.230	-0.136
2099A	2247629.114	14089019.466	6231.480	6231.420	-0.060
2099B	2244375.705	14087059.913	6007.688	6007.600	-0.088
2100	2474627.633	14233551.109	6612.743	6612.790	0.047
2100A	2474641.068	14233593.409	6612.461	6612.470	0.009

VERTICAL ACCURACY CONCLUSIONS

Raw Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.217 Feet Non vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 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 points.

LAS Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.229 Feet Non vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 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 ground points.

Table 5.3: NVA Check Point Analysis DEM					
Point ID	Easting (Feet)	Northing (Feet)	Elevation (Feet)	DEM Elevation (Feet)	Dz (Feet)
2001	2243540.716	13991734.828	4718.101	4718.149	-0.048
2002	2232113.580	14018839.767	4659.403	4659.559	-0.156
2002A	2233386.540	14016933.971	4665.926	4666.009	-0.083
2003	2218807.029	14053747.598	4621.047	4620.849	0.198
2004	2281371.710	14082966.457	6771.755	6771.697	0.058
2004A	2284543.994	14085707.425	6778.907	6779.077	-0.170
2004B	2284559.545	14085694.243	6777.644	6777.967	-0.323
2004C	2281330.080	14082915.354	6772.677	6772.667	0.010
2005	2331559.900	14114805.251	6617.608	6617.827	-0.219
2005A	2331556.062	14114783.575	6617.930	6618.107	-0.177
2005C	2332861.322	14115714.859	6553.799	6553.596	0.203
2006	2406012.553	14121226.177	5272.368	5272.431	-0.063
2006A	2405982.983	14121256.469	5269.819	5269.801	0.018
2007	2197525.907	14150056.952	6445.925	6445.836	0.089
2007A	2197499.539	14150058.911	6445.174	6445.056	0.118
2008	2242006.303	14165998.010	6505.335	6505.296	0.039
2008A	2242030.595	14166033.262	6505.958	6505.896	0.062
2009	2282160.324	14170968.347	6869.110	6869.018	0.092
2009A	2282164.809	14170905.664	6869.924	6869.898	0.026
2010	2192577.721	14238858.838	4765.893	4765.839	0.054
2010A	2192629.230	14238855.869	4768.160	4768.169	-0.009
2011	2225498.649	14251415.178	4762.061	4762.019	0.042
2011A	2225508.577	14251371.874	4761.762	4761.629	0.133
2012	2192177.820	14295408.574	5245.249	5245.441	-0.192
2012A	2192175.790	14295439.778	5246.564	5246.611	-0.047
2013	2211952.590	14297416.336	4922.083	4922.170	-0.087
2013A	2211967.623	14297375.887	4922.530	4922.560	-0.030
2014	2257299.025	14298121.981	4937.654	4937.680	-0.026
2014A	2257316.040	14298139.094	4937.133	4937.000	0.133
2015	2259167.296	14268283.835	4771.309	4771.539	-0.230
2015A	2259135.518	14268283.537	4770.765	4770.689	0.076
2016	2282828.958	14226945.257	4502.557	4502.618	-0.061
2016A	2282801.445	14226927.619	4499.715	4500.018	-0.303
2017	2289968.632	14291015.043	5359.510	5359.471	0.039
2017A	2289967.667	14291067.927	5361.426	5361.241	0.185
2018	2308662.948	14257813.515	4916.155	4916.160	-0.005
2018A	2308690.212	14257799.604	4916.253	4916.090	0.163
2019	2332421.542	14214192.323	4721.398	4721.309	0.089
2019A	2332424.456	14214166.411	4721.017	4721.109	-0.092
2020	2365709.442	14168795.796	4666.897	4667.059	-0.162
2020A	2365727.791	14168784.848	4666.936	4667.159	-0.223
2021	2423703.696	14172388.115	7244.838	7244.579	0.259

2021A	2423678.086	14172436.665	7241.462	7241.169	0.293
2022	2389348.249	14212656.059	4716.414	4716.429	-0.015
2022A	2389401.350	14212674.288	4716.474	4716.489	-0.015
2023	2413014.085	14240144.416	4835.751	4836.039	-0.288
2024	2418758.479	14272773.429	4855.351	4855.399	-0.048
2024A	2418722.607	14272796.477	4855.368	4855.519	-0.151
2025	2366811.474	14279310.099	6070.158	6070.174	-0.016
2025A	2366774.971	14279325.152	6069.850	6069.784	0.066
2026	2377106.141	14305279.949	5826.550	5826.713	-0.163
2027	2438295.392	14304702.106	4975.656	4975.620	0.036
2027A	2438240.370	14304683.723	4975.321	4975.260	0.061
2028	2465675.515	14306058.081	5960.441	5960.424	0.017
2028A	2465633.884	14306015.049	5960.205	5960.294	-0.089
2029	2450440.322	14245107.950	5174.796	5174.971	-0.175
2029A	2450399.820	14245071.067	5174.465	5174.641	-0.176
2029B	2452703.556	14266852.293	6050.303	6050.334	-0.031
2029C	2452788.700	14266848.930	6057.370	6057.574	-0.204
2030	2451611.537	14202156.048	8047.894	8047.842	0.052
2030A	2451626.570	14202200.920	8045.630	8045.532	0.098
2031	2479088.703	14186629.635	########	#########	-0.290
2031A	2479142.998	14186629.379	########	#########	-0.239
2032	2504299.348	14214250.495	9815.715	9815.699	0.016
2032A	2504225.057	14214223.081	9805.738	9805.749	-0.011
2033	2502563.961	14265385.862	6169.194	6169.225	-0.031
2033A	2502637.990	14265392.670	6171.569	6171.715	-0.146
2034	2524107.045	14273986.153	6869.760	6869.828	-0.068
2034A	2524135.086	14274042.075	6870.334	6870.348	-0.014
2035	2548297.791	14240405.817	8892.121	8892.096	0.025
2035A	2548343.384	14240304.912	8891.406	8891.316	0.090
2036	2557032.616	14256069.516	8131.404	8131.213	0.191
2036A	2557025.923	14256130.687	8129.708	8129.633	0.075
2037	2552794.333	14277146.862	7223.873	7223.959	-0.086
2037A	2552693.205	14277246.813	7222.505	7222.569	-0.064
2038	2566949.587	14285144.002	7475.982	7475.940	0.042
2038A	2567004.738	14285164.730	7471.022	7470.830	0.192
2039	2588725.065	14310986.142	6886.085	6886.158	-0.073
2039A	2588742.890	14311045.016	6883.569	6883.558	0.011
2040	2580590.446	14299403.888	7943.459	7943.422	0.037
2040A	2580546.656	14299477.185	7941.401	7941.362	0.039
2041	2576896.391	14271018.964	7813.154	7813.261	-0.107
2041A	2576925.519	14270985.073	7814.377	7814.391	-0.014
2042	2624135.316	14282853.471	7855.194	7855.021	0.173
2042A	2623983.919	14282894.121	7848.455	7848.211	0.244
2043	2616173.534	14291218.698	7612.632	7612.551	0.081
2043A	2616383.445	14291183.740	7607.134	7607.080	0.054
2044	2606540.233	14304084.528	7067.453	7067.098	0.355
2044A	2606590.499	14303944.453	7077.043	7076.948	0.095
2045	2627110.874	14297569.974	9405.368	9405.228	0.140
2045A	2627299.663	14297529.125	9401.740	9401.638	0.102
2046	2217627.664	14150387.677	6831.535	6831.487	0.048
2046A	2217662.527	14150387.529	6832.808	6832.647	0.161
2047	2269269.966	14165847.990	6743.376	6743.427	-0.051

2047A	2269299.756	14165879.388	6742.513	6742.597	-0.084
2048	2281614.033	14130671.676	8738.778	8738.865	-0.087
2048A	2281570.988	14130709.452	8737.804	8737.885	-0.081
2049	2250867.470	14114647.469	9072.170	9072.246	-0.076
2049A	2250916.407	14114637.312	9071.662	9071.516	0.146
2050	2230441.261	14133171.802	8086.857	8086.862	-0.005
2050A	2230421.271	14133224.319	8084.652	8084.552	0.100
2051	2239750.685	14117974.671	9073.663	9073.566	0.097
2051A	2239819.303	14117984.231	9076.068	9075.886	0.182
2052	2201730.557	14074782.585	4536.562	4536.658	-0.096
2052A	2201703.707	14074796.588	4537.094	4537.338	-0.244
2053	2193616.059	14214491.449	4605.690	4605.738	-0.048
2054	2251201.944	14202733.350	6797.250	6796.847	0.403
2054A	2251201.341	14202741.348	6796.801	6796.657	0.144
2055	2350784.039	14133720.991	5974.434	5974.404	0.030
2055A	2350773.222	14133744.180	5972.924	5972.844	0.080
2056	2340424.240	14275101.371	7060.268	7060.258	0.010
2056A	2340421.110	14275136.991	7059.838	7059.888	-0.050
2057	2322102.426	14291886.521	7226.190	7226.249	-0.059
2057A	2322080.484	14291802.194	7232.800	7232.739	0.061
2058	2350330.890	14253034.509	6957.965	6957.938	0.027
2058A	2350369.020	14252992.649	6956.098	6956.198	-0.100
2059	2434117.566	14268354.222	5282.050	5282.121	-0.071
2059A	2434111.333	14268304.436	5283.628	5283.681	-0.053
2060	2465557.526	14201032.543	9330.450	9330.467	-0.017
2060A	2465587.251	14201015.686	9334.420	9334.717	-0.297
2061	2426663.906	14160265.308	6036.520	6036.354	0.166
2062	2353887.608	14094978.660	7233.729	7233.779	-0.050
2063	2318252.870	14048994.297	8292.972	8292.813	0.159
2064	2336361.187	14030991.275	8670.823	8670.565	0.258
2065	2293964.037	14016268.772	8509.550	8509.694	-0.144
2066	2259896.081	14037364.051	6486.060	6486.096	-0.036
2067	2340503.987	14233160.667	5015.466	5015.500	-0.034
2067A	2340521.530	14233194.496	5016.745	5016.780	-0.035
2068	2383043.548	14261883.451	6539.734	6540.086	-0.352
2068A	2383067.822	14261923.733	6537.247	6537.516	-0.269
2069	2453162.256	14287133.935	5667.935	5668.013	-0.078
2069A	2453204.700	14287178.893	5671.084	5670.903	0.181
2070	2508994.185	14232011.667	8129.695	8129.603	0.092
2070A	2509045.379	14231955.821	8135.961	8136.043	-0.082
2071	2524839.366	14244685.946	7630.283	7629.831	0.452
2071A	2524944.015	14244595.900	7641.107	7641.001	0.106
2072	2513661.652	14249028.966	6789.626	6789.597	0.029
2072A	2513728.398	14249054.379	6784.750	6784.547	0.203
2073	2543569.486	14260769.720	8009.639	8009.312	0.327
2073A	2543574.985	14260656.492	8007.130	8007.142	-0.012
2074	2292237.820	14132350.948	8608.346	8608.254	0.092
2075	2335136.294	14187524.243	4643.672	4643.759	-0.087
2075A	2335130.159	14187466.713	4644.118	4644.219	-0.101
2076	2312454.118	14183376.686	5056.158	5056.110	0.048
2076A	2312468.669	14183314.678	5056.735	5056.740	-0.005
2077	2275978.801	14192647.920	6857.726	6857.617	0.109

2078	2276154.650	14002538.330	5844.106	5844.113	-0.007
2079	2451334.084	14235250.381	5672.039	5672.233	-0.194
2079A	2451288.126	14235248.445	5672.525	5672.583	-0.058
2080	2451839.594	14217297.379	6652.749	6652.977	-0.228
2080A	2451843.079	14217252.697	6652.152	6652.307	-0.155
2081	2398149.984	14207254.758	4963.563	4963.780	-0.217
2081A	2398145.256	14207202.625	4966.056	4966.130	-0.074
2082	2381291.248	14149032.309	4843.842	4843.799	0.043
2082A	2381305.838	14149018.733	4844.278	4844.219	0.059
2083	2364535.989	14209639.002	4781.152	4781.099	0.053
2083A	2364555.632	14209670.406	4781.506	4781.489	0.017
2084	2501778.500	14283825.756	7148.270	7148.299	-0.029
2084A	2501763.966	14283895.946	7154.671	7154.479	0.192
2085	2533272.082	14291094.256	7996.332	7996.192	0.140
2085A	2533254.185	14291167.100	7996.798	7996.652	0.146
2086	2601703.310	14238724.209	9021.406	9021.736	-0.330
2086A	2601692.648	14238787.155	9020.290	9020.406	-0.116
2087	2597646.566	14253920.777	8505.761	8505.974	-0.213
2087A	2597643.423	14254021.334	8503.310	8503.574	-0.264
2088	2594753.836	14265746.662	8247.490	8247.623	-0.133
2088A	2594775.152	14265653.004	8248.793	8248.883	-0.090
2089	2583203.013	14266340.096	8173.547	8173.303	0.244
2089A	2583198.971	14266344.249	8173.133	8172.913	0.220
2090	2477528.861	14248412.445	5549.228	5549.272	-0.044
2090A	2477556.774	14248469.508	5548.752	5548.872	-0.120
2091	2477901.363	14261071.865	5892.026	5892.144	-0.118
2091A	2477859.490	14261104.457	5891.819	5891.914	-0.095
2093	2420039.720	14293712.771	5055.912	5056.050	-0.138
2093A	2420103.204	14293723.903	5056.187	5056.140	0.047
2094	2411348.028	14284091.645	5023.724	5023.820	-0.096
2094A	2411327.441	14284128.334	5022.916	5022.870	0.046
2095	2392477.226	14279763.471	5495.140	5495.032	0.108
2095A	2392430.038	14279743.406	5495.481	5495.372	0.109
2096	2390271.384	14173816.216	5037.316	5037.300	0.016
2096A	2390216.125	14173811.655	5036.191	5036.110	0.081
2097	2319404.298	14163763.726	5914.135	5913.924	0.211
2097A	2319396.710	14163807.594	5911.494	5911.364	0.130
2098	2440718.396	14220464.607	6693.674	6693.767	-0.093
2098A	2440677.674	14220486.342	6693.855	6693.987	-0.132
2099	2247631.889	14089039.548	6232.366	6232.175	0.191
2099A	2247629.114	14089019.466	6231.480	6231.385	0.095
2099B	2244375.705	14087059.913	6007.688	6007.354	0.334
2100	2474627.633	14233551.109	6612.743	6612.746	-0.003
2100A	2474641.068	14233593.409	6612.461	6612.406	0.055

VERTICAL ACCURACY CONCLUSIONS

Bare-Earth DEM Non-Vegetated Vertical Accuracy (NVA) Tested 0.286 Feet Non-Vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 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.

Table 5.4: VVA Quality Check Point Analysis DEM					
Point ID	Easting (Feet)	Northing (Feet)	Elevation (Feet)	DEM Elevation (Feet)	Dz (Feet)
3001A	2225561.789	14251418.915	4759.446	4759.559	-0.113
3001	2225554.309	14251445.762	4762.691	4762.879	-0.188
3002	2259484.831	14266434.951	4740.053	4740.149	-0.096
3002A	2259485.314	14266375.686	4738.462	4738.599	-0.137
3003	2282908.462	14228560.975	4504.476	4504.658	-0.182
3004	2332080.556	14214335.925	4726.477	4726.279	0.198
3005	2364465.438	14209508.247	4774.023	4774.389	-0.366
3006	2391734.505	14212412.661	4723.321	4723.229	0.092
3006A	2391790.738	14212484.938	4724.213	4724.279	-0.066
3007	2441588.545	14220583.589	6641.834	6641.787	0.047
3007A	2441550.573	14220569.177	6644.836	6644.887	-0.051
3008	2627082.489	14297602.458	9410.080	9409.898	0.182
3008A	2627299.040	14297557.441	9403.423	9403.468	-0.045
3009	2588804.107	14313548.686	6804.973	6805.357	-0.384
3009A	2588823.431	14313633.879	6799.839	6800.157	-0.318
3010	2567505.787	14285771.504	7421.432	7421.310	0.122
3010A	2567551.991	14285820.802	7422.229	7422.650	-0.421
3011	2597626.639	14254016.092	8501.735	8502.174	-0.439
3011A	2597621.872	14253959.317	8501.673	8502.354	-0.681
3012	2583230.372	14266342.533	8176.595	8176.473	0.122
3012A	2583216.093	14266302.281	8174.245	8174.423	-0.178
3013	2556991.736	14256114.342	8128.563	8128.773	-0.210
3013A	2556907.219	14256112.747	8128.583	8128.553	0.030
3014	2543534.506	14260749.113	8009.669	8009.592	0.077
3014A	2543639.194	14260771.813	8006.165	8006.382	-0.217
3015	2502615.526	14215110.470	9695.525	9695.469	0.056
3015A	2502696.642	14215066.954	9696.414	9696.499	-0.085
3016	2336406.449	14030955.498	8669.609	8669.575	0.034
3017	2277442.059	14003672.481	5919.384	5919.564	-0.180
3018	2242187.546	13988212.630	4722.694	4722.899	-0.205
3019	2218756.947	14053743.132	4624.171	4623.969	0.202
3019A	2218753.351	14053721.797	4625.033	4624.909	0.124
3020	2239875.261	14118064.247	9077.137	9076.966	0.171
3020A	2239818.604	14118057.971	9076.501	9076.246	0.255
3021	2201761.404	14074839.764	4539.194	4539.588	-0.394
3021A	2201767.923	14074851.112	4539.391	4539.798	-0.407
3022	2254369.143	14113275.966	9091.632	9091.696	-0.064
3022A	2254335.937	14113259.060	9092.659	9093.076	-0.417
3024	2318312.112	14049032.400	8291.483	8291.353	0.130

3025	2364870.129	14168493.982	4650.588	4650.659	-0.071
3025A	2364842.501	14168530.295	4650.699	4650.879	-0.180
3026	2396490.840	14150272.690	5123.828	5123.801	0.027
3026A	2396448.714	14150282.287	5120.666	5120.711	-0.045
3027	2465511.148	14201181.453	9302.921	9302.777	0.144
3027A	2465441.500	14201196.647	9294.322	9294.337	-0.015
3028	2451637.203	14202290.122	8039.495	8039.492	0.003
3028A	2451613.430	14202348.616	8034.462	8034.362	0.100
3029	2424623.792	14171590.758	7644.775	7644.871	-0.096
3030	2398101.067	14207202.714	4965.692	4966.080	-0.388
3030A	2398099.475	14207144.906	4968.120	4968.470	-0.350
3031	2450720.499	14243926.961	5196.459	5196.611	-0.152
3031A	2450705.778	14243975.249	5194.662	5194.811	-0.149
3032	2501809.015	14283859.303	7151.367	7151.539	-0.172
3032A	2501802.099	14283921.212	7156.229	7156.519	-0.290
3033	2624129.552	14282841.342	7854.161	7854.171	-0.010
3033A	2623983.062	14282869.761	7847.478	7847.401	0.077
3034	2601671.453	14238832.624	9019.129	9017.786	1.343
3034A	2601737.972	14238761.122	9019.647	9020.036	-0.389
3035	2616347.392	14291240.587	7612.800	7613.021	-0.221
3035A	2616264.659	14291313.720	7621.215	7621.371	-0.156
3036	2582424.044	14300698.311	7993.547	7993.592	-0.045
3036A	2582498.024	14300766.270	7993.111	7993.142	-0.031
3037	2308215.065	14256505.453	4894.918	4895.000	-0.082
3037A	2308251.663	14256565.863	4895.436	4895.380	0.056
3038	2290512.456	14292900.482	5493.664	5493.812	-0.148
3039	2257426.026	14298080.892	4937.428	4937.530	-0.102
3039A	2257448.421	14298033.641	4936.906	4936.980	-0.074
3040	2210777.481	14301319.304	4969.140	4969.320	-0.180
3040A	2210742.472	14301355.665	4969.803	4970.110	-0.307
3041	2192930.647	14238887.841	4785.581	4785.809	-0.228
3041A	2192999.794	14238860.371	4789.751	4789.679	0.072
3042	2195010.141	14149966.483	6388.114	6388.276	-0.162
3042A	2195035.725	14149966.391	6388.573	6388.766	-0.193
3043	2246529.562	14168185.659	6493.225	6493.496	-0.271
3043A	2246566.586	14168185.354	6493.675	6493.756	-0.081
3044	2282291.160	14168695.032	6903.543	6903.878	-0.335
3044A	2282295.537	14168644.855	6903.992	6904.198	-0.206
3045	2350571.965	14133068.594	5993.987	5994.064	-0.077
3045A	2350562.874	14133088.295	5991.468	5991.524	-0.056
3046	2355001.215	14095902.084	7232.778	7232.789	-0.011
3047	2331630.376	14114877.679	6616.706	6616.917	-0.211
3047A	2331591.561	14114851.189	6617.378	6617.747	-0.369
3047B	2331577.528	14114837.699	6617.556	6617.787	-0.231
3048	2335062.754	14187443.410	4643.905	4644.009	-0.104

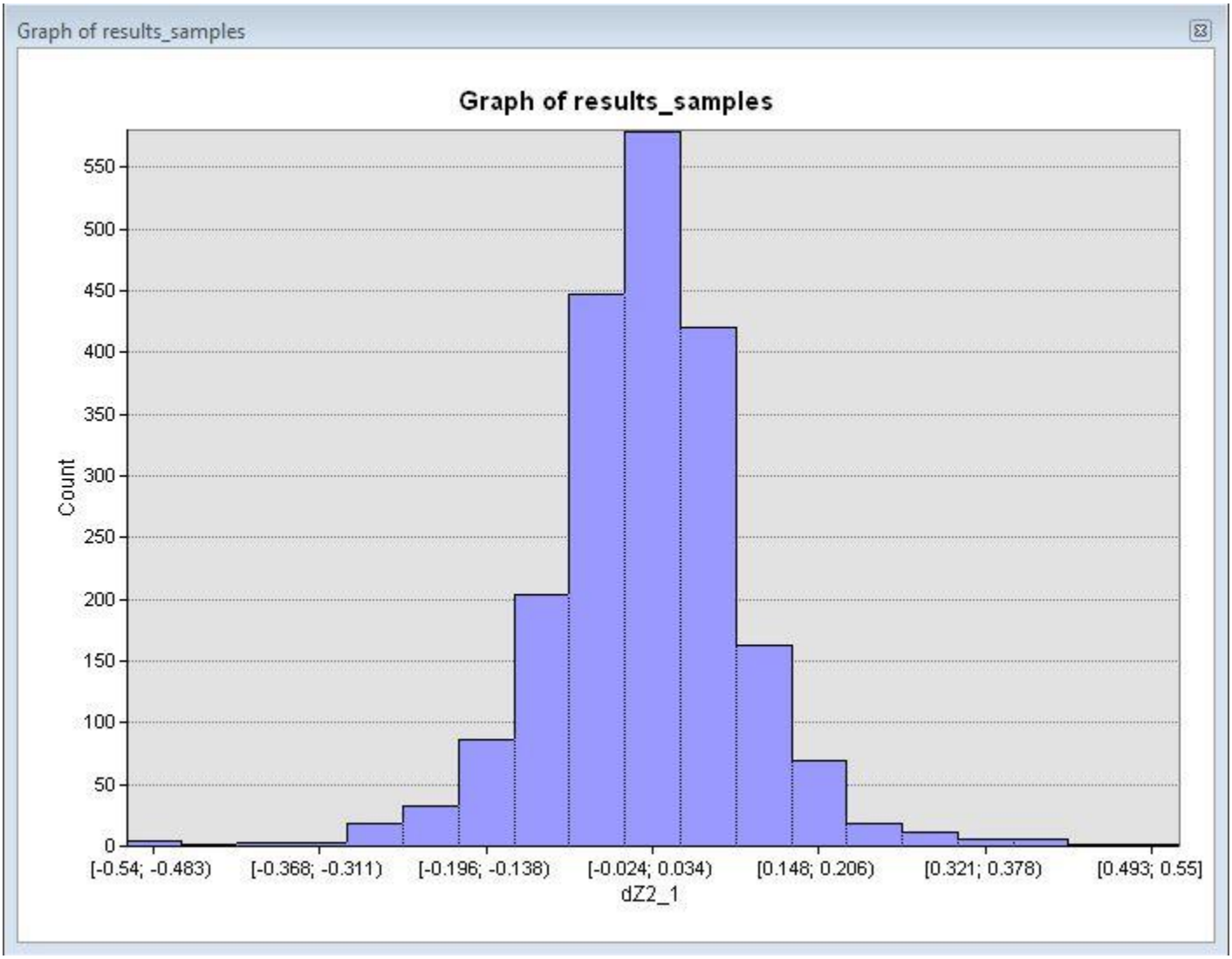
3048A	2335037.436	14187501.310	4642.786	4642.989	-0.203
3049	2281728.780	14130675.534	8744.589	8744.565	0.024
3049A	2281681.874	14130668.428	8743.500	8743.565	-0.065
3050	2312627.606	14183264.675	5050.876	5050.700	0.176
3050A	2312671.710	14183248.667	5052.152	5052.210	-0.058
3051	2340474.404	14275069.393	7058.070	7058.118	-0.048
3051A	2340507.100	14275084.553	7055.084	7055.408	-0.324
3052	2378498.229	14306045.715	5790.602	5791.063	-0.461
3053	2364448.673	14279527.389	6140.831	6140.935	-0.104
3053A	2364404.218	14279515.785	6141.668	6141.815	-0.147
3054	2411230.443	14283844.654	5038.507	5038.450	0.057
3054A	2411191.270	14283876.691	5038.084	5038.190	-0.106
3055	2453091.216	14287177.101	5666.350	5666.173	0.177
3055A	2453043.929	14287145.527	5663.909	5663.943	-0.034
3056	2478147.101	14260489.832	5909.276	5909.274	0.002
3056A	2478191.556	14260448.582	5911.307	5911.574	-0.267
3057	2548337.029	14240368.999	8891.557	8891.586	-0.029
3057A	2548248.863	14240381.713	8892.292	8892.236	0.056
3058	2351312.925	14252512.236	6936.984	6937.058	-0.074
3058A	2351272.542	14252477.656	6945.751	6945.498	0.253
3059	2251212.345	14202835.164	6793.034	6793.027	0.007
3060	2259635.533	14036811.391	6538.392	6538.516	-0.124
3061	2533387.108	14291058.672	7994.029	7994.002	0.027
3061A	2533446.045	14291042.855	8003.531	8003.322	0.209
3062	2293923.221	14016309.070	8507.365	8507.134	0.231
3063	2284570.142	14085708.351	6778.697	6778.997	-0.300
3063A	2284541.596	14085683.305	6777.352	6777.637	-0.285
3063B	2284517.452	14085748.889	6780.554	6780.617	-0.063
3063C	2284537.983	14085683.242	6777.696	6777.737	-0.041
3064	2295976.504	14134016.817	8738.818	8738.615	0.203
3065	2500712.177	14263528.448	5999.342	5999.544	-0.202
3065A	2500748.086	14263604.412	5998.541	5998.844	-0.303
3066	2465663.228	14308700.162	5776.179	5776.103	0.076
3066A	2465677.309	14308650.205	5779.670	5779.703	-0.033
3067	2532043.151	14273767.893	7233.342	7233.519	-0.177
3067A	2532130.159	14273792.761	7234.795	7234.979	-0.184
3068	2552701.876	14277160.707	7218.998	7219.209	-0.211
3068A	2552774.048	14277219.060	7223.073	7223.229	-0.156
3069	2606520.437	14304133.678	7062.597	7063.808	-1.211
3069A	2606577.303	14303936.389	7076.626	7076.948	-0.322
3070	2322125.799	14291743.893	7246.229	7246.359	-0.130
3070A	2322107.830	14291680.704	7242.948	7242.869	0.079
3071	2383079.975	14261875.052	6539.675	6539.876	-0.201
3071A	2383129.000	14261877.195	6538.458	6538.556	-0.098
3072	2434207.021	14268302.664	5278.395	5278.561	-0.166

3072A	2434198.793	14268363.724	5276.817	5277.071	-0.254
3073	2452596.319	14266862.719	6051.117	6051.194	-0.077
3073A	2452657.260	14266835.055	6051.199	6051.404	-0.205
3074	2451027.680	14216421.124	6706.401	6706.497	-0.096
3074A	2451070.810	14216450.127	6703.819	6703.967	-0.148
3075	2388519.744	14173690.924	4997.001	4996.900	0.101
3075A	2388575.439	14173686.367	4997.913	4997.870	0.043

Vertical Accuracy Conclusions

Vegetated Vertical Accuracy (VVA) Tested 0.417 Feet at the 95th percentile reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM. VVA Errors larger than 95th percentile include:
Point 3010A, Easting 2567551.991, Northing 14285820.802, Z-Error 0.421 Feet
Point 3011, Easting 2597626.639, Northing 14254016.092, Z-Error 0.439 Feet
Point 3011A, Easting 2597621.872, Northing 14253959.317, Z-Error 0.681 Feet
Point 3034, Easting 2601671.453, Northing 14238832.624, Z-Error 1.343 Feet
Point 3052, Easting 2378498.229, Northing 14306045.715, Z-Error 0.461 Feet
Point 3069, Easting 2606520.437, Northing 14304133.678, Z-Error 1.211 Feet

Figure 5.1: LIDAR Relative Accuracy Histogram for Mesa County CO QL2 Lidar



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 Mesa County CO QL2 Lidar measured at 0.102 feet RMSDz.

Approved by:	Name	Signature	Date
Associate Member, Lidar Specialist Certified Photogrammetrist #1381	Qian Xiao		October 2016

Section 6: LiDAR Acquisition Flight Logs

This section contains the Flight Log(s) covering the project. Flight Logs list mission specific details such as crew members, airports, weather conditions, real time PDOP values and document any issues encountered during the mission. Flight Logs are filled out by the sensor operator during the acquisition flight.

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/20/2015	324	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC [X] N404CP [ ] N7079F [ ] N475CP [ ] N1107Q [ ]	SH-8170 [X] SH_6157 [ ] SH-7108 [ ]	267.5	10:30	17:30
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers			2702.2	13:40	20:40

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes [ ] No [X]	GPS Base #1	Annen	KGJT
		GPS Base #2	Operator	PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
L/V	10	11000	75	4	0	30.11		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___ Fine/Down ___	Single [ ] Multi [ ]	2 + 2 [ ] 4 + 3 [ ]

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 [ ]
A10	N	18:09:00	18:18:00		17	0.7	1.1	
A9	S	18:21:00	18:30:00					
A8	N	18:33:00	18:43:00					
A7	S	18:45:00	18:54:00					
A6	N	18:58:00	19:08:00					
A5	S	19:09:00	19:19:00					
A4	N	19:21:00	19:31:00					
A3	S	19:33:00	19:44:00					
A2	N	19:47:00	19:55:00					
A1	S	19:57:00	20:07:00					
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments:	Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/15/2015	319	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC [X]	SH-8170 [X]	263.4	8:15	15:15
Pilot	N404CP [ ]	SH_6157 [ ]	Hobbs End	Local End Time	Zulu End Time
Albers	N7079F [ ]	SH-7108 [ ]	266.8	12:00	19:00
Passengers	N475CP [ ]	Using or Relying on CORS	GPS Base #1	Operator Annen	PID KGJT
	N1107Q [ ]	Yes [ ] No [X]	GPS Base #2	Operator	PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
Calm	10	0	0	-2	-4	30.02		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___	Single [ ]	2 + 2 [ ]
				Fine/Down ___	Multi [ ]	4 + 3 [ ]

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 [ ]
A25	S	15:41:00	15:50:00		18	0.7	1.1	
A24	N	15:53:00	16:01:00					
A23	S	16:04:00	16:12:00					
A22	N	16:15:00	16:23:00					
A21	S	16:26:00	16:35:00					
A20	N	16:38:00	16:47:00					
A19	S	16:50:00	16:58:00					
A18	N	17:01:00	17:10:00					
A17	S	17:13:00	17:22:00					
A16	N	17:25:00	17:34:00					
A15	S	17:37:00	17:47:00					
A14	N	17:50:00	17:59:00					
A13	S	18:03:00	18:12:00					Raw Data not recording error
A12	N	18:15:00	18:25:00					
A11	S	18:28:00	18:38:00					
A10	N	18:40:00						System crash GNSS Error
			End of flt					
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments:

See related reports

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/13/2015	317	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC [X] N404CP [ ] N7079F [ ] N475CP [ ] N1107Q [ ]	SH-8170 [X] SH_6157 [ ] SH-7108 [ ]	253.7	8:30	15:30
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers			261.1	16:25	23:25

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes [ ] No [X]	GPS Base #1	Annen	KGJT
		GPS Base #2		

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
160/6	10	0	0	-6	-5	30.36		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode
40	51	272	100	Course/Up ___ Fine/Down ___	Single [ ] Multi [ ] 2 + 2 [ ] 4 + 3 [ ]

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 [ ]
A42	S	16:09:00	16:17:00		17	0.7	1.1	Inflight restart prior to this line.
A43	N	16:20:00	16:27:00					
A44	S	16:30:00	16:40:00					
A45	N	16:42:00	16:47:00					
A46	S	16:50:00	16:57:00					
A47	N	17:00:00	17:07:00					
A48	S	17:10:00	17:17:00					
A49	N	17:20:00	17:28:00					
A50	S	17:30:00	17:38:00					
A51	N	17:40:00	17:47:00					
A52	S	17:50:00	17:57:00					
A53	N	18:00:00	18:06:00					
A54	S	18:09:00	18:15:00					
A55	N	18:18:00	18:24:00					
A56	S	18:27:00	18:34:00					
A57	N	18:37:00	18:44:00					
A58	S	18:46:00	18:53:00					
A59	N	18:56:00	19:02:00					
A60	S	19:05:00	19:11:00					
A61	N	19:14:00	19:19:00					
A62	S	19:22:00	19:26:00					
A63	N	19:29:00	19:33:00					System crash end of line
A64	S	20:28:00	20:32:00					Land, reboot, crash, inflight restart
A65	N	20:36:00	20:40:00					
A66	S	20:44:00	20:49:00					
A67	N	20:52:00	20:58:00					
A68	S	21:02:00	21:09:00					
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments:
/STEM LOCKED UP WITH IMU FAILURE ERRORS, NUMEROUS WARNINGS. SYSTEM CRASH. LANDED REBOOTED AND TOOK OFF. CRASHED AGAIN PRIOR TO LINE, INFLIGHT RESTART

Drive #

WOOLPERT FLIGHT LOG SHEET #2

Leica ALS-70	DD/MM/YYYY 11/13/2015	Day of Year 317	Mission Name / Job # MesaCO/75927

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
A69	N	21:12:00	21:18:00		17	0.7	1.2	
A70	S	21:21:00	21:28:00					
A71	N	21:31:00	21:38:00					
A72	S	21:41:00	21:48:00					
A73	N	21:50:00	21:57:00					
A74	S	22:01:00	22:08:00					
A75	N	22:11:00	22:18:00					
A76	S	22:21:00	22:28:00					
A77	N	22:31:00	22:38:00					
A78	S	22:40:00	22:48:00					
A79	N	22:51:00	22:58:00					
A80	S	23:00:00	23:08:00					

↑ Times entered are Zulu / GMT ↑ | 0:00:00 Total Time On Line | Verify S-Turns After Mission Yes ☐ No ☐

Additional Comments: | Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/13/2015	317	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC [X] N404CP [ ] N7079F [ ] N475CP [ ] N1107Q [ ]	SH-8170 [X] SH_6157 [ ] SH-7108 [ ]	253.7	8:30	15:30
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers			261.1	16:25	23:25

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes [ ] No [X]	GPS Base #1	Annen	KGJT
		GPS Base #2		

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
160/6	10	0	0	-6	-5	30.36		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode
40	51	272	100	Course/Up ___ Fine/Down ___	Single [ ] Multi [ ] 2 + 2 [ ] 4 + 3 [ ]

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 [ ]
A42	S	16:09:00	16:17:00		17	0.7	1.1	Inflight restart prior to this line.
A43	N	16:20:00	16:27:00					
A44	S	16:30:00	16:40:00					
A45	N	16:42:00	16:47:00					
A46	S	16:50:00	16:57:00					
A47	N	17:00:00	17:07:00					
A48	S	17:10:00	17:17:00					
A49	N	17:20:00	17:28:00					
A50	S	17:30:00	17:38:00					
A51	N	17:40:00	17:47:00					
A52	S	17:50:00	17:57:00					
A53	N	18:00:00	18:06:00					
A54	S	18:09:00	18:15:00					
A55	N	18:18:00	18:24:00					
A56	S	18:27:00	18:34:00					
A57	N	18:37:00	18:44:00					
A58	S	18:46:00	18:53:00					
A59	N	18:56:00	19:02:00					
A60	S	19:05:00	19:11:00					
A61	N	19:14:00	19:19:00					
A62	S	19:22:00	19:26:00					
A63	N	19:29:00	19:33:00					System crash end of line
A64	S	20:28:00	20:32:00					Land, reboot, crash, inflight restart
A65	N	20:36:00	20:40:00					
A66	S	20:44:00	20:49:00					
A67	N	20:52:00	20:58:00					
A68	S	21:02:00	21:09:00					
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments:
/STEM LOCKED UP WITH IMU FAILURE ERRORS, NUMEROUS WARNINGS. SYSTEM CRASH. LANDED REBOOTED AND TOOK OFF. CRASHED AGAIN PRIOR TO LINE, INFLIGHT RESTART

Drive #

WOOLPERT FLIGHT LOG SHEET #2

Leica ALS-70	DD/MM/YYYY 11/13/2015	Day of Year 317	Mission Name / Job # MesaCO/75927

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
A69	N	21:12:00	21:18:00		17	0.7	1.2	
A70	S	21:21:00	21:28:00					
A71	N	21:31:00	21:38:00					
A72	S	21:41:00	21:48:00					
A73	N	21:50:00	21:57:00					
A74	S	22:01:00	22:08:00					
A75	N	22:11:00	22:18:00					
A76	S	22:21:00	22:28:00					
A77	N	22:31:00	22:38:00					
A78	S	22:40:00	22:48:00					
A79	N	22:51:00	22:58:00					
A80	S	23:00:00	23:08:00					

↑ Times entered are Zulu / GMT ↑ | 0:00:00 | Total Time On Line | Verify S-Turns After Mission Yes ☐ No ☐

Additional Comments: | Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/12/2015	316	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC [X] N404CP [ ] N7079F [ ] N475CP [ ] N1107Q [ ]	SH-8170 [X] SH_6157 [ ] SH-7108 [ ]	250.1	11:20	18:20
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers			253.7	15:25	22:25

Passengers	Using or Relying on CORS	GPS Base #1	Operator	Annen	PID	KGJT
	Yes [ ] No [X]	GPS Base #2	Operator		PID	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KGJT
Calm	10	0	0	10	-5	30.38		Arriving ICAO	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___ Fine/Down ___	Single [ ] Multi [ ]	2 + 2 [ ] 4 + 3 [ ]

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 [ ]
A01	S	18:47:00	18:58:00		18	0.7	1.1	Snow, south end of line
A02	N	19:01:00	19:11:00					Snow, south end of line
A26	S	19:16:00	19:23:00					Moved to snow free area
A27	N	19:26:00	19:32:00					
A28	S	19:35:00	19:42:00					
A29	N	19:45:00	19:52:00					
A30	S	19:55:00	20:001					
A31	N	20:04:00	20:11:00					
A32	S	20:13:00	20:20:00					
A33	N	20:23:00	20:30:00					
A34	S	20:32:00	20:39:00					
A35	N	20:42:00	20:49:00					
A36	S	20:52:00	20:59:00					
A37	N	21:02:00	21:09:00					
A38	S	21:12:00	21:19:00					
A39	N	21:23:00	21:32:00					
A40	S	21:34:00	21:42:00					
A41	N	21:44:00	21:53:00					Lost IMU data stream
								Terminated flight
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes [ ] No [X]

Additional Comments: Would not restart in flight. Ended mission.

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/2/2015	306	Mesa CO QL2 / 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC X, N404CP, N7079F, N475CP, N1107Q	713 SH-7177, SH_6157, SH-7108	235.4	8:40	15:30
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers			240.1	13:50	20:50

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes ☐ No X	GPS Base #1	Annen	KGJT
		GPS Base #2	Operator	PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
100/10	10	0	0	8	1	29.98		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	41	272	100	Course/Up ___ Fine/Down ___	Single ☐ Multi ☐	2 + 2 ☐ 4 + 3 ☐

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	4,786 Ft	16,820 Ft	/	@ 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 ☐
D13	S	16:16:00	16:17:00					
D14	N	16:20:00	16:21:00					
D15	S	16:24:00	16:24:00					
D16	N	16:28:00	16:29:00					
D17	S	16:32:00	16:33:00					
D18	N	16:36:00	16:37:00					
D19	W	16:41:00	16:50:00					
D20	E	16:54:00	17:02:00					
D21	W	17:06:00	17:15:00					
D22	E	17:18:00	17:27:00					System Crash. Land to restart.
D23	E	18:48:00	18:58:00					
D24	E	19:01:00	10:09:00					
D25	W	19:12:00	19:23:00					
D26	E	19:25:00	19:34:00					
D27	W	19:38:00	19:48:00					
D37	E	19:50:00	19:52:00					
D38	W	19:54:00	19:57:00					
D39	E	20:01:00	20:01:00					
D28	E	20:05:00	20:09:00					
D29	W	20:12:00	20:16:00					
D30	E	20:20:00	20:22:00					ABORT LINE, A/C MALFUNCTION
								RTB / FAILED O2 SYSTEM
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes X No ☐

Additional Comments:
was opened through external control. Emission lights stayed on. System locked up. Attempted an inflight restart, failed due to IMU in reverse. Landed and restarted system, back u

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	11/1/2015	305	Mesa Co QL1/QL2 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC [X] N404CP [ ] N7079F [ ] N475CP [ ] N1107Q [ ]	713 SH-7177 [ ] SH_6157 [ ] SH-7108 [ ]	232.4	12:30	19:30
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers			235.4	15:45	22:45

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes [ ] No [X]	GPS Base #1	Annen	KGJT
		GPS Base #2		

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
Calm	10	0	0	14	2	30.15		KGJT	WGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
20	66	343	100	Course/Up ___ Fine/Down ___	Single [ ] Multi [ ]	2 + 2 [ ] 4 + 3 [ ]

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
130 Kts	Various Ft	Various Ft	/	@ 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 [ ]
E17	E	19:56:00	19:57:00		16	0.6	1.2	Altitudes decrease with each line
E16	W	20:00:00	20:01:00					
E15	E	20:04:00	20:05:00					
E14	W	20:08:00	20:07:00					
E13	E	20:12:00	20:13:00					
E12	W	20:16:00	20:18:00					
E11	E	20:02:00	20:21:00					
E10	W	20:24:00	20:26:00					
E9	E	20:28:00	20:32:00					
E8	W	20:34:00	20:35:00					
E7	E	20:37:00	20:38:00					
E6	W	20:40:00	20:42:00					
E5	E	20:45:00	20:46:00					
E4	W	20:49:00	20:50:00					
E3	E	20:53:00	20:54:00					
E2	W	20:57:00	20:58:00					
E1	E	21:01:00	21:02:00					
D01	W	21:14:00	21:28:00		18	0.6	1	QL2 16821'MSL
D02	E	21:21:00	21:25:00					
D03	W	21:28:00	21:32:00					
D04	E	21:34:00	21:38:00					
D05	W	21:41:00	21:44:00					
D06	E	21:47:00	21:48:00					
D07	N	21:53:00	21:54:00					
D08	S	21:56:00	21:57:00					
D09	S	22:01:00	22:03:00					
		CONT:	NEXT	PAGE				
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments: System worked well, no issues.This is the Leica loaner system.

Drive #

WOOLPERT FLIGHT LOG SHEET #2

Leica ALS-70	DD/MM/YYYY 11/1/2015	Day of Year 305	Mission Name / Job # 75927/QL2

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
D10	N	22:06:00	22:07:00					
D11	S	22:10:00	22:11:00					
D12	N	22:15:00	22:15:00					

↑ Times entered are Zulu / GMT ↑ 0:00:00 Total Time On Line

Verify S-Turns After Mission Yes ☐ No ☐

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	7/17/2016	199	75927		mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
SMITH	N475RC	537.2	7:45:00	13:45:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	539.6	10:13:00	16:13:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	gjt
								Arriving	gjt

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	var	Ft	Yes		No		@	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	
b149	e	14:06:00	14:13:00		19	0.6	1.1	12,818'				
b150	w	14:16:00	14:23:00		19	0.6	1.1					
b151	e	14:25:00	14:32:00		18	0.6	1.2					
b152	w	14:36:00	14:42:00		17	0.6	1.3					
b153	e	14:45:00	14:51:00		18	0.6	1.3					
b154	w	14:53:00	14:59:00		18	0.6	1.2					
b155	e	15:02:00	15:07:00		20	0.6	1.1					
b156	w	15:10:00	15:15:00		22	0.6	1.1					
b157	e	15:18:00	15:22:00		21	0.6	1					
b158	w	15:25:00	15:29:00		21	0.6	1					
b159	e	15:32:00	15:35:00		20	0.6	1.1					
b160	w	15:38:00	15:42:00		19	0.6	1.2					
b161	e	15:45:00	15:49:00		19	0.6	1.1					
b162	w	15:52:00	15:56:00		19	0.6	1.1					
b165	s	16:00:00	16:01:00		17	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
	7/16/2016	198	75927		mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
SMITH	N475RC	532.2	7:57:00	13:57:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	537.2	12:48:00	18:48:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	gjt
								Arriving	gjt

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	var Ft	Yes / No	@ 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
b127	e	14:14:00	14:24:00		20	0.6	1.1	12,818'
b128	w	14:27:00	14:38:00		20	0.6	1.1	
b129	e	14:41:00	14:53:00		19	0.6	1.3	
b130	w	14:56:00	15:08:00		20	0.6	1.2	
b131	e	15:11:00	15:23:00		22	0.6	1.1	
b132	w	15:26:00	15:38:00		22	0.6	1	
b133	e	15:41:00	15:53:00		21	0.6	1.1	
b134	w	15:55:00	16:06:00		20	0.6	1.1	
b135	e	16:10:00	16:19:00		21	0.6	1	
b136	w	16:22:00	16:30:00		20	0.6	1	
b137	e	16:36:00	16:46:00		19	0.6	1.2	
b138	w	16:48:00	16:58:00		18	0.6	1.2	
b139	e	17:01:00	17:11:00		18	0.6	1.2	
b140	w	17:14:00	17:22:00		17	0.6	1.3	
b141	e	17:25:00	17:34:00		16	0.6	1.4	
b142	w	17:37:00	17:43:00		20	0.6	1	
b143	e	17:46:00	17:50:00		20	0.6	1	
b144	w	17:53:00	17:58:00		19	0.6	1.1	
b145	e	18:03:00	18:10:00		19	0.6	1.1	
b146	w	18:13:00	18:20:00		18	0.6	1.2	
b147	e	18:22:00	18:29:00		18	0.6	1.2	
b148	w	18:32:00	18:39:00		16	0.6	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
	7/15/2016	197	75927		mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
SMITH	N475RC	526.3	8:00:00	14:00:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	532.3	2:01:00	20:01:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	gjt
								Arriving	gjt

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	var Ft	Yes / No	@ 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
c2	e	14:26:00	14:27:00		22	0.6	1.1	14,820'
c3	w	14:30:00	14:31:00		22	0.6	1.1	
c8	n	14:37:00	14:39:00		21	0.6	1.2	
c9	s	14:43:00	14:46:00		20	0.6	1.4	
c10	n	14:49:00	14:52:00		21	0.6	1.3	
c15	s	14:55:00	15:05:00		21	0.6	1.3	
c16	n	15:08:00	15:19:00		22	0.6	1.1	
c17	s	15:22:00	15:32:00		23	0.6	1.1	
c18	n	15:35:00	15:46:00		23	0.6	1	
c19	s	15:49:00	15:59:00		21	0.6	1.2	
c20	n	16:02:00	16:13:00		22	0.6	1.1	
c21	s	16:16:00	16:27:00		23	0.6	0.9	
c22	n	16:30:00	16:41:00		20	0.6	1.2	
c23	s	16:43:00	16:54:00		19	0.6	1.2	
c24	n	16:57:00	17:08:00		18	0.6	1.3	
c25	s	17:11:00	17:22:00		17	0.6	1.4	
c26	n	17:25:00	17:36:00		16	0.6	1.5	
c27	s	17:39:00	17:50:00		17	0.6	1.2	
c28	n	17:53:00	18:04:00		18	0.6	1.1	
c29	s	18:07:00	18:18:00		18	0.6	1.1	
c40	n	18:24:00	18:29:00		18	0.6	1	reflt 18-1
c42	s	18:32:00	18:36:00		16	0.6	1.3	reflt 1-17
c43	n	18:39:00	18:42:00		16	0.6	1.3	reflt 14-1
c44	s	18:45:00	18:48:00		17	0.6	1.2	reflt 1-15
c45	n	18:51:00	18:55:00		18	0.6	1.1	reflt 17-1
c50	s	18:58:00	18:59:00		18	0.6	1.1	
b34	n	19:09:00	19:22:00		19	0.6	1	12,818'
b35	s	19:24:00	19:38:00		14	0.6	1.2	
b51	n	19:43:00	19:54:00		15	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
	7/14/2016	196	75927		mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
SMITH	N475RC	520.2	7:42:00	13:42:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	526.3	1:50:00	19:50:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	gjt
								Arriving	gjt

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	var Ft	Yes		No		@ 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
c74	e	14:04:00	14:20:00		19	0.6	1.3	14,820'
c75	w	14:24:00	14:41:00		20	0.6	1.1	
c76	e	14:44:00	15:00:00		19	0.6	1.2	
c77	w	15:04:00	15:19:00		19	0.6	1.2	
c78	e	15:22:00	15:38:00		20	0.6	1.1	
c79	w	15:42:00	15:58:00		19	0.6	1.1	
c80	e	16:01:00	16:18:00		19	0.6	1.1	
c81	w	16:21:00	16:38:00		21	0.6	1.1	
c82	e	16:40:00	16:57:00		19	0.6	1.2	
c83	w	16:59:00	17:16:00		18	0.6	1.3	
c100	e	17:19:00	17:22:00		16	0.6	1.3	
c101	w	17:25:00	17:28:00		15	0.6	1.5	
c102	e	17:31:00	17:34:00		15	0.6	1.5	
c103	w	17:37:00	17:39:00		16	0.6	1.2	
c104	e	17:42:00	17:45:00		17	0.6	1.1	
c105	w	17:48:00	17:50:00		18	0.6	1	
c106	e	17:53:00	17:54:00		18	0.6	1	
c84	e	17:59:00	18:10:00		18	0.6	1	
c85	w	18:13:00	18:23:00		18	0.6	1	
c86	e	18:26:00	18:36:00		17	0.6	1	
c87	w	18:38:00	18:48:00		16	0.6	1.2	
c88	e	18:51:00	19:00:00		17	0.6	1.1	
c89	w	19:03:00	19:12:00		17	0.6	1.1	
c90	e	19:15:00	19:21:00		18	0.6	1	
c91	w	19:24:00	19:27:00		15	0.6	1.1	
c92	e	19:30:00	19:33:00		14	0.6	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
	7/13/2016	195	75927		mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
SMITH	N475RC	513.8	8:00:00	14:00:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	520.2	2:25:00	20:25:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	gjt
								Arriving	gjt

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	var Ft	Yes / No	@ 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
d22	w	14:25:00	14:33:00		19	0.6	1.2	16,821'
d37	e	14:37:00	14:39:00		19	0.6	1.2	
d38	w	14:43:00	14:44:00		19	0.6	1.2	
d39	e							tm1b error-reboot,refly
d39	e	15:05:00	15:06:00		17	0.6	1.4	
d30	e	15:10:00	15:13:00		18	0.6	1.2	
d31	w	15:17:00	15:20:00		18	0.6	1.2	
d32	e	15:23:00	15:27:00		20	0.6	1.1	
d33	w	15:30:00	15:33:00		21	0.6	1	
d34	e	15:36:00	15:38:00		20	0.6	1.1	
d35	w	15:41:00	15:43:00		19	0.6	1.1	
d36	e	15:46:00	15:47:00		19	0.6	1.1	
c51	w	15:54:00	16:00:00		19	0.6	1.1	14,820'
c52	e	16:03:00	16:10:00		18	0.6	1.2	
c53	w	16:13:00	16:19:00		17	0.6	1.2	
c54	e	16:22:00	16:29:00		18	0.6	1.2	
c55	w	16:32:00	16:39:00		17	0.6	1.2	
c56	e	16:42:00	16:49:00		18	0.6	1.2	
c57	w	16:52:00	16:59:00		18	0.6	1.2	
c94	e	17:09:00	17:11:00		17	0.6	1.3	
c95	w	17:14:00	17:16:00		16	0.6	1.4	
c96	e	17:20:00	17:22:00		16	0.6	1.4	
c97	w	17:25:00	17:28:00		16	0.6	1.4	
c98	e	17:30:00	17:33:00		16	0.6	1.4	
c99	w	17:36:00	17:38:00		15	0.6	1.5	
c66	e	17:42:00	17:58:00		16	0.6	1.2	
c67	w	18:01:00	18:17:00		19	0.6	1	
c68	e	18:20:00	18:37:00		19	0.6	1.1	
c69	w	18:39:00	18:56:00		18	0.6	1.2	
c70	e	18:59:00	19:16:00		18	0.6	1.1	
c71	w	19:18:00	19:35:00		20	0.6	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
	7/13/2016	195	75927	0	mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
								Arriving	

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

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
Kts	Ft	Ft	Yes		No		@ 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 No
c72	e	19:38:00	19:56:00		17	0.6	1.1	
c73	w	19:58:00	20:16:00		18	0.6	1.1	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page		2		Verify S-Turns After Mission Yes No

Additional Comments:	Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	7/13/2016	195	75927		mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
SMITH	N475RC	513.8	8:00:00	14:00:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	520.2	2:25:00	20:25:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	gjt
								Arriving	gjt

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	var Ft	Yes / No	@ 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
d22	w	14:25:00	14:33:00		19	0.6	1.2	16,821'
d37	e	14:37:00	14:39:00		19	0.6	1.2	
d38	w	14:43:00	14:44:00		19	0.6	1.2	
d39	e							tm1b error-reboot,refly
d39	e	15:05:00	15:06:00		17	0.6	1.4	
d30	e	15:10:00	15:13:00		18	0.6	1.2	
d31	w	15:17:00	15:20:00		18	0.6	1.2	
d32	e	15:23:00	15:27:00		20	0.6	1.1	
d33	w	15:30:00	15:33:00		21	0.6	1	
d34	e	15:36:00	15:38:00		20	0.6	1.1	
d35	w	15:41:00	15:43:00		19	0.6	1.1	
d36	e	15:46:00	15:47:00		19	0.6	1.1	
c51	w	15:54:00	16:00:00		19	0.6	1.1	14,820'
c52	e	16:03:00	16:10:00		18	0.6	1.2	
c53	w	16:13:00	16:19:00		17	0.6	1.2	
c54	e	16:22:00	16:29:00		18	0.6	1.2	
c55	w	16:32:00	16:39:00		17	0.6	1.2	
c56	e	16:42:00	16:49:00		18	0.6	1.2	
c57	w	16:52:00	16:59:00		18	0.6	1.2	
c94	e	17:09:00	17:11:00		17	0.6	1.3	
c95	w	17:14:00	17:16:00		16	0.6	1.4	
c96	e	17:20:00	17:22:00		16	0.6	1.4	
c97	w	17:25:00	17:28:00		16	0.6	1.4	
c98	e	17:30:00	17:33:00		16	0.6	1.4	
c99	w	17:36:00	17:38:00		15	0.6	1.5	
c66	e	17:42:00	17:58:00		16	0.6	1.2	
c67	w	18:01:00	18:17:00		19	0.6	1	
c68	e	18:20:00	18:37:00		19	0.6	1.1	
c69	w	18:39:00	18:56:00		18	0.6	1.2	
c70	e	18:59:00	19:16:00		18	0.6	1.1	
c71	w	19:18:00	19:35:00		20	0.6	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
7/13/2016	195	75927	0	mesa

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base

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

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	
								Arriving	

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

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
Kts	Ft	Ft	Yes / No	@ 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 / No
c72	e	19:38:00	19:56:00		17	0.6	1.1	
c73	w	19:58:00	20:16:00		18	0.6	1.1	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page		2		Verify S-Turns After Mission Yes / No

Additional Comments:	Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	6/2/2016	154	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
Osterfeld	404CP	5531.3	9:30:00	15:30:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5533.5	11:50:00	17:50:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
160 7				13	3			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	14825	Ft	Yes		No		@	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	
62	E	15:55:00	16:02:00		17		1.3					
61	W	16:04:00	16:12:00		17		1.3					
60	E	16:15:00	16:21:00		17		1.2					
59	W	16:24:00	16:31:00		16		1.4					
58	E	16:34:00	16:40:00		18		1.2					
63	NE	16:52:00	16:53:00		19		1.3					
64	NE	16:58:00	17:04:00		21		1.1					
65	SW	17:07:00	17:14:00		21		1.1					
93	SW	17:21:00	17:23:00		21		1.2					
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission	Yes	X	No	

Additional Comments:	Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	6/1/2016	153	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
Osterfeld	404CP	5491.7	8:30:00	14:30:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5496.8	3:30:00	21:30:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
11				17	2			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	12825 Ft	Yes / No	@ 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
49	NW	15:11:00	15:13:00		17		1.1	
48	SE	15:16:00	15:18:00		18		1.2	
47	NW	15:22:00	15:25:00		19		1.1	
46	SE	15:28:00	15:40:00		19		1.1	
45	NW	15:43:00	15:55:00		19		1.2	Cloud 5-10
44	SE	15:57:00	16:09:00		18		1.3	Cloud Start
43	NW	16:12:00	16:24:00		18		1.2	
42	SE	16:27:00	16:40:00		17		1.5	
41	NW	16:42:00	16:54:00		19		1.2	
40	SE	16:57:00	17:09:00		19		1.3	
39	NW	17:12:00	17:24:00		19		1.2	
38	SE	17:28:00	17:40:00		19		1.2	
37	NW	17:43:00	17:55:00		19		1.3	
36	SE	17:58:00	18:10:00		20		1.2	
35	NW	18:13:00	18:26:00		20		1.2	
34	SE	18:28:00	18:40:00		21		1.1	
33	NW	18:43:00	18:57:00		20		1.1	
32	SE	18:58:00	19:09:00		19		1.2	
31	NW	19:13:00	19:25:00		18		1.3	
30	SE	19:28:00	19:41:00		21		1.2	
11	NW	19:50:00	19:53:00		21		1.2	
12	SE	19:56:00	20:00:00		20		1.3	
13	NW	20:02:00	20:06:00		20		1.3	
14	SE	20:09:00	20:14:00		19		1.5	
114	N	20:36:00	20:41:00		18		1.3	Moved to 10825
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments:	Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/31/2016	152	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5491.7	8:45:00	14:45:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5496.8	1:00:00	19:00:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
11				15	3			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	12825 Ft	Yes / No	@ 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
54	S	14:58:00	15:10:00		16		1.2	
55	N	15:13:00	15:25:00		18		1.1	
56	S	15:28:00	15:40:00		18		1	
57	N	15:43:00	15:54:00		17		1.2	
58	S	15:57:00	16:08:00		18		1.2	
59	N	16:12:00	16:23:00		19		1.2	
77	S	16:28:00	16:36:00		18		1.2	
1	W	16:55:00	16:56:00		19		1.1	
2	E	16:59:00	17:00:00		19		1.1	
3	W	17:03:00	17:04:00		19		1.1	
4	E	17:06:00	17:07:00		19		1.1	
5	NW	17:15:00	17:16:00		21		1.1	
6	SE	17:19:00	17:20:00		21		1.1	
7	NW	17:24:00	17:26:00		21		1.1	
8	SE	17:30:00	17:32:00		21		1.1	
9	NW	17:36:00	17:39:00		20		1.2	
10	SE	17:43:00	17:46:00		19		1.4	
50	NW	17:54:00	17:55:00		20		1.3	
49	SE	17:58:00	18:00:00		20		1.3	
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/30/2016	146	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5516.2	8:13:00	14:13:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5521.5	1:29:00	19:29:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
110 4				14	4			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	12825	Ft	Yes		No		@	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
36	S	14:30:00	14:43:00			16	1.1	
37	N	14:45:00	14:58:00			17	1.1	
38	S	15:02:00	15:17:00			19	1	
39	N	15:19:00	15:33:00			19	1	
40	S	15:36:00	15:50:00			19	1.1	
41	N	15:53:00	16:06:00			18	1.2	
42	S	16:10:00	16:24:00			18	1.2	
43	N	16:26:00	16:40:00			18	1.2	
44	S	16:43:00	16:57:00			19	1.1	
45	N	16:59:00	17:12:00			20	1.1	
46	S	17:14:00	17:30:00			22	1.1	
47	N	17:32:00	17:45:00			23	1.1	
48	S	17:48:00	18:01:00			20	1.3	
49	N	18:03:00	18:15:00			21	1.3	
50	S	18:19:00	18:31:00			22	1.1	
51	N	18:34:00	18:36:00			23	1	
52	S	18:49:00	19:01:00			22	1.1	
53	N	19:05:00	19:16:00			21	1.1	
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/29/2016	145	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5514.0	9:25:00	15:25:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5516.2	11:40:00	17:40:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
110 12				18	3			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	12825	Ft	Yes		No		@	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
31	S	15:40:00	15:53:00		20		1.1	
32	N	15:57:00	16:10:00		19		1.2	
33	S	16:13:00	16:27:00		19		1.2	
34	N	16:29:00	16:44:00		18		1.3	
35	S	16:46:00	17:00:00		19		1.3	
36	N	17:03:00	17:16:00		21		1.1	Fatal error: data gap

↑ Times entered are Zulu / GMT ↑		0:00:00	Total Time On Line	Verify S-Turns After Mission: Yes x No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/28/2016	144	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5509.9	9:05:00	15:05:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5514.0	1:03:00	19:03:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
10 Kts				19	3			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	12825	Ft	Yes		No		@	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
23	S	15:21:00	15:35:00		19		1	
24	N	13:38:00	15:53:00		18		1.1	
25	S	15:57:00	16:11:00		17		1.2	
26	N	16:16:00	16:29:00		17		1.2	
27	S	16:32:00	16:45:00		17		1.2	
28	N	16:48:00	17:02:00		18		1.1	Descended to 10825
112	N	17:18:00	17:23:00		19		1.1	
113	S	17:26:00	17:32:00		19		1.1	
115	N	17:34:00	17:40:00		19		1.1	Ascended to 12825
105	NW	17:50:00	17:57:00		18		1.2	
104	SE	18:00:00	18:07:00		17		1.3	
29	S	18:19:00	18:33:00		19		1.2	
30	N	18:35:00	18:48:00		21		1.1	
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/26/2016	147	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5506.7	9:17:00	15:17:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS80	5509.9	12:33:00	18:33:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
120 10				13	-2			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	12825	Ft	Yes		No		@	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
176	N	15:44:00	15:49:00		19		1.1	All lines done manual today
175	S	15:54:00	15:59:00		20		1.1	due to line up issues.
174	N	16:09:00	16:14:00		19		1.3	
173	S	16:20:00	16:23:00		19		1.3	
172	N	16:28:00	16:33:00		19		1.3	North end snow
171	S	16:38:00	15:42:00		19		1.2	Snow
170	N	16:47:00	16:49:00		18		1.5	
169	N	16:59:00	17:01:00		20		1.3	
168	S	17:05:00	17:07:00		20		1.1	
167	N	17:12:00	17:13:00		20		1.2	
166	S	17:17:00	17:18:00		19		1.2	
165	N	17:22:00	17:23:00		20		1.2	
164	S	17:26:00	17:28:00		20		1.2	
163	N	17:31:00	17:32:00		22		1.1	
58	S	17:50:00	18:03:00		20		1.3	Snow on line end
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/23/2016	144	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5500.7	8:59:00	14:59:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Rader	ALS80	5506.7	3:00:00	21:00:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
20 190				13	-3			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts		Ft	12700	Ft	Yes		No		@	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	S	15:23:00	15:35:00	0:12:00	18		1.1	
2	N	15:38:00	15:49:00	0:11:00	18		1.1	
3	S	15:53:00	16:05:00	0:12:00	20		1	
4	N	16:08:00	16:20:00	0:12:00	19		1.2	
5	S	16:23:00	16:35:00	0:12:00	19		1.2	
6	N	16:37:00	16:49:00	0:12:00	18		1.2	
7	S	16:52:00	17:03:00	0:11:00	18		1.2	
8	N	17:06:00	17:16:00	0:10:00	17		1.2	
9	S	17:20:00	17:32:00	0:12:00	19		1.1	
10	N	17:34:00	17:47:00	0:13:00	22		1.2	
11	S	17:49:00	18:02:00	0:13:00	22		1.1	
12	N	18:05:00	18:18:00	0:13:00	22		1.1	
13	S	18:20:00	18:33:00	0:13:00	20		1.4	
14	N	18:36:00	18:48:00	0:12:00	22		1.1	
15	S	18:52:00	19:05:00	0:13:00	24		1	
16	N	19:07:00	19:22:00	0:15:00	24		1	
17	S	19:24:00	19:37:00	0:13:00	22		1.2	
18	N	19:40:00	19:50:00	0:10:00	21		1.1	
19	S	19:53:00	20:04:00	0:11:00	22		1.2	
20	N	20:08:00	20:18:00	0:10:00	21		1.2	
21	S	20:21:00	20:31:00	0:10:00	21		1.2	
22	N	20:35:00	20:47:00	0:12:00	20		1.2	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				4:22:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/22/2016	143	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5496.8	8:46:00	14:46:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Rader	ALS80	5500.7	1:25:00	19:25:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
Calm				16	-8			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	12700 Ft	Yes / No	@ 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
78	S	15:03:00	15:12:00		15		1.2	
77	N	15:21:00	15:26:00		17		1.1	Manual
76	S	15:30:00	15:38:00		15		1.2	
75	N	15:41:00	15:49:00		19		1	
74	S	15:52:00	16:01:00		20		1.1	
73	N	16:04:00	16:12:00		20		1.1	
72	S	16:15:00	16:25:00		20		1.1	
71	N	16:28:00	16:36:00		19		1.2	
70	S	16:39:00	16:48:00		19		1.2	
69	N	16:51:00	17:00:00		19		1.2	
68	S	17:03:00	17:13:00		19		1.2	
67	N	17:16:00	17:25:00		20		1.2	
66	S	17:28:00	17:38:00		21		1.1	
65	N	17:41:00	17:51:00		20		1.1	
64	S	17:57:00	18:05:00		20		1.1	
63	N	18:07:00	18:16:00		19		1.2	
62	S	18:19:00	18:30:00		18		1.3	
61	N	18:32:00	18:42:00		19		1.3	
60	S	18:44:00	18:56:00		19		1.2	Light snow at line ends.
59	N	19:05:00	19:16:00		21		1	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	5/21/2016	142	75927.02	#REF!	USGS Mesa CO.

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Osterfeld	404CP	5491.7	8:45:00	14:45:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Rader	ALS80	5496.8	1:00:00	19:00:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
120 10				18	-1			Arriving	GJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	51	272		Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	Ft	12700 Ft	Yes / No	@ 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
97	NW	15:01:00	15:06:00	6:22:00	14		1.3	
96	SE	15:09:00	15:13:00	0:00:00	15		1.2	
95	NW	15:16:00	15:19:00	0:00:00	16		1.1	
94	SE	15:22:00	15:26:00	0:00:00	15		1.2	
93	NW	15:28:00	15:32:00	0:00:00	16		1.1	
92	SE	15:34:00	15:39:00	0:00:00	17		1.2	
91	NW	15:41:00	15:44:00	0:00:00	16		1.1	
90	SE	15:46:00	15:51:00	0:00:00	18		1.1	
89	NW	15:54:00	15:56:00	0:00:00	17		1.1	
88	SE	16:00:00	16:02:00	0:00:00	17		1.1	
87	NW	16:05:00	16:07:00	0:00:00	17		1.2	
86	SE	16:10:00	16:12:00	0:00:00	18		1.1	
85	NW	16:14:00	16:15:00	0:00:00	18		1.1	
84	SE	16:19:00	16:20:00	0:00:00	18		1.1	
83	NW	16:23:00	16:24:00	0:00:00	17		1.1	
82	SE	16:28:00	16:28:00	0:00:00	18		1.1	
117	E	16:32:00	16:43:00	0:00:00	17		1.2	
118	W	16:46:00	16:55:00	0:00:00	18		1.2	
119	E	16:58:00	17:08:00	0:00:00	19		1.2	
120	W	17:10:00	17:20:00	0:00:00	18		1.3	
121	E	17:24:00	17:33:00	0:00:00	18		1.3	
122	W	17:36:00	17:46:00	0:00:00	20		1.3	
123	E	17:49:00	18:00:00	0:00:00	20		1.1	
124	W	18:02:00	18:14:00	0:00:00	20		1.1	
125	E	18:16:00	18:29:00	0:00:00	19		1.2	
126	W	18:31:00	18:42:00	0:00:00	19		1.3	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				6:22:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica LIDAR

MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
5/20/2016	141			

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
		5489.4		14:30:00	

Pilot	Sensor Type	HOBBS END	Local End Time	Zulu End Time	PID
	ALS80 8191	5491.7		17:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
			Broken	17	3			Arriving	GJT

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

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
Kts	Ft	Ft	Yes / No	@ 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
79	S	14:55:00	15:01:00	0:06:00			1.4	Corrupt encoder data warning
79	N	15:22:00	15:30:00	0:08:00			1.4	
103	NW	15:38:00	15:45:00	0:07:00			1.1	
102	SE	15:49:00	15:55:00	0:06:00			1.1	
101	NW	15:58:00	16:04:00	0:06:00			1.1	
104	S	16:07:00	16:11:00	0:04:00			1.1	Manual Control 1-14
105	N	16:15:00	16:18:00	0:03:00			1	Manual Control 10-1
100	S	16:21:00	16:26:00	0:05:00			1.1	
99	N	16:29:00	16:34:00	0:05:00			1.1	
98	S	16:36:00	16:42:00	0:06:00			1.2	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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				0:00:00				

↑ 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
	5/19/2016	140			

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
		5488.2		14:52:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
	ALS80 8191	5589.4		16:09:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
			Broken	13	6			Arriving	GJT

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

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
	Kts		Ft		Ft	Yes		No		@	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
105	**NW**	**15:06:00**	**15:13:00**	**0:07:00**			**1.4**	**WP 8-End Clouds**
104	**SE**	**15:16:00**	**15:23:00**	**0:07:00**			**1.3**	**WP 1-14 Clouds**
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				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 #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	5/18/2016	139			

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
		5481.6		15:01:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
	ALS80	5488.2		21:40:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
			Broken	14	5			Arriving	GJT

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

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
	Kts		Ft		Ft	Yes		No		@	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
81	N	15:22:00	15:29:00	0:07:00			1.1	
82	S	15:32:00	15:39:00	0:07:00			1.1	
83	N	15:41:00	15:49:00	0:08:00			1.3	
84	S	15:51:00	15:58:00	0:07:00			1.2	
85	N	16:00:00	16:08:00	0:08:00			1.2	
90	S	16:10:00	16:17:00	0:07:00			1.2	
91	N	16:20:00	16:26:00	0:06:00			1.2	
92	S	16:28:00	16:35:00	0:07:00			1.1	
93	N	16:38:00	16:43:00	0:05:00			1.2	
94	S	16:46:00	16:52:00	0:06:00			1.3	
95	N	16:54:00	17:00:00	0:06:00			1.3	
96	S	17:02:00	17:07:00	0:05:00			1.3	
97	N	17:10:00	17:15:00	0:05:00			1.3	
98	S	17:18:00	17:23:00	0:05:00			1.2	
99	N	17:25:00	17:30:00	0:05:00			1.7	
100	S	17:33:00	17:38:00	0:05:00			1.3	
101	N	17:39:00	17:46:00	0:07:00			1.3	
102	S	17:49:00	17:55:00	0:06:00			1.3	
103	N	17:58:00	18:03:00	0:05:00			1.3	
104	S	18:07:00	18:13:00	0:06:00			1.2	
105	N	18:15:00	18:21:00	0:06:00			1.2	
106	S	18:24:00	18:30:00	0:06:00			1.2	
107	N	18:33:00	18:39:00	0:06:00			1.4	
108	S	18:42:00	18:48:00	0:06:00			1.4	
109	N	18:51:00	18:56:00	0:05:00			1.4	
110	S	18:59:00	19:04:00	0:05:00			1.2	
111	N	19:13:00	19:14:00	0:01:00			1.2	
112	S	19:16:00	19:21:00	0:05:00			1	
113	N	19:24:00	19:29:00	0:05:00			1.1	
114	S	19:32:00	19:37:00	0:05:00			1.2	Waypoint 7/8 Rain
115	N	19:40:00		##########			1.2	Rain, line aborted
↑ 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
	5/18/2016	139			

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
		5481.6		15:01:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
	ALS80	5488.2		21:40:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	GJT
			Broken	14	5			Arriving	GJT

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

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
	Kts		Ft		Ft	Yes		No		@	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
132	S	19:52:00	19:52:00	0:00:00			1.2	
131	N	19:55:00	19:56:00	0:01:00			1.2	
130	S	19:58:00	20:00:00	0:02:00			1.2	
129	N	20:02:00	20:03:00	0:01:00			1.2	
128	S	20:06:00	20:08:00	0:02:00			1.2	
127	N	20:11:00	20:12:00	0:01:00			1.2	
126	S	20:14:00	20:16:00	0:02:00			1.3	
125	N	20:18:00	20:20:00	0:02:00			1.1	
124	S	20:22:00	20:24:00	0:02:00			1.2	
123	N	20:27:00	20:29:00	0:02:00			1.2	
122	S	20:31:00	20:33:00	0:02:00			1.2	
121	N	20:36:00	20:38:00	0:02:00			1.2	
120	S	20:40:00	20:43:00	0:03:00			1.2	
119	N	20:45:00	20:51:00	0:06:00			1.2	
118	S	20:53:00	21:00:00	0:07:00			1.2	
117	N	21:01:00	21:07:00	0:06:00			1.4	
116	S	21:10:00	21:15:00	0:05:00			1.4	
115	N	21:18:00	21:23:00	0:05:00			1.2	
				0:00:00				
				0:00:00				
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				0:00:00				
↑ Times entered are Zulu / GMT ↑			Page		2			Verify S-Turns After Mission Yes X No

Additional Comments: Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	3/17/2016	77	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC ☐ N404CP ☐ N7079F X N475CP ☐ N1107Q ☐	SH-8170 X SH_6157 ☐ SH-7108 ☐	364.6	9:45	15:45
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Gebhart			368.7	14:10	20:10

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes ☐ No X	GPS Base #1	Annen	KGJT
		GPS Base #2	Operator	PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
130/6	10+	0	0	2	-7	30.03		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___ Fine/Down ___	Single ☐ Multi ☐	2 + 2 ☐ 4 + 3 ☐

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 ☐
B116	S	16:17:00	16:19:00					
B115	N	16:23:00	16:25:00					
B114	N	16:30:00	16:31:00					
B113	S	16:35:00	16:36:00					
B112	S	16:42:00	16:50:00					
B111	N	16:54:00	17:02:00					
B110	S	17:06:00	17:14:00					
B109	N	17:19:00	17:27:00					
B108	S	17:31:00	17:39:00					
B107	N	17:42:00	17:51:00					
B106	S	17:54:00	18:01:00					Moved due to snow accumilation
B82	N	18:07:00	18:08:00					
B83	S	18:11:00	18:12:00					
B84	N	18:16:00	18:17:00					
B85	S	18:20:00	18:21:00					
B86	N	18:25:00	18:26:00					
B87	S	18:33:00	18:35:00					
B88	N	18:39:00	18:40:00					Moved due to snow accumilation
B180	S	18:48:00	18:52:00					
B179	N	18:55:00	18:59:00					
B178	S	19:03:00	19:08:00					
B177	N	19:10:00	19:15:00					
B176	S	19:18:00	19:32:00					
B80	S	19:30:00	19:37:00					Snow south end
B81	N	19:39:00	19:43:00					Snow south end
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes X No ☐

Additional Comments: System worked well, no issues. Need to evaluate snow accumilation areas.

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	12/25/1900	76	MesaCO 75927

Operator	Aircraft		Sensor		Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC		SH-8170	X	360.1	11:10	17:10
Pilot	N404CP		SH_6157		Hobbs End	Local End Time	Zulu End Time
Gebhart	N7079F	X	SH-7108		364.6	16:52	21:52
Passengers	N475CP						
	N1107Q						

Using or Relying on CORS			GPS Base #1	Operator	Annen	PID	KGJT
Yes		No	X	GPS Base #2	Operator		PID	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KGJT
Var/4	10	0	0	3	-2	30.23		Arriving ICAO	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain		Mode			
40	51	272	100	Course/Up		Single		2 + 2	
				Fine/Down		Multi		4 + 3	

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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
A208	S	17:36:00	17:44:00		14	0.8	1.3	
A207	N	17:47:00	17:54:00					
A206	S	17:57:00	18:04:00					
A205	N	18:07:00	18:14:00					
A204	S	18:17:00	18:23:00					
A203	N	18:26:00	18:32:00					
A202	S	18:34:00	18:41:00					
A201	N	18:44:00	18:51:00					
A200	S	18:53:00	19:00:00					
A199	N	19:03:00	19:10:00					
A198	S	19:13:00	19:20:00					
A197	N	19:24:00	19:31:00					
A196	S	19:34:00	19:42:00					
A195	N	19:44:00	19:52:00					
A194	S	19:55:00	20:02:00					
A193	N	20:05:00	20:14:00					
A192	S	20:16:00	20:21:00					
A191	N	20:25:00	20:28:00					
A190	S	20:31:00	20:35:00					
A86	N	21:03:00	21:10:00		15	0.8	1.6	
A87	S	21:13:00	21:21:00					
A88	N	21:23:00	21:30:00					
A89	S	21:33:00	21:40:00					
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes X No

Additional Comments: System worked well, no issues.

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	3/15/2016	75	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC ☐ N404CP ☐ N7079F X N475CP ☐ N1107Q ☐	SH-8170 X SH_6157 ☐ SH-7108 ☐	356.6	12:30	18:30
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Gebhart			360.1	4:19	22:19

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
	Yes ☐ No X	GPS Base #1	Annen	KGJT
		GPS Base #2		

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
330/10	10	0	0	7	-9	30.15		KGJT	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___ Fine/Down ___	Single ☐ Multi ☐	2 + 2 ☐ 4 + 3 ☐

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 ☐
A182	N	19:01:00	19:06:00		15	0.8	1.4	
A183	S	19:09:00	19:13:00					
A184	N	19:16:00	19:19:00					
A185	S	19:22:00	19:25:00					
A188	N	19:29:00	19:30:00					
A189	S	19:32:00	19:33:00					
A228	S	19:52:00	19:53:00					
A227	N	19:56:00	19:57:00					
A226	S	20:00:00	20:02:00					
A225	N	20:05:00	20:06:00					
A224	S	20:10:00	20:12:00					
A223	N	20:15:00	20:18:00					
A222	S	20:21:00	20:24:00					
A221	N	20:26:00	20:29:00					
A220	S	20:32:00	20:34:00					
A219	N	20:37:00	20:39:00					
A218	S	20:42:00	20:44:00					
A217	N	20:47:00	20:51:00					
A216	S	20:54:00	20:57:00					
A215	N	21:00:00	21:03:00					
A214	S	21:09:00	21:14:00					
A213	N	21:17:00	21:24:00					
A212	S	21:37:00	21:34:00					
A211	N	21:36:00	21:43:00					
A210	S	21:46:00	21:53:00					
A209	N	21:56:00	22:03:00					
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes X No ☐

Additional Comments: System worked well, no issues.

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	3/13/2016	73	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC ☐ N404CP ☐ N7079F X N475CP ☐ N1107Q ☐	SH-8170 X SH_6157 ☐ SH-7108 ☐	350.5	9:00	15:00
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Gebhart			356.6	15:25	21:25

Passengers	Using or Relying on CORS	GPS Base #1	Operator	Annen	PID	KGJT
	Yes ☐ No X	GPS Base #2	Operator		PID	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KGJT
120/7	10	12K	78	6	-2	30.01		Arriving ICAO	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___ Fine/Down ___	Single ☐ Multi ☐	2 + 2 ☐ 4 + 3 ☐

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 ☐
A153	N	15:29:00	15:35:00		15	0.6	1.1	TDC Buffer error
A154	S	15:38:00	15:44:00					
A155	N	15:47:00	15:53:00					
A156	S	15:56:00	16:02:00					
A157	N	16:05:00	16:11:00					
A158	S	16:15:00	16:22:00					
A159	N	16:24:00	16:32:00					
A160	S	16:35:00	16:43:00					
A161	N	16:46:00	16:53:00					
A162	S	16:56:00	17:04:00					
A163	N	17:08:00	17:18:00					
A164	S	17:21:00	17:31:00					
A165	N	17:33:00	17:42:00					
A166	S	17:45:00	17:57:00					
A167	N	17:59:00	18:11:00					
A168	S	18:14:00	18:26:00					
A169	N	18:29:00	18:41:00					
A170	S	18:44:00	18:55:00					
A171	N	18:57:00	19:08:00					
A172	S	19:12:00	19:18:00					
A173	N	19:21:00	19:28:00					
A174	S	19:30:00	19:36:00					
A175	N	19:39:00	19:45:00					
A176	S	19:49:00	19:55:00					
A177	N	19:58:00	20:04:00					
A178	S	20:07:00	20:13:00					
		see next	page					
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes X No ☐

Additional Comments: System worked well, except one TDC Buffer error on A153. That line was reflown.

Drive #

WOOLPERT FLIGHT LOG SHEET #2

Leica ALS-70	DD/MM/YYYY	Day of Year	Mission Name / Job #
	3/13/2016	73	MesaCO/75927

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
A179	N	20:16:00	20:22:00					
A180	S	20:24:00	20:30:00					
A181	N	20:32:00	20:38:00					SNOW
A186	S	20:42:00	20:45:00					
A187	N	20:48:00	20:50:00					SNOW
A153	S	20:58:00	21:04:00					Reflight

↑ Times entered are Zulu / GMT ↑ 0:00:00 Total Time On Line

Verify S-Turns After Mission Yes [ ] No [ ]

Additional Comments:

Drive #

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY	Day of Year	Mission Name / Job #
	3/12/2016	72	MesaCO 75927

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC ☐ N404CP ☐ N7079F X N475CP ☐ N1107Q ☐	SH-8170 X SH_6157 ☐ SH-7108 ☐	346.7	8:20	15:20
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Gebhart			350.5	12:20	19:20

Passengers	Using or Relying on CORS	GPS Base #1	Operator	Annen	PID	KGJT
	Yes ☐ No X	GPS Base #2	Operator		PID	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KGJT
L/V	10	12K	67	9	-3	29.78		Arriving ICAO	KGJT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	51	272	100	Course/Up ___ Fine/Down ___	Single ☐ Multi ☐	2 + 2 ☐ 4 + 3 ☐

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	6,500 Ft	10,800 Ft	/	@ 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 ☐
A07	N	15:52:00	16:01:00		18	0.7	1.2	
A08	S	16:04:00	16:15:00					
A09	N	16:17:00	16:26:00					
A10	S	16:29:00	16:39:00					
A133	N	16:52:00	16:53:00					Had to restart due to traffic in area
A134	S	16:57:00	16:58:00					
A135	N	17:01:00	17:04:00					
A136	S	17:07:00	17:09:00					
A137	N	17:11:00	17:14:00					
A138	S	17:17:00	17:19:00					
A139	N	17:21:00	17:25:00					
A140	S	17:28:00	17:30:00					
A141	N	17:32:00	17:35:00					
A142	S	17:39:00	17:42:00					
A143	N	17:44:00	17:47:00					
A144	S	17:50:00	17:53:00					
A145	N	17:56:00	18:00:00					
A146	S	18:02:00	18:06:00					
A147	N	18:09:00	18:13:00					
A148	S	18:16:00	18:20:00					
A149	N	18:23:00	18:27:00					
A150	S	18:29:00	18:33:00					
A151	N	18:36:00	18:40:00					
A152	S	18:43:00	18:49:00					
A230	S	18:58:00	18:59:00					
A229	N	19:01:00	19:02:00					
↑ Times entered are Zulu / GMT ↑				#REF!	Total Time On Line			Verify S-Turns After Mission Yes X No ☐

Additional Comments: System worked well, no issues.

Drive #

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 shapefile
- Bridge Breaklines as ESRI shapefile
- Digital Elevation Model in ERDAS .IMG format
- Bare Earth Surface Raster DEM Mosaics (4' for QL2 and 2' for QL1)
- 8-bit gray scale intensity images in .TIF format
- Tile Index provided as ESRI shapefile
- Control Points provided as ESRI shapefile
- FGDC compliant metadata per product in XML format
- Lidar processing report in pdf format
- Survey report in pdf format
- 2’ interval contours delivered by township boundary (to be delivered based on DEM acceptance)