AIRBORNE LIDAR TASK ORDER REPORT

NEW ENGLAND CMGP SANDY LIDAR
UNITED STATES GEOLOGICAL SURVEY (USGS)

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PROJECT REPORT

USGS NEW ENGLAND CMGP SANDY LIDAR PROCESSING

WOOLPERT PROJECT #73667

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SECTION 1: OVERVIEW

PROJECT NAME: NEW ENGLAND CMGP LIDAR

WOOLPERT PROJECT #73667

This report contains a comprehensive outline of the New England CMGP Lidar Processing task order for the United States Geological Survey (USGS). This task order requires lidar data to be acquired over several AOIs in central to eastern Massachusetts. The combined area of both AOI's is approximately 2,120 square miles. The lidar was collected and processed to meet a maximum Nominal Post Spacing (NPS) of 0.7 meters. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.

The data was collected using a Leica ALS70 and an Optech ALTM Gemini lidar sensor. Both sensors collect up to four returns (echo) 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:

ALS70 SPECIFICATIONS

Post Spacing (Minimum):	2.3 ft / 0.7m
AGL (Above Ground Level) average flying height:	6,500 ft / 1,981 m
MSL (Mean Sea Level) average flying height:	variable
Average Ground Speed:	150 knots / 173 mph
Field of View (full):	40 degrees
Pulse Rate:	272 kHz
Scan Rate:	42.3 Hz
Side Lap (Average):	25%

OPTECH ALTM GEMINI SPECIFICATIONS

Post Spacing (Minimum):	2.3 ft / 0.7m
AGL (Above Ground Level) average flying height:	5,000 ft / 1,524 m
MSL (Mean Sea Level) average flying height:	variable
Average Ground Speed:	130 knots / 149 mph
Field of View (full):	25 degrees
Pulse Rate:	125 kHz
Scan Rate:	46 Hz
Side Lap (Average):	30%

The lidar data for this AOI was processed and projected in UTM, Zone 19N, North American Datum of 1983 (2011) in units of meters. The vertical datum used for the task order was referenced to NAVD 1988, GEOID12A, in units of meters. However, a portion of the AOI crossed into the UTM18N Zone. All products for this portion of the AOI will be referenced to UTM18N American Datum of 1983 (2011). The vertical datum used for the task order was referenced to NAVD 1988, meters, GEOID12A. Coordinate positions were specified in units of meters.

Figure 1.1 Lidar Task Order AOI

SECTION 2: ACQUISITION

The existing lidar data was acquired with a Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) lidar sensor system and an Optech Gemini Lidar System, on board a Cessna 404 and Cessna 310 aircraft. The ALS70 lidar system, developed by Leica Geosystems of Heerbrugg, Switzerland includes the simultaneous first, intermediate and last pulse data capture module, the extended altitude range module, and the target signal intensity capture module. The Optech Gemini Lidar System developed by Optech of Canada collects up to four returns (echo) per pulse, recording attributes such as time stamp and intensity data, for the first three returns.

Table 2.1: ALS70 Lidar System Specifications

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

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

Table 2.2: Optech ALTM Gemini Lidar System Specifications

The ALTM Gemini Multiple Pulses in Air (MPiA) Lidar System has the following specifications:

Specification	
Operating Altitude	150 – 4,000m AGL nominal, 10% reflective target
Scan Angle	0 to 50° (variable)
Swath Width	0 to 1.5 X altitude (variable)
Scan Frequency	0 – 70 Hz (variable based on scan angle)
Maximum Pulse Rate	167kHz
Range Resolution	Better than 1 cm
Elevation Accuracy	5 - 35 cm single shot (one standard deviation)
Horizontal Accuracy	1/5,500 x altitude (m AGL)
Number of Returns per Pulse	4 (first, second, third, last)
Number of Intensities	3 (first, second, third)
Intensity Digitization	12 bit dynamic measurement range
Laser Beam Divergence	Dual Divergence: .25 mrad (1/e) and 0.8 mrad(1/e) nominal
Laser Classification	Class IV laser product (FDA CFR 21)
Eye Safe Range	400m single shot depending on laser repetition rate
Roll Compensation	±5° at full FOV
Power Requirements	28 VDC @ 35A
Operating Temperature	0-40°C
Humidity	0-95% non-condensing

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

Woolpert survey crews were onsite, operating multiple Global Navigation Satellite System (GNSS) Base Stations for the airborne GPS support.

The lidar data was collected in thirty-five (35) separate missions, flown as close together as the weather permitted, to ensure consistent ground conditions across the project area.

An initial quality control process was performed immediately on the lidar data to review the data coverage, airborne GPS data, and trajectory solution. Any gaps found in the lidar data were relayed to the flight crew, and the area was re-flown.

Figure 2.1: Lidar Flight Layout: New England CMGP Sandy Lidar

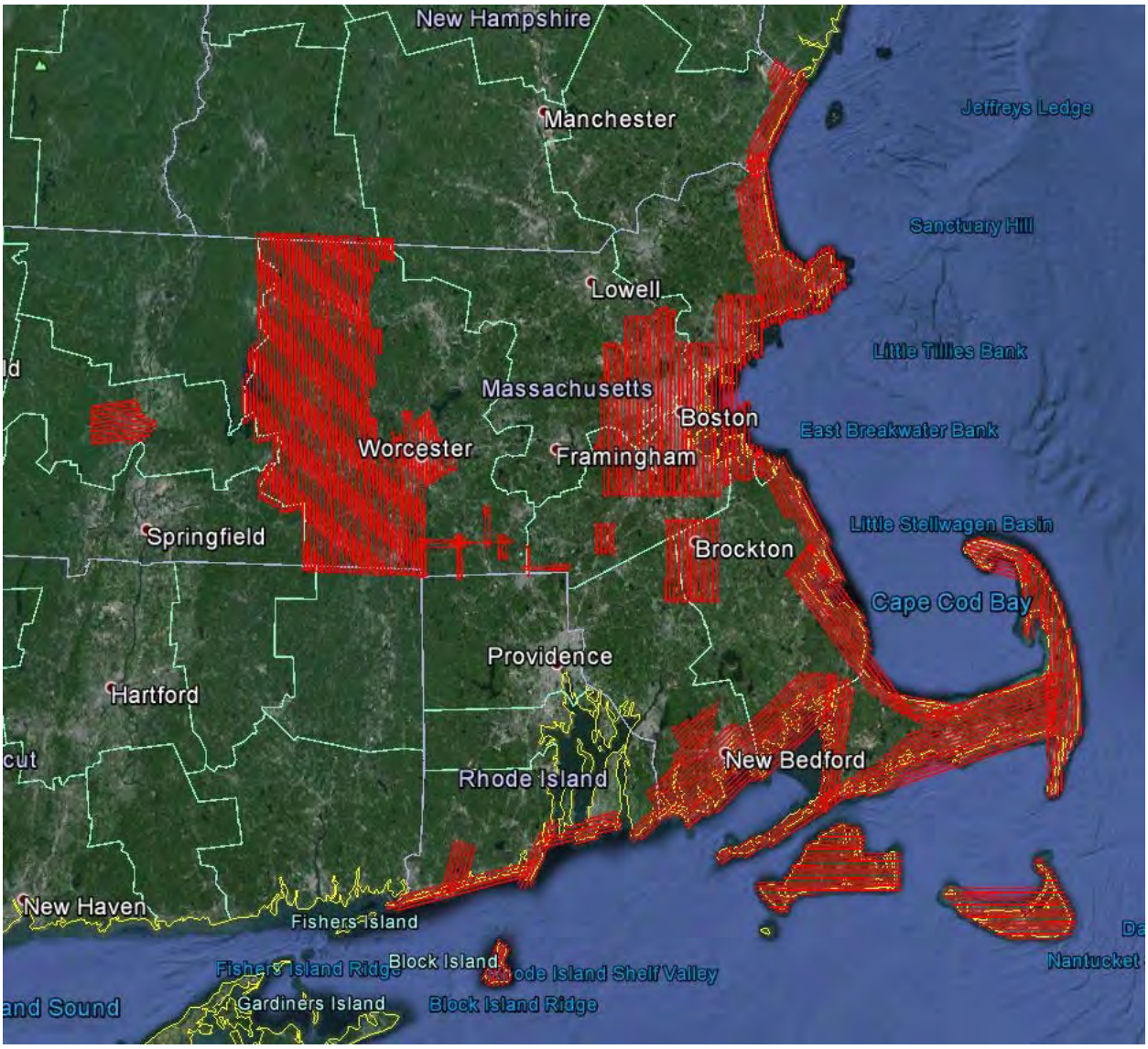


Table 2.3: Airborne Lidar Acquisition Flight Summary

Airborne Lidar Acquisition Flight Summary			
Date of Mission	**Lines Flown**	**Mission Time (UTC)** **Wheels Up/** **Wheels Down**	**Mission Time (Local = EDT)** **Wheels Up/** **Wheels Down**
November 16, 2013 – SensorOP108	1-17	22:50 - 02:15	05:04PM – 09:15PM
November 18, 2013 – SensorOP108	191-226	20:30 – 01:10	03:30PM – 08:10PM
November 20, 2013 – SensorOP108A	272,273,300-313	11:45 – 15:50	06:45AM – 10:50AM
November 20, 2013 – SensorOP108B	385-397	17:20 – 22:02	12:20PM– 05:02PM
November 21, 2013 – SensorOP108A	274-289	14:10 – 17:30	09:10AM – 12:30PM
November 21, 2013 – SensorOP108B	347-358,398,399,400-408	18:30 – 23:30	10:30AM – 06:30PM
November 23, 2013 – SensorOP108A	290-299	12:50 – 15:10	07:50AM – 10:10AM
November 23, 2013 – SensorOP108B	314-332,346,345,359-361	20:40 – 01:20	03:40PM – 08:15PM
November 25, 2013 – SensorOP108A	333-344	11:40 – 14:25	06:40AM – 09:25AM
November 25, 2013 – SensorOP108B	409-421	21:01 – 00:30	04:01PM – 07:30PM
November 28, 2013 – SensorOP108A	422-444	15:30 – 20:45	10:30AM – 03:45PM
November 28, 2013 – SensorOP108B	445-457	21:15 – 01:15	04:15PM – 08:15PM
November 29, 2013 – SensorOP108	458,535-554,576-579	16:30 – 20:40	11:30AM – 03:40PM
December 03, 2013 – SensorOP108	459-471	19:55 – 22:50	02:55PM – 05:50PM
December 03, 2013 – Sensor7177	48-52	20:14 – 20:57	03:14PM – 03:57PM
December 04, 2013 – SensorOP108	555-575	21:05 – 01:55	03:05PM – 08:55PM
December 04, 2013 – Sensor7177	1-11,17-30	20:40 – 02:40	03:40PM – 09:40PM
December 08, 2013 – Sensor7177A	105,106-123,207-216	14:25 – 19:26	09:25AM – 02:26PM
December 08, 2013 – Sensor7177B	145-164	00:05 – 04:10	07:05PM – 11:10PM
April 03, 2014 – Sensor7177	67-75	22:35 – 23:14	05:35PM – 06:14PM

Airborne Lidar Acquisition Flight Summary			
Date of Mission	**Lines Flown**	**Mission Time (UTC)** **Wheels Up/** **Wheels Down**	**Mission Time (Local = EDT)** **Wheels Up/** **Wheels Down**
April 04, 2014 – Sensor7177	217-239	13:02 – 16:07	08:02AM – 11:07AM
April 06, 2014 – Sensor7177	240-256,355,365	13:32 – 17:31	08:32 AM – 12:31PM
April 07, 2014 – Sensor7177A	266-272,285-287,K1-K8	11:49 – 15:09	06:49AM – 10:09AM
April 07, 2014 – Sensor7177B	257-259,273-277,K57-K62	16:30 – 18:23	11:30AM – 01:23PM
April 09, 2014 – Sensor7177	217,278-284,K52	14:43 – 15:54	09:43AM – 10:54AM
April 10, 2014 – Sensor7177A	44-51	12:22 – 14:52	07:22AM – 09:52AM
April 10, 2014 – Sensor7177B	K10-K17,K43-K56	16:45 – 20:38	11:45AM – 03:10PM
April 12, 2014 – Sensor7177A	34-43	14:01 – 17:11	09:01AM – 12:11PM
April 12, 2014 – Sensor7177B	K7,K8,K18-K31	19:02 – 21:35	02:02PM – 04:35PM
April 13, 2014 – Sensor7177	K32-K42	21:04 – 21:56	04:04PM – 04:56PM
April 14, 2014 – Sensor7177	52-61,66	13:24 – 15:15	08:24AM – 10:15AM
April 16, 2014 – Sensor7177A	31-34,49,54,60,62-66,76-86	19:02 – 22:29	02:02PM – 05:29PM
April 16, 2014 – Sensor7177B	K9,280,282,284	23:34 – 00:11	06:29PM – 07:11PM
April 20, 2014 – Sensor7177	76,280,282,284	19:59 – 21:02	02:59PM – 04:02PM
December 27, 2014- Sensor7108	3001-3008	19:25 – 23:30	02:25PM – 06:30PM

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.

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. 14.01.

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.14.011.

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.14.011.

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.

The aircraft are all configured with a NovAtel Millennium 12-channel, L1/L2 dual frequency Global Navigation Satellite System (GNSS) receivers collecting at 2 Hz.

All Woolpert aerial sensors are equipped with a Litton LN200 series Inertial Measurement Unit (IMU) operating at 200 Hz.

A base-station unit was mobilized for each acquisition mission, and was operated by a member of the Woolpert acquisition team. 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.

Woolpert's acquisition team was on site operating GNSS base stations at KOQU, KOWD, KLWM, KFIT, KORH airports along with utilizing MASA, MATU, and MAWM CORS stations.

The GNSS base station operated during the lidar acquisition missions are listed below:

Table 3.1: GNSS Base Stations

Station Name	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height (L1 Phase center) (Meters)
KOQU_Arpt_Base	41°35'38.50261"	71°24'44.77775"	-27.546
KOWD_Arpt_Base	42°11'28.54987"	71°10'43.65760"	-14.216
KLWM_Arpt_Base	42°42'50.89145"	71°07'16.09907"	20.086
KFIT_Arpt_Base	42°33'27.60544"	71°48'22.47957"	76.391
KORH_Arpt_Base	42°16'03.63503"	71°52'10.52484"	272.057
MASA_CORS	42°51'45.88625"	70°53'24.94600"	-10.236
MATU_CORS	41°58'51.70825"	70°02'36.89124"	13.400
MAWM_CORS	42°33'40.62118"	71°55'59.20777"	317.420
NGS_PID_AI5585	41°40'11.43252"	70°02'36.89124"	13.400

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

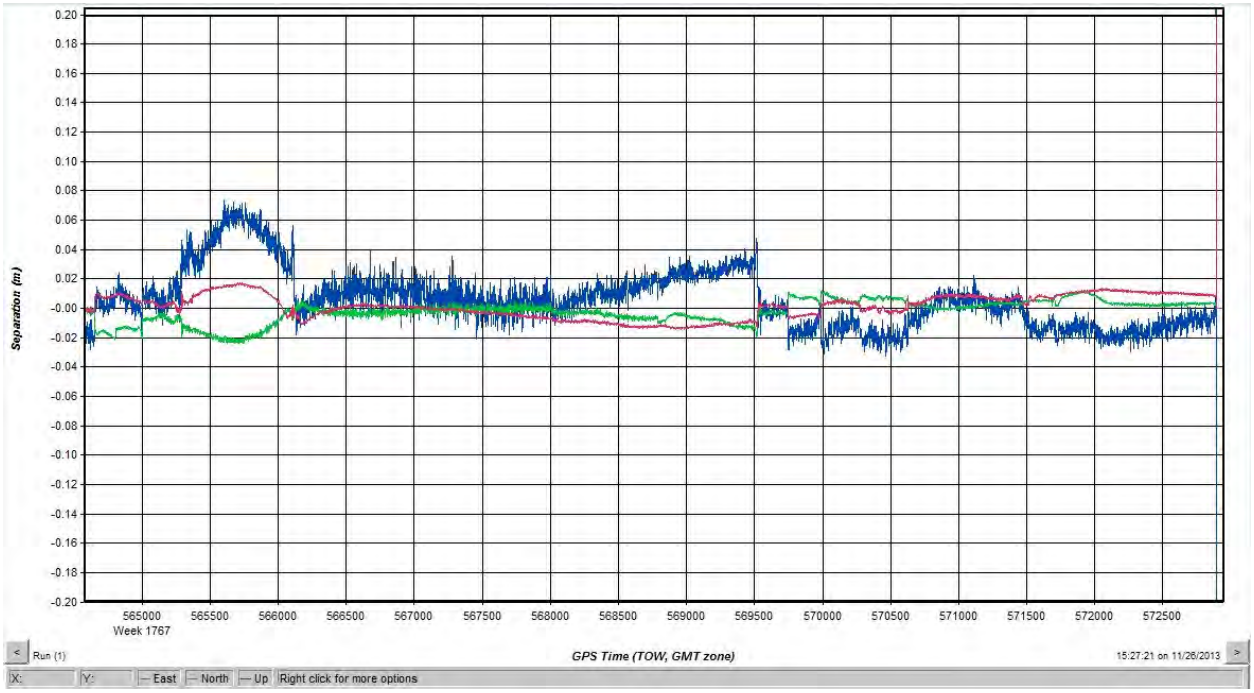
The GNSS Trajectory, along with high quality IMU data are key factors in determining the overall positional accuracy of the final sensor data. Within the trajectory processing, there are many factors that affect the overall quality, but the most indicative are the Combined Separation, the Estimated Positional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

Combined 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 3.1: Combined Separation, Day32713_OP108_A

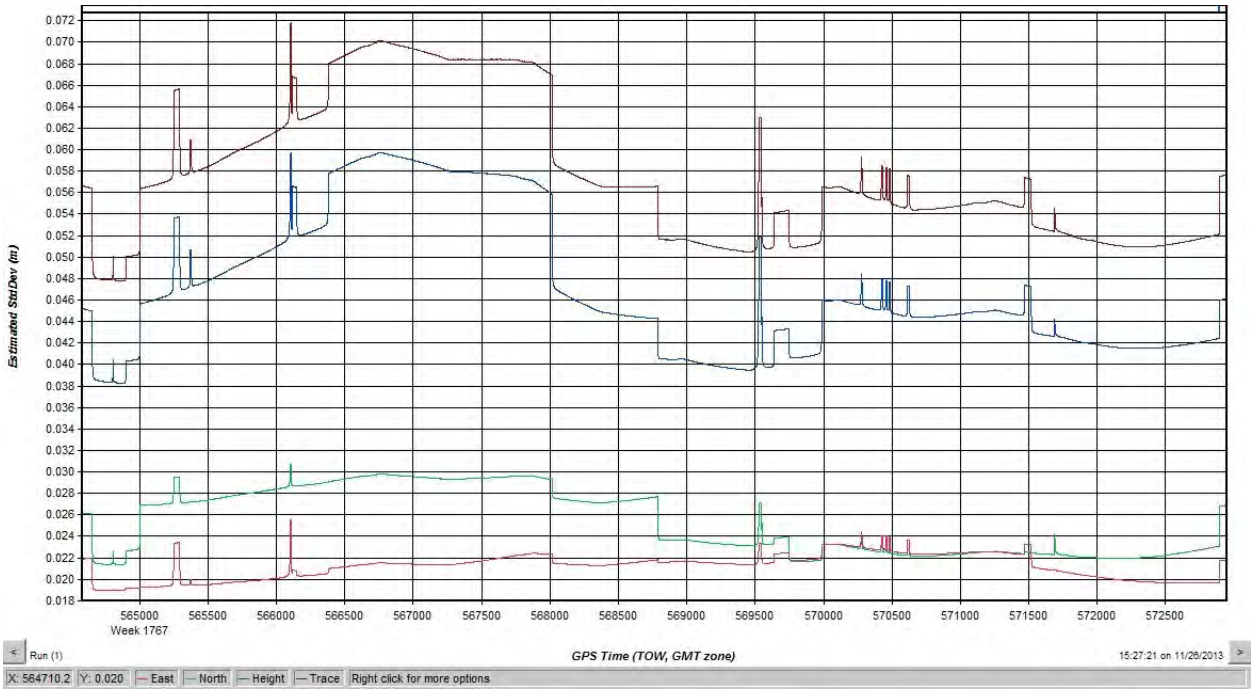


Estimated Positional Accuracy

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 3.2: Estimated Positional Accuracy, Day32713_OP108_A

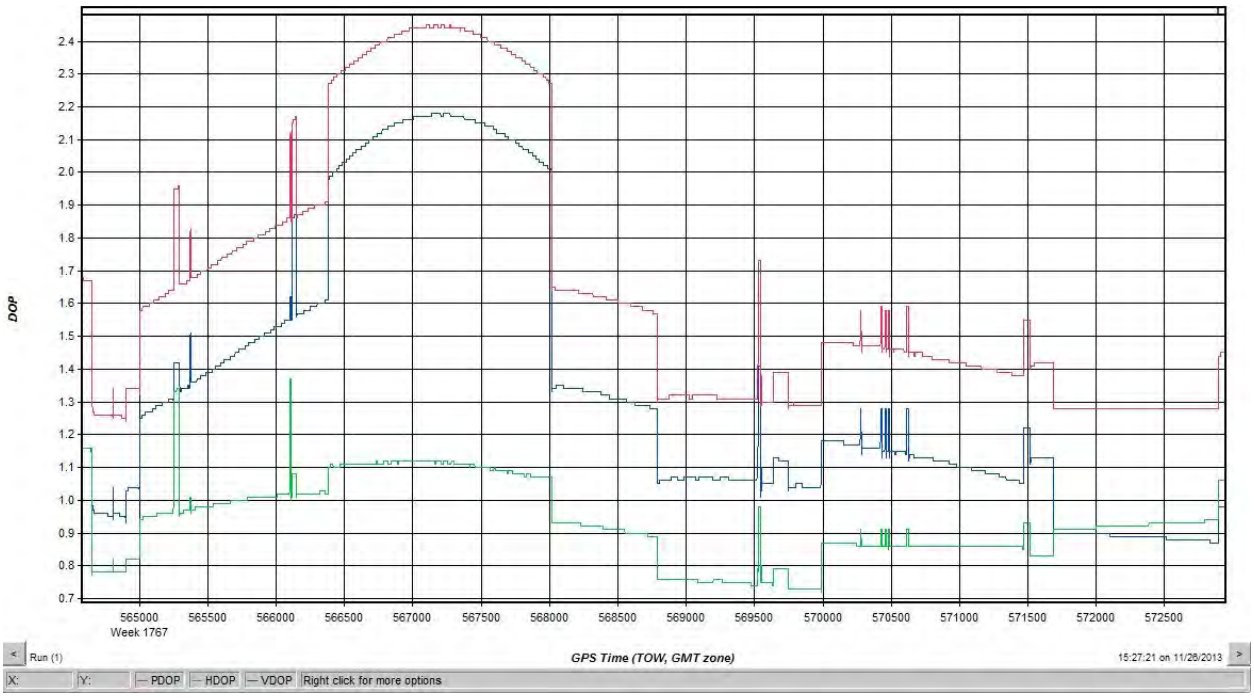


PDOP

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 3.3: PDOP, Day32713_OP108_A



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), Noise (Class 7), Water (Class 9), Ignored Ground (Class 10), Overlap default (Class 17), and Overlap Ground (Class 18) classifications.

- FGDC Compliant metadata was developed for the task order in .xml format for the final data products.

- The horizontal datum used for the task order was referenced to UTM19N American Datum of 1983 (2011). The vertical datum used for the task order was referenced to NAVD 1988, meters, GEOID12A. Coordinate positions were specified in units of meters. However, a portion of the AOI crossed into the UTM18N Zone. All products for this portion of the AOI will be referenced to UTM18N American Datum of 1983 (2011). The vertical datum used for the task order was referenced to NAVD 1988, meters, GEOID12A. Coordinate positions were specified in units of meters.

SECTION 4: HYDROLOGIC FLATTENING

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

New England CMGP Sandy 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-acres 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 30.5 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

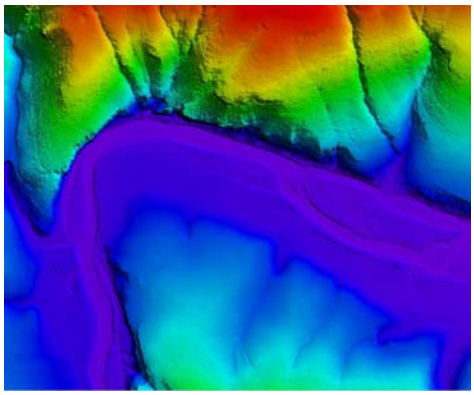
Woolpert utilized the following steps to hydrologically flatten the water bodies and for gradient hydrologic flattening of the double line streams within the existing lidar data.

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-acres or greater, were compiled as closed polygons. **Figure 4.1** illustrates a good example of 2-acre lakes and 30.5 meters (100 feet) nominal streams identified and defined with hydrologic breaklines. The breaklines defining rivers and streams, at a nominal minimum width of 30.5 meters (100 feet), were draped with both sides of the stream maintaining an equal gradient elevation.

Figure 4.1



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 4.2 **Figure 4.3**

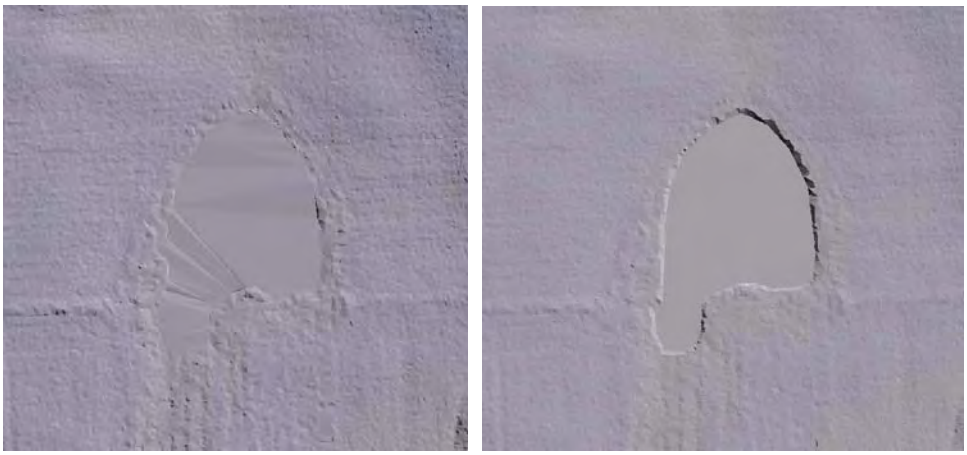


Figure 4.2 reflects a DEM generated from original lidar bare earth point data prior to the hydrologic flattening process. Note the "tinning" across the lake surface.

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.

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 at a 1-meter cell size.

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-acres were provided as a PolygonZ file. The breaklines compiled for the gradient flattening of all rivers and streams at a nominal minimum width of 30.5 meters (100 feet) were provided as a PolylineZ file.

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: FINAL ACCURACY ASSESSMENT

FINAL VERTICAL ACCURACY ASSESSMENT

The vertical accuracy statistics were calculated by comparison of the lidar bare earth points to the ground surveyed quality check points.

Table 5.1: Overall Vertical Accuracy Statistics

Average error	0.024	meters
Minimum error	-0.099	meters
Maximum error	0.127	meters
Root mean square	0.052	meters
Standard deviation	0.047	meters

Table 5.2: Swath Quality Check Point Analysis, FVA, UTM 19N, NAD83, NAVD88 GEOID12A, New England CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	TIN Elevation (meters)	Dz (meters)
2000	238808.593	4729756.684	314.18	0.003
2001	252759.177	4729893.198	326.87	0.067
2002	237618.673	4708622.584	323.81	0.086
2003	253465.281	4712370.364	314.24	0.025
2004	243974.963	4696601.057	176.47	0.017
2005	235652.093	4689464.52	166.6	0.031
2006	255894.516	4682504.737	305.19	0.052
2007	246531.315	4678704.569	188.77	-0.015
2008	236426.37	4678344.342	184.64	-0.023
2009	244533.427	4666949.275	176.48	0.015
2010	254643.417	4670174.208	273.62	0.054
2011	262845.434	4661671.384	158.91	0.019
2012	266140.096	4690653.403	217.4	-0.029
2013	269551.403	4683276.298	145.64	-0.04
2014	331635.343	4663356.124	52.54	0.026

Point ID	Easting (UTM meters)	Northing (UTM meters)	TIN Elevation (meters)	Dz (meters)
2015	272371.509	4680766.15	147.67	-0.046
2016	354345.284	4772155.384	14.94	0.038
2017	348903.617	4747615.689	10.2	0.006
2018	348765.111	4727425.284	12.32	-0.007
2019	355666.19	4715570.539	5.39	0.032
2020	346321.445	4710788.537	5.81	0.082
2021	334260.606	4696641.591	2.67	0.029
2022	332048.784	4682896.277	5.06	0.062
2023	313582.502	4674808.346	89.01	0.116
2024	359291.041	4653578.747	22.26	-0.002
2025	401506.667	4656352.653	12.29	-0.025
2026	375010.975	4606304.672	15.21	0.008
2027	418525.474	4567325.331	4.1	0.067
2027A	417360.834	4568379.525	6.4	0.127
2028	376950.144	4581313.943	6.38	0.078
2028A	369525.441	4582995.29	11	0.037
2029	285229.732	4560128.137	32.59	-0.017
2030	268325.483	4580419.341	10.01	0.058
2031	196027.548	4696458.637	126.19	-0.099
2032	195575.274	4691688.981	86.68	0.001

VERTICAL ACCURACY CONCLUSIONS

LAS Swath Fundamental Vertical Accuracy (FVA) Tested 0.101 meters fundamental vertical accuracy at 95 percent confidence level, derived according to NSSDA, in open terrain in open using (RMSEz) x 1.9600, tested against the TIN.

Bare-Earth DEM Fundamental Vertical Accuracy (FVA) Tested 0.096 meters fundamental vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 Tested against the DEM.

Table 5.3: Quality Check Point Analysis, Urban, UTM 19N, NAD83, NAVD88 GEOID12A, New England CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
3000	234962.073	4720616.776	165.340	0.007
3001	250520.367	4730454.835	301.199	-0.023
3002	254527.833	4716169.511	303.449	0.051
3003	252207.457	4707627.623	311.790	-0.017
3004	244579.866	4701342.542	275.250	-0.072
3005	235615.322	4689492.95	168.639	-0.082
3006	259662.283	4681177.525	280.290	0.020
3007	247446.386	4679136.532	191.810	0.024
3008	236384.139	4678321.435	184.590	-0.049
3009	248887.338	4662666.915	154.810	0.030
3010	253893.341	4670334.432	264.720	-0.067
3011	263075.189	4660510.531	142.380	-0.055
3012	265332.983	4691362.992	226.319	-0.009
3013	269455.365	4683256.102	144.490	-0.107
3014	330473.031	4662531.222	51.680	0.055
3015	272375.124	4680831.624	147.160	-0.119
3016	354396.316	4772130.534	14.609	-0.019
3017	346652.013	4741321.474	18.550	-0.086
3018	349250.596	4726896.414	4.340	-0.022
3019	363306.846	4719622.13	14.760	-0.034
3020	346346.676	4710753.598	5.670	0.013
3021	334020.685	4696519.915	3.480	-0.003
3022	332131.62	4682886.051	3.230	-0.029

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
3023	318584.559	4673872.131	42.250	0.052
3024	361875.6	4646249.882	29.520	-0.068
3024A	361880.557	4646260.955	29.690	-0.047
3025	401916.825	4656049.563	2.770	-0.079
3026	366665.258	4601719.152	4.790	-0.092
3027	408097.046	4569130.472	7.590	0.045
3028	372661.015	4583072.608	5.990	-0.051
3029	285561.929	4560723.93	18.199	-0.059
3030	268355.197	4580434.056	10.359	0.012
3031	197694.609	4693640.105	82.329	-0.067
3032	195571.531	4691666.238	86.159	-0.081

ACCURACY CONCLUSIONS

Urban Land Cover Classification Supplemental Vertical Accuracy (SVA) Tested 0.097 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Urban errors larger than 95th percentile include:

- Point 3013, Easting 269455.365, Northing 4683256.102, Z-Error 0.107 meters
- Point 3015, Easting 272375.124, Northing 4680831.624, Z-Error 0.119 meters

Table 5.4: Quality Check Point Analysis, Tall Weeds and Crops, UTM 19N, NAD83, NAVD88 GEOID12A, New England CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
4000	238723.992	4729721.466	313.259	0.107
4001	250459.313	4730491.118	301.300	0.068
4002	237679.481	4708663.508	322.079	0.105
4003	253336.833	4711947.695	319.040	0.067

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
4004	243867.582	4698561.629	261.610	0.007
4005	236684.257	4689435.696	193.270	0.019
4006	255819.676	4682601.761	306.819	0.072
4007	247469.866	4679132.207	192.090	0.020
4008	234830.924	4678817.96	174.050	0.182
4009	244358.441	4666836.576	173.180	0.112
4010	253545.004	4670163.681	251.210	0.116
4011	263527.355	4661327.512	161.729	-0.070
4012	266142.502	4690687.861	217.520	0.038
4013	270215.164	4683593.849	224.490	-0.156
4014	329971.02	4663911.847	74.069	0.039
4015	272504.744	4680798.618	145.960	-0.046
4016	354062.334	4771859.156	13.289	0.112
4017	349772.904	4747930.714	1.530	0.064
4018	350509.038	4728314.725	5.740	0.020
4019	357505.699	4715324.584	3.050	0.130
4020	345366.941	4709902.099	3.010	0.071
4021	336017.987	4695058.727	3.380	0.190
4022	332177.118	4678825.325	53.310	0.006
4023	313536.222	4674812.681	89.590	0.017
4024	357796.157	4651526.885	4.080	0.040
4025	401244.682	4656635.371	3.650	-0.049
4026	367203.481	4601992.273	2.120	-0.045
4027	417390.024	4568399.593	4.830	0.094
4028	374666.068	4582434.587	0.330	0.112
4028A	371618.162	4582722.953	7.240	0.120
4029	284738.546	4559504.572	41.770	0.090

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
4030	268391.122	4580126.098	3.100	0.056
4031	196903.762	4693394.108	71.870	-0.051
4032	193686.868	4691584.482	102.660	-0.095

ACCURACY CONCLUSIONS

Tall Weeds and Crops Land Cover Classification Supplemental Vertical Accuracy (SVA) Tested 0.165 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Tall Weeds and Crops Errors larger than 95th percentile include:

- Point 4008, Easting 234830.924, Northing 4678817.960, Z-Error 0.182 meters
- Point 4024, Easting 336017.987, Northing 4695058.727, Z-Error 0.190 meters

Table 5.5: Quality Check Point Analysis, Brushlands and Trees, UTM 19N, NAD83, NAVD88 GEOID12A, New England CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
5000	238741.054	4729712.805	313.649	0.173
5002	237662.504	4708638.37	322.790	0.186
5003	254316.201	4715591.329	305.970	0.137
5004	243890.881	4698526.936	259.759	0.062
5005	236724.105	4689461.304	194.569	0.252
5006	255808.631	4682616.68	305.100	0.008
5007	246563.261	4678663.058	188.830	0.097
5008	234848.955	4678830.941	174.289	0.23
5010	254298.897	4671319.996	259.430	0.168
5011	263576.874	4661388.022	164.639	0.089
5013	270200.462	4683647.545	222.050	0.039
5013A	266134.279	4690692.919	217.259	0.151

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
5014	329961.347	4663570.709	71.099	0.214
5016	354082.81	4771823.554	13.369	0.262
5018	350490.588	4728385.472	3.190	0.03
5020	345337.418	4709910.754	2.910	0.129
5020A	346166.375	4710631.192	4.750	0.037
5021	335996.154	4695100.172	3.220	0.185
5022	332189.868	4678831.404	53.200	0.182
5023	313515.349	4674809.804	89.810	0.174
5024	357559.55	4651610.213	3.150	0.13
5025	401264.123	4656637.305	4.000	0.103
5026	367202.022	4602030.601	1.580	0.184
5027	415204.015	4568456.29	21.809	0.15
5027A	400824.181	4570292.988	1.640	0.116
5028	370017.754	4582813.325	4.650	0.131
5028A	368146.555	4583071.973	12.440	0.274
5030	268387.719	4580110.127	2.290	0.188
5031	198839.963	4693965.995	76.120	-0.05
5032	193627.894	4691618.982	104.420	0.072

ACCURACY CONCLUSIONS

Brushlands and Trees Land Cover Classification Supplemental Vertical Accuracy (SVA) Tested 0.257 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Brushlands and Trees Errors larger than 95th percentile include:

- Point 5016, Easting 354082.810, Northing 4771823.554, Z-Error 0.262 meters
- Point 5028A, Easting 368146.555, Northing 4583071.973, Z-Error 0.274 meters

Table 5.6: Quality Check Point Analysis, Forested and Fully Grown, UTM 19N, NAD83, NAVD88 GEOID12A, New England CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
6000	238742.091	4729764.491	313.110	0.039
6001	252726.388	4729861.049	326.459	0.151
6002	237694.839	4708678.244	321.420	0.078
6003	253520.654	4712405.245	313.709	0.046
6004	243898.393	4698474.383	257.800	-0.039
6005	236723.033	4689433.755	192.680	-0.029
6006	255845.987	4682660.412	304.230	-0.088
6006A	255854.135	4682661.619	304.160	-0.004
6007	246556.723	4678618.124	187.310	0.048
6007A	246547.805	4678621.578	187.020	0.019
6008	234834.853	4678785.776	173.680	-0.022
6009	244323.527	4666819.685	174.840	0.018
6009A	244323.505	4666835.866	173.720	0.028
6010	254317.833	4671360.279	260.269	0.042
6010A	254292.26	4671340.715	259.720	-0.125
6011	263599.408	4661326.903	162.840	-0.084
6011A	263607.371	4661296.481	161.830	-0.121
6012	266104.481	4690660.81	216.960	-0.38
6013	270266.778	4683749.093	208.970	-0.189
6013A	270253.071	4683734.874	212.370	-0.109
6014	329966.803	4663480.088	71.859	0.095
6014A	329929.882	4663474.98	72.780	0.09
6015	272450.957	4680737.587	145.080	-0.119
6015A	272459.274	4680736.94	145.030	-0.114
6016	354206.167	4771989.72	13.710	-0.048

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Dz (meters)
6017	349783.635	4747894.696	2.170	0.066
6018	350444.718	4728315.389	6.780	-0.055
6019	357583.905	4715312.223	3.940	-0.063
6020	346155.551	4710454.603	8.300	0.088
6020A	346124.719	4710473.634	8.880	-0.008
6021	335919.132	4695161.956	3.760	-0.022
6021A	335941.799	4695161.76	3.800	0.049
6024	357634.708	4651322.514	4.260	-0.081
6024A	357643.728	4651344.29	4.630	-0.127
6025	401264.094	4656683.011	5.610	-0.025
6025A	401270.322	4656672.119	5.780	0.006
6026	367214.471	4602068.719	1.040	0.395
6026A	367222.678	4602068.581	0.370	0.156
6027	415067.026	4568367.474	21.600	0.121
6027A	415034.416	4568375.816	21.730	0.265
6028	370138.131	4582875.073	6.590	0.066
6028A	370170.643	4582872.686	6.720	0.022
6029	284782.199	4559374.558	45.000	0.067
6029A	284775.286	4559369.883	44.850	0.032
6030	268397.164	4580035.748	1.820	0.051
6030A	268410.843	4580037.999	1.360	0.161
6031	198988.543	4694035.977	73.519	-0.065
6032	193649.434	4691649.357	102.959	-0.023

ACCURACY CONCLUSIONS

Forested and Fully Grown Land Cover Classification Supplemental Vertical Accuracy (SVA) Tested 0.238 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Forested and Fully Grown Errors larger than 95th percentile include:

- Point 6012, Easting 266104.481, Northing 4690660.810, Z-Error 0.380 meters
- Point 6026, Easting 367214.471, Northing 4602068.719, Z-Error 0.395 meters
- Point 6027A, Easting 415034.416, Northing 4568375.816, Z-Error 0.265 meters

CONSOLIDATED VERTICAL ACCURACY ASSESSMENT

ACCURACY CONCLUSIONS

Consolidated Vertical Accuracy (CVA) Tested 0.189 meters consolidated vertical accuracy at the 95th percentile level, tested against the DEM. Consolidated errors larger than 95th percentile include:

- Point 4021, Easting 336017.987, Northing 4695058.727, Z-Error 0.190 meters
- Point 5005, Easting 236724.105, Northing 4689461.304, Z-Error 0.252 meters
- Point 5008, Easting 234848.955, Northing 4678830.941, Z-Error 0.230 meters
- Point 5014, Easting 329961.347, Northing 4663570.709, Z-Error 0.214 meters
- Point 5016, Easting 354082.810, Northing 4771823.554, Z-Error 0.262 meters
- Point 5028A, Easting 368146.555, Northing 4583071.973, Z-Error 0.274 meters
- Point 6012, Easting 266104.481, Northing 4690660.810, Z-Error 0.380 meters
- Point 6013, Easting 270266.778, Northing 4683749.093, Z-Error 0.189 meters
- Point 6026, Easting 367214.471, Northing 4602068.719, Z-Error 0.395 meters
- Point 6027A, Easting 415034.416, Northing 4568375.816, Z-Error 0.265 meters

Approved By:			
Title	Name	Signature	Date
Associate Lidar Specialist Certified Photogrammetrist #1281	Qian Xiao		February 2015

SECTION 6: FLIGHT LOGS

FLIGHT LOGS

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

Woolpert

Optech LIDAR	MM/DD/YYYY	Day of Year	Project #	Phase #	Project Name
	11/16/2013	320	73067	2	Massachusetts

Operator	Aircraft	Flight #	Local Start Time	UTC Start Time	Area
SIMMONS	N1337Q	1947.2	17:50:00	22:50	WOOLPERT PIR
PIC	**Sensor Type**	**POWER ON#**	**Local End Time**	**UTC End Time**	**PIC**
SWAIN	Optech- Gemini 108	1990.2	21:20:00	2:13:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Base/Tops/Cloud	Departing	KORH
	10 SM	CLR						Arriving	KORH

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt.	Pdop	Geo. Sep.	Alt. Adj.	Alter Range
130	5500				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:
↑ Times entered are Zulu / GMT ↑								Verify 2-Turns Before Mission: Yes X / No
1	N	23:17:00	23:19:00	0:02:00				*
2	S	23:22:00	23:26:00	0:04:00				*
3	N	23:29:00	23:33:00	0:04:00				*
4	S	23:36:00	23:40:00	0:04:00				*
5	N	23:43:00	23:47:00	0:04:00				*
6	S	23:50:00	23:54:00	0:04:00				*
7	N	23:57:00	0:03:00	##########				*
8	S	0:06:00	0:12:00	0:06:00				*
9	N	0:15:00	0:21:00	0:06:00				*
10	S	0:24:00	0:31:00	0:07:00				*
11	N	0:35:00	0:41:00	0:06:00				*
12	S	0:45:00	0:52:00	0:07:00				*
14	N	0:56:00	1:04:00	0:08:00				*
13	N	1:06:00	1:09:00	0:03:00				*
15	S	1:12:00	1:27:00	0:15:00				*
16	N	1:30:00	1:44:00	0:14:00				*
17	S	1:47:00	2:01:00	0:14:00				*
				0:00:00				
				0:00:00				
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				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X / No

Additional Comments: Data #

*LOTS OF RED SWATH.....ALMOST EVERY OTHER LINE....TRIED LOWERING ALTITUDE 200-300 FEET AND STILL GOT RED SWATH.

Woolpert

Optech LIDAR					
	11/18/2013	322	73667	2	Massachusetts
SIMMONS	N1107Q		1990.2	15:30:00	20:30:00	WOOLPERT PIR
PILOT	Sensor Type		KOBES END	Local End Time	GMT End Time	PIC
SWAIN	Optech- Gemini 108		1994.7	20:10:00	1:10:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Rain/Fog/Cloud	Departing	KORH
	10 SM	CLR						Arriving	KORH

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FIX X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt	Pdop	Geo. Sep.	Calc. Alt	Mea Range
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission: Yes X / No
191	E	20:40:00	20:44:00	0:04:00				Red Swath
192	W	20:49:00	20:53:00	0:04:00				Cut the line short by mistake-fly missing
193	E	20:57:00	21:00:00	0:03:00				Red Swath
194	W	21:05:00	21:09:00	0:04:00				Red Swath
195	E	21:12:00	21:16:00	0:04:00				Red Swath
196	S	21:21:00	21:25:00	0:04:00				
197	N	21:29:00	21:33:00	0:04:00				Red Swath
198	S	21:37:00	21:40:00	0:03:00				
199	N	21:45:00	21:46:00	0:01:00				
203	N	21:51:00	21:54:00	0:03:00				
202	S	21:57:00	22:00:00	0:03:00				
201	N	22:04:00	22:07:00	0:03:00				
200	S	22:10:00	22:13:00	0:03:00				
204	N	22:16:00	22:18:00	0:02:00				
205	S	22:22:00	22:25:00	0:03:00				
206	N	22:30:00	22:32:00	0:02:00				
207	S	22:36:00	22:39:00	0:03:00				
208	N	22:43:00	22:45:00	0:02:00				
209	S	22:49:00	22:52:00	0:03:00				
210	N	22:56:00	22:58:00	0:02:00				
211	S	23:01:00	23:04:00	0:03:00				
212	N	23:07:00	23:10:00	0:03:00				
213	E	23:14:00	23:17:00	0:03:00				
214	W	23:21:00	23:25:00	0:04:00				
215	E	23:28:00	23:32:00	0:04:00				
216	W	23:36:00	23:40:00	0:04:00				
217	N	23:51:00	23:53:00	0:02:00				
218	S	23:57:00	23:59:00	0:02:00				
219	N	0:02:00	0:04:00	0:02:00				
220	S	0:08:00	0:10:00	0:02:00				
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X / No

Additional Comments:

Disk #

Woolpert

Optech LIDAR

MM/DD/YYYY	Day of Year	Project #	Phase #	Project Name
11/18/2013	322	73067	2	Massachusetts

Operator	Aircraft		Local Start Time	Zulu Start Time	Date

Pilot	Sensor Type		Local End Time	Zulu End Time	PDI

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

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	ARF	DIGITIZER
			ON / OFF	WD / NR	OFF / ON / FIX	OFF / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed			Avg. Elev.		

Line #	Dir.	Mission ID#	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 5-Turns Before Mission	Yes	No
221	N	0:13:00	0:16:00	0:03:00				
222	S	0:19:00	0:21:00	0:02:00				
223	N	0:25:00	0:27:00	0:02:00				
224	S	0:30:00	0:33:00	0:03:00				
225	N	0:36:00	0:38:00	0:02:00				
226	S	0:42:00	0:44:00	0:02:00				
192	W	0:52:00	0:59:00	0:07:00				REFLIGHT
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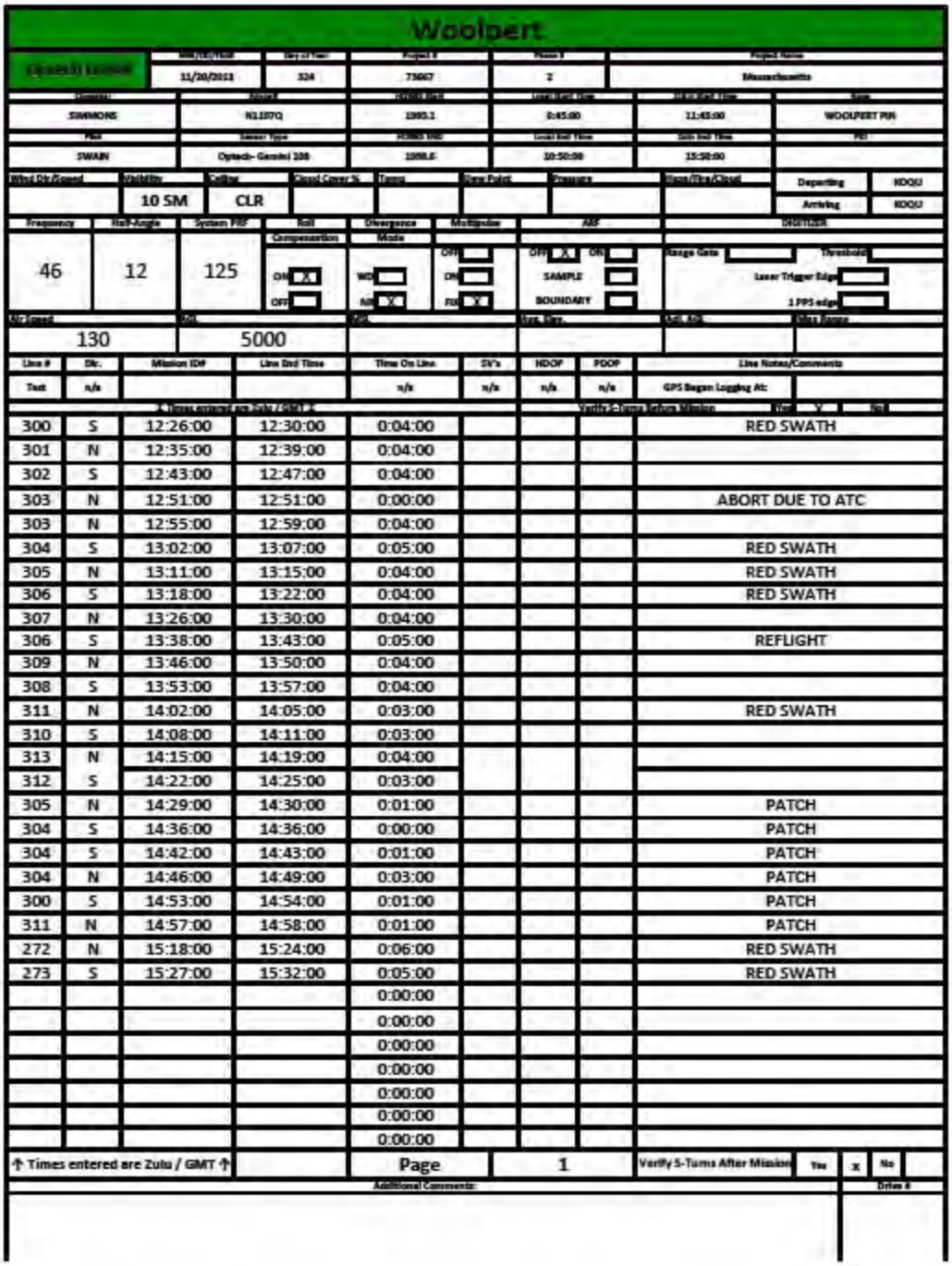
↑ Times entered are Zulu / GMT ↑			Page	2		Verify 5-Turns After Mission	Yes	No

Additional Comments	Drive #



Woolpert

	11/20/2013	324	73667	2	Massachusetts
SIMMONS	N1107Q	1995.1	0:45:00	11:45:00	WOOLPERT PIN
PILOT	Sensor Type	HOBBS END	Local End Time	GMT End Time	PIC
SWAIN	Optech- Gemini 108	1998.0	10:50:00	15:50:00	

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

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FIX X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

GC Speed	Alt.	Pdop	Ave. Sep.	Calc. Alt.	Mins Recon
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Text	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:
↑ Times entered are Zulu / GMT ↑								Verify 2-Turns Before Mission: Yes X No
300	S	12:26:00	12:30:00	0:04:00				RED SWATH
301	N	12:35:00	12:39:00	0:04:00				
302	S	12:43:00	12:47:00	0:04:00				
303	N	12:51:00	12:51:00	0:00:00				ABORT DUE TO ATC
303	N	12:55:00	12:59:00	0:04:00				
304	S	13:02:00	13:07:00	0:05:00				RED SWATH
305	N	13:11:00	13:15:00	0:04:00				RED SWATH
306	S	13:18:00	13:22:00	0:04:00				RED SWATH
307	N	13:26:00	13:30:00	0:04:00				
306	S	13:38:00	13:43:00	0:05:00				REFLIGHT
309	N	13:46:00	13:50:00	0:04:00				
308	S	13:53:00	13:57:00	0:04:00				
311	N	14:02:00	14:05:00	0:03:00				RED SWATH
310	S	14:08:00	14:11:00	0:03:00				
313	N	14:15:00	14:19:00	0:04:00				
312	S	14:22:00	14:25:00	0:03:00				
305	N	14:29:00	14:30:00	0:01:00				PATCH
304	S	14:36:00	14:36:00	0:00:00				PATCH
304	S	14:42:00	14:43:00	0:01:00				PATCH
304	N	14:46:00	14:49:00	0:03:00				PATCH
300	S	14:53:00	14:54:00	0:01:00				PATCH
311	N	14:57:00	14:58:00	0:01:00				PATCH
272	N	15:18:00	15:24:00	0:06:00				RED SWATH
273	S	15:27:00	15:32:00	0:05:00				RED SWATH
				0:00:00				
				0:00:00				
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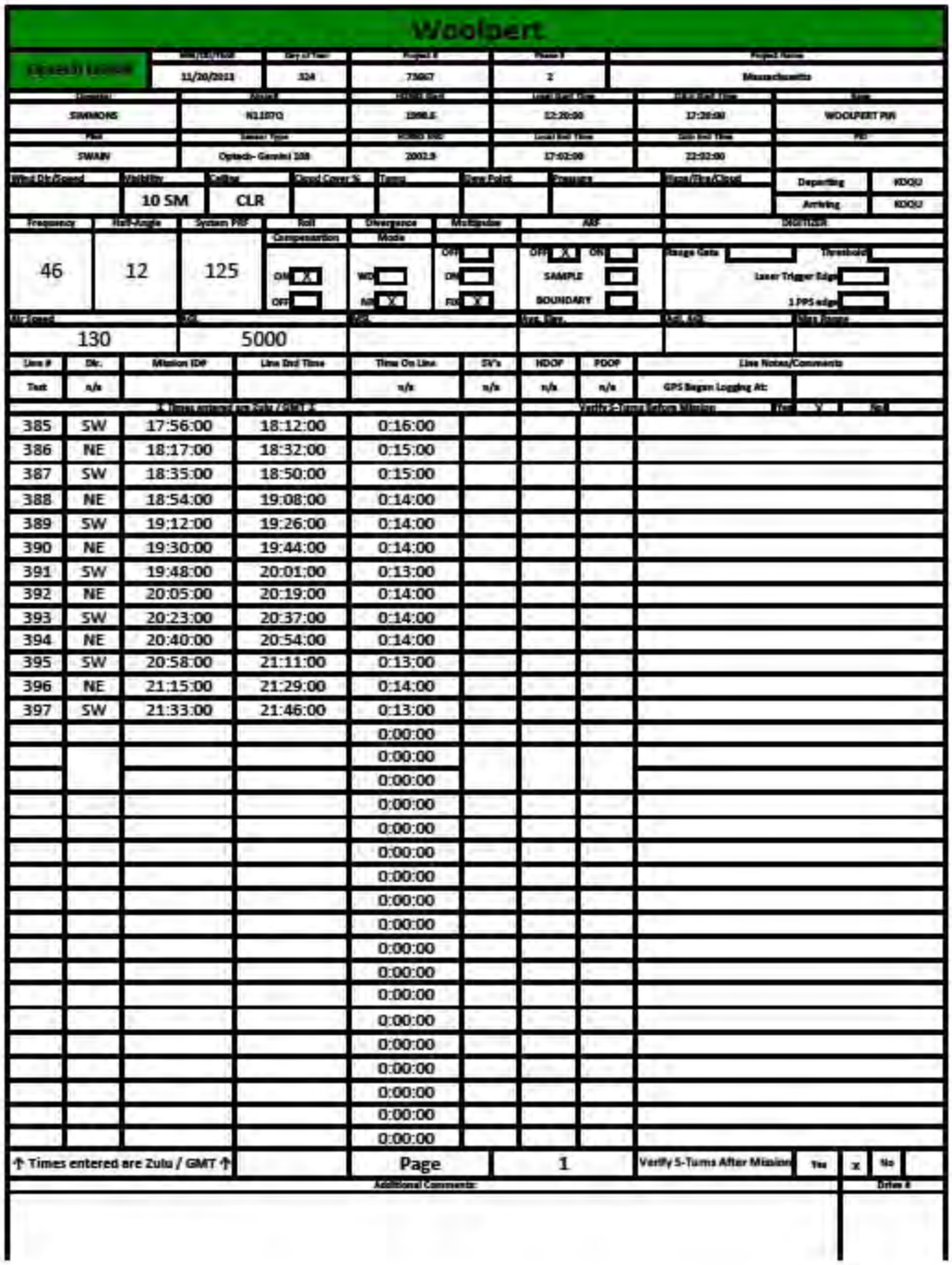
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X No

Additional Comments: Drive #



Woolpert

	11/20/2013	324	73067	2	Massachusetts
SIMMONS	N1107Q	1998.E	12:20:00	17:20:00	WOOLPERT PIR
SWAIN	Optech- Gemini 108	2002.9	17:02:00	22:02:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Rain/Fog/Cloud		
	10 SM	CLR						Departing	KDOU
								Arriving	KDOU

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FO X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt.	Kts.	Ave. Elev.	Add. Alt.	Elev Datum
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Text	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:

↑ Times entered are Zulu / GMT ↑ — Verify 5-Turns Before Mission: Yes X No

385	SW	17:56:00	18:12:00	0:16:00
386	NE	18:17:00	18:32:00	0:15:00
387	SW	18:35:00	18:50:00	0:15:00
388	NE	18:54:00	19:08:00	0:14:00
389	SW	19:12:00	19:26:00	0:14:00
390	NE	19:30:00	19:44:00	0:14:00
391	SW	19:48:00	20:01:00	0:13:00
392	NE	20:05:00	20:19:00	0:14:00
393	SW	20:23:00	20:37:00	0:14:00
394	NE	20:40:00	20:54:00	0:14:00
395	SW	20:58:00	21:11:00	0:13:00
396	NE	21:15:00	21:29:00	0:14:00
397	SW	21:33:00	21:46:00	0:13:00
				0:00:00
				0:00:00
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↑ Times entered are Zulu / GMT ↑ — Page 1 — Verify 5-Turns After Mission: Yes X No

Additional Comments: — Drive #

Woolpert

Optech LIDAR	MM/DD/YYYY	Day of Year	Project #	Phase #	Project Name
	11/21/2013	325	73667	2	Massachusetts

Operator	Aircraft	FLIGHT ID#	Local Start Time	GPS End Time	Area
SIMMONS	N1107Q	2002.9	9:10:00	14:10:00	WOOLPERT PIR
PIC	**Sensor Type**	**HOBBS END**	**Local End Time**	**GPS End Time**	**PIC**
SWAIN	Optech- Gemini 108	2005.3	12:30:00	17:30:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KDQU
330 @ 05	10 SM	CLR		1	-6	3063		Arriving	KDQU

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multiplier	AGF	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt	Pdop	Area, Sq.n.	Alt. Adj.	Miles Scans
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Text	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:

↑ Times entered are Zulu / GMT ↑						Verify 2-Turns Before Mission	Yes	X	No	
274	N	14:38:00	14:44:00	0:06:00						
275	S	14:47:00	14:53:00	0:06:00				RED SWATH		
276	N	14:56:00	15:02:00	0:06:00				RED SWATH		
277	S	15:07:00	15:13:00	0:06:00						
278	N	15:16:00	15:22:00	0:06:00						
279	S	15:26:00	15:32:00	0:06:00						
280	N	15:35:00	15:41:00	0:06:00						
281	S	15:45:00	15:51:00	0:06:00						
282	N	15:55:00	16:05:00	0:10:00						
283	S	16:04:00	16:10:00	0:06:00						
284	N	16:14:00	16:19:00	0:05:00						
285	S	16:23:00	16:29:00	0:06:00						
286	N	16:33:00	16:39:00	0:06:00						
287	S	16:42:00	16:48:00	0:06:00						
288	N	16:51:00	16:57:00	0:06:00						
289	S	17:01:00	17:07:00	0:06:00						
				0:00:00						
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↑ Times entered are Zulu / GMT ↑				Page	1	Verify 5-Turns After Mission	Yes	X	No	

Additional Comments: Drive #

Woolpert

Optech LIDAR					
	11/21/2013	325	73667	2	Massachusetts
SIMMONS	N1107Q		2005.8	13:50:00	18:30:00	WOOLPERT PIR
PIC	Sensor Type		H2885 ENC	Local End Time	GPS End Time	PIC
SWAIN	Optech- Gemini 108		2010.4	18:30:00	22:32:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Flaps/Flts/Cloud		
330 @ 05	10 SM	CLR		1	-6	3063		Departing	KDQU
								Arriving	KDQU

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt	Hdg	Ave. Elev.	Add. Alt	Misc Notes
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Text	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:
↑ Times entered are Zulu / GMT ↑								Verify 2-Turns Before Mission: Yes X No
398	NE	18:56:00	19:09:00	0:13:00				
399	SW	19:13:00	19:26:00	0:13:00				
400	NE	19:31:00	19:43:00	0:12:00				
401	SW	19:47:00	19:59:00	0:12:00				
402	NE	20:03:00	20:14:00	0:11:00				
403	SW	20:17:00	20:28:00	0:11:00				
404	NE	20:32:00	20:39:00	0:07:00				
405	SW	20:42:00	20:50:00	0:08:00				
406	NE	20:54:00	21:00:00	0:06:00				
407	SW	21:05:00	21:11:00	0:06:00				
408	NE	21:17:00	21:23:00	0:06:00				
347	S	21:47:00	21:51:00	0:04:00				
348	N	21:55:00	21:59:00	0:04:00				
349	S	20:02:00	22:06:00	2:04:00				
350	N	22:09:00	22:13:00	0:04:00				
351	S	22:17:00	22:21:00	0:04:00				
352	N	22:24:00	22:28:00	0:04:00				
353	S	22:32:00	22:36:00	0:04:00				
354	N	22:39:00	22:43:00	0:04:00				
355	S	22:47:00	22:50:00	0:03:00				
356	N	22:54:00	22:56:00	0:02:00				
357	S	23:00:00	23:02:00	0:02:00				
358	N	23:05:00	23:08:00	0:03:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Optech LIDAR

[illegible]	Day of Year	Project #	Phase #	Project Name
11/23/2011	327	73667	2	Massachusetts

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Base
SIMMONS	N1107Q	2010.4	7:50:00	12:50:00	WOOLPERT PIR

Pilot	Sensor Type	[illegible]	Local End Time	Zulu End Time	PID
SWAIN	Optech- Gemini 108	2012.4	10:10:00	2:10:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	[illegible]		
310 @ 15	10 SM	CLR		6	-2	2985		Departing	KOQU
								Arriving	KOQU

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AEF	DIGITIZER
46	12	125	ON ☒ OFF ☐	WD ☐ NR ☒	OFF ☐ ON ☐ FIX ☒	OFF ☒ ON ☐ SAMPLE ☐ BOUNDARY ☐	Range Gate ☐ Threshold ☐ Laser Trigger Edge ☐ 1 PPS edge ☐

Air Speed	AGL	[illegible]	[illegible]	[illegible]	[illegible]
130	5000				

Line #	Dir.	Mission ID#	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:	
[illegible]						Verify 5-Turns Before Mission	Yes	Y	No
290	N	13:16:00	13:23:00	0:07:00					
291	S	13:26:00	13:32:00	0:06:00					
292	N	13:36:00	13:42:00	0:06:00					
293	S	13:45:00	13:50:00	0:05:00					
294	N	13:54:00	14:00:00	0:06:00					
295	S	14:03:00	14:09:00	0:06:00					
296	N	14:13:00	14:19:00	0:06:00					
297	S	14:23:00	14:28:00	0:05:00					
298	N	14:32:00	14:38:00	0:06:00					
299	S	14:41:00	14:47:00	0:06:00					
				0:00:00					
				0:00:00					
				0:00:00					
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↑ Times entered are Zulu / GMT ↑		Page	1	Verify 5-Turns After Mission	Yes	X	No

Additional Comments:	Drive #

Woolpert

Optech LIDAR	Date (UTC)	Day of Year	Project #	Phase #	Project Name
	11/23/2013	327	73667	2	Massachusetts

Operator	Aircraft	Flight Start	Local Start Time	GPS Start Time	Area
SIMMONS	N1107Q	2012.4	15:40:00	20:40:00	WOOLPERT PIR
PIC	**Sensor Type**	**Flight End**	**Local End Time**	**GPS End Time**	**PIC**
SWAIN	Optech- Gemini 108	2016.7	20:20:00	1:20:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KDQU
310 @ 15	10 SM	CLR		7	-10	2986		Arriving	KDQU

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multiplier	AGF	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt	Alt	Area, Sq.	Grid, Alt	Miles Scans
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/x	n/x	n/x	n/x	GPS Began Logging At:

↑ Times entered are Zulu / GMT ↑ — Verify 2-Turns Before Mission: Yes X No

359	S	21:04:00	21:06:00	0:02:00				
360	N	21:10:00	21:12:00	0:02:00				
361	S	21:16:00	21:18:00	0:02:00				
314	E	21:30:00	21:39:00	0:09:00				
315	W	21:45:00	21:54:00	0:09:00				
316	E	21:59:00	22:09:00	0:10:00				
317	W	22:13:00	22:24:00	0:11:00				
318	E	22:27:00	22:37:00	0:10:00				
319	W	22:41:00	22:51:00	0:10:00				
320	E	22:54:00	23:04:00	0:10:00				
321	W	23:10:00	23:15:00	0:05:00				
322	E	23:19:00	23:21:00	0:02:00				
323	N	23:24:00	23:26:00	0:02:00				
324	S	23:31:00	23:35:00	0:04:00				
325	N	23:39:00	23:44:00	0:05:00				
326	S	23:47:00	23:52:00	0:05:00				
327	N	23:56:00	0:01:00	###########				
328	S	0:05:00	0:10:00	0:05:00				
329	N	0:13:00	0:19:00	0:06:00				
330	S	0:23:00	0:28:00	0:05:00				
331	N	0:32:00	0:37:00	0:05:00				
332	S	0:41:00	0:46:00	0:05:00				
346	E	0:51:00	0:54:00	0:03:00				
345	W	0:57:00	1:00:00	0:03:00				
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↑ Times entered are Zulu / GMT ↑ — Page 1 — Verify 5-Turns After Mission: Yes X No

Additional Comments: — Drive #

Woolpert

Optech LIDAR	11/25/2013	Day of Year 329	Project # 73667	Phase # 2	Project Name Massachusetts
Operator ANNEN	Aircraft N1107Q	2016.7	Local Start Time 6:40:00	Zulu Start Time 11:40:00	Base IWG
Pilot LaROCQUE	Sensor Type Optech- Gemini 108	HOBBS END 2019.0	Local End Time 9:25:00	Zulu End Time 14:25:00	FBO KYAA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Rain/Fog/Cloud	Departing	KOQU
320/18	10	Clear	Clear	18 F	4 F	30.4		Arriving	KOQU

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	ARF	DIGITIZER
46	12	125	ON ☒ OFF ☐	WD ☐ NR ☒	OFF ☐ ON ☐ FIX ☒	OFF ☒ ON ☐ SAMPLE ☐ BOUNDARY ☐	Range Gate ☐ Threshold ☐ Laser Trigger Edge ☐ 1 PPS edge ☐

Air Speed	Alt.		Avg. Elev.		
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a	12:01	12:03	n/a	n/a	n/a	n/a	GPS Began Logging At:	
↓ Times entered are Zulu / GMT ↓						Verify 5-Turns Before Mission		Yes Y	No
333	E	12:13:00	12:15:00	0:02:00				Red Swaths, disregard line	
333	W	12:25:00	12:28:00	0:03:00					
334	E	12:31:00	12:34:00	0:03:00					
335	W	12:40:00	12:43:00	0:03:00					
336	E	12:48:00	12:54:00	0:06:00					
337	W	12:58:00	13:04:00	0:06:00					
338	E	13:07:00	13:13:00	0:06:00					
339	W	13:18:00	13:24:00	0:06:00					
340	E	13:27:00	13:35:00	0:08:00					
341	W	13:37:00	13:43:00	0:06:00					
342	E	13:47:00	13:52:00	0:05:00					
343	W	13:57:00	14:03:00	0:06:00					
344	E	14:06:00	14:10:00	0:04:00					
				0:00:00					
				0:00:00					
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↑ Times entered are Zulu / GMT ↑			Page	1		Verify 5-Turns After Mission	Yes	X	No

Additional Comments:	Drive #

Woolpert

Optech LIDAR					
	25 Nov 13 S	329	73667	2	Massachusetts

ANNEN	N110TQ	2019.3	16:01:00	21:01:00		WGS
LaROCQUE	Optech- Gemini 105	2022.0	19:30:00	0:30:00		KYAA

Wind Dir/Speed	Visibility	Sailing	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KHTA
260/20	8	Clear	Clear	0 c	-21	30.34		Arriving	KHTA

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	Wide / Alt X	OFF / ON / FIX X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Alt Speed	Roll	Pitch	Yaw Rate	Pitch Adj	Main Swath
130	5000				

Line #	Dir.	Mission IDP	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	21:38	21:39	n/a	n/a	n/a	n/a	GPS Began Logging At: 21:18
↑ Times entered are Zulu / GMT ↑						Verify S-Turns before Mission		Yes Y No
409	E	21:47:00	21:49:00	0:02:00				
410	W	21:55:00	21:57:00	0:02:00				
411	E	22:01:00	22:04:00	0:03:00				
412	W	22:09:00	22:13:00	0:04:00				
413	E	22:17:00	22:52:00	0:35:00				
414	W	22:30:00	22:38:00	0:08:00				
415	E	22:43:00	22:51:00	0:08:00				
416	W	22:55:00	23:02:00	0:07:00				
417	E	23:06:00	23:13:00	0:07:00				
418	W	23:18:00	23:24:00	0:06:00				
419	E	23:29:00	23:35:00	0:06:00				
420	W	23:39:00	23:43:00	0:04:00				
421	E	23:52:00	23:54:00	0:02:00				
415	W	23:57:00	23:59:00	0:02:00				Gap fill between 415/416
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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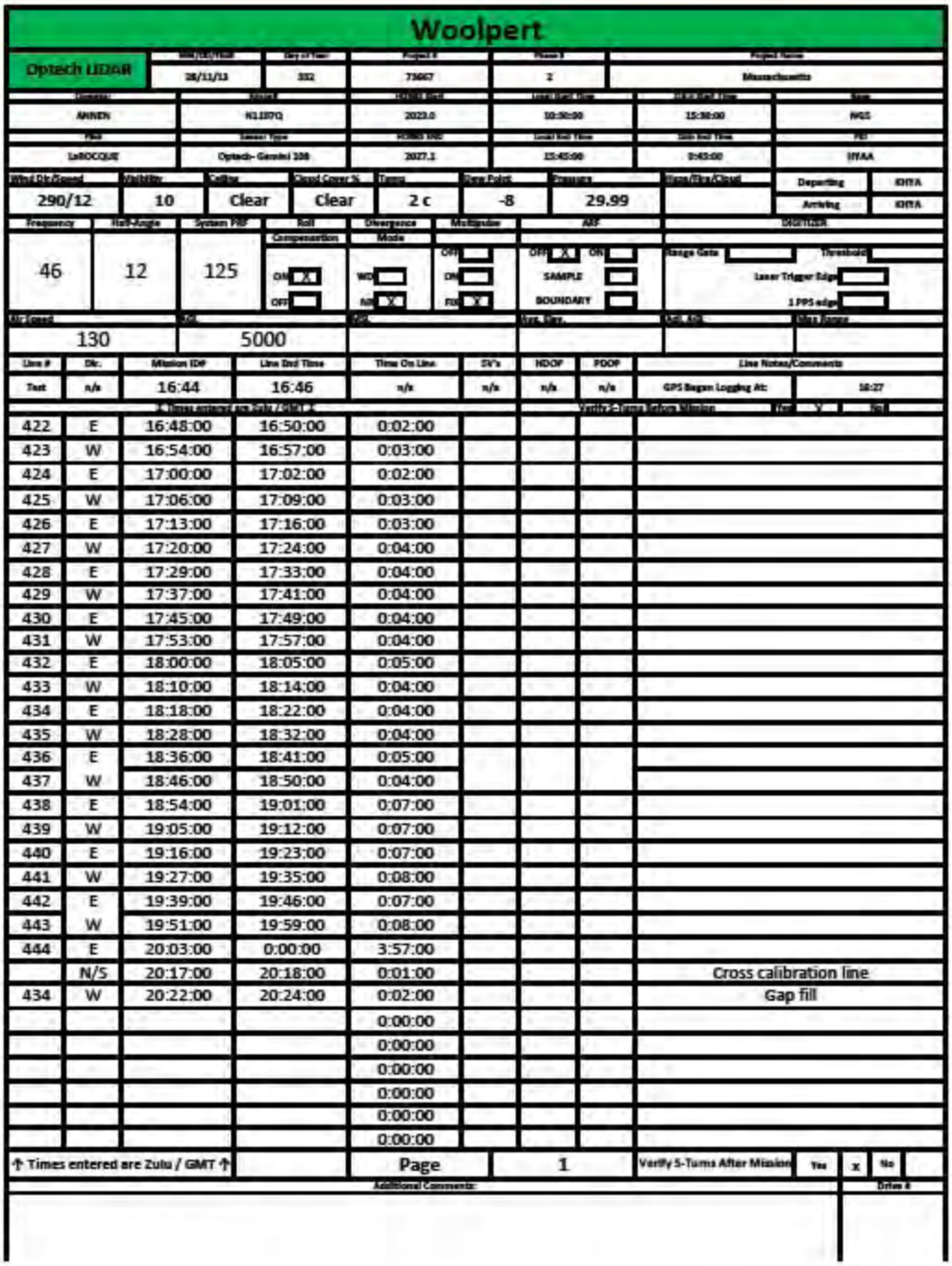
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	1	Verify S-Turns After Mission	Yes X	No

Additional Comments: Drive #



Woolpert

Optech LIDAR	Date (UTC)	Day of Year	Project #	Phase #	Project Name
	28/11/13	332	73667	2	Massachusetts

Operator	Aircraft	Flight ID	Local Start Time	UTC Start Time	Base
ANNEN	N1197Q	2023.0	10:30:00	15:30:00	IWIS
PIC	**Sensor Type**	**KOMES END**	**Local End Time**	**UTC End Time**	**PIC**
LaROCQUE	Optech- Gemini 108	2027.1	15:45:00	0:45:00	DYAA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Flaps/Flts/Cloud	Departing	KHTA
290/12	10	Clear	Clear	2 c	-8	29.99		Arriving	KHTA

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt	Pdop	Area, Sites	Add. Alts	Alternate
130	5000				

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a	16:44	16:46	n/x	n/x	n/x	n/x	GPS Began Logging At:	16:27
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission	Yes: X / No:
422	E	16:48:00	16:50:00	0:02:00					
423	W	16:54:00	16:57:00	0:03:00					
424	E	17:00:00	17:02:00	0:02:00					
425	W	17:06:00	17:09:00	0:03:00					
426	E	17:13:00	17:16:00	0:03:00					
427	W	17:20:00	17:24:00	0:04:00					
428	E	17:29:00	17:33:00	0:04:00					
429	W	17:37:00	17:41:00	0:04:00					
430	E	17:45:00	17:49:00	0:04:00					
431	W	17:53:00	17:57:00	0:04:00					
432	E	18:00:00	18:05:00	0:05:00					
433	W	18:10:00	18:14:00	0:04:00					
434	E	18:18:00	18:22:00	0:04:00					
435	W	18:28:00	18:32:00	0:04:00					
436	E	18:36:00	18:41:00	0:05:00					
437	W	18:46:00	18:50:00	0:04:00					
438	E	18:54:00	19:01:00	0:07:00					
439	W	19:05:00	19:12:00	0:07:00					
440	E	19:16:00	19:23:00	0:07:00					
441	W	19:27:00	19:35:00	0:08:00					
442	E	19:39:00	19:46:00	0:07:00					
443	W	19:51:00	19:59:00	0:08:00					
444	E	20:03:00	0:00:00	3:57:00					
	N/S	20:17:00	20:18:00	0:01:00				Cross calibration line	
434	W	20:22:00	20:24:00	0:02:00				Gap fill	
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission	Yes: X / No:

Additional Comments: Drive #

Woolpert

Optech LIDAR	Date (UTC)	Day of Year	Project #	Phase #	Project Name
	28/11/13	332	73667	2	Massachusetts

Operator	Aircraft	Flight #	Local Start Time	UTC Start Time	Base
ANNEN	N1197Q	2027.1	16:15:00	21:15:00	AVOS

PIC	Sensor Type	AGPS ENC	Local End Time	UTC End Time	PIC
LaROCQUE	Optech- Gemini 108	2030.0	20:15:00	1:15:00	DYAA

Wind Dir/Speed	Visibility	Sat/Sm	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KHYA
290/8	10	Clear	Clear	1 c	-11	30.21		Arriving	KHYA

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	ABF	DIGITIZER
46	12	125	ON X / OFF	WD / NR Y	OFF / ON / FD Y	OFF / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Alt	Alt	Area, Sites	Alt. Adj.	Alltec Range
130	5,000	5,000			

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	21:36	21:38	n/a	n/a	n/a	n/a	GPS Began Logging At: 21:10
		↑ Times entered are Zulu / GMT ↑						Verify 5-Turns Before Mission: Yes X / No
445	E	21:43:00	21:51:00	0:08:00				
446	W	21:56:00	22:04:00	0:08:00				
447	E	22:08:00	22:16:00	0:08:00				
448	W	22:20:00	22:28:00	0:08:00				
449	E	22:32:00	22:40:00	0:08:00				
450	W	22:46:00	22:54:00	0:08:00				
451	E	22:59:00	23:08:00	0:09:00				
452	W	23:13:00	23:21:00	0:08:00				
453	E	23:26:00	23:34:00	0:08:00				
454	W	23:40:00	23:40:00	0:00:00				Need to restart this line
454	W	23:45:00	23:53:00	0:08:00				
455	E	23:59:00	0:09:00	0:10:00				
456	W	0:14:00	0:24:00	0:10:00				
457	E	0:28:00	0:38:00	0:10:00				
				0:00:00				Software failure on line
				0:00:00				458- ended for the night
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	2			Verify 5-Turns After Mission: Yes / No

Additional Comments: Disk #

Software failure on line 458. Too close to the end of the flight to refly the line. No data loss.

Woolpert

Optech LIDAR	Date (UTC)	Day of Year	Project #	Phase #	Project Name
	11/29/2013	333	73667	2	Massachusetts

Operator	Aircraft	Flight Start	Local Start Time	UTC Start Time	Base
ANNEN	N1107Q	2031.0	11:30:00	16:30:00	IWIS
PIC	**Sensor Type**	**Flight End**	**Local End Time**	**UTC End Time**	**PIC**
LaROCQUE	Optech- Gemini 108	2034.7	15:40:00	20:40:00	IIYAA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KHYA
340/6	10	10K	80	-1	-9	30.53		Arriving	KHYA

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	AGL	ASL	Ave. Elev.	Max. AGL	Max Range
130	5,000	5,000			

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	16:51	16:55	n/x	n/x	n/x	n/x	GPS Began Logging At: 16:52
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission: Yes X No
579	E	17:05:00	17:10:00	0:05:00				Clouds over Martha's Vineyard
578	W	17:15:00	17:20:00	0:05:00				Moved to Nantucket
577	E	17:24:00	17:29:00	0:05:00				
576	W	17:33:00	17:39:00	0:06:00				
535	E	17:44:00	17:46:00	0:02:00				Clouds developing south side of island
536	W	17:51:00	17:53:00	0:02:00				Moved to north side
537	E	17:56:00	17:58:00	0:02:00				
538	W	18:03:00	18:05:00	0:02:00				
539	E	18:08:00	18:10:00	0:02:00				
540	W	18:14:00	18:16:00	0:02:00				
541	E	18:19:00	18:21:00	0:02:00				
542	W	18:26:00	18:28:00	0:02:00				
543	E	18:31:00	18:33:00	0:02:00				
544	W	18:38:00	18:40:00	0:02:00				
545	E	18:44:00	18:46:00	0:02:00				
546	W	18:51:00	18:53:00	0:02:00				
547	E	18:57:00	18:59:00	0:02:00				
548	W	19:03:00	19:06:00	0:03:00				
549	E	19:09:00	19:11:00	0:02:00				
550	W	19:16:00	19:18:00	0:02:00				
551	E	19:22:00	19:24:00	0:02:00				
552	W	19:28:00	19:36:00	0:08:00				
553	E	19:40:00	19:48:00	0:08:00				Cloud on line, over water?
554	W	19:52:00	20:00:00	0:08:00				Cloud on line, over water?
				0:00:00				Moved back to Martha's Vineyard
458	W	20:04:00	20:13:00	0:09:00				
				0:00:00				Clouds developing here too.
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X No

Additional Comments: Drive #

Clouds developed and moved throught the area causing us to skip around a bit. The couple of clouds we did get in the line were possibly over water and may not affect the collect.

Woolpert

Optech LIDAR	Date (UTC)	Day of Year	Project #	Mission #	Project Name
	12/1/2012	337	73667	2	Massachusetts

Operator	Aircraft	Flight Start	Laser Start Time	Laser End Time	Base
ANNEN	N1107Q	2034.7	14:55:00	18:55:00	IWIS
PIC	**Sensor Type**	**Flight End**	**Local End Time**	**GPS End Time**	**PIC**
LaROCQUE	Optech- Gemini 108	2037.0	17:50:00	22:50:00	IFFAA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Flaps/Tire/Chocs		
140/8	10	Clear	Clear	6	-10	29.82		Departing	KHTA
								Arriving	KHTA

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multiplier	ARF	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	AGL	ASL	Prev. Elev.	Add. Alt	Elev Source
130	5,000	5,000			

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOF	PDOP	Line Notes/Comments
Test	n/a	20:22	20:24	n/a	n/a	n/a	n/a	GPS Began Logging At: 20:00
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Below Mission: Yes X No
459	W	20:30:00	20:39:00	0:09:00				
460	E	20:44:00	20:49:00	0:05:00				
461	W	20:54:00	21:00:00	0:06:00				
462	E	21:03:00	21:07:00	0:04:00				
463	W	21:12:00	21:16:00	0:04:00				
464	E	21:19:00	21:23:00	0:04:00				
465	W	21:28:00	21:31:00	0:03:00				
466	E	21:34:00	21:37:00	0:03:00				
467	W	21:42:00	21:44:00	0:02:00				
468	E	21:48:00	21:50:00	0:02:00				
469	W	21:55:00	21:57:00	0:02:00				
470	E	22:01:00	22:03:00	0:02:00				
471	W	22:08:00	22:10:00	0:02:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X No

Additional Comments: Drive #

Right engine developed a substantial oil leak at the end of the flight. Aircraft down for repairs. Possibly #6 push-rod tube seal blown.

Woolpert

Leica LIDAR					
	12/3/2013	33713	73667	1	Massachusetts/Post Hurricane Sandy

GALAMBOS	N7079F	2876.2	15:14:00	20:14:00	WOOLPERT PIN
RADER	ALS-7177	2879.3	15:57:00	20:57:00	KORH

330 6	10	CLR		7	-1		2984	Departing	KHYA
								Arriving	KORH

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.	
150	Kts	6500	Ft	Varies	Ft	Yes		No	x	@ NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	20:09:57	20:01:00	n/a	n/a	n/a	n/a	GPS Began Logging At: 20:05:45
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission Yes X No
52	S	20:14:42	20:22:25	16:57:05	19	0.8	1.4	Cloud wpt 4? Overfly Base
51	N	20:25:03	20:32:02	0:00:00	19	0.8	1.4	CLOUD WPT 48
50	S	20:35:00	20:42:30	0:00:00	21	0.7	1.2	48 START
49	N	20:45:30	20:50:20	0:00:00	21	0.7	1.2	error on sensor aborted line
48	S	20:55:02	20:57:02	0:00:00	18	0.8	1.4	
				0:00:00				
				0:00:00				TDC data fetch timeout error due to
				0:00:00				no mem switch signal on I/O Aux 1
				0:00:00				connection on TDC
				0:00:00				Landing KORH 21:05:22
				0:00:00				
				0:00:00				end static: 21:08:00
				0:00:00				
				0:00:00				error on Trac Gui not on FCMS
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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				0:00:00				
				0:00:00				ALS FILE #20131203_191816
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission Yes X No

Additional Comments:	Drive #
Depart KPWM 2876.2 Land KORH 2877.0 Land HYA 2877.7 Overfly Base 2878.3 Land ORH 2879.3	ALS-70-2 #3

Woolpert

Optech LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	12/4/2013	338	73667	2	Massachusetts

Operator	Aircraft	Flight Start	Local Start Time	Local End Time	Base
ANNEN	N110TQ	2037.0	16:05:00	21:55:00	IWGS
PIC	**Sensor Type**	**Flight End**	**Local End Time**	**Lock End Time**	**PIC**
LaROCQUE	Optech- Gemini 108	2041.4	20:55:00	1:55:00	IIYAA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Rain/Fog/Cloud	Departing	IDITA
330/5	10	Clear	Clear	6	-1	30.13		Arriving	IDITA

Frequency	Half-Angle	System PRF	Roll Compensation	Divergence Mode	Multipulse	AGC	DIGITIZER
46	12	125	ON X / OFF	WD / NR X	OFF / ON / FD X	OFF X / ON / SAMPLE / BOUNDARY	Range Gate / Threshold / Laser Trigger Edge / 1 PPS edge

Air Speed	Roll	Pitch	Yaw Bias	Roll Bias	Pitch Bias
130	5,000	5,000			

Line #	Dir.	Mission ID#	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	21:34	21:36	n/a	n/a	n/a	n/a	GPS Began Logging At: 21:15
		↑ Times entered are Zulu / GMT ↑						Verify 5-Turns Before Mission: Yes X No
575	W	21:41:00	21:47:00	0:06:00				
574	E	21:51:00	21:58:00	0:07:00				
573	W	22:02:00	22:09:00	0:07:00				
572	E	22:13:00	22:20:00	0:07:00				
571	W	22:23:00	22:30:00	0:07:00				
570	E	22:34:00	22:41:00	0:07:00				
569	W	22:45:00	22:52:00	0:07:00				
568	E	22:56:00	23:03:00	0:07:00				
567	W	23:07:00	23:14:00	0:07:00				
566	E	23:18:00	23:26:00	0:08:00				
565	W	23:30:00	23:38:00	0:08:00				
564	E	23:41:00	23:49:00	0:08:00				
563	W	23:54:00	0:01:00	0:07:00				
562	E	00:06	0:13:00	0:07:00				
561	W	0:20:00	0:27:00	0:07:00				
560	E	0:31:00	0:39:00	0:08:00				
559	W	0:42:00	0:50:00	0:08:00				
558	E	0:54:00	1:03:00	0:09:00				
557	W	1:06:00	1:15:00	0:09:00				
556	E	1:18:00	1:26:00	0:08:00				
555	W	1:31:00	1:40:00	0:09:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes X No

Additional Comments: Drive #

Oil leak in right engine fixed, bad lifter and push rod tube.

Woolpert

Leica LIDAR					
	11/30/2013	338	73667	1	73667 Mast

SIMMONS	N707FF	2884.9	15:40:00	20:40:00	WOOLPERT PIN
PIC	Sensor Type	Flight No.	Local Start Time	Local End Time	PIC
SWAN	ALS-7177	2890.4	21:40:00	2:40:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
250 @ 03	10 SM	CLR		3	-4	3009	haze	Departing	KORH
								Arriving	KORH

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	5	Single		A	190
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↑ Times entered are Zulu / GMT ↑						Verify 5-Turns Before Mission Yes X No
1	W	21:16:00	21:19:00					A MISSION
2	E	21:22:00	21:24:00					
3	W	21:28:00	21;30					
4	E	21:33:00	21:36:00					
5	W	21:40:00	21:42:00					
6	E	21:45:00	21:48:00					
7	W	21:51:00	21:55:00					
8	E	21:58:00	22:01:00					
9	W	22:05:00	22:08:00					
10	E	22:11:00	22:14:00					
11	W	22:17:00	22:18:00					
17	N	22:28:00	22:31:00					ABORTED AT W/P 34 DUE TO TRAC G
								REBOOT - OVERFLY BASE
17	N	23:15:00	23:26:00					B MISSION
18	S	23:29:00	23:40:00					
19	N	23:43:00	23:54:00					
24	S	23:57:00	0:12:00					
23	N	0:15:00	0:17:00					
22	S	0:21:00	0:22:00					
21	N	0:25:00	0:27:00					
20	S	0:30:00	0:31:00					
25	N	0:35:00	0:49:00					
26	S	0:51:00	1:06:00					
27	N	1:09:00	1:23:00					
28	S	1:27:00	1:42:00					
29	N	1:45:00	1:59:00					
30	S	2:02:00	2:16:00					
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR		12/8/2013	34213	75667	1	Massachusetts/Post Hurricane Sandy
Operator		Aircraft		Flight Line #	Local Start Time	GPS Start Time	Base
GALAMBOS		N707SF		2890.4	9:45:00	14:25:00	WOOLPERT FBN
							ARP
RADIR		ALS-7177		2895.7	2:26:00	19:26:00	KLWM
							Departing KORH
300 S	10	CLR		-4	-10		3058	Arriving KLWM

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values
40	42.3	272	100	Gain - Coarse/Up	5	Single		A 180
				Gain - Fine/Down	12	Multi	X	B 170

Air Speed	AGL	MSL	Waveform Used					Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	Varies Ft	Yes		No	X		@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 14:15:00
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission Yes X No
216	NE	14:45:25	14:51:06	5:53:05	19	0.6	1.1	TAKEOFF 14:19
215	SW	14:53:32	14:59:33	0:00:00	17	0.7	1.2	Overfly base 14:35:14-/37:44/40:14
214	NE	15:01:27	15:07:37	0:00:00	17	0.7	1.2	Slight dusting of snow
213	SW	15:10:41	15:16:23	0:00:00	17	0.7	1.2	north side of trees
212	NE	15:18:30	15:23:49	0:00:00	17	0.7	1.2	
211	SW	15:25:48	15:30:37	0:00:00	17	0.7	1.2	
210	NE	15:34:41	15:36:15	0:00:00	18	0.7	1	
209	SW	15:38:01	15:39:32	0:00:00	18	0.6	1	
208	NW	15:41:41	15:43:07	0:00:00	18	0.6	1	
207	SW	15:44:50	15:45:07	0:00:00	19	0.6	1	
1	SE	15:51:00	15:54:08	0:00:00	16	0.7	1.1	Shoals
2	NE	15:58:11	15:59:10	0:00:00	16	0.7	1.1	FCMS says line 2, CCNS says 3
3	W	16:02:25	16:03:25	0:00:00	16	0.7	1.1	end shoals FCMS says line 2, CCNS 3
123	S	16:17:23	16:26:37	0:00:00	16	0.7	1.1	BLOCK A
122	N	16:28:34	16:37:50	0:00:00	16	0.7	1.3	
121	S	16:39:59	16:49:22	0:00:00	15	0.7	1.3	
120	N	16:51:37	17:00:52	0:00:00	15	0.7	1.2	
119	S	17:02:58	17:11:26	0:00:00	15	0.7	1.2	
118	N	17:14:06	17:22:58	0:00:00	15	0.6	1	
117	S	17:24:59	17:33:36	0:00:00	17	0.6	1	
116	N	17:35:38	17:44:40	0:00:00	19	0.6	0.9	
115	S	17:46:30	17:55:20	0:00:00	19	0.6	0.9	
114	N	17:57:26	18:06:39	0:00:00	18	0.6	1	
113	S	18:08:22	18:11:12	0:00:00	18	0.6	1.2	
112	N	18:19:12	18:28:00	0:00:00	18	0.7	1.3	
111	S	18:30:08	18:37:41	0:00:00	18	0.7	1.1	
110	N	18:39:32	18:46:59	0:00:00	18	0.7	1.2	
109	S	18:48:48	18:56:15	0:00:00	19	0.6	1.1	
108	N	18:58:11	19:05:34	0:00:00	18	0.7	1.1	Landing2:36/19:36
107	S	19:07:33	19:14:58	0:00:00	18	0.7	1.2	static 19:39:54
105	N	19:17:48	19:18:21	0:00:00	18	0.7	1.2	
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission Yes X No

Additional Comments:

ALS file # 131208_170258

Drive #: ALS-60 #3

Woolpert

Leica LIDAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	12/8/2013	34213	73667	1	Massachusetts/Post Hurricane Sandy

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GALAMBOS	N707FF	2890.8	9:45:00	14:45:00	WOOLPERT PIN
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
BAKER	ALS-7177	2895.7	2:26:00	19:26:00	KLWN

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

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	6500	Ft	Varies	Ft	Yes		No	x	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission	Yes X No
106	N	19:21:47	19:25:39	0:00:00	19	0.6	1		
				0:00:00					
				0:00:00					
				0:00:00					
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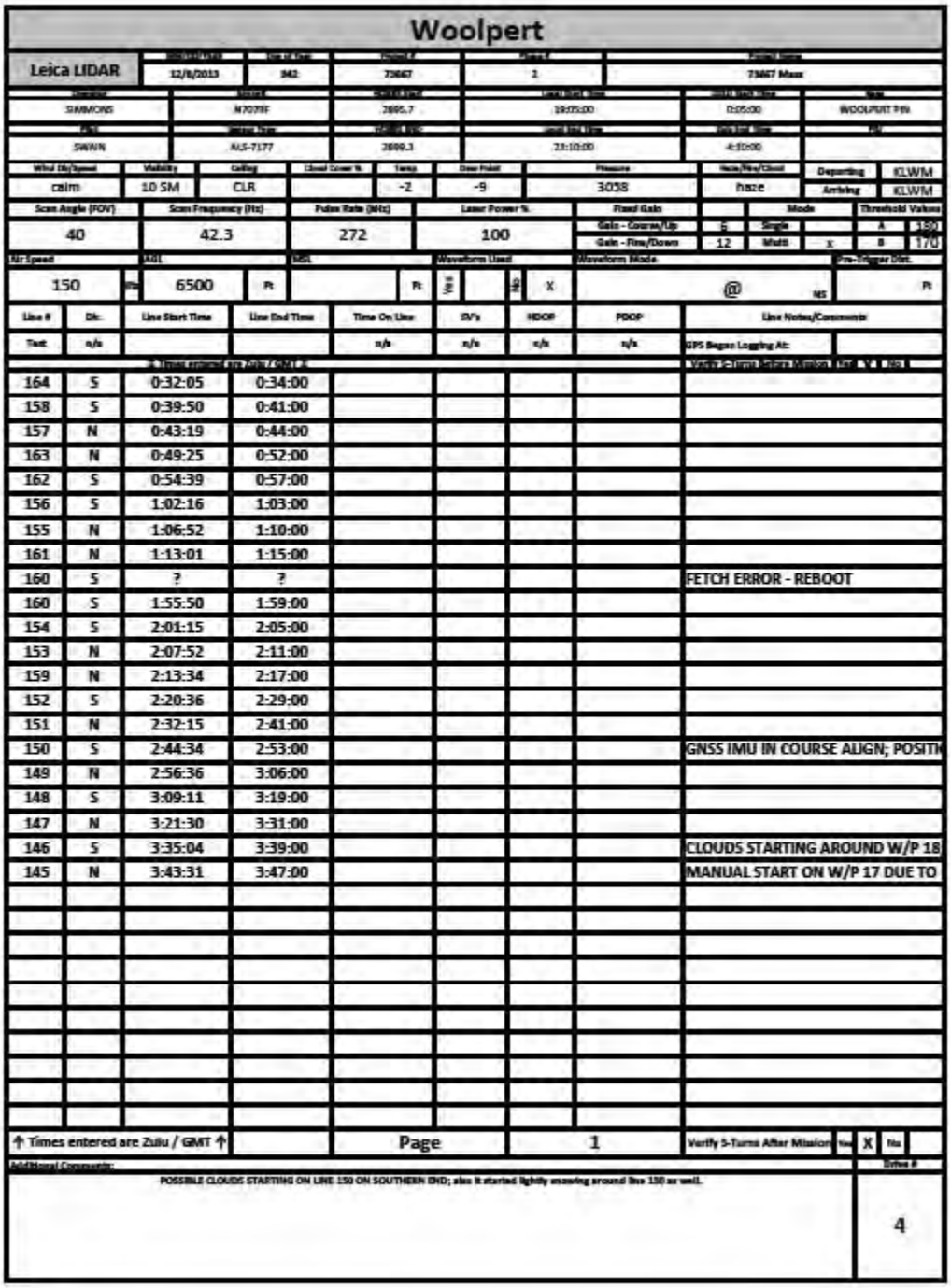
↑ Times entered are Zulu / GMT ↑				Page		2		Verify S-Turns After Mission	Yes No

Additional Comments:	Drive #



Woolpert

Leica LIDAR					
	12/8/2013	342	73647	1	73647 Mass

SIMMONS	N707FF	2895.7	19:05:00	0:05:00	WOOLPERT PIN
SWAN	AUS-7177	2899.3	23:10:00	4:10:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
calm	10 SM	CLR		-2	-9	3038	haze	Departing	KLWM
								Arriving	KLWM

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Coarse/Up	5	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Nr Speed	AGL	MSL	Waveform Used			Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	Ft	Yes		No X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↑ Times entered are Zulu / GMT ↑						Verify S-Turns After Mission Yes X No
164	S	0:32:05	0:34:00					
158	S	0:39:50	0:41:00					
157	N	0:43:19	0:44:00					
163	N	0:49:25	0:52:00					
162	S	0:54:39	0:57:00					
156	S	1:02:16	1:03:00					
155	N	1:06:52	1:10:00					
161	N	1:13:01	1:15:00					
160	S	?	?					FETCH ERROR - REBOOT
160	S	1:55:50	1:59:00					
154	S	2:01:15	2:05:00					
153	N	2:07:52	2:11:00					
159	N	2:13:34	2:17:00					
152	S	2:20:36	2:29:00					
151	N	2:32:15	2:41:00					
150	S	2:44:34	2:53:00					GNSS IMU IN COURSE ALIGN; POSITI
149	N	2:56:36	3:06:00					
148	S	3:09:11	3:19:00					
147	N	3:21:30	3:31:00					
146	S	3:35:04	3:39:00					CLOUDS STARTING AROUND W/P 18
145	N	3:43:31	3:47:00					MANUAL START ON W/P 17 DUE TO

↑ Times entered are Zulu / GMT ↑ | Page 1

Additional Comments: POSSIBLE CLOUDS STARTING ON LINE 150 ON SOUTHERN END; also it started lightly snowing around line 150 as well.

Drive # 4

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY: 12/27/2014	Day of Year: 361 FLT2	Mission Name / Job #: 73667 MA Flood/ Hanscom AFB

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475RC ☐ N404CP ☐ N707BF ☐ N475CP ☐ N1107Q ☒	SH-7177 ☐ SH_6157 ☐ SH-7188 ☐	2373.1	2:25	19:25
Pilot			**Hobbs End**	**Local End Time**	**Zulu End Time**
Larocque			2376.8	18:30	23:30
Passengers	**Using or Relying on CORS**	**GPS Base #1**	**Operator**	**PID**	**MAWM**
	Yes ☒ No ☐	**GPS Base #2**	**Operator**	**PID**	**WES2**

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KDMW
N/A						30.17		Arriving ICAO	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Line: Course/Up ☐ Flite/Down ☐	Mode: Single ☐ Multi ☐ 2+2 ☐ 4+3 ☐
40	42	272	100		

Air Speed	AGL	MSL	Threshold	Waveform Mode	Pre-Trigger Dist.
150 Kts	7,300 Ft	7,300 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 ☒ No ☐
		MA	FLOOD	GAP				CORS MAWM
1	N	21:22:00	21:23:00					30001
2	S	21:26:00	21:27:00					30002
3	N	21:30:00	21:31:00					30003
4	S	21:34:00	21:36:00					30004
5	N	21:39:00	21:41:00					30005
		HANSCOM	AFB					CORS WES2
1	S	21:57:00	21:58:00					
2	N	22:02:00	22:03:00					
3	S	22:06:00	22:07:00					
		MA	FLOOD	GAP				CORS MAFA
6	S	22:57:00	22:58:00					30006, WITHIN TIDES
7	N	23:01:00	23:02:00					30007
8	S	23:06:00	23:07:00					30008
† Times entered are Zulu / GMT †				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes ☒ No ☐

Additional Comments: SYSTEM WORKED WELL

Drive #

Woolpert

Leica LIDAR	4/3/2014	93	73667	1	Mass Post Hurricane Sandy
	GALAMBOS	N111SD	2490.5	6:35:00	22:35:00
	WOOLPERT PIN				
	LaROCQUE	ALS-7177	2491.5	7:14:00	23:14:00

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure		Departing	KFIT
320 8	10	clear		12	-5	3005		Arriving	KFIT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	6500	Ft	6854	Ft	Yes		No	X	@ MS	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:	22:15:50
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission Yes X No	
75	N	22:35:22	22:35:55	0:00:00	16	0.7	1.1	takeoff: 22:21z	
74	S	22:38:32	22:39:09	0:00:00	16	0.7	1.2	OFFLINE	
73	N	22:42:05	22:42:56	0:00:00	16	0.7	1.2	POSSIBLE LIGHT SNOW SPOTTY	
72	S	22:45:37	22:46:25	0:00:00	16	0.7	1.2		
71	N	22:48:56	22:50:46	0:00:00	18	0.7	1		
70	S	22:53:47	22:56:00	0:00:00	17	0.7	1.1		
69	N	22:58:41	23:01:31	0:00:00	17	0.7	1.1		
68	S	23:04:35	23:08:00	0:00:00	17	0.7	1.1		
67	N	23:10:30	23:13:48	0:00:00	18	0.8	1.3		
				0:00:00				LANDING: 23:25	
				0:00:00				STATIC: 23:29:10Z	
				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 #

783516

Woolpert

Leica LIDAR					
	4/4/2014	94	73667	1	Mass Post Hurricane Sandy
Operator	Aircraft		Local Start Time		Base
GALAMBOS	N111SD	2491.5	9:02:00	13:02:00	WOOLPERT PIN
Pilot	Sensor Type		Local End Time		Pilot
LaROCQUE	ALS-7177	2495.8	12:07:00	16:07:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
060 3	10	clear		3	-4	3016		Departing	KFIT
								Arriving	KFIT

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Nr Speed	AGL	MSL	Waveform Used				Waveform Mode		Pre-Trigger Dist.
150 Kts	6500 Ft	6854 Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	12:26:31
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission Start	Yes X No
217	SE	13:02:00	13:04:32	0:00:00	15	0.7	1.3	TAKEOFF: 12:31Z	
218	NW	13:07:42	13:11:00	0:00:00	16	0.7	1.2		
219	SE	13:13:53	13:17:42	0:00:00	17	0.7	1.2		
220	NW	13:21:04	13:24:30	0:00:00	16	0.7	1.2		
221	SE	13:27:16	13:30:47	0:00:00	16	0.7	1.3		
222	NW	13:33:42	13:36:49	0:00:00	17	0.7	1.1		
223	SE	13:39:42	13:42:40	0:00:00	17	0.7	1.1		
224	NW	13:45:26	13:48:15	0:00:00	17	0.7	1.1		
225	S	13:52:45	13:57:02	0:00:00	16	0.8	1.2		
226	N	13:59:42	14:04:08	0:00:00	15	1.1	1.9		
227	S	14:07:14	14:11:23	0:00:00	17	0.7	1.1		
228	N	14:14:51	14:17:52	0:00:00	17	0.7	1.1		
229	S	14:21:10	14:24:29	0:00:00	15	0.8	1.4		
230	N	14:27:10	14:30:24	0:00:00	15	0.8	1.4		
231	S	14:33:35	14:44:35	0:00:00	16	0.7	1.2	WATCHED GPS FLUCTUATE	
232	N	14:47:23	14:57:48	0:00:00	17	0.7	1.1	Ray turns off spot.	
233	S	15:01:04	15:11:06	0:00:00	16	0.7	1.2		
234	N	15:15:32	15:23:28	0:00:00	16	0.7	1.2		
235	S	15:27:04	15:34:02	0:00:00	17	0.7	1.1	LOST LOCK	
236	N	15:36:33	15:42:31	0:00:00	17	0.7	1.1		
237	S	15:46:22	15:51:23	0:00:00	17	0.7	1.1		
238	N	15:54:30	15:57:53	0:00:00	17	0.7	1.1		
239	N	16:01:00	16:07:20	0:00:00	17	0.7	1.1	possible cloud	
				0:00:00				landing: 16:46z	
				0:00:00				Static: 16:47:30	
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission Yes X No	

Additional Comments:

Drive #: 783516

Woolpert

Leica LIDAR					
	6/6/2014	96	73667	1	Mass Post Hurricane Sandy

GALAMBOS	N111SD	2496.3	9:32:07	13:32:00	WOOLPERT PIR
LeROCQUE	AUS-7177	2500.8	1:31:00	17:31:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
320 11G 18	10	clear		3	-6	3010		Departing	KHYA
								Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed	AGL		MSL		Waveform Used			Waveform Mode		Pre-Trigger Dist.	
150	6500	Ft	6854	Ft	Yes		No	X	@ NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	13:11:00
		↑ Times entered are Zulu / GMT ↑						Verify 5-Turns Before Mission	Yes X No
365	E	13:32:07	13:35:59	0:00:00	17	0.7	1.2	Takeoff: 13:18z	
355	W	13:42:30	13:49:10	0:00:00	18	0.7	1.2		
240	E	13:59:35	14:07:19	0:00:00	15	0.7	1.3		
241	W	14:10:28	14:17:58	0:00:00	15	0.7	1.3		
242	E	14:21:10	14:28:13	0:00:00	15	0.7	1.3		
243	W	14:31:04	14:39:05	0:00:00	16	0.7	1.3		
244	E	14:47:18	14:55:41	0:00:00	16	0.7	1.1		
245	W	14:58:45	15:07:33	0:00:00	16	0.7	1.1		
246	E	15:12:43	15:21:58	0:00:00	16	0.7	1.2		
247	W	15:25:12	15:34:58	0:00:00	18	0.7	1		
248	E	15:38:38	15:49:18	0:00:00	17	0.7	1.1		
249	W	15:52:36	16:03:29	0:00:00	16	0.7	1.3		
250	E	16:06:30	16:17:37	0:00:00	16	0.7	1.2		
251	W	16:20:49	16:32:00	0:00:00	16	0.7	1.2		
252	E	16:35:20	16:46:19	0:00:00	16	0.7	1.2		
253	W	16:49:31	17:00:43	0:00:00	14	0.8	1.4		
254	E	17:04:02	17:13:53	0:00:00	16	0.7	1.2		
255	NW	17:19:41	17:24:18	0:00:00	16	0.7	1.2		
256	SE	17:26:48	17:30:34	0:00:00	15	0.7	1.1		
				0:00:00				LANDING: 17:39Z	
				0:00:00				STATIC:17:41:52Z	
				0:00:00					
				0:00:00					
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				0:00:00					
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission	Yes X No

Additional Comments:

Drive #: 783516

Woolpert

Leica LIDAR	Date (mm/dd/yyyy)	Day of Year	Project #	Survey #	Project Name
	4/7/2014	97	73667	1	Mass Post Hurricane Sandy

Operator	Aircraft	Aircraft Start Time	Local Start Time	Aircraft End Time	Date
GALAMBOS	N111SD	2500.8	7:49:00	11:49:00	NGS
Pilot	**Sensor Type**	**Aircraft ID#**	**Local End Time**	**Data End Time**	**File**
LeROCQUE	ALS-7177	2504.8	11:09:00	15:09:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KHYA
080 3	10	clear		0	-2	3021		Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6854 Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 11:32:15
		All Times entered are Zulu / GMT #						Verify S-Turns Before Mission Yes X No
266	N	11:49:40	11:52:56	0:00:00	18	0.6	1.2	takeoff: 11:39z
267	S	11:55:51	11:59:59	0:00:00	18	0.6	1.2	
268	N	12:05:10	12:11:52	0:00:00	19	0.6	1.1	
269	S	12:14:46	12:21:31	0:00:00	18	0.6	1.2	
270	N	12:24:10	12:30:51	0:00:00	17	0.6	1.2	
271	S	12:33:50	12:40:10	0:00:00	18	0.6	1.2	
272	N	12:42:50	12:48:29	0:00:00	18	0.6	1.2	
287	SW	12:51:29	13:03:33	0:00:00	18	0.6	1.2	
286	NE	13:06:25	13:18:23	0:00:00	18	0.6	1.1	
285	SW	13:21:39	13:33:33	0:00:00	17	0.6	1.2	
K1	NE	13:49:40	13:58:22	0:00:00	17	0.8	1.5	7500/32/41.6/239.0/100%/6-12/
K2	N	14:01:23	14:10:08	0:00:00	18	0.6	1.2	7500/32/41.6/239.0/100%/6-12/
K3	S	14:13:06	14:21:58	0:00:00	15	0.8	1.4	7500/32/41.6/239.0/100%/6-12/
K4	N	14:26:05	14:33:13	0:00:00	16	0.7	1.2	7500/32/41.6/239.0/100%/6-12/
K5	S	14:35:52	14:43:14	0:00:00	16	0.7	1.2	7500/32/41.6/239.0/100%/6-12/
K6	N	14:46:05	14:53:17	0:00:00	16	0.7	1.2	7500/32/41.6/239.0/100%/6-12/
K7	S	14:56:21	15:03;44	0:00:00	16	0.7	1.1	7500/32/41.6/239.0/100%/6-12/
K8	N	15:06:33	15:08:38	0:00:00	16	0.7	1.1	TDC Error No PPS detected by TDC
				0:00:00				more than 300000 t zeros detected
				0:00:00				without a PPS
				0:00:00				
				0:00:00				Landing: 15:29Z
				0:00:00				STATIC: 15:31:14
247				0:00:00				
248				0:00:00				
249				0:00:00				
250				0:00:00				
251				0:00:00				
252				0:00:00				
253				0:00:00				
254				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #: 783516

Woolpert

Leica LIDAR						
	4/7/2014	97	75067	1	Mass Post Hurricane Sandy	
Operator	Aircraft		Flight Log #	Lines Start Time	Lines End Time	Base
GALAMBOS	N111SD		2504.8	12:30:00	18:30:00	NGS
Pilot	Sensor Type		Flight Log #	Lines Start Time	Lines End Time	POC
LeROCQUE	ALS-7177		2507.1	2:23:00	08:23:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
200 9	10	clear		3	2	3024		Departing	KHYA
								Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	5	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed	AGL		MSL		Waveform Used			Waveform Mode		Pre-Trigger Dist.	
150	Kts	6500	Ft	6854	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	16:13:40
↑ Times entered are Zulu / GMT ↑								Verify S-Turns before Mission	Yes X No
257	NW	16:30:17	16:33:38	0:00:00	15	0.7	1.4	MISSION 2	
258	SE	16:36:14	16:38:54	0:00:00	15	0.7	1.4	takeoff: 16:21z	
259	NW	16:41:58	16:44:09	0:00:00	15	0.7	1.4		
K62	NW	16:50:54	16:55:37	0:00:00	14	0.8	1.4	7500/32/41.6/239.0/100%/6-12/	
K61	SE	16:58:17	17:03:22	0:00:00	17	0.7	1.3	7500/32/41.6/239.0/100%/6-12/	
K60	NW	17:06:10	17:11:28	0:00:00	18	0.7	1.2	7500/32/41.6/239.0/100%/6-12/	
K59	SE	17:14:16	17:20:06	0:00:00	18	0.7	1.2	7500/32/41.6/239.0/100%/6-12/	
K58	NW	17:26:55	17:36:42	0:00:00	17	0.6	1	7500/32/41.6/239.0/100%/6-12/	
K57	SE	17:39:48	17:49:41	0:00:00	17	0.6	1	7500/32/41.6/239.0/100%/6-12/	
277	SW	18:00:11	18:03:07	0:00:00	16	0.6	1.1		
276	NE	18:06:19	18:09:09	0:00:00	16	0.7	1.1		
275	SW	18:12:52	18:15:07	0:00:00	17	0.6	1.1		
274	NE	18:18:06	18:19:12	0:00:00	17	0.6	1.1		
273	SW	18:22:54	18:23:13	0:00:00	17	0.6	1.1		
				0:00:00				Landing: 18:40z	
				0:00:00				Static: 18:42:27	
				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 #: 783516

Woolpert

Leica LIDAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	6/9/2014	99	73667	1	Mass Post Hurricane Sandy

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GALAMBOS	N111SD	2507.1	9:43:00	14:43:00	NGS
LaROCQUE	ALS-7177	2508.8	10:54:00	15:54:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KHYA
340 10g19	10	clear		10	2	2960		Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	6500	Ft	6854	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 14:25:45
↓ Times entered are Zulu / GMT ↓								Verify S-Turns Before Mission Yes X No
217	NW	14:43:45	14:46:29	0:00:00	18	0.8	1.2	t/o: 14:31z
278	SW	15:01:34	15:04:32	0:00:00	18	0.8	1.2	
279	NE	15:07:29	15:10:28	0:00:00	17	0.7	1.1	OFFLINE TO MISS CLOUD
280	SW	15:13:26	15:17:55	0:00:00	17	0.7	1.1	THIN CL BEGINNING
281	NE	15:21:00	15:25:35	0:00:00	17	0.7	1.1	8 MILES CL LEFT SIDE
282	SW	15:29:05	15:34:39	0:00:00	17	0.7	1.1	THIN CL BEGINNING
283	NE	15:37:27	15:43:00	0:00:00	16	0.7	1.2	THIN CLOUDS NEAR END
284	SW	15:45:56	15:53:30	0:00:00	17	0.7	1.1	CLOUD THICK, 5 MILES INTO IT
K52	NW			0:00:00				Landing: 16:11Z
				0:00:00				STATIC: 16:13:27
				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 #
	783516

Woolpert

Leica LIDAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	4/10/2014	100	73667	1	Mass Post Hurricane Sandy

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GALAMBOS	N111SD	2508.8	8:22:00	12:22:00	WOOLPERT PIN
LaROCQUE	ALS-7177	2512.9	10:52:00	14:52:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KHYA
020 4	10	clear		3	-7	3012		Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Coarse/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	6500	Ft	6847	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	12:04:12
↓ Times entered are Zulu / GMT ↓								Verify S-Turns Before Mission Yes X No	
51	S	12:22:30	12:38:34	0:00:00	17	0.7	1.3	Takeoff HYA : 11:10z	
50	N	12:41:30	12:57:22	0:00:00	17	0.7	1.3	arrive KFIT: 7:48local	
49	S	13:00:51	13:16:44	0:00:00	17	0.7	1.3	LATE START - MANUAL	
48	N	13:20:10	13:36:17	0:00:00	16	1	1.4	PDOP JUMPING	
47	S	13:39:21	13:55:41	0:00:00	16	1.3	2.2		
46	N	13:58:27	14:14:13	0:00:00	16	0.7	1.2	LIGHT TRACE OF SNOW	
45	S	14:17:15	14:33:55	0:00:00	16	0.7	1.1	HIGHER ELEVATIONS	
44	N	14:36:38	14:52:39	0:00:00	14	0.7	1.2		
				0:00:00					
				0:00:00				Takeoff FIT: 12:09z/2509.4	
				0:00:00				LANDING FIT: 15:05z/2512.4	
				0:00:00				static:15:06:550z	
				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:

SOFTWARE GLITCH? TRAC GUI SAYS SC IS INITIALIZING PLEASE WAIT ALL FUNCTIONS APPEAR NORMAL

Drive #

783516

Woolpert

Leica LIDAR					
	4/10/2014	300	75667	1	Mass Post Hurricane Sandy

GALAMBOS	N111SD	2512.9	12::45	16:45:00	NGS
LeROCQUE	AJS-7177	2517.4	6:38:00	20:38:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
220 12	10	clear		9	-2	30.18		Departing	KHYA
								Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	7500 Ft	7500 Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	16:27:00
↑ Times entered are Zulu / GMT ↑								Verify S-Turns Before Mission: Yes X No	
K56	NW	16:45:10	16:54:37	0:00:00	14	0.8	1.3	MISSION 2/TAKEOFF: 16:34Z	
K55	SE	16:57:44	17:06:47	0:00:00	16	0.8	1.3		
K54	NW	17:10:15	17:18:55	0:00:00	15	0.7	1.1		
K53	SE	17:21:43	17:29:36	0:00:00	17	0.7	1.1		
K52	NW	17:33:10	17:40:31	0:00:00	16	0.8	1.1		
K43	NW	17:43:21	17:47:18	0:00:00	17	0.6	1.1		
K44	SE	17:50:26	17:54:12	0:00:00	15	0.7	1.3		
K45	NW	18:00:46	18:08:14	0:00:00	17	0.7	1.1		
K46	SE	18:11:06	18:18:22	0:00:00	16	0.6	1.1		
K47	NW	18:21:05	18:28:07	0:00:00	16	0.6	1.1		
K48	SE	18:31:12	18:38:03	0:00:00	16	0.6	1.1		
K49	NW	18:40:54	18:47:50	0:00:00	16	0.6	1.1		
K50	NW	18:50:42	18:57:19	0:00:00	15	0.7	1.6		
K51	SE	19:01:39	19:05:07	0:00:00	15	0.7	1.6		
K17	N	19:09:59	19:18:36	0:00:00	18	0.7	1.4		
K16	S	19:21:50	19:30:51	0:00:00	17	0.7	1.5		
K15	N	19:33:21	19:42:21	0:00:00	17	0.6	1.3		
K14	S	19:45:41	19:55:14	0:00:00	18	0.6	1.3		
K13	N	19:58:00	20:07:05	0:00:00	18	0.6	1.3		
K12	S	20:10:46	20:18:11	0:00:00	17	0.6	1.3		
K11	N	20:21:03	20:28:08	0:00:00	16	0.7	1.4		
K10	S	20:30:30	20:37:44	0:00:00	17	0.6	1.3		
K9	N			0:00:00				Landing: 20:54z	
K8	S			0:00:00				Static: 20:56:06	
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
				0:00:00					
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission: Yes X No	

Additional Comments:

Drive #: 783516

Woolpert

Leica LIDAR

4/12/2014	102	73667	1

Mass Post Hurricane Sandy

GALAMBOS	N111SD	2524.3	10:01:00	14:01:00	WOOLPERT PIW
LaROCQUE	ALS-7177	2528.2	1:11:00	17:11:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud
330 7	10	clear		12	4	3014	

Departing KOWD
Arriving KOWD

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %
40	42.3	272	100

Fixed Gain		Mode		Threshold Values	
Gain - Coarse/Up	6	Single		A	180
Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	6500	Ft	6854	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	13:34:25
43	N	14:00:56	14:17:37	0:00:00	14	0.7	1.4	T/O 13:42Z	
42	S	14:20:28	14:36:50	0:00:00	16	0.7	1.2	SLIGHTLY OFFLINE BEGINNING	
41	N	14:39:46	14:56:03	0:00:00	15	0.7	1.2		
40	S	14:58:37	15:14:57	0:00:00	17	0.6	1		
39	N	15:18:04	15:34:22	0:00:00	17	0.6	1		
38	S	15:37:10	15:53:34	0:00:00	15	0.7	1.3		
37	N	15:56:29	16:12:48	0:00:00	16	0.7	1.2		
36	S	16:15:38	16:32:00	0:00:00	13	0.7	1.5		
35	N	16:35:02	16:51:38	0:00:00	13	0.7	1.5		
34	S	16:54:43	17:11:24	0:00:00	15	0.7	1.1	MODERATE TURBULENCE	
				0:00:00				Landing:17:31	
				0:00:00				Static: 17:33:36	
				0:00:00					
				0:00:00					
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				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 #

783516

Woolpert

Leica LIDAR

Date (mm/dd/yy)	Day of Year	Project #	Flight #	Flight Name
4/12/2014	102	73667	1	Mass Post Hurricane Sandy

Operator	Aircraft	Aircraft Start	Local Start Time	Local Stop Time	Base
GALAMBOS	N111SD	2528.2	15:02:00	19:02:00	WOOLPERT PVA
Pilot	Sensor Type	Aircraft Stop	Local Start Time	Local Stop Time	POC
LaROCQUE	ALS-7177	2531.2	5:35:00	21:35:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KOWD
270 12 g18	10	clear		19	-2	3012		Arriving	KOWD

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	5	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Nr Speed	AGL		MSL		Waveform Used			Waveform Mode		Pre-Trigger Dist.	
150	Kts	7500	Ft	7542	Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	18:43:15
↑ Times entered are Zulu / GMT ↑								Verify 5-Turns Before Mission	Yes X No
K7	N	19:01:59	19:09:32	0:00:00	14	0.7	1.6	Mission 2	
K8	S	19:12:50	19:20:09	0:00:00	16	0.7	1.2	t/o:18:51z	
K18	N	19:32:45	19:36:04	0:00:00	16	0.6	1.2	moderate turbulence	
K19	S	19:39:06	19:45:50	0:00:00	16	0.6	1		
K20	N	19:48:48	19:55:57	0:00:00	16	0.6	1.2		
K21	S	19:58:38	20:05:37	0:00:00	16	0.6	1.2		
K22	N	20:08:44	20:16:40	0:00:00	16	0.6	1.2		
K23	S	20:19:44	20:27:34	0:00:00	13	0.7	1.5		
K24	N	20:30:56	20:39:13	0:00:00	14	0.7	1.3		
K25	S	20:42:12	20:50:09	0:00:00	16	0.6	1.1		
K26	N	20:53:03	21:01:02	0:00:00	16	0.6	1.1		
K27	S	21:04:06	21:11:50	0:00:00	16	0.6	1.1		
K28	N	21:14:45	21:17:54	0:00:00	16	0.6	1.1		
K29	S	21:21:00	21:24:00	0:00:00	17	0.6	1.1		
K30	N	21:26:54	21:29:45	0:00:00	14	0.8	1.3		
K31	S	21:32:33	21:35:00	0:00:00	14	0.8	1.3		
				0:00:00				Landing: 21:50z	
				0:00:00				Static: 21:54:24	
				0:00:00					
				0:00:00					
				0:00:00					
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Additional Comments:

Drive #

783516

Woolpert

Leica LIDAR

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4/13/2014	103	73667	1	Mass Post Hurricane Sandy

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GALAMBOS	N111SD	2531.2	5:04:00	21:04:00	WOOLPERT PVA
LaROCQUE	ALS-7177	2532.9	5:56:00	21:56:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KOWD
200 12 g19	10	clear		19	10	3007		Arriving	KOWD

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7500	Ft	7500	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a	20:56:42	20:57:13	n/a	n/a	n/a	n/a	GPS Began Logging At:	20:36:09
		↑ Times entered are Zulu / GMT ↑						Verify S-Turns Before Mission Yes Y No	
K32	N	21:03:46	21:05:57	0:00:00	17	0.6	1.1	t/o 20:55z	
K33	S	21:09:04	21:11:24	0:00:00	17	0.6	1.1		
K34	N	21:14:15	21:16:46	0:00:00	17	0.6	1.1		
K35	S	21:19:24	21:22:00	0:00:00	17	0.6	1.1		
K36	N	21:24:40	21:27:13	0:00:00	17	0.6	1.1		
K37	S	21:30:01	21:32:36	0:00:00	17	0.6	1.1		
K38	N	21:35:23	21:37:40	0:00:00	15	0.7	1.2		
K39	S	21:40:39	21:42:46	0:00:00	15	0.7	1.2		
K40	N	21:45:30	21:47:15	0:00:00	15	0.7	1.2		
K41	S	21:50:57	21:51:59	0:00:00	16	0.6	1.1		
K42	N	21:54:44	21:55:40	0:00:00	16	0.6	1.1		
				0:00:00				Landing: 22:22z	
				0:00:00				Static: 22:23:05	
				0:00:00					
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Additional Comments:

Drive #: 783516

Woolpert

Leica LIDAR	Date	Day of Year	Project #	Flight #	Project Name
	4/14/2014	104	73667	1	Mass Post Hurricane Sandy

Operator	Aircraft	Hobbs Start	Local Start Time	Zulu Start Time	Base
GALAMBOS	N111SD	2532.9	9:24:00	13:24:00	NGS
Pilot	**Sensor Type**	**Hobbs End**	**Local End Time**	**Zulu End Time**	**PDI**
LaROCQUE	ALS-7177	2535.8	11:15:00	15:15:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
200 8	10	clear		18	13	29.97		Departing	KOWD
								Arriving	KOWD

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	6500	Ft	6854	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	13:07:00
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission Yes Y No	
66	S	13:23:51	13:32:20	0:00:00	15	0.9	1.6	LAST 2 MILES CLOUDS	
52	N	13:36:32	13:43:57	0:00:00	16	0.7	1.2	OFFLINE BEGINNING/FAST	
53	S	13:47:25	13:55:46	0:00:00	16	0.7	1.2		
54	N	13:58:21	14:04:23	0:00:00	16	0.7	1.2	LATE START MANUAL UL001	
55	S	14:09:10	14:15:18	0:00:00	16	0.7	1.1	1 MILE SML THIN CLOUD	
56	N	14:18:03	14:23:33	0:00:00	17	0.7	1.1	OFFLINE BEGINNING	
57	S	14:27:33	14:33:21	0:00:00	16	0.7	1.2		
58	N	14:36:02	14:42:46	0:00:00	16	0.7	1.2		
59	S	14:46:21	14:53:38	0:00:00	17	0.7	1		
60	N	14:56:13	15:02:43	0:00:00	16	0.7	25	FAST	
61	S	15:05:47	15:14:38	0:00:00	17	0.7	1.1	9 MILES SMALL CLOUD 4 MILES	
				0:00:00				dep OWD:2532.9	
				0:00:00				arr:FIT: 2533.2	
				0:00:00				T/O13:11Z	
				0:00:00				DEP FIT: 2535.6	
				0:00:00				STATIC:15:31:30	
				0:00:00					
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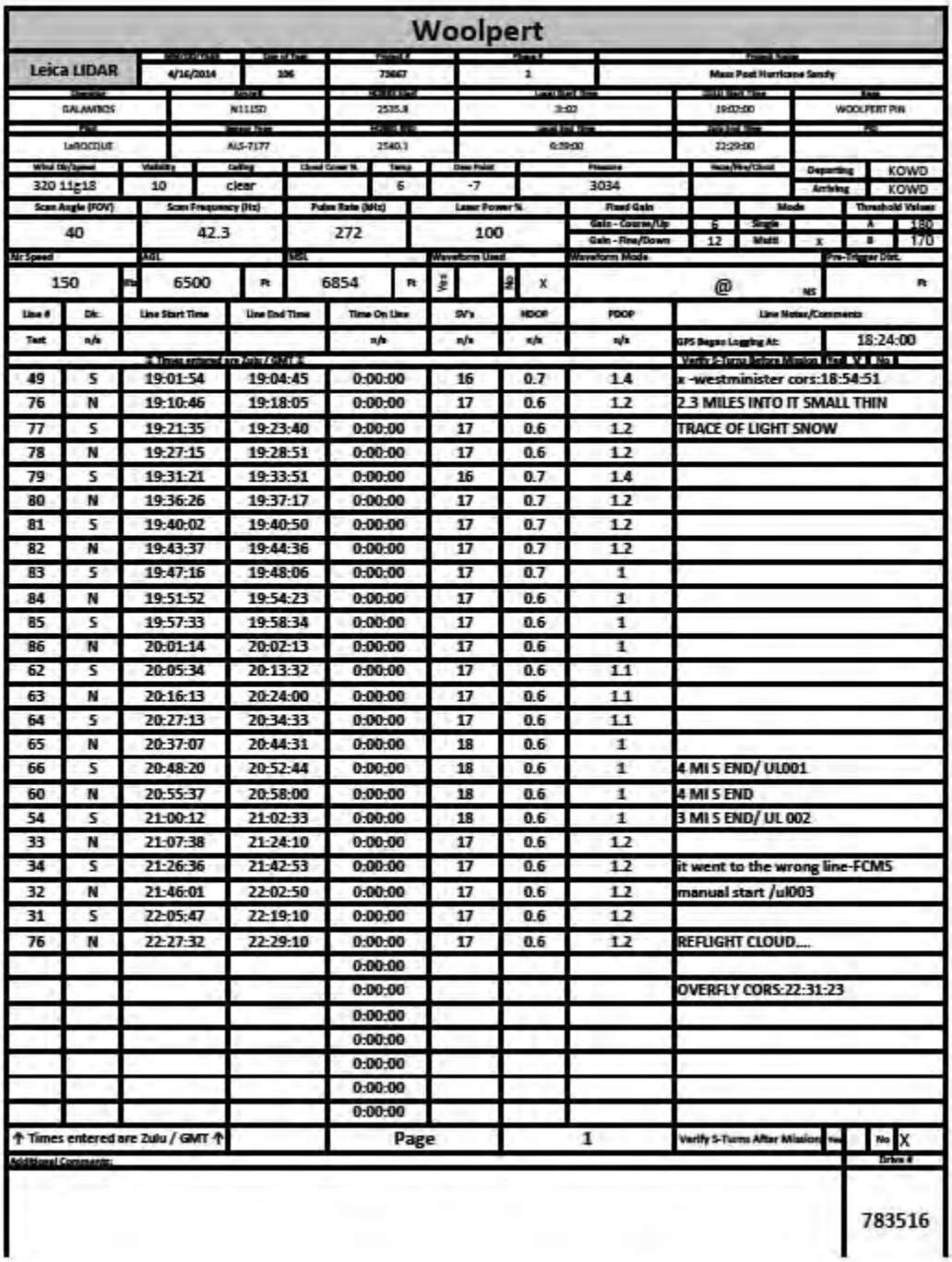
Additional Comments:	Drive #
	783516



Woolpert

Leica LIDAR		Date of Flight	Project #	Flight #	Project Name
	4/16/2014	106	73667	1	Mass Post Hurricane Sandy

Operator	Aircraft	Aircraft Type	Lower Start Time	Upper Start Time	Base
GALAMBOS	N111SD	2535.8	3:02	19:02:00	WOOLPERT PVN

Pilot	Sensor Type	Engine Hrs	Lower End Time	Upper End Time	Fuel
LaROCQUE	ALS-7177	2540.1	6:39:00	22:29:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
320 11g18	10	clear		6	-7	3034		Departing	KOWD
								Arriving	KOWD

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	5	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Air Speed	AGL	MSL	Waveform Used	Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6854 Ft	Yes	NS X	@ NS Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 18:24:00
		↑ Times entered are Zulu / GMT ↑						Verify S-Turns Before Mission Yes Y No
49	S	19:01:54	19:04:45	0:00:00	16	0.7	1.4	x -westminister cors:18:54:51
76	N	19:10:46	19:18:05	0:00:00	17	0.6	1.2	2.3 MILES INTO IT SMALL THIN
77	S	19:21:35	19:23:40	0:00:00	17	0.6	1.2	TRACE OF LIGHT SNOW
78	N	19:27:15	19:28:51	0:00:00	17	0.6	1.2	
79	S	19:31:21	19:33:51	0:00:00	16	0.7	1.4	
80	N	19:36:26	19:37:17	0:00:00	17	0.7	1.2	
81	S	19:40:02	19:40:50	0:00:00	17	0.7	1.2	
82	N	19:43:37	19:44:36	0:00:00	17	0.7	1.2	
83	S	19:47:16	19:48:06	0:00:00	17	0.7	1	
84	N	19:51:52	19:54:23	0:00:00	17	0.6	1	
85	S	19:57:33	19:58:34	0:00:00	17	0.6	1	
86	N	20:01:14	20:02:13	0:00:00	17	0.6	1	
62	S	20:05:34	20:13:32	0:00:00	17	0.6	1.1	
63	N	20:16:13	20:24:00	0:00:00	17	0.6	1.1	
64	S	20:27:13	20:34:33	0:00:00	17	0.6	1.1	
65	N	20:37:07	20:44:31	0:00:00	18	0.6	1	
66	S	20:48:20	20:52:44	0:00:00	18	0.6	1	4 MI S END/ UL001
60	N	20:55:37	20:58:00	0:00:00	18	0.6	1	4 MI S END
54	S	21:00:12	21:02:33	0:00:00	18	0.6	1	3 MI S END/ UL 002
33	N	21:07:38	21:24:10	0:00:00	17	0.6	1.2	
34	S	21:26:36	21:42:53	0:00:00	17	0.6	1.2	it went to the wrong line-FCM5
32	N	21:46:01	22:02:50	0:00:00	17	0.6	1.2	manual start /ul003
31	S	22:05:47	22:19:10	0:00:00	17	0.6	1.2	
76	N	22:27:32	22:29:10	0:00:00	17	0.6	1.2	REFLIGHT CLOUD....
				0:00:00				
				0:00:00				OVERFLY CORS:22:31:23
				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 No X

Additional Comments: Drive #

783516

Woolpert

Leica LIDAR	Mission Date	Day of Year	Project #	Flight #	Project Name
	4/16/2014	106	73667	1	Mass Post Hurricane Sandy

Operator	Aircraft	HOBBS Start	Local Start Time	UTC Start Time	Base
GALAMBOS	N111SD	2540.1	7:34:00	23:34:00	WOOLPERT PIA
Pilot	Sensor Type	HOBBS End	Local End Time	UTC End Time	[illegible]
LaROCQUE	ALS-7177	2541.1	8:11:00	0:11:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KOWD
360 7G12	10	clear		6	-8	3045		Arriving	KOWD

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
150	kts	6500	Ft	6854	Ft	Yes		No	X	@	MS	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:	23:13:00
		↑ Times entered are Zulu / GMT ↑						Verify S-Turns Before Mission Yes X No	
K9	S	23:34:11	23:41:42	0:00:00	16	0.7	1.4	272/42.3/40/100%/MPIA/6-12/	
				0:00:00				7900/7500 GPS	
280	SW	23:53:20	23:57:36	0:00:00	17	0.7	1.1		
284	NW	23:59:37	0:05:55	0:00:00	17	0.7	1.1		
282	SW	0:08:01	0:10:31	0:00:00	17	0.7	1.1		
				0:00:00				SHUTDOWN W/O STATIC	
				0:00:00					
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Additional Comments:

Drive #

783516

Woolpert

Leica LIDAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	4/20/2014	110	73667	1	Mass Post Hurricane Sandy

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GALAMBOS	N111SD	2547.0	1:59:00	19:59:00	NGS
LaROCQUE	ALS-7177	2550.4	5:03:00	21:02:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KTTN
110 6	10	clear	35 sct	10	1	30.45		Arriving	KHYA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Coarse/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.	
150	kts	6854	ft	7000	ft	Yes		No	x	@ MS		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:	19:11:03
↓ Times entered are Zulu / GMT ↓								Verify S-Turns Before Mission: Yes X No	
76	S	19:59:20	20:06:30	0:00:00	16	0.6	1.2	KHYA:2548.3/over westminster	
				0:00:00				t/o 19:16/over wes19:52:15	
				0:00:00				Overfly wes: 20:10:38	
280	SW	20:39:03	20:43:43	0:00:00	18	0.6	1		
282	NE	20:46:19	20:51:52	0:00:00	17	0.6	1.3		
284	SW	20:54:38	21:02:27	0:00:00	15	0.7	1.3		
				0:00:00				LANDING: 21:22Z	
				0:00:00				STATIC: 21:23:04	
				0:00:00					
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Additional Comments:

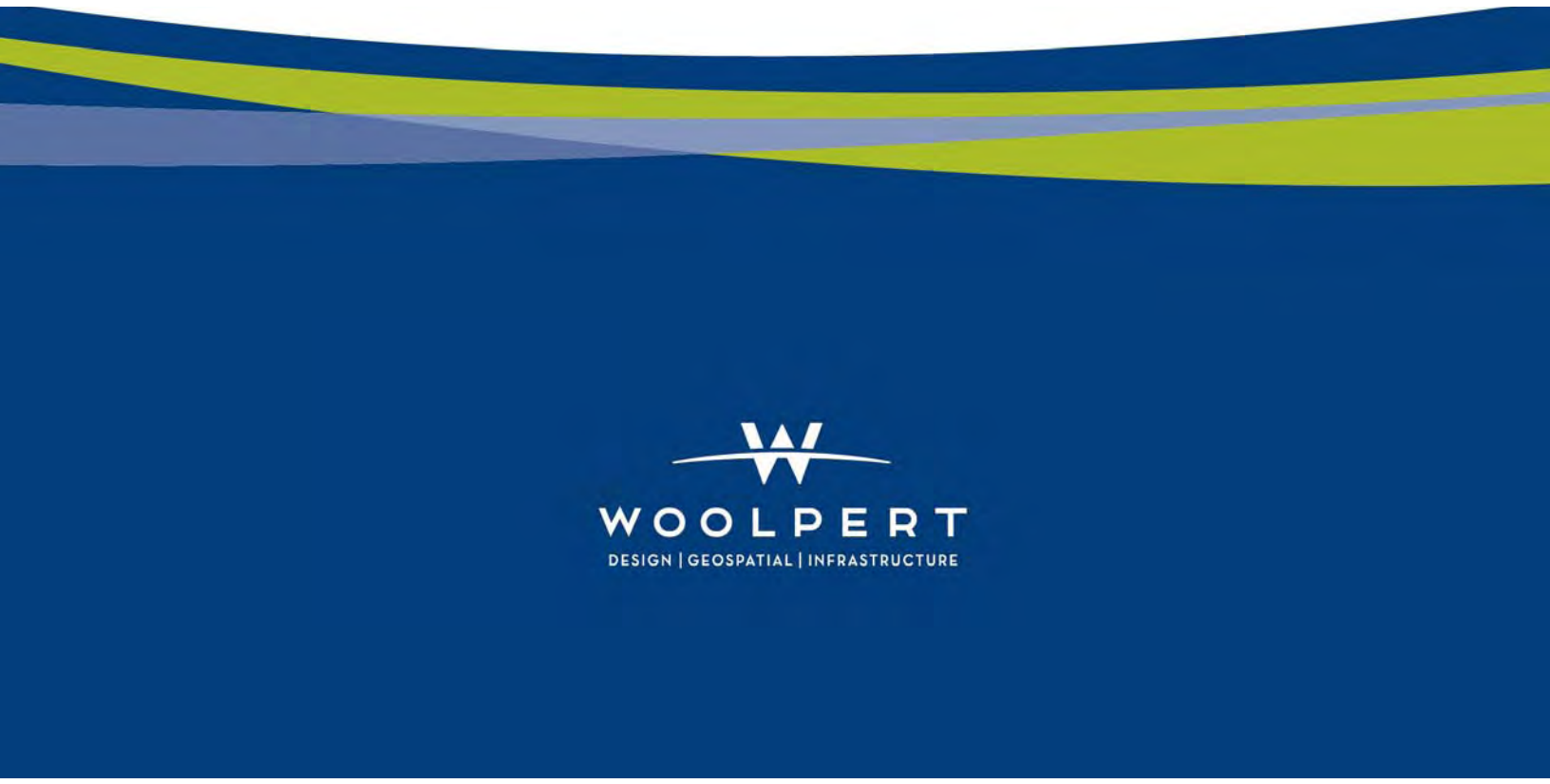
Drive #: 783516

SECTION 7: FINAL DELIVERABLES

FINAL DELIVERABLES

The final lidar deliverables are listed below.

- LAS v1.2 classified point cloud
- LAS v1.2 raw unclassified point cloud flight line strips no greater than 2GB. Long swaths greater than 2GB will be split into segments)
- Hydrologically flattened Polygon z and Polyline z shapefiles
- Hydrologically flattened bare earth 1-meter DEM in ERDAS .IMG format
- 8-bit gray scale intensity images
- Tile layout and data extent 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


WOOLPERT
DESIGN | GEOSPATIAL | INFRASTRUCTURE