USGS White Sands, NM QL0 Lidar

USGS/NGTOC Rolla, MO

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Section 1: Overview

Project Name: NM WHITE SANDS QL0 LIDAR

Woolpert Project: #75721

This report contains a comprehensive outline of the MN White Sands QLO Lidar task order. This task is issued under USGS Task Order Number: G15PD00566. This task order requires lidar data to be acquired over White Sands NM. The total area of the White Sands Lidar AOI is approximately 43 square miles. The lidar was collected and processed to meet a maximum Nominal Post Spacing (NPS) of .25 meter. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.

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

Table 1.1: Acquisition Specs	
Post Spacing	.82 ft / .25m
AGL (Above Ground Level) average flying height	5,000 ft / 1,524 m
MSL (Mean Sea Level) average flying height	8,911 ft / 2,716 m
Average Ground Speed:	130 knots / 150 mph
Field of View (full)	10 degrees
Pulse Rate	171.5 kHz
Scan Rate	65 Hz
Side Lap	27.5%

The lidar data was processed and projected in UTM, Zone 13, 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.

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, on board Precision Aerial Reconnaissance (PAR) Cessna 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 system software is operated on an OC50 Operation Controller aboard the aircraft.

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

Table 2.1: ALS Lidar System Specifications	
Operating Altitude	200 – 3,500 meters
Scan Angle	0 to 75° (variable)
Swath Width	0 to 1.5 X altitude (variable)
Scan Frequency	0 – 200 Hz (variable based on scan angle)
Maximum Pulse Rate	500 kHz (Effective)
Range Resolution	Better than 1 cm
Elevation Accuracy	7 - 16 cm single shot (one standard deviation)
Horizontal Accuracy	5 – 38 cm (one standard deviation)
Number of Returns per Pulse	7 (infinite)
Number of Intensities	3 (first, second, third)
Intensity Digitization	8 bit intensity + 8 bit AGC (Automatic Gain Control) level
MPiA (Multiple Pulses in Air)	8 bits @ 1nsec interval @ 50kHz
Laser Beam Divergence	0.22 mrad @ $1/e^2$ (~0.15 mrad @ 1/e)
Laser Classification	Class IV laser product (FDA CFR 21)
Eye Safe Range	400m single shot depending on laser repetition rate
Roll Stabilization	Automatic adaptive, range = 75 degrees minus current FOV
Power Requirements	28 VDC @ 25A
Operating Temperature	0-40°C
Humidity	0-95% non-condensing
Supported GNSS Receivers	Ashtech Z12, Trimble 7400, Novatel Millenium

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

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

The lidar data was collected in three (3) 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, WHITE SANDS NM QLO LIDAR

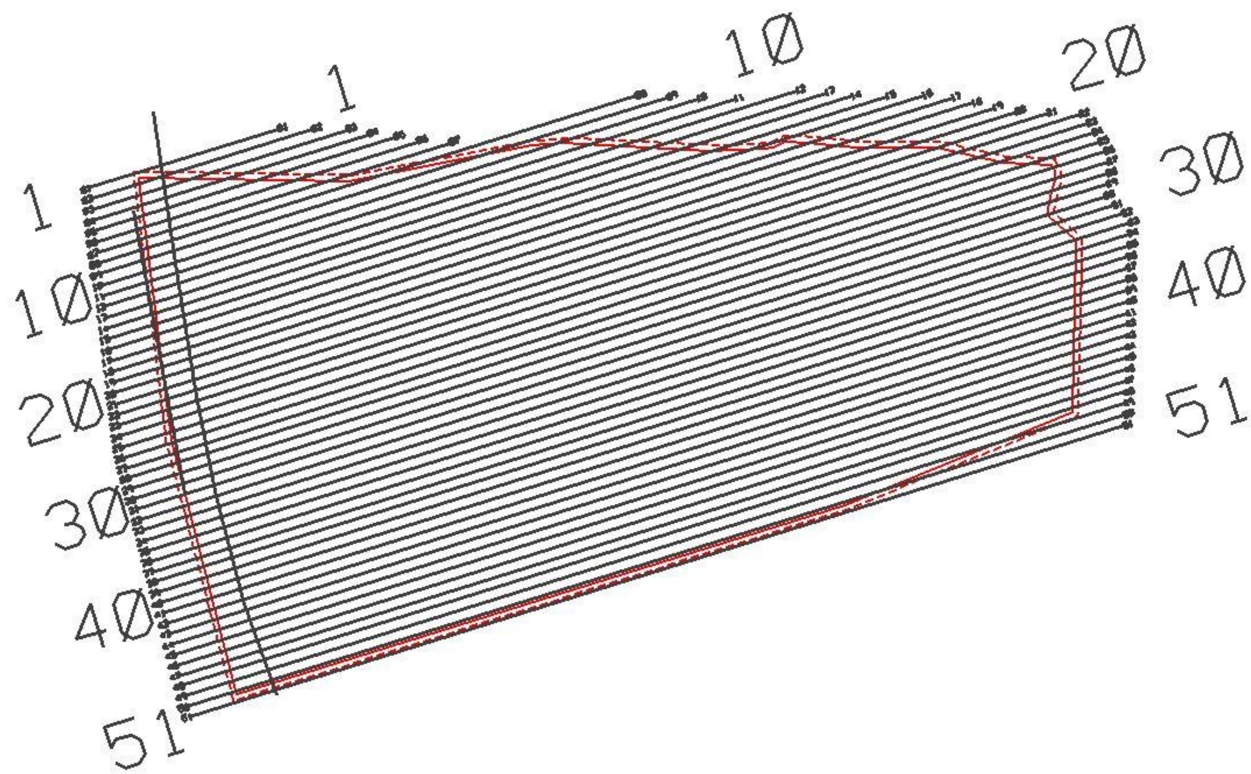


Table 2.2: Airborne Lidar Acquisition Flight Summary			
Date of Mission	Lines Flown	Mission Time (UTC) Wheels Up/ Wheels Down	Mission Time (Local = EDT) Wheels Up/ Wheels Down
August 08, 2015	1-28	14:41 – 18:02	08:41AM – 12:02AM
August 08, 2015	29-51	19:02 – 22:10	01:02PM - 04:10PM
August 09, 2015	29-30	17:02 – 17:22	11:02AM – 11:22AM

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: Leica Cloud Pro v 1.2.1, Proprietary Software, TerraMatch v. 15.015.
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.15.026.
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.15.026.

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 acquisition team. Ground planes were used on the base-station antennas. Data was collected at 1 or 2 Hz.

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

Table 3.1: GNSS Base Station

Station (Name)	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height (L1 Phase center) (Meters)
NGS_PID_CW0460	32°50' 47.16602"	-105°58' 55.80935"	1256.741

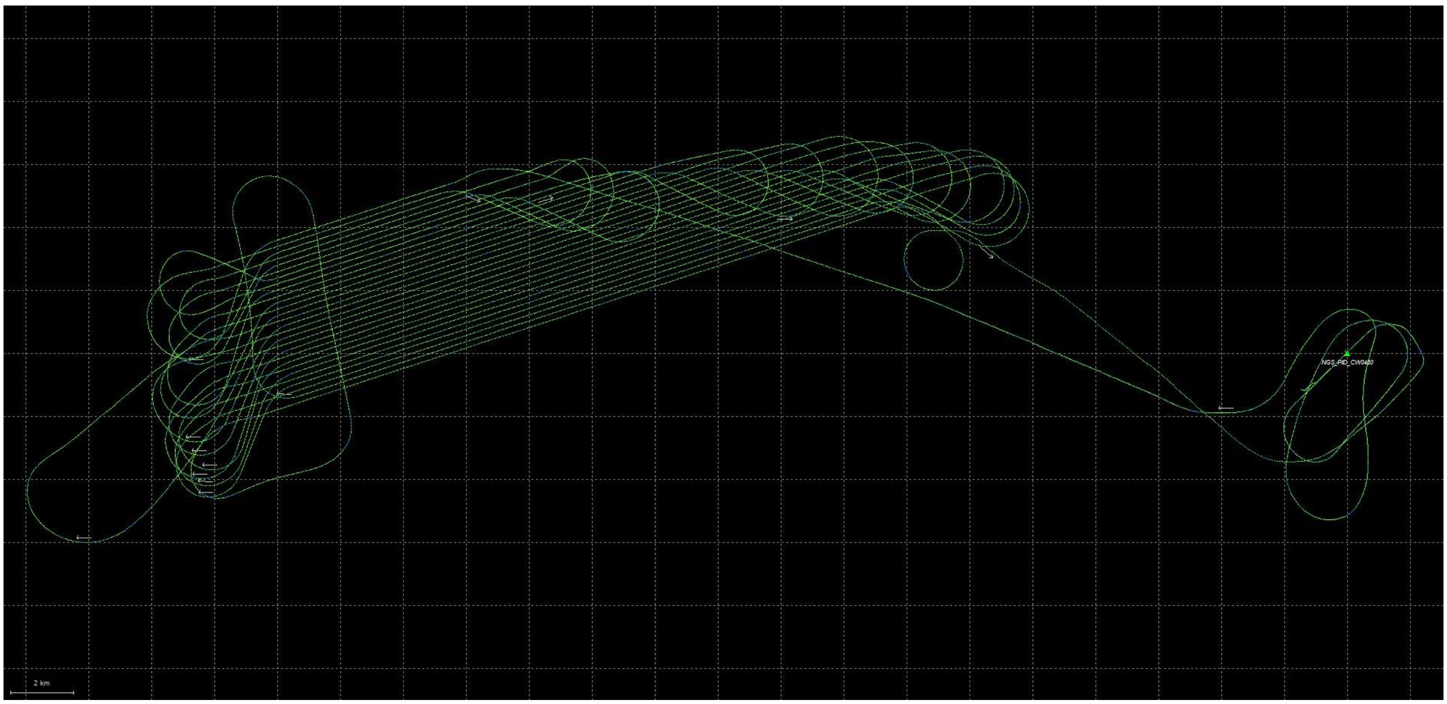
Data Processing

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

Trajectory Quality

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

Figure 3.1: Trajectory, Day 22215_ PAR_A

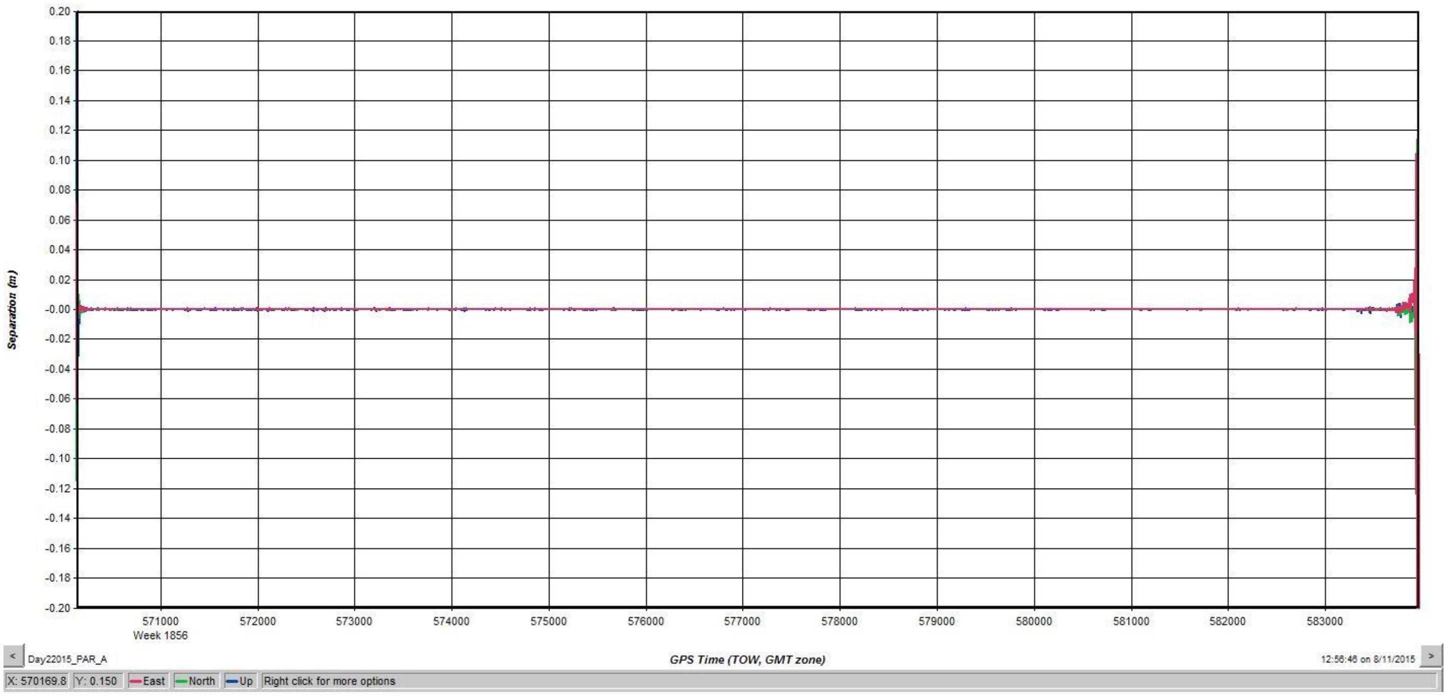


Combined Separation

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 results below this threshold are achieved.

Figure 3.2: Combined Separation, Day 22215_PAR_A

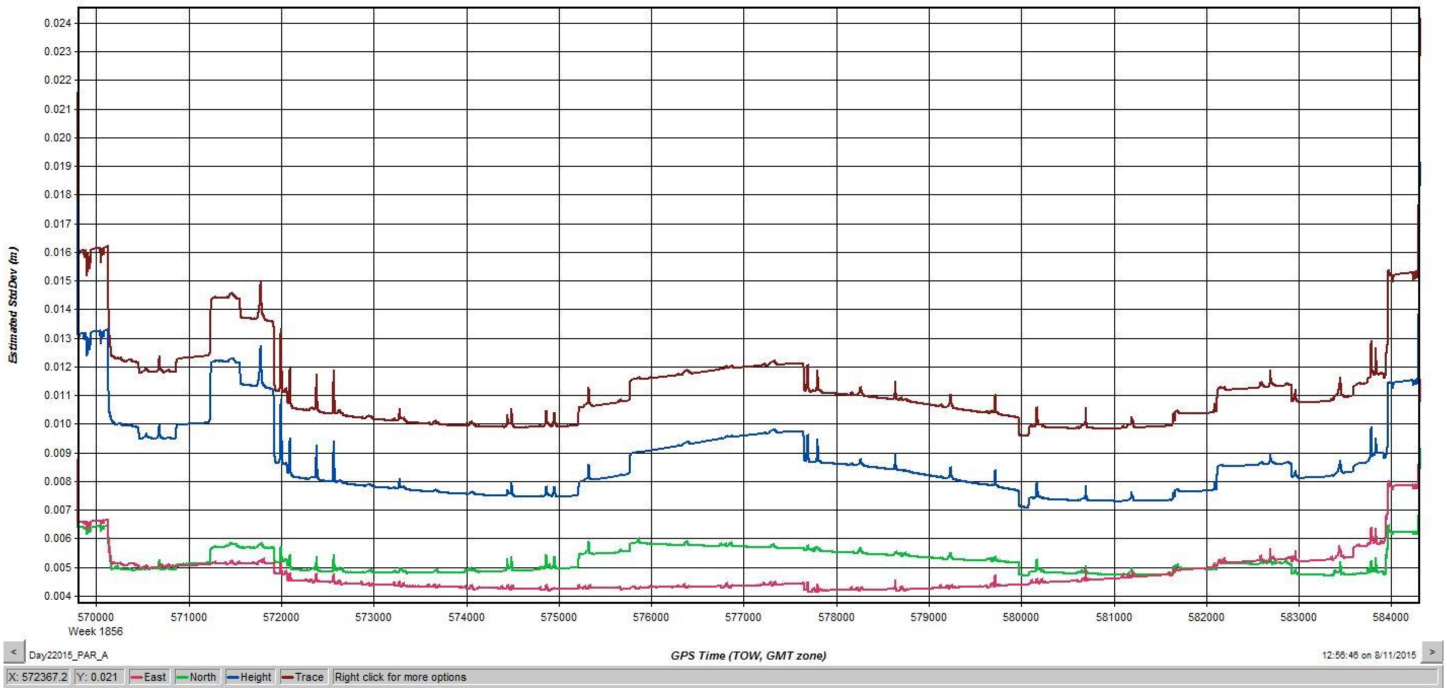


Estimated Positional Accuracy

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 3.3: Estimated Positional Accuracy, Day 22215_PAR_A

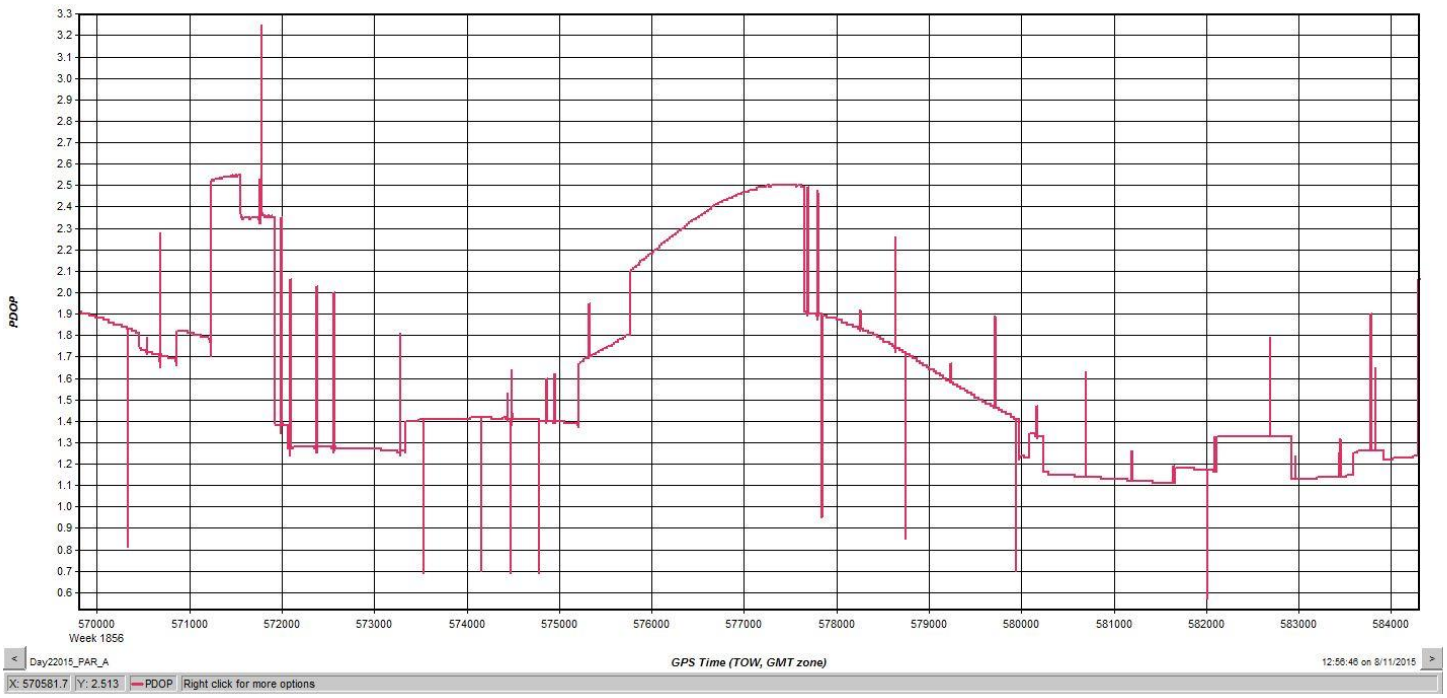


PDOP

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 3.4: PDOP, Day 22215_PAR_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), Low Vegetation (Class 3), Medium Vegetation (Class 4), High Vegetation (Class 5), Low Noise (Class 7), Bridges (Class 17), and High Noise (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 UTM13N 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.
- Relative accuracy also known as "between swath" accuracy was tested through a series of well distributed flight line overlap locations. The relative accuracy for this site tested at 0.055 meters RMSDz.

Section 4: ACCURACY ASSESSMENT

Accuracy Assessment

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

Table 4.1: Overall Vertical Accuracy Statistics,		
Average error	0.029	Meter
Minimum error	-0.020	Meter
Maximum error	+0.122	Meter
Average magnitude	0.035	Meter
Root mean square	0.046	Meter
Standard deviation	0.037	Meter

Table 4.2: Raw Swath Quality Check Point Analysis NVA

Point ID	Easting (UTM Meter)	Northing (UTM Meter)	TIN Elevation (Meter)	Dz (Meter)
2001	392098.293	3636630.035	1239.958	0.014
2002	392084.420	3634857.349	1241.994	0.081
2003	392128.703	3637845.771	1232.215	0.037
2004	375778.041	3638909.191	1192.650	0.029
2005	377662.767	3638856.083	1202.852	-0.015
2005A	377662.551	3638862.414	1202.666	0.000
2006	382198.270	3639378.296	1211.717	-0.008
2007	384194.163	3639448.643	1211.937	0.006
2008	385954.682	3639379.215	1212.761	0.052
2010	391561.825	3639186.136	1232.365	0.009
2011	391750.697	3638758.301	1230.726	0.068
2012	391661.213	3638291.727	1232.195	0.049
2013	391830.351	3638100.353	1232.735	0.011
2014	391830.084	3637983.542	1231.370	0.021
2015	391133.793	3637983.842	1234.920	-0.017
2016	391088.223	3638245.684	1230.941	-0.004
2017	379367.585	3638396.787	1205.433	0.077
2018	379859.727	3637743.906	1205.729	0.008
2019	387883.185	3638298.943	1219.297	0.025
2020	391597.159	3637419.446	1235.748	-0.020
2021	381877.160	3631442.343	1209.046	0.093
2022	384841.649	3639404.766	1211.826	0.027
2023	385124.362	3639288.898	1211.862	0.050

2024	386704.201	3639437.065	1215.084	0.044
2024A	386699.895	3639447.135	1215.902	0.122
2025	391744.583	3639103.068	1232.666	-0.013

VERTICAL ACCURACY CONCLUSIONS

Raw LAS Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.09 meters non-vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the TIN using all points.

LAS Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.072 meters non-vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the TIN using ground points

NVA/VVA ASSESMENT

Table 4.3: Non-Vegetated Vertical Accuracy Quality Check Point Analysis NVA

Point ID	Easting (UTM Meter)	Northing (UTM Meter)	DEM Elevation (Meter)	Dz (Meter)
2001	392098.293	3636630.035	1239.952	0.008
2002	392084.420	3634857.349	1241.903	-0.010
2003	392128.703	3637845.771	1232.189	0.011
2004	375778.041	3638909.191	1192.645	0.024
2005	377662.767	3638856.083	1202.828	-0.039
2005A	377662.551	3638862.414	1202.651	-0.015
2006	382198.270	3639378.296	1211.722	-0.003
2007	384194.163	3639448.643	1211.934	0.003
2008	385954.682	3639379.215	1212.670	-0.039
2010	391561.825	3639186.136	1232.312	-0.044
2011	391750.697	3638758.301	1230.660	0.002
2012	391661.213	3638291.727	1232.168	0.022
2013	391830.351	3638100.353	1232.666	-0.058
2014	391830.084	3637983.542	1231.334	-0.015
2015	391133.793	3637983.842	1234.914	-0.023
2016	391088.223	3638245.684	1230.942	-0.003
2017	379367.585	3638396.787	1205.427	0.071
2018	379859.727	3637743.906	1205.706	-0.015
2019	387883.185	3638298.943	1219.252	-0.020
2020	391597.159	3637419.446	1235.710	-0.058
2021	381877.160	3631442.343	1209.075	0.122
2022	384841.649	3639404.766	1211.794	-0.005
2023	385124.362	3639288.898	1211.806	-0.006
2024	386704.201	3639437.065	1215.056	0.016
2024A	386699.895	3639447.135	1215.777	-0.003

2025	391744.583	3639103.068	1232.663	-0.016

VERTICAL ACCURACY CONCLUSIONS

Bare-Earth DEM Non-Vegetated Vertical Accuracy (NVA) Tested 0.072 meters non-vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM

Table 4.4: Vegetated Vertical Accuracy Quality Check Point Analysis VVA

Point ID	Easting (UTM Meter)	Northing (UTM Meter)	DEM Elevation (Meter)	Dz (Meter)
3001	391520.040	3639155.697	1231.498	-0.062
3002	392053.449	3637777.363	1231.710	0.067
3003	392131.112	3637453.052	1233.989	-0.008
3004	379670.342	3637736.653	1205.701	0.020
3005	392089.324	3634872.998	1242.009	0.037
3006	391121.175	3637995.697	1234.013	0.000
3007	387730.061	3638374.798	1219.046	-0.006
3008	385584.716	3639397.632	1212.404	-0.078

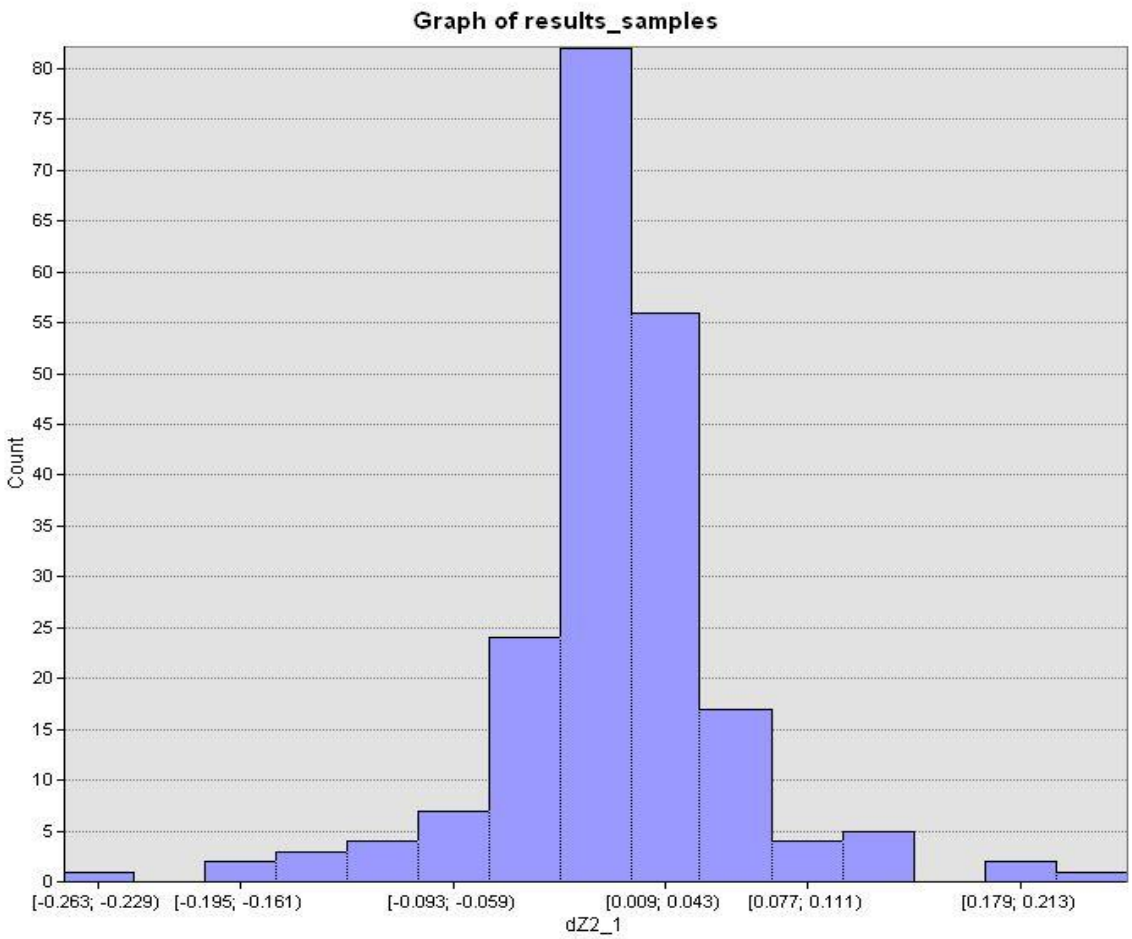
VERTICAL ACCURACY CONCLUSIONS

Vegetated Vertical Accuracy (VVA) Tested 0.074 meters vegetated vertical accuracy at the 95th percentile in the vegetated vertical accuracy class reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM. Vegetated Vertical Accuracy Errors at the 95th percentile include:
Point 3008, Easting 385584.716, Northing 3639397.632, Z-Error 0.078 Meters

Relative Accuracy

Relative accuracy also known as “between swath accuracy” was tested through a series of well distributed flight line overlap locations. The relative accuracy for the White Sands QL0 Lidar task order tested at 0.055 meters RMSDz.

Figure 4.1: Relative Accuracy Histogram, White Sands, NM QL0



Approved by:	Name	Signature	Date
Associate Member, Lidar Specialist Certified Photogrammetrist #1381	Qian Xiao		December 2015

Section 5: Flight Logs

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

PAR LLC – PRECISION AERIAL RECONNAISSANCE
P.O. Box 72357
Bossier City, LA 72357

LIDAR Daily Log

Field Crew			
Project #	TBA		
Project Description	Woolpert		
RCD B / DRIVE 012			
Location	Alamogordo, NM		
MISSION 1			
Lever Arm	x	y	z
GPS (m)	-0.110	0.210	-1.220

Flight Date (UTC)	Pilot	Operator	Sensor	Aircraft	SENSOR NAVIGATION FILE NAME
8/8/2015	Merriman	Parker	ALS70	N799AC	20150808_140901

GPS Information		AGC
Base 1	19822201.T02	
Base 2		Auto
Base3		
Aero 1		
IMU Information		
Start Time	14:15:58	
Stop Time	18:17:15	

Meteorological Conditions	Elevation	Temp			Pressure
Airport	4,199	23.0'c	296.15'k	29.94 inHg	101388 Pa
@ Altitude	3800AGL	27.0'c	300.15'k	29.92 inHg	101321 Pa
@ Altitude					

GPS Base Station Information	File Name	RNX File	Ant Hgt	Ant Type
Base 1	19822201.T02		2.05m	Trimble R10
Base 2				
Base 3				

Reflight	Line	Dir	Start	Stop	Total Time	FOV	Scan Rate	Pulse Rate Hz	Roll Comp	Muti Pulse (Y,N)	Altitude ellipsoid (m)	Altitude ellipsoid (ft)	Speed	Nautical Miles Flown	Void "Y"	PDOP	Operator	Conditions/Comments
	1	LDR150808_144127_	14:41:44	14:42:58	0:01:14	9.4	65.1	171500	YES	N	1554	5098					Parker	GOOD
	2	LDR150808_144614_	14:46:31	14:47:57	0:01:26	9.4	65.1	171500	YES	N	1569	5148					Parker	GOOD
	3	LDR150808_145103_	14:51:21	14:53:04	0:01:43	9.4	65.0	171500	YES	N	1551	5089					Parker	GOOD
	4	LDR150808_145528_	14:55:46	14:57:29	0:01:43	9.4	65.1	171500	YES	N	1566	5138					Parker	GOOD
	5	LDR150808_150024_	15:00:42	15:02:30	0:01:48	9.4	65.1	171500	YES	N	1539	5049					Parker	GOOD
	6	LDR150808_150515_	15:05:33	15:07:27	0:01:54	9.3	65.0	171500	YES	N	1565	5135					Parker	GOOD
	7	LDR150808_151047_	15:11:04	15:13:16	0:02:12	9.4	65.1	171500	YES	N	1538	5046					Parker	GOOD
	8	LDR150808_151603_	15:16:21	15:19:30	0:03:09	9.4	65.0	171500	YES	N	1568	5144					Parker	GOOD
	9	LDR150808_152235_	15:22:52	15:26:07	0:03:15	9.4	65.0	171500	YES	N	1544	5066					Parker	GOOD
	10	LDR150808_152911_	15:29:29	15:32:43	0:03:14	9.4	65.1	171500	YES	N	1563	5128					Parker	GOOD
	11	LDR150808_153556_	15:36:13	15:39:40	0:03:27	9.4	65.1	171500	YES	N	1537	5043					Parker	GOOD
	12	LDR150808_154240_	15:42:57	15:46:41	0:03:44	9.4	65.1	171500	YES	N	1554	5098					Parker	GOOD
	13	LDR150808_154950_	15:50:07	15:54:02	0:03:55	9.4	65.1	171500	YES	N	1524	5000					Parker	GOOD
	14	LDR150808_160011_	16:00:29	16:04:24	0:03:55	9.4	65.1	171500	YES	N	1555	5102					Parker	GOOD
	15	LDR150808_160742_	16:07:59	16:12:06	0:04:07	9.4	65.1	171500	YES	N	1521	4990					Parker	GOOD
	16	LDR150808_161519_	16:15:37	16:20:01	0:04:24	9.4	65.1	171500	YES	N	1551	5089					Parker	GOOD
	17	LDR150808_162311_	16:23:28	16:27:52	0:04:24	9.4	65.1	171500	YES	N	1516	4974					Parker	GOOD
	18	LDR150808_163049_	16:31:06	16:35:41	0:04:35	9.4	65.1	171500	YES	N	1548	5079					Parker	GOOD
	19	LDR150808_163848_	16:39:05	16:43:40	0:04:35	9.4	65.1	171500	YES	N	1510	4954					Parker	GOOD
	20	LDR150808_164649_	16:47:06	16:51:52	0:04:46	9.4	65.1	171500	YES	N	1553	5095					Parker	GOOD
	21	LDR150808_165459_	16:55:16	17:00:03	0:04:47	9.4	65.1	171500	YES	N	1508	4947					Parker	GOOD
	22	LDR150808_170249_	17:03:05	17:08:15	0:05:10	9.4	65.1	171500	YES	N	1552	5092					Parker	GOOD
	23	LDR150808_171108_	17:11:25	17:16:23	0:04:58	9.4	65.0	171500	YES	N	1512	4961					Parker	GOOD
	24	LDR150808_171915_	17:19:33	17:24:42	0:05:09	9.4	65.1	171500	YES	N	1554	5098					Parker	GOOD
	25	LDR150808_172736_	17:27:54	17:32:58	0:05:04	9.4	65.1	171500	YES	N	1502	4928					Parker	GOOD
	26	LDR150808_173544_	17:36:01	17:41:11	0:05:10	9.4	65.1	171500	YES	N	1550	5085					Parker	GOOD
	27	LDR150808_174405_	17:44:22	17:49:26	0:05:04	9.3	65.1	171500	YES	N	1500	4921					Parker	GOOD
	UL001	LDR150808_175228_	17:52:45	17:54:05	0:01:20	9.4	65.1	171500	YES	N	1548	5079					Parker	GOOD
	28	LDR150808_175656_	17:57:13	18:02:11	0:04:58	9.4	65.1	171500	YES	N	1552	5092					Parker	GOOD

LIDAR FLIGHT SUMMARY			
		Hobbs Start	2456.1
Aircraft IMU Time	4:01:17	Hobbs Stop	2459.8
Sensor Collection Time	1:45:10	Hobbs Total	3.7
Line Miles Flown	0.0	Mission Hobbs	#DIV/0!
Average Flight Lines Speed	0 kts	Reflight Hobbs	#DIV/0!
Average Nautical Line miles Per Mission Hour			#DIV/0!

DATA COLLECTION			
Total Lines	0	Project % Complete	#DIV/0!
# Reflight Lines	0	Total Flight Lines	0
Reflight Percent	#DIV/0!	Line Complete	0
Sensor Re-Flight Miles	0.0	Mission Lines	0
Average Nautical Line Miles Per Re-Flight Hour	#DIV/0!		

Comments

Cloud Cover	
Clear	X
Fair	
Partly Cloudy	
Cloudy	

Special Case Aircraft Mobilization			
Mission Onsite Hobbs Start	0.0	Special Case Mission Hobb	#DIV/0!
Mission Hobbs Stop:	0.0	Special Case Reflight Hob	#DIV/0!
Special Case Mission Hobbs TOTAL:	0.0	Special Case Mob Hobbs	FALSE

ine miles Per Mission Hour #DIV/0!

LIDAR Daily Log

XPAR LLC — PRECISION AERIAL RECONNAISSANCE
P.O. Box 72357
Bossier City, LA 72357

Field Crew			
Project #	TBA		
Project Description	Woolpert		
RCD B / DRIVE 012			
Location	Alamogordo, NM		
MISSION 2			

Flight Date (UTC)	Pilot	Operator	Sensor	Aircraft	SENSOR NAVIGATION FILE NAME
8/8/2015	Merriman	Parker	ALS70	N799AC	20150808_183926

Lever Arm	x	y	z
GPS (m)	-0.110	0.210	-1.220

GPS Information		AGC
Base 1	19822201.T02	Auto
Base 2		
Base3		
Aero 1		
IMU Information		
Start Time	18:43:47	
Stop Time	22:32:15	

Meteorological Conditions	Elevation	Temp			Pressure
Airport	4,199	23.0'c	296.15'k	29.94 inHg	101388 Pa
@ Altitude	3800AGL	27.0'c	300.15'k	29.92 inHg	101321 Pa
@ Altitude					

GPS Base Station Information	File Name	RNX File	Ant Hgt	Ant Type
Base 1	19822201.T02		2.05m	Trimble R10
Base 2				
Base 3				

Reflight	Line	Dir	Start	Stop	Total Time	FOV	Scan Rate	Pulse Rate Hz	Roll Comp	Muti Pulse (Y,N)	Altitude ellipsoid (m)	Altitude ellipsoid (ft)	Speed	Nautical Miles Flown	Void "Y"	PDOP	Operator	Conditions/Comments
	29	LDR150808_190218_	19:02:34	19:07:55	0:05:21	9.4	65.1	171500	YES	N	1532	5026					Parker	DO NOT USE, Turbulent, Reflew in Mission 3
	30	LDR150808_191040_	19:10:57	19:15:55	0:04:58	9.4	65.1	171500	YES	N	1548	5079					Parker	DO NOT USE, Turbulent, Reflew in Mission 3
	31	LDR150808_191853_	19:19:10	19:24:20	0:05:10	9.4	65.1	171500	YES	N	1523	4997					Parker	GOOD
	32	LDR150808_192714_	19:27:30	19:32:34	0:05:04	9.4	65.1	171500	YES	N	1546	5072					Parker	GOOD
	33	LDR150808_193521_	19:35:37	19:40:53	0:05:16	9.3	65.1	171500	YES	N	1499	4918					Parker	GOOD
	34	LDR150808_194345_	19:44:01	19:48:59	0:04:58	9.4	65.1	171500	YES	N	1549	5082					Parker	GOOD
	35	LDR150808_195218_	19:52:35	19:57:39	0:05:04	9.4	65.1	171500	YES	N	1495	4905					Parker	GOOD
	36	LDR150808_200033_	20:00:49	20:05:47	0:04:58	9.4	65.1	171500	YES	N	1567	5141					Parker	GOOD
	37	LDR150808_200848_	20:09:04	20:14:14	0:05:10	9.4	65.1	171500	YES	N	1506	4941					Parker	GOOD
	38	LDR150808_201710_	20:17:27	20:22:19	0:04:52	9.4	65.1	171500	YES	N	1566	5138					Parker	GOOD
	39	LDR150808_202457_	20:25:13	20:30:23	0:05:10	9.3	65.0	171500	YES	N	1496	4908					Parker	GOOD
	40	LDR150808_203308_	20:33:24	20:38:17	0:04:53	9.4	65.0	171500	YES	N	1561	5121					Parker	GOOD
	41	LDR150808_204108_	20:41:25	20:46:34	0:05:09	9.4	65.0	171500	YES	N	1505	4938					Parker	GOOD
	42	LDR150808_204922_	20:49:39	20:54:31	0:04:52	9.4	65.1	171500	YES	N	1537	5043					Parker	GOOD
	43	LDR150808_205704_	20:57:20	21:02:29	0:05:09	9.4	65.1	171500	YES	N	1501	4925					Parker	GOOD
	44	LDR150808_210519_	21:05:35	21:10:28	0:04:53	9.4	65.1	171500	YES	N	1540	5052					Parker	GOOD
	45	LDR150808_211307_	21:13:23	21:18:39	0:05:16	9.3	65.1	171500	YES	N	1523	4997					Parker	GOOD
	46	LDR150808_212137_	21:21:53	21:26:57	0:05:04	9.4	65.1	171500	YES	N	1562	5125					Parker	GOOD
	47	LDR150808_212922_	21:29:38	21:34:42	0:05:04	9.4	65.1	171500	YES	N	1509	4951					Parker	GOOD
	48	LDR150808_213729_	21:37:45	21:42:43	0:04:58	9.4	65.1	171500	YES	N	1539	5049					Parker	GOOD
	49	LDR150808_214506_	21:45:23	21:50:32	0:05:09	9.4	65.1	171500	YES	N	1528	5013					Parker	GOOD
	50	LDR150808_215309_	21:53:26	21:58:18	0:04:52	9.4	65.1	171500	YES	N	1542	5059					Parker	GOOD
	51	LDR150808_220042_	22:00:57	22:06:01	0:05:04	9.4	65.1	171500	YES	N	1507	4944					Parker	GOOD
	UL001	LDR150808_220743_	22:07:59	22:10:40	0:02:41	9.3	65.1	171500	YES	N	1543	5062					Parker	GOOD

LIDAR FLIGHT SUMMARY

		Hobbs Start	2456.1
Aircraft IMU Time	3:48:28	Hobbs Stop	2459.8
Sensor Collection Time	1:59:05	Hobbs Total	3.7
Line Miles Flown	0.0	Mission Hobbs	#DIV/0!
Average Flight Lines Speed	0 kts	Reflight Hobbs	#DIV/0!
Average Nautical Line miles Per Mission Hour			#DIV/0!

DATA COLLECTION

Total Lines	0	Project % Complete	#DIV/0!
# Reflight Lines	0	Total Flight Lines	0
Reflight Percent	#DIV/0!	Line Complete	0
Sensor Re-Flight Miles	0.0	Mission Lines	0
Average Nautical Line Miles Per Re-Flight Hour	#DIV/0!		

Comments

Cloud Cover

Clear	X
Fair	
Partly Cloudy	
Cloudy	

Special Case Aircraft Mobilization

Mission Onsite Hobbs Start	0.0	Special Case Mission Hobb	#DIV/0!
Mission Hobbs Stop:	0.0	Special Case Reflight Hobb	#DIV/0!
Special Case Mission Hobbs TOTAL:	0.0	Special Case Mob Hobbs	FALSE

ine miles Per Mission Hour #DIV/0!

XPAR LLC
PRECISION AERIAL RECONNAISSANCE
P.O. Box 72357
Bossier City, LA 72357

LIDAR Daily Log

Field Crew	
Project #	TBA
Project Description	Woolpert
RCD B	
DRIVE 012	
Location	Alamogordo, NM
MISSION 3	

Lever Arm	x	y	z
GPS (m)	-0.110	0.210	-1.220

GPS Information		AGC
Base 1	19822212.T02	
Base 2		Auto
Base3		
Aero 1		

IMU Information	
Start Time	16:38:22
Stop Time	17:37:45

Meteorological Conditions	Elevation	Temp			Pressure
Airport	4,199	23.0'c	296.15k	29.94 inHg	101388 Pa
@ Altitude	3800AGL	27.0'c	300.15k	29.92 inHg	101321 Pa
@ Altitude					

GPS Base Station Information	File Name	RNX File	Ant Hgt	Ant Type
Base 1	19822212.T02		2.05m	Trimble R10
Base 2				
Base 3				

Flight Date (UTC)	Pilot	Operator	Sensor	Aircraft	SENSOR NAVIGATION FILE NAME
8/9/2015	Merriman	Parker	ALS70	N799AC	20150809_163446

Reflight	Line	Dir	Start	Stop	Total Time	FOV	Scan Rate	Pulse Rate Hz	Roll Comp	Muti Pulse (Y,N)	Altitude ellipsoid (m)	Altitude ellipsoid (ft)	Speed	Nautical Miles Flown	Void "Y"	PDOP	Operator	Conditions/Comments
	29	LDR150809_170150_	17:02:06	17:07:10	0:05:04	9.4	65.1	171500	YES	N	1504	4934					Parker	GOOD, This is the Refly line to replace in Mission 2
	30	LDR150809_171029_	17:10:47	17:15:45	0:04:58	9.4	65.0	171500	YES	N	1548	5079					Parker	GOOD, This is the Refly line to replace in Mission 2
	UL001	LDR150809_172100_	17:21:18	17:21:46	0:00:28	9.4	65.1	171500	YES	N	1507	4944					Parker	GOOD

LIDAR FLIGHT SUMMARY

		Hobbs Start	2460.2
Aircraft IMU Time	0:59:23	Hobbs Stop	2461.3
Sensor Collection Time	0:10:30	Hobbs Total	1.1
Line Miles Flown	0.0	Mission Hobbs	#DIV/0!
Average Flight Lines Speed	0 kts	Reflight Hobbs	#DIV/0!
Average Nautical Line miles Per Mission Hour			#DIV/0!

DATA COLLECTION

Total Lines	0	Project % Complete	#DIV/0!
# Reflight Lines	0	Total Flight Lines	0
Reflight Percent	#DIV/0!	Line Complete	0
Sensor Re-Flight Miles	0.0	Mission Lines	0
Average Nautical Line Miles Per Re-Flight Hour	#DIV/0!		

Comments

Cloud Cover

Clear	X
Fair	
Partly Cloudy	
Cloudy	

Special Case Aircraft Mobilization

Mission Onsite Hobbs Start	0.0	Special Case Mission Hobb	#DIV/0!
Mission Hobbs Stop:	0.0	Special Case Reflight Hobb	#DIV/0!
Special Case Mission Hobbs TOTAL:	0.0	Special Case Mob Hobbs	FALSE

ine miles Per Mission Hour #DIV/0!

Section 6: Final Deliverables

The final lidar deliverables are listed below.

- LAS v1.4 classified point cloud
- LAS v1.4 raw unclassified point cloud flight line
- Bare Earth Surface Raster DEM
- First Return DSM IMG Format
- 8-bit gray scale intensity Tiff images
- Tile layout USNG and data extent provided as ESRI shapefile
- FGDC compliant metadata per product in XML format
- Lidar processing report in pdf format
- Survey report in .pdf format