AIRBORNE LIDAR TASK ORDER REPORT

NRCS LAUDERDALE MS 0.7M NPS LIDAR
UNITED STATES GEOLOGICAL SURVEY (USGS)

CONTRACT NUMBER: G10PC00057

TASK ORDER NUMBER: G12PD000125

Woolpert Project Number: 73054
October 2013

AIRBORNE LIDAR TASK ORDER REPORT

NRCS LAUDERDALE MS 0.7M LIDAR

USGS CONTRACT: G10PC00057

TASK ORDER NUMBER: G12PD000125

For:

United States Geological Survey
(USGS)
National Geospatial Technical Operations Center
(NGTOC)
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SECTION 1: OVERVIEW

TASK ORDER NAME: NRCS LAUDERDALE MS 0.7M NPS LIDAR

WOOLPERT PROJECT #73054

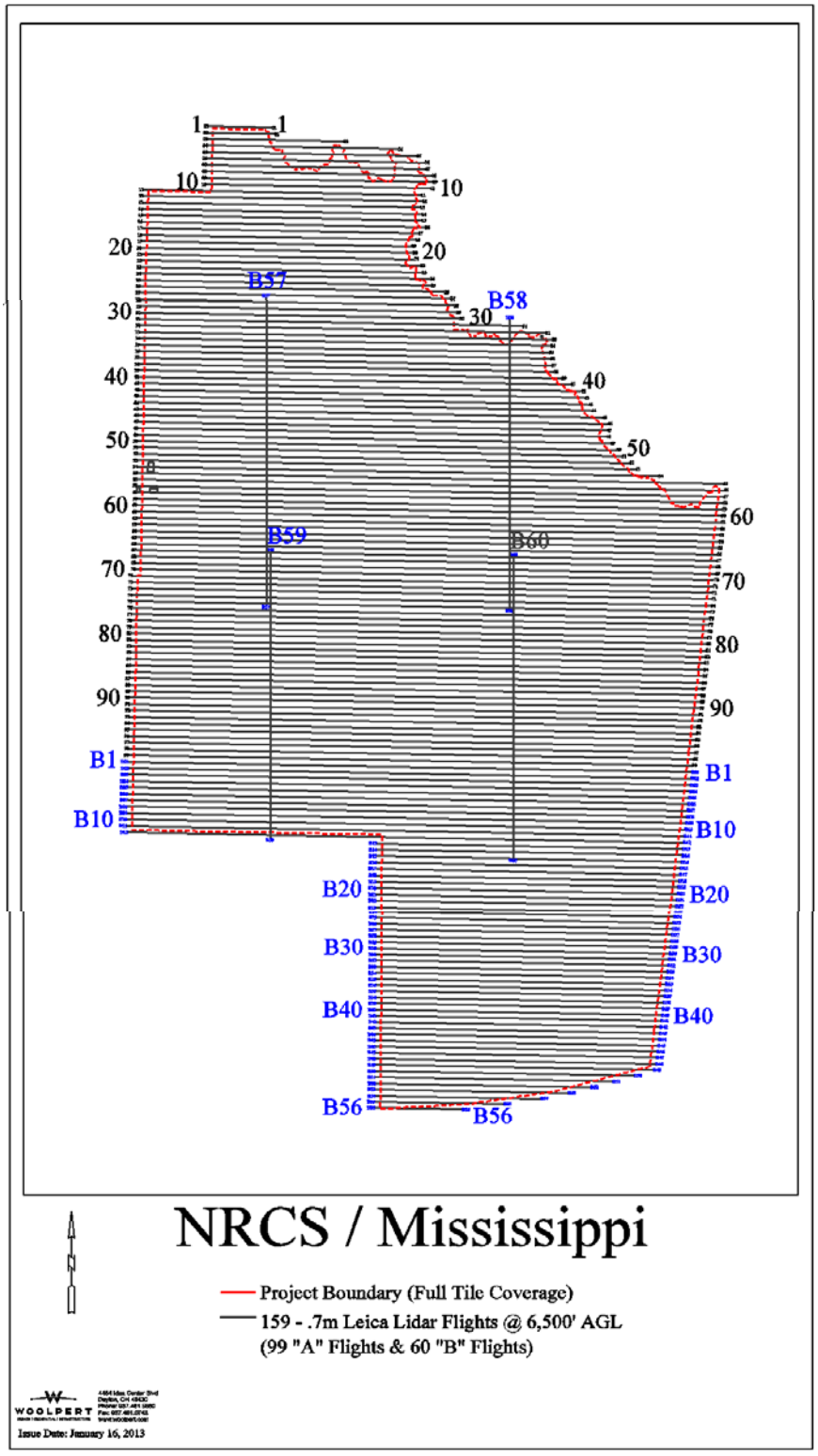
This report contains a comprehensive outline of the airborne LiDAR data acquisition consisting of approximately 3,518 square miles of southeastern Mississippi; Contract Number G10PC00057; Task Order Number G12PD000125, for the United States Geological Survey (USGS). The LiDAR was collected and processed to meet a maximum Nominal Pulse Spacing (NPS) of 0.7 meters. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.

The data was acquired using a Leica ALS70 Multiple Pulses in Air (MPiA) LiDAR sensor. The Leica ALS70 sensor collects up to four returns (echo) per pulse, recording attributes such as time stamp and 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:

Nominal Pulse Spacing (NPS):	2.3 ft / 0.7 m
AGL (Above Ground Level) average flying height:	6,500 ft / 1,981 m
MSL (Mean Sea Level) average flying height:	6,650 ft / 2,027 m
Average Ground Speed:	150 knots / 173 mph
Field of View (full):	40 degrees
Pulse Rate:	272.0 kHz
Scan Rate:	42.3 Hz
Side Lap (Minimum):	25%

The LiDAR data was processed and projected in UTM 16N, North American Datum of 1983 (NAD83) in units of meters. The vertical datum used for the task order was referenced to NAVD 1988, meters, GEOID12A.

Figure 1.1: Task Order and LiDAR Flight Layout Lauderdale, MS



SECTION 2: ACQUISITION

The LiDAR data was acquired with a Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) LiDAR sensor system, on board a Cessna 404. 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.

Flight navigation is performed using IGI CCNS (Computer Controlled Navigation System). The pilots are thoroughly trained and 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 heading cannot be properly maintained, the mission is aborted until suitable conditions occur.

Woolpert's aerial acquisition team coordinated with the necessary Air Traffic Control and restricted airspace personnel prior to flying to ensure access.

All of the aircraft are configured with a NovAtel Millennium 12-channel, L1/L2 dual frequency GNSS receivers collecting at 2 Hz.

All of Woolpert's aerial cameras and sensors are equipped with Litton LN200 series IMU's operating at 200 Hz.

A base-station unit was mobilized for each acquisition mission, and was operated by a member of the Woolpert survey and/or flight crew. Each base-station setup consisted of one (1) Trimble 5000 series dual frequency receiver, one (1) Trimble Zephyr Geodetic L1/L2 dual frequency antenna, one (1) 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. All GNSS base station data and point locations were tied together, along with the ground control.

The Leica ALS-70 LiDAR System has the following specifications:

Table 2.1: ALS70 LiDAR System 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

Table 2.1: ALS70 LiDAR System Specifications	
Specification	
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

Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at Key Field Airport (KMEI) to provide airborne GPS support with coordinates 32° 20' 08.32445 (N), -88° 44' 36.30934'' (W), Ellipsoid Height 60.741 meters on days 03213, 03313, 03413, 03713 and 04013.

Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at Philadelphia Municipal Airport (KMPE) to provide airborne GPS support with coordinates 32°48' 02.50211" (N), -89° 07' 30.58053" (W), Ellipsoid Height 107.179 meters on days 04513, 04613, 04713, 04713 and 04813.

Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at MSDC CORS to provide airborne GPS support with coordinates 32° 26' 22.97139'' (N), -89° 06' 44.44326" (W), Ellipsoid Height 120.977 meters on day 04913.

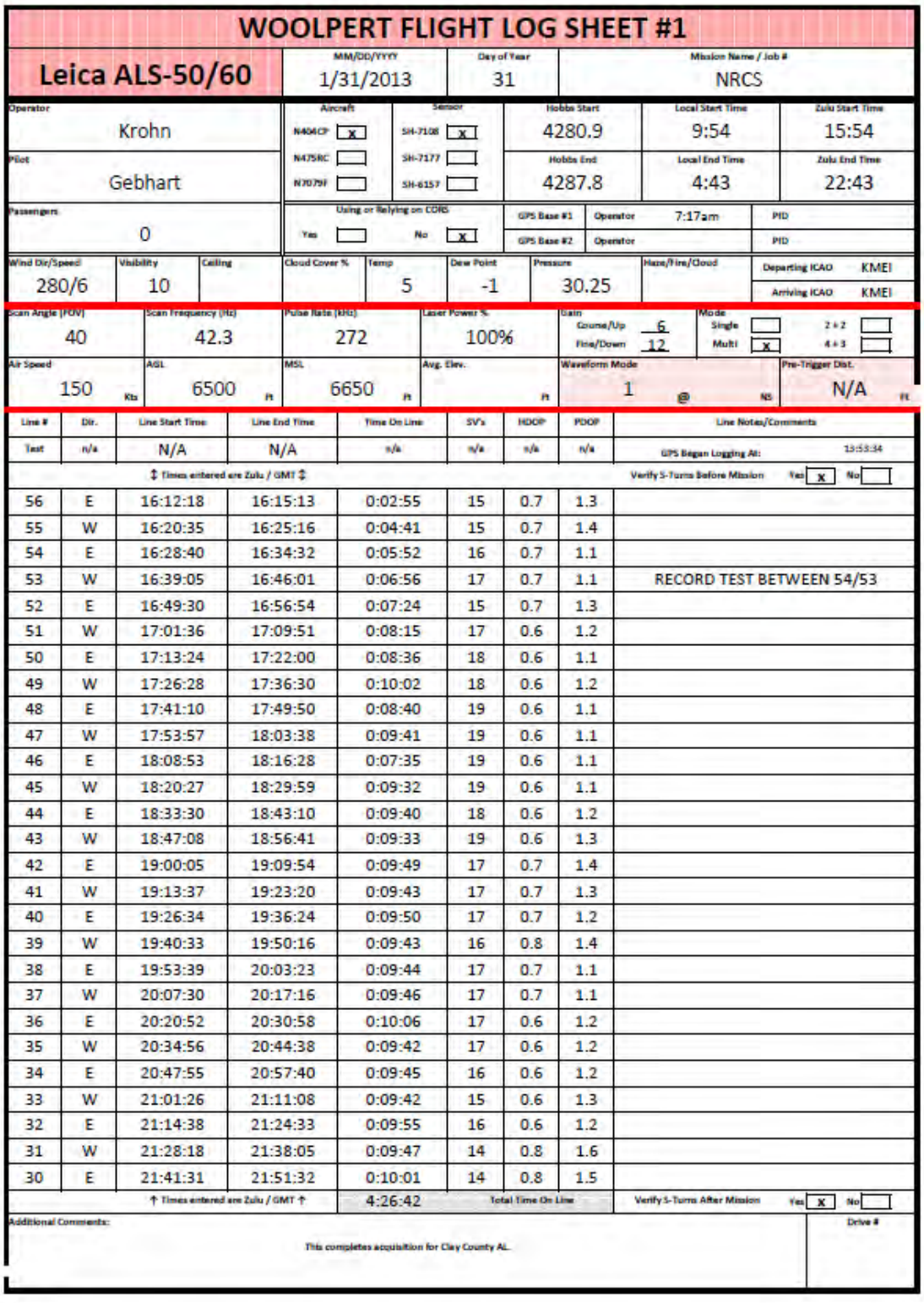
Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at MSME CORS to provide airborne GPS support with coordinates 32° 22' 03.02211'' (N), -88° 43' 56.77908" (W), Ellipsoid Height 103.297 meters on days 03113 and 05813.

The LiDAR data was collected in fourteen (14) missions.

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.

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
Jan 31, 2013 – SH7108	30-56	15:54 -22:43	09:54 AM – 04:43 PM
Feb 1, 2013 – SH7108	6-26	16:08 – 22:35	10:08 AM – 04:35 PM
Feb 2, 2013 – SH7108	1-5, 97-99	16:34 – 19:59	10:34 AM – 01:59 PM
Feb 3, 2013 – SH7108	83-96	16:06 – 22:06	10:06 AM – 04:06 PM
Feb 6, 2013 – SH7108	5-7, 79-82	18:44 – 22:39	12:44 PM – 04:39 PM
Feb 9, 2013 – SH7108	62-82, 97, B59, B60	14:42 – 23:06	08:42 AM – 05:06 PM
Feb 14, 2013 – SH7108	1-10	15:48 - 17:07	09:48 AM – 11:07 AM
Feb 15, 2013 – SH7108	7-36	14:31 – 20:20	08:31 AM – 02:20 PM
Feb 16, 2013A – SH7108	57-61	14:29 – 16:19	08:29 AM – 10:19 AM
Feb 16, 2013B – SH7108	52-58	21:44 – 23:55	03:44 PM – 05:55 PM
Feb 17, 2013 - SH7108	8, 28-52	17:44 - -23:59	11:44 AM – 05:59 PM
Feb 18, 2013 – SH7108	B57, B58	15:51 – 16:21	09:51 AM – 10:21 AM
Feb 27, 2013 – SH7108	56,57	23:53 – 01:34	05:06 PM – 07:34 PM
Mar 3, 2013 – SH7108	56, 57	18:12 – 18:56	12:12 PM – 12:56 PM

Figure 2.1: ALS Log Sheet for Day031, January 31, 2013



WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-50/60	MM/DD/YYYY: 1/31/2013	Day of Year: 31	Mission Name / Job #: NRCS

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Krohn	N404CP [X]	SH-7108 [X]	4280.9	9:54	15:54
Pilot	N475RC [ ]	SH-7177 [ ]	Hobbs End	Local End Time	Zulu End Time
Gebhart	N7079F [ ]	SH-6157 [ ]	4287.8	4:43	22:43

Passengers	Using or Relying on CORS	GPS Base #1	Operator	7:17am	PID
0	Yes [ ] No [X]	GPS Base #2	Operator		PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KMEI
280/6	10			5	-1	30.25		Arriving ICAO	KMEI

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	42.3	272	100%	Course/Up 6	Single [ ]	2 + 2 [ ]
				Fine/Down 12	Multi [X]	4 + 3 [ ]

Air Speed	AGL	MSL	Avg. Elev.	Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6650 Ft	Ft	1 @ NS	N/A Ft

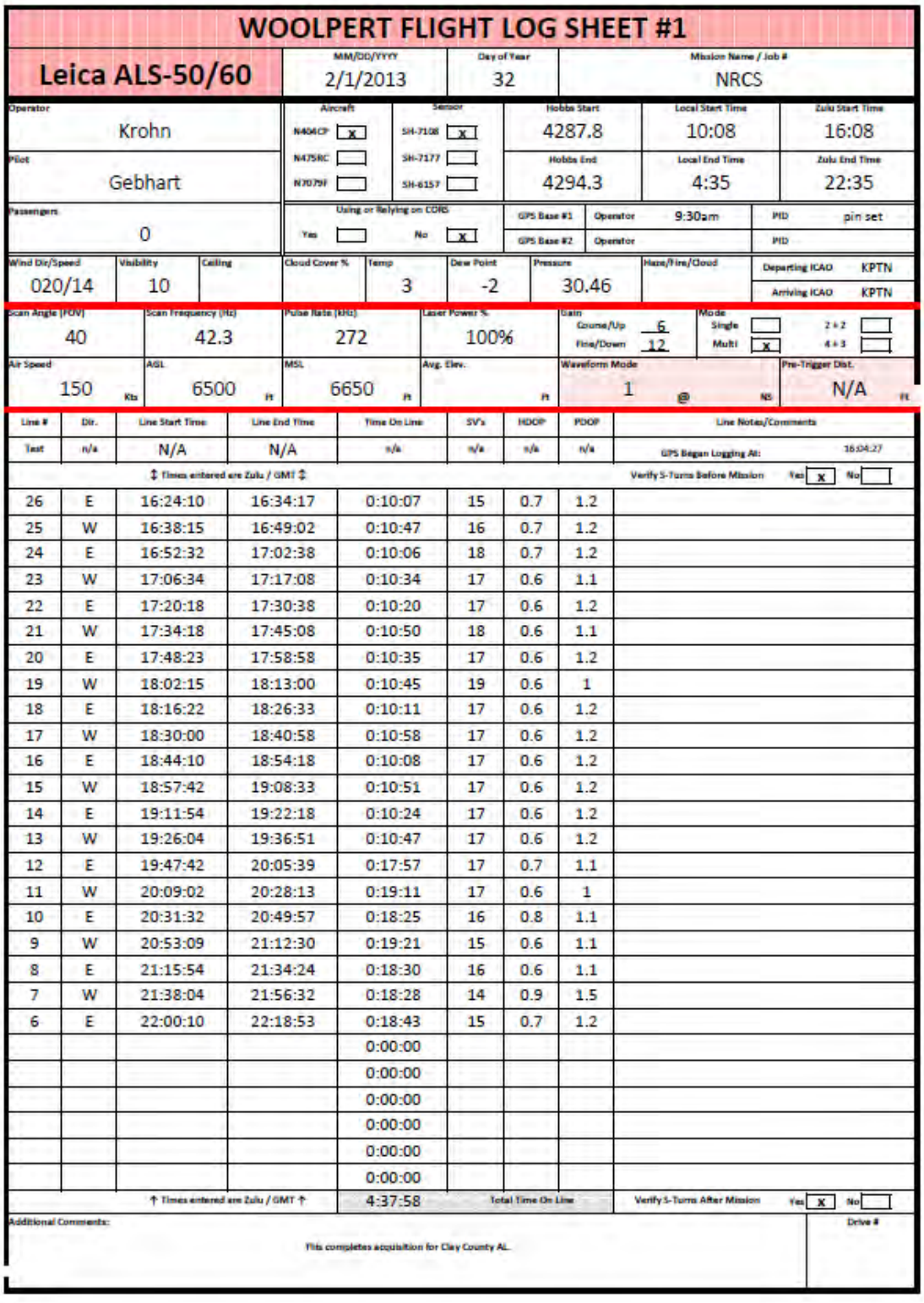
Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	N/A	N/A	n/a	n/a	n/a	n/a	GPS Began Logging At: 13:53:34
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes [X] No [ ]
56	E	16:12:18	16:15:13	0:02:55	15	0.7	1.3	
55	W	16:20:35	16:25:16	0:04:41	15	0.7	1.4	
54	E	16:28:40	16:34:32	0:05:52	16	0.7	1.1	
53	W	16:39:05	16:46:01	0:06:56	17	0.7	1.1	RECORD TEST BETWEEN 54/53
52	E	16:49:30	16:56:54	0:07:24	15	0.7	1.3	
51	W	17:01:36	17:09:51	0:08:15	17	0.6	1.2	
50	E	17:13:24	17:22:00	0:08:36	18	0.6	1.1	
49	W	17:26:28	17:36:30	0:10:02	18	0.6	1.2	
48	E	17:41:10	17:49:50	0:08:40	19	0.6	1.1	
47	W	17:53:57	18:03:38	0:09:41	19	0.6	1.1	
46	E	18:08:53	18:16:28	0:07:35	19	0.6	1.1	
45	W	18:20:27	18:29:59	0:09:32	19	0.6	1.1	
44	E	18:33:30	18:43:10	0:09:40	18	0.6	1.2	
43	W	18:47:08	18:56:41	0:09:33	19	0.6	1.3	
42	E	19:00:05	19:09:54	0:09:49	17	0.7	1.4	
41	W	19:13:37	19:23:20	0:09:43	17	0.7	1.3	
40	E	19:26:34	19:36:24	0:09:50	17	0.7	1.2	
39	W	19:40:33	19:50:16	0:09:43	16	0.8	1.4	
38	E	19:53:39	20:03:23	0:09:44	17	0.7	1.1	
37	W	20:07:30	20:17:16	0:09:46	17	0.7	1.1	
36	E	20:20:52	20:30:58	0:10:06	17	0.6	1.2	
35	W	20:34:56	20:44:38	0:09:42	17	0.6	1.2	
34	E	20:47:55	20:57:40	0:09:45	16	0.6	1.2	
33	W	21:01:26	21:11:08	0:09:42	15	0.6	1.3	
32	E	21:14:38	21:24:33	0:09:55	16	0.6	1.2	
31	W	21:28:18	21:38:05	0:09:47	14	0.8	1.6	
30	E	21:41:31	21:51:32	0:10:01	14	0.8	1.5	
		↑ Times entered are Zulu / GMT ↑		4:26:42	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments:

This completes acquisition for Clay County AL.

Drive #

Figure 2.2: ALS Log Sheet for Day032, February 1, 2013



WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-50/60	MM/DD/YYYY	Day of Year	Mission Name / Job #
	2/1/2013	32	NRCS

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Krohn	N404CP [x]	SN-7108 [x]	4287.8	10:08	16:08
Pilot	N475RC [ ]	SN-7177 [ ]	Hobbs End	Local End Time	Zulu End Time
Gebhart	N7079F [ ]	SN-6157 [ ]	4294.3	4:35	22:35

Passengers	Using or Relying on CORS	GPS Base #1	Operator	PID
0	Yes [ ] No [x]	GPS Base #1	9:30am	pin set
		GPS Base #2	Operator	PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
020/14	10			3	-2	30.46		KPTN	KPTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	42.3	272	100%	Course/Up 6	Single [ ]	2 + 2 [ ]
				Fine/Down 12	Multi [x]	4 + 3 [ ]

Air Speed	AGL	MSL	Avg. Elev.	Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6650 Ft	Ft	1 @ NS	N/A Ft

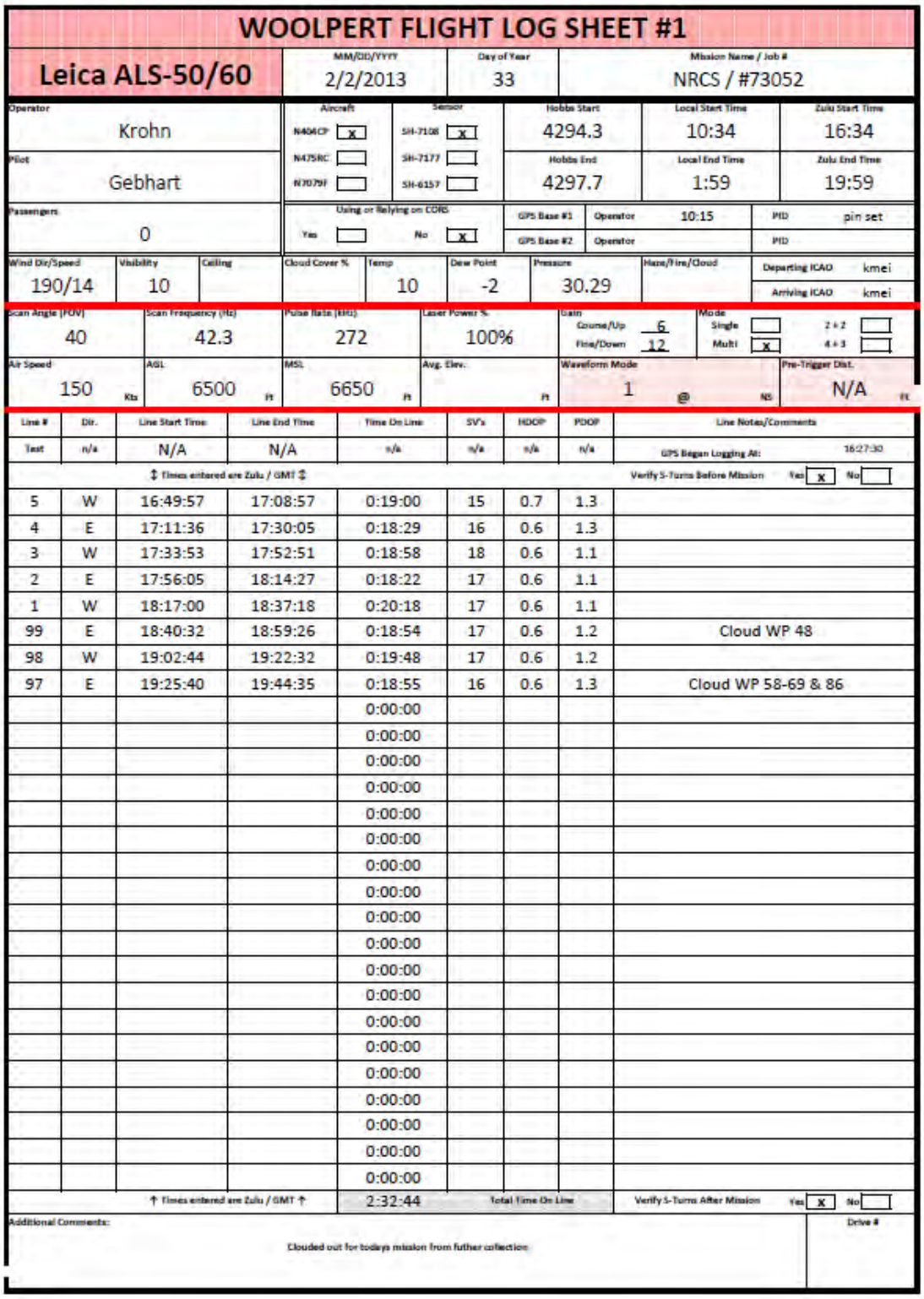
Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a	N/A	N/A	n/a	n/a	n/a	n/a	GPS Began Logging At: 16:04:27
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes [x] No [ ]
26	E	16:24:10	16:34:17	0:10:07	15	0.7	1.2	
25	W	16:38:15	16:49:02	0:10:47	16	0.7	1.2	
24	E	16:52:32	17:02:38	0:10:06	18	0.7	1.2	
23	W	17:06:34	17:17:08	0:10:34	17	0.6	1.1	
22	E	17:20:18	17:30:38	0:10:20	17	0.6	1.2	
21	W	17:34:18	17:45:08	0:10:50	18	0.6	1.1	
20	E	17:48:23	17:58:58	0:10:35	17	0.6	1.2	
19	W	18:02:15	18:13:00	0:10:45	19	0.6	1	
18	E	18:16:22	18:26:33	0:10:11	17	0.6	1.2	
17	W	18:30:00	18:40:58	0:10:58	17	0.6	1.2	
16	E	18:44:10	18:54:18	0:10:08	17	0.6	1.2	
15	W	18:57:42	19:08:33	0:10:51	17	0.6	1.2	
14	E	19:11:54	19:22:18	0:10:24	17	0.6	1.2	
13	W	19:26:04	19:36:51	0:10:47	17	0.6	1.2	
12	E	19:47:42	20:05:39	0:17:57	17	0.7	1.1	
11	W	20:09:02	20:28:13	0:19:11	17	0.6	1	
10	E	20:31:32	20:49:57	0:18:25	16	0.8	1.1	
9	W	20:53:09	21:12:30	0:19:21	15	0.6	1.1	
8	E	21:15:54	21:34:24	0:18:30	16	0.6	1.1	
7	W	21:38:04	21:56:32	0:18:28	14	0.9	1.5	
6	E	22:00:10	22:18:53	0:18:43	15	0.7	1.2	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
		↑ Times entered are Zulu / GMT ↑		4:37:58	Total Time On Line			Verify S-Turns After Mission Yes [x] No [ ]

Additional Comments:

This completes acquisition for Clay County AL.

Drive #

Figure 2.3: ALS Log Sheet for Day033, February 2, 2013



WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-50/60

MM/DD/YYYY	Day of Year	Mission Name / Job #
2/2/2013	33	NRCS / #73052

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Krohn	N404CP [x]	SH-7108 [x]	4294.3	10:34	16:34
Pilot	N475RC [ ]	SH-7177 [ ]	Hobbs End	Local End Time	Zulu End Time
Gebhart	N707PF [ ]	SH-6157 [ ]	4297.7	1:59	19:59
Passengers	Using or Relying on CORS	GPS Base #1	Operator 10:15	PID pin set	
0	Yes [ ] No [x]	GPS Base #2	Operator	PID	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	Arriving ICAO
190/14	10			10	-2	30.29		kmei	kmei

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	42.3	272	100%	Course/Up 6 / Fine/Down 12	Single [ ] Multi [x]	2 x 2 [ ] 4 x 3 [ ]

Air Speed	AGL	MSL	Avg. Elev.	Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6650 Ft	Ft	1 @ NS	N/A 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	n/a	n/a	GPS Began Logging At: 16:27:30
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes [x] No [ ]
5	W	16:49:57	17:08:57	0:19:00	15	0.7	1.3	
4	E	17:11:36	17:30:05	0:18:29	16	0.6	1.3	
3	W	17:33:53	17:52:51	0:18:58	18	0.6	1.1	
2	E	17:56:05	18:14:27	0:18:22	17	0.6	1.1	
1	W	18:17:00	18:37:18	0:20:18	17	0.6	1.1	
99	E	18:40:32	18:59:26	0:18:54	17	0.6	1.2	Cloud WP 48
98	W	19:02:44	19:22:32	0:19:48	17	0.6	1.2	
97	E	19:25:40	19:44:35	0:18:55	16	0.6	1.3	Cloud WP 58-69 & 86
				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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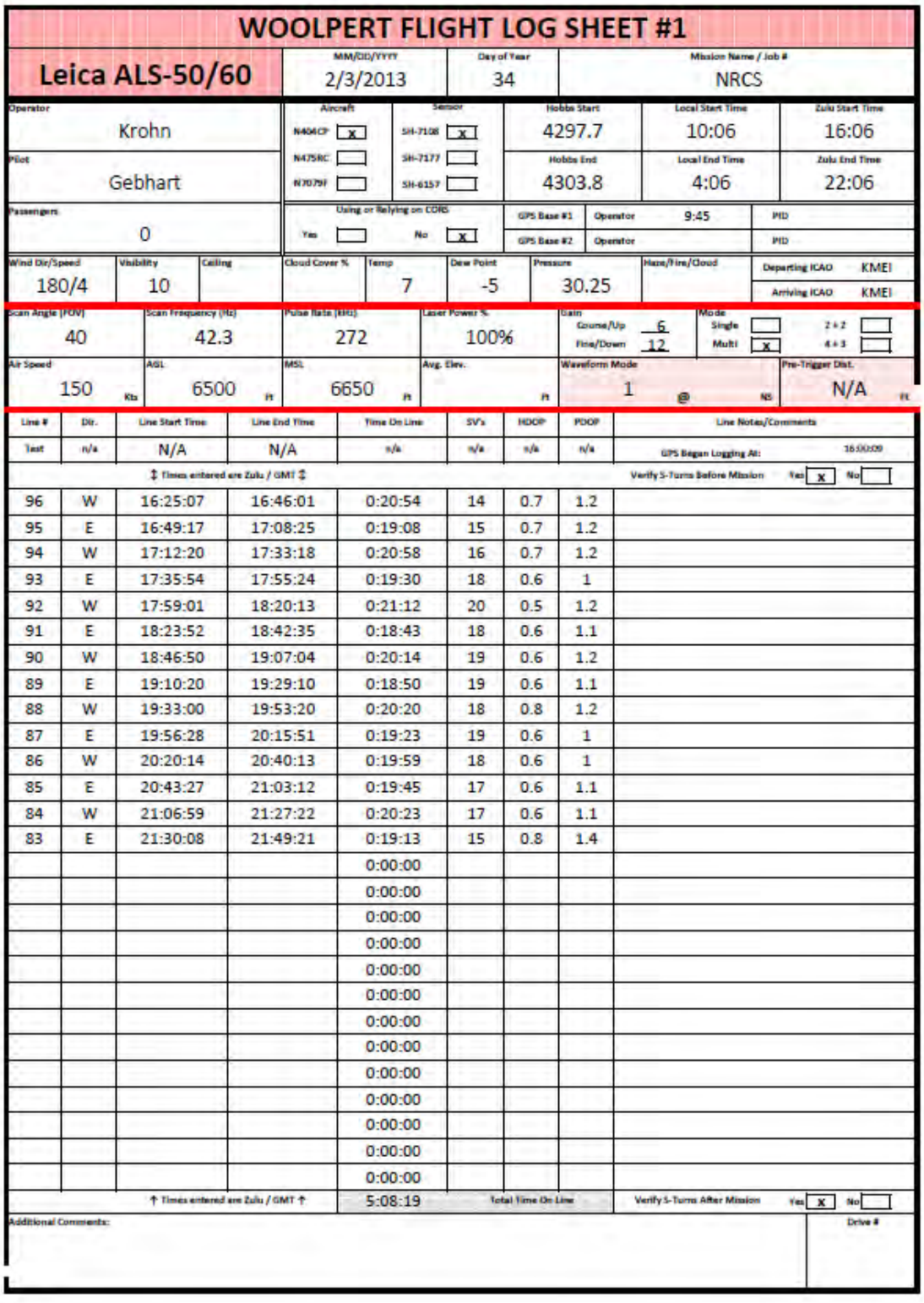
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				2:32:44 Total Time On Line				Verify S-Turns After Mission Yes [x] No [ ]

Additional Comments:

Clouded out for todays mission from futher collection

Drive #

Figure 2.4: ALS Log Sheet for Day034, February 3, 2013



WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-50/60	MM/DD/YYYY: 2/3/2013	Day of Year: 34	Mission Name / Job #: NRCS

Operator	Aircraft	Sensor	Hobbs Start	Local Start Time	Zulu Start Time
Krohn	N404CP [X]	SH-7108 [X]	4297.7	10:06	16:06
Pilot	N475RC [ ]	SH-7177 [ ]	Hobbs End	Local End Time	Zulu End Time
Gebhart	N7079F [ ]	SH-6157 [ ]	4303.8	4:06	22:06

Passengers	Using or Relying on CORS	GPS Base #1	Operator	9:45	PID
0	Yes [ ] No [X]	GPS Base #2	Operator		PID

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO	KMEI
180/4	10			7	-5	30.25		Arriving ICAO	KMEI

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Gain	Mode	
40	42.3	272	100%	Course/Up 6	Single [ ]	2 + 2 [ ]
				Fine/Down 12	Multi [X]	4 + 3 [ ]

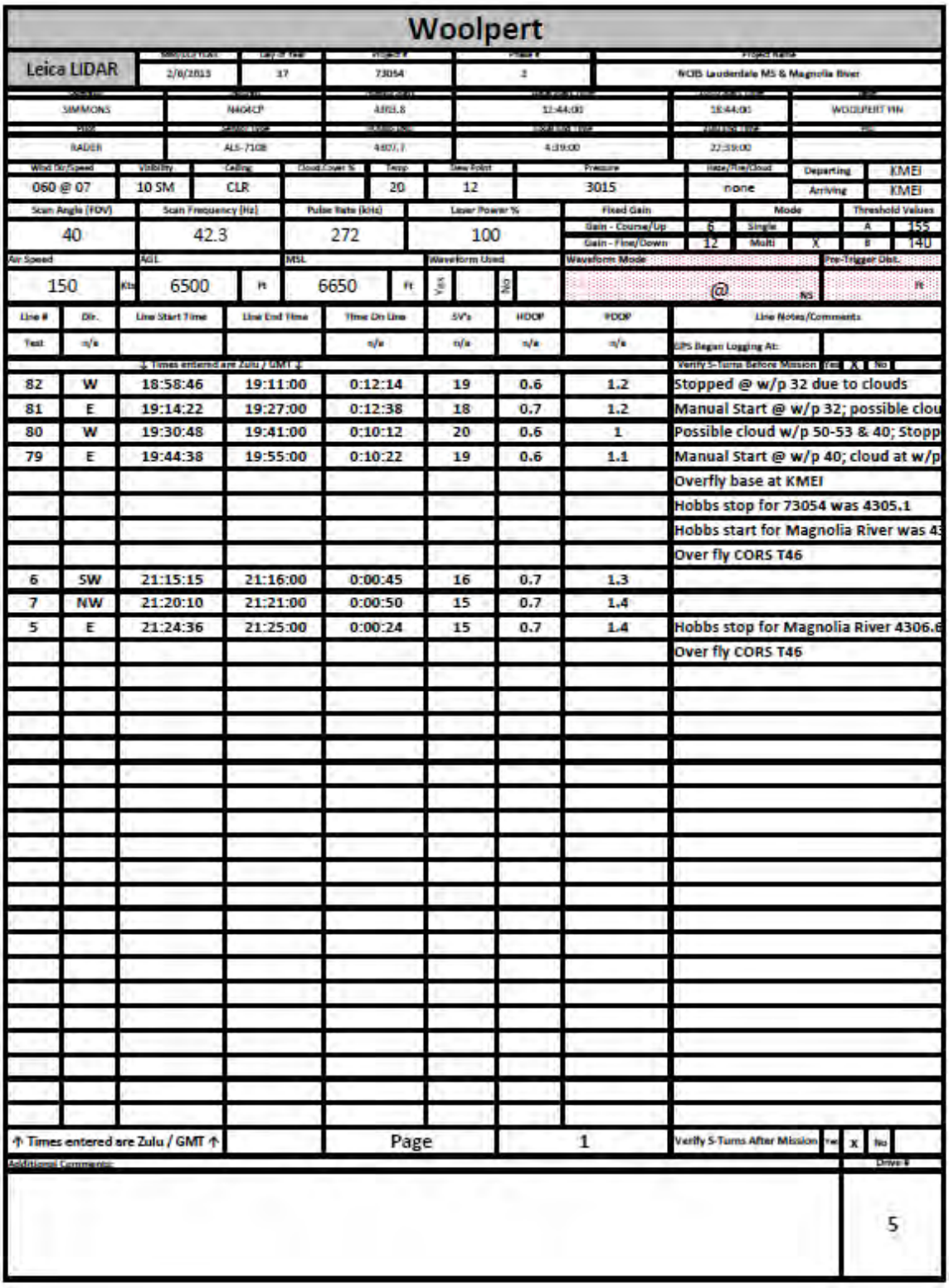
Air Speed	AGL	MSL	Avg. Elev.	Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6650 Ft	Ft	1 @ NS	N/A Ft

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	n/a	n/a	GPS Began Logging At: 16:00:09
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes [X] No [ ]
96	W	16:25:07	16:46:01	0:20:54	14	0.7	1.2	
95	E	16:49:17	17:08:25	0:19:08	15	0.7	1.2	
94	W	17:12:20	17:33:18	0:20:58	16	0.7	1.2	
93	E	17:35:54	17:55:24	0:19:30	18	0.6	1	
92	W	17:59:01	18:20:13	0:21:12	20	0.5	1.2	
91	E	18:23:52	18:42:35	0:18:43	18	0.6	1.1	
90	W	18:46:50	19:07:04	0:20:14	19	0.6	1.2	
89	E	19:10:20	19:29:10	0:18:50	19	0.6	1.1	
88	W	19:33:00	19:53:20	0:20:20	18	0.8	1.2	
87	E	19:56:28	20:15:51	0:19:23	19	0.6	1	
86	W	20:20:14	20:40:13	0:19:59	18	0.6	1	
85	E	20:43:27	21:03:12	0:19:45	17	0.6	1.1	
84	W	21:06:59	21:27:22	0:20:23	17	0.6	1.1	
83	E	21:30:08	21:49:21	0:19:13	15	0.8	1.4	
				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				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
		↑ Times entered are Zulu / GMT ↑		5:08:19	Total Time On Line			Verify S-Turns After Mission Yes [X] No [ ]

Additional Comments:

Drive #

Figure 2.5: ALS Log Sheet for Day037, February 6, 2013



Woolpert

Leica LIDAR	Survey Year: 2/6/2013	Day of Year: 37	Project #: 73054	Phase #: 2	Project Name: NOB Lauderdale MS & Magnolia River
Pilot: SIMMONS	Sensor ID: N404CP	Flight #: 4303.8	Mission Start Time: 12:44:00	Mission Stop Time: 18:44:00	Base: WOOLPERT YN
Pilot: RADER	Sensor Type: ALS-710B	Mission #: 4307.7	Mission Start Time: 4:39:00	Mission Stop Time: 22:39:00	Base:

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
060 @ 07	10 SM	CLR		20	12	3015	none	Departing	KMEI
								Arriving	KMEI

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	155
				Gain - Fine/Down	12	Multi	X	B	140

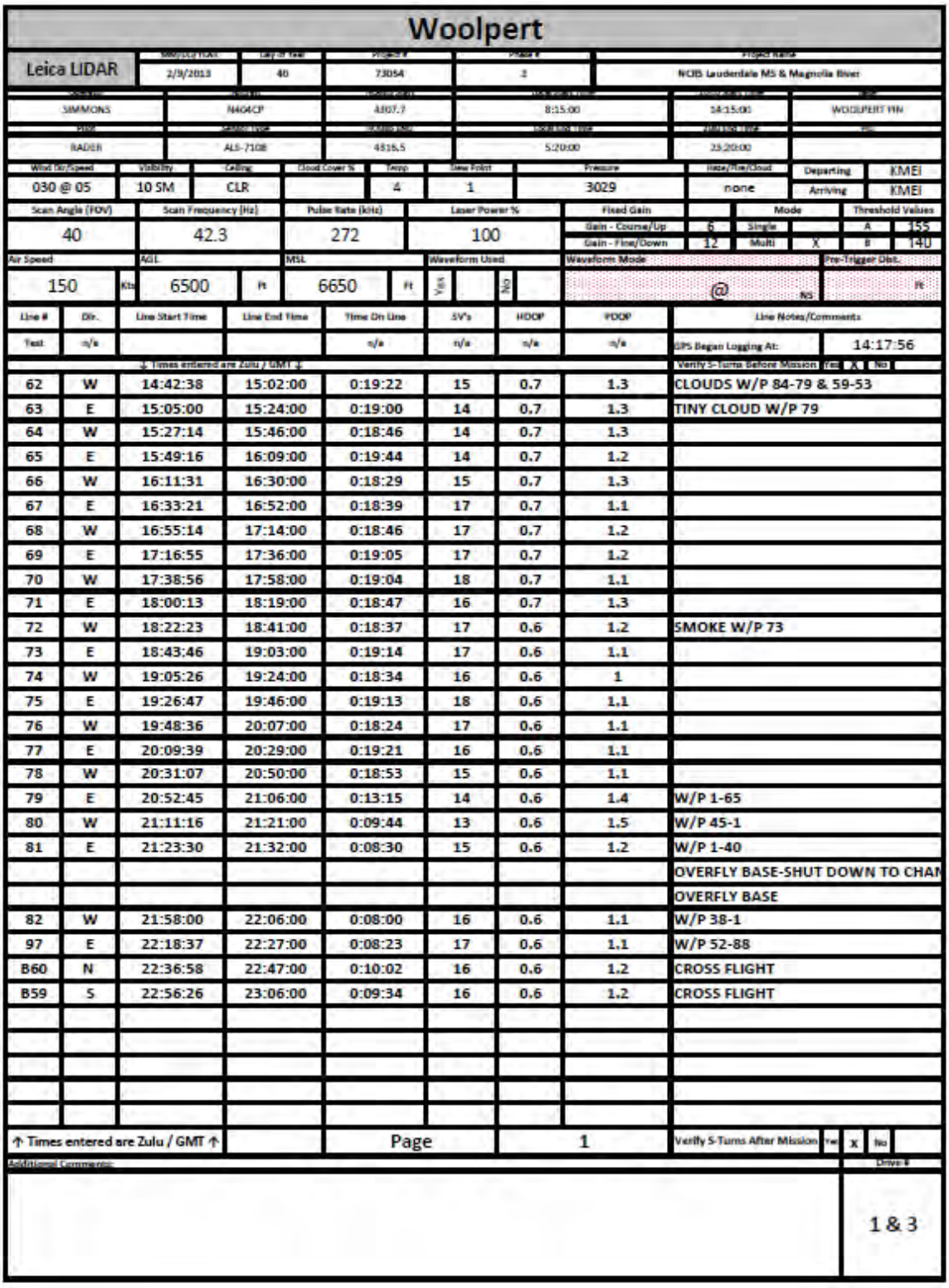
Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 ft	6650 ft	Yes		No		@ NS	ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission: Yes X No
82	W	18:58:46	19:11:00	0:12:14	19	0.6	1.2	Stopped @ w/p 32 due to clouds
81	E	19:14:22	19:27:00	0:12:38	18	0.7	1.2	Manual Start @ w/p 32; possible clou
80	W	19:30:48	19:41:00	0:10:12	20	0.6	1	Possible cloud w/p 50-53 & 40; Stopp
79	E	19:44:38	19:55:00	0:10:22	19	0.6	1.1	Manual Start @ w/p 40; cloud at w/p
								Overfly base at KMEI
								Hobbs stop for 73054 was 4305.1
								Hobbs start for Magnolia River was 43
								Over fly CORS T46
6	SW	21:15:15	21:16:00	0:00:45	16	0.7	1.3	
7	NW	21:20:10	21:21:00	0:00:50	15	0.7	1.4	
5	E	21:24:36	21:25:00	0:00:24	15	0.7	1.4	Hobbs stop for Magnolia River 4306.6
								Over fly CORS T46

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

Additional Comments:	Drive #
	5

Figure 2.6: ALS Log Sheet for Day040a-b, February 9, 2013



Woolpert

Leica LIDAR	2/9/2013	40	73054	2	NCIB Lauderdale MS & Magnolia River
SIMMONS	N404CP	4307.7	8:15:00	14:15:00	WOOLPERT FIN
RADER	ALS-710E	4816.5	5:20:00	23:20:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
030 @ 05	10 SM	CLR		4	1	3029	none	Departing	KMEI
								Arriving	KMEI

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	155
				Gain - Fine/Down	12	Multi	X	B	140

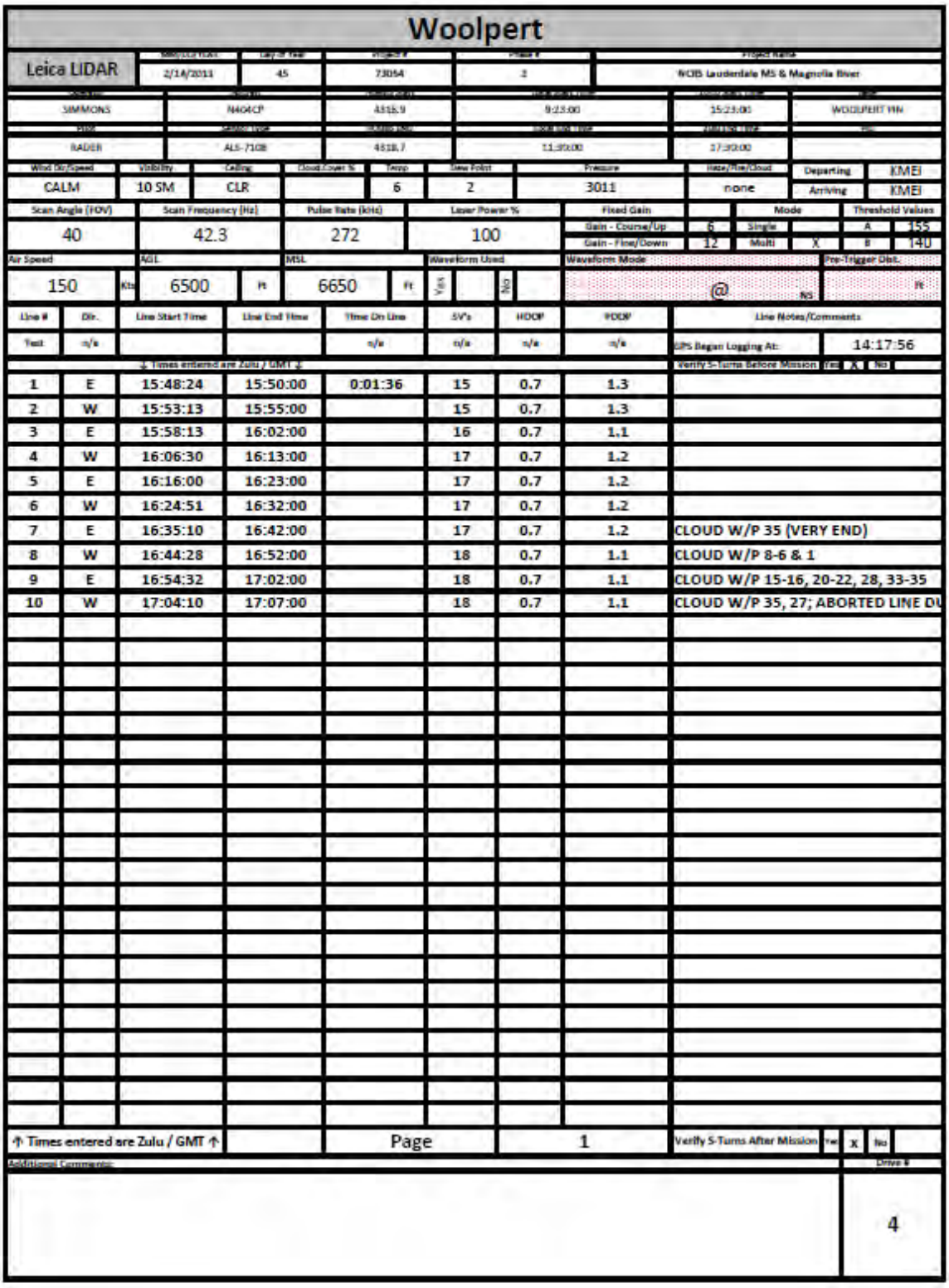
Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 ft	6650 ft	Yes		No		@ NS	ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 14:17:56
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission: Yes X No
62	W	14:42:38	15:02:00	0:19:22	15	0.7	1.3	CLOUDS W/P 84-79 & 59-53
63	E	15:05:00	15:24:00	0:19:00	14	0.7	1.3	TINY CLOUD W/P 79
64	W	15:27:14	15:46:00	0:18:46	14	0.7	1.3	
65	E	15:49:16	16:09:00	0:19:44	14	0.7	1.2	
66	W	16:11:31	16:30:00	0:18:29	15	0.7	1.3	
67	E	16:33:21	16:52:00	0:18:39	17	0.7	1.1	
68	W	16:55:14	17:14:00	0:18:46	17	0.7	1.2	
69	E	17:16:55	17:36:00	0:19:05	17	0.7	1.2	
70	W	17:38:56	17:58:00	0:19:04	18	0.7	1.1	
71	E	18:00:13	18:19:00	0:18:47	16	0.7	1.3	
72	W	18:22:23	18:41:00	0:18:37	17	0.6	1.2	SMOKE W/P 73
73	E	18:43:46	19:03:00	0:19:14	17	0.6	1.1	
74	W	19:05:26	19:24:00	0:18:34	16	0.6	1	
75	E	19:26:47	19:46:00	0:19:13	18	0.6	1.1	
76	W	19:48:36	20:07:00	0:18:24	17	0.6	1.1	
77	E	20:09:39	20:29:00	0:19:21	16	0.6	1.1	
78	W	20:31:07	20:50:00	0:18:53	15	0.6	1.1	
79	E	20:52:45	21:06:00	0:13:15	14	0.6	1.4	W/P 1-65
80	W	21:11:16	21:21:00	0:09:44	13	0.6	1.5	W/P 45-1
81	E	21:23:30	21:32:00	0:08:30	15	0.6	1.2	W/P 1-40
								OVERFLY BASE-SHUT DOWN TO CHAN
								OVERFLY BASE
82	W	21:58:00	22:06:00	0:08:00	16	0.6	1.1	W/P 38-1
97	E	22:18:37	22:27:00	0:08:23	17	0.6	1.1	W/P 52-88
B60	N	22:36:58	22:47:00	0:10:02	16	0.6	1.2	CROSS FLIGHT
B59	S	22:56:26	23:06:00	0:09:34	16	0.6	1.2	CROSS FLIGHT
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #: 1 & 3

Figure 2.7: ALS Log Sheet for Day045, February 14, 2013



Woolpert

Leica LIDAR					
	2/14/2013	45	73054	2	NOB Lauderdale MS & Magnolia River
SIMMONS	N404CP	4518.9	9:23:00	15:23:00	WOOLPERT HN
RADER	ALS-710B	4518.7	11:30:00	17:30:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
CALM	10 SM	CLR		6	2	3011	none	Departing	KMEI
								Arriving	KMEI

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	155
				Gain - Fine/Down	12	Multi	X	B	140

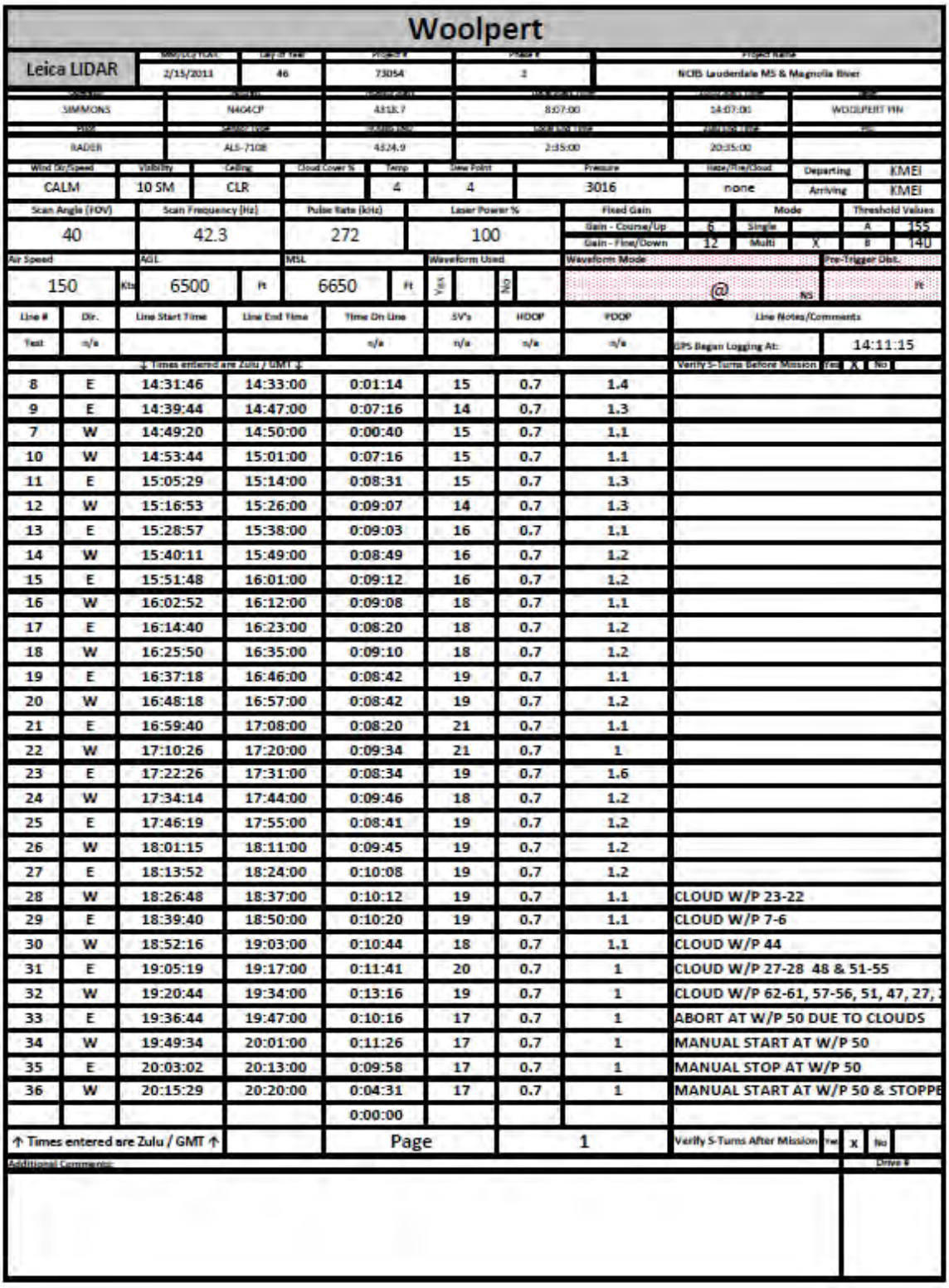
Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	6500	ft	6650	ft	Yes		No		@	ns		ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 14:17:56
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission: Yes X No
1	E	15:48:24	15:50:00	0:01:36	15	0.7	1.3	
2	W	15:53:13	15:55:00		15	0.7	1.3	
3	E	15:58:13	16:02:00		16	0.7	1.1	
4	W	16:06:30	16:13:00		17	0.7	1.2	
5	E	16:16:00	16:23:00		17	0.7	1.2	
6	W	16:24:51	16:32:00		17	0.7	1.2	
7	E	16:35:10	16:42:00		17	0.7	1.2	CLOUD W/P 35 (VERY END)
8	W	16:44:28	16:52:00		18	0.7	1.1	CLOUD W/P 8-6 & 1
9	E	16:54:32	17:02:00		18	0.7	1.1	CLOUD W/P 15-16, 20-22, 28, 33-35
10	W	17:04:10	17:07:00		18	0.7	1.1	CLOUD W/P 35, 27; ABORTED LINE DU
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #: 4

Figure 2.8: ALS Log Sheet for Day046, February 15, 2013



Woolpert

Leica LIDAR	Date (yy/mm/dd)	Day of Year	Project #	Phase #	Project Name
	2/15/2013	46	73054	2	NCBS Lauderdale MS & Magnolia River

Pilot	Aircraft	Flight #	Flight Start Time	Flight End Time	Base
SIMMONS	N404CP	4818.7	8:07:00	14:07:00	WOOLPERT FIN
RADER	ALS-710E	4824.9	2:35:00	20:35:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
CALM	10 SM	CLR		4	4	3016	none	Departing	KMEI
								Arriving	KMEI

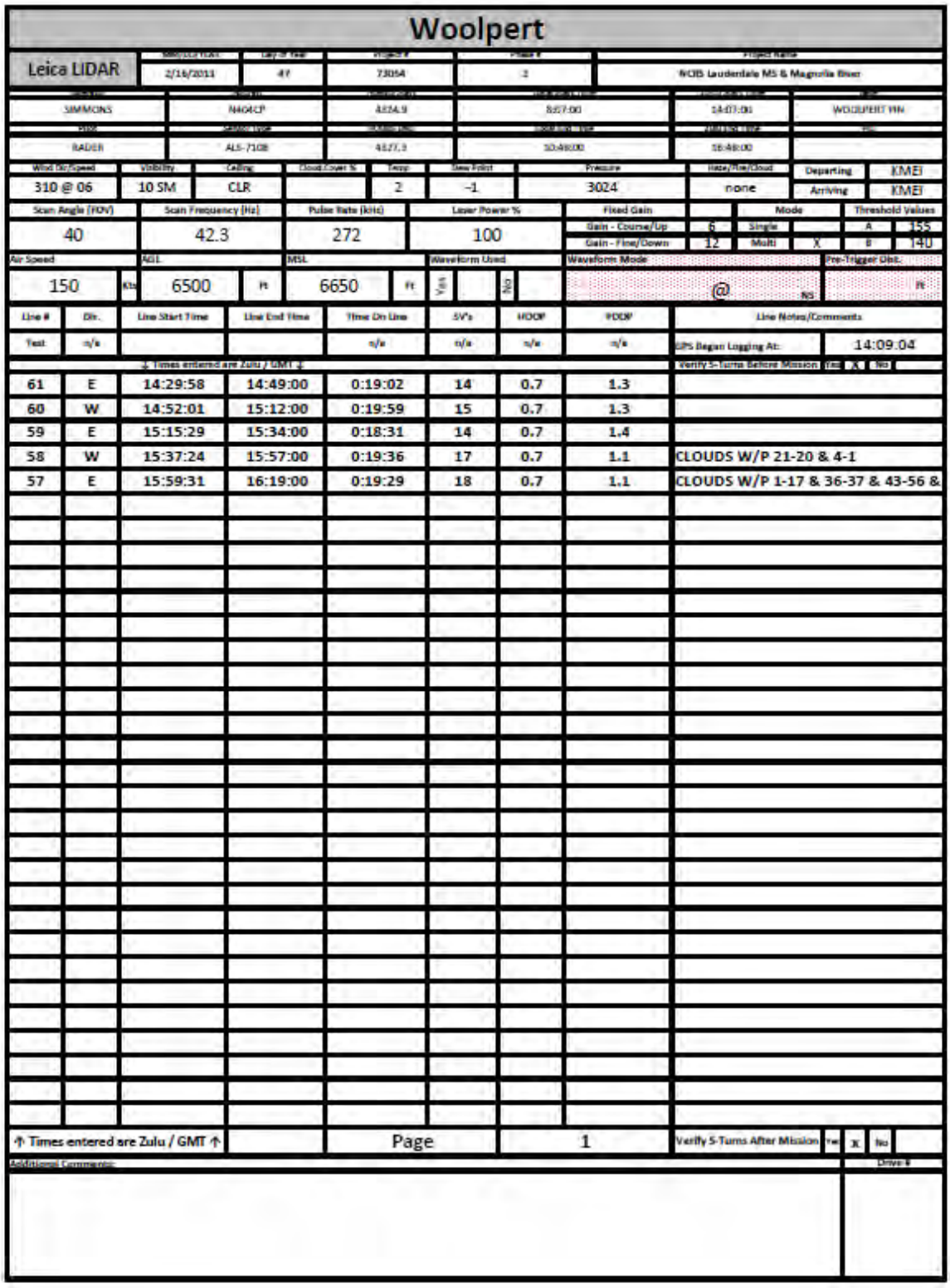
Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	155
				Gain - Fine/Down	12	Multi	X	B	140

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6650 Ft	Yes		No		@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 14:11:15
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission: Yes X No
8	E	14:31:46	14:33:00	0:01:14	15	0.7	1.4	
9	E	14:39:44	14:47:00	0:07:16	14	0.7	1.3	
7	W	14:49:20	14:50:00	0:00:40	15	0.7	1.1	
10	W	14:53:44	15:01:00	0:07:16	15	0.7	1.1	
11	E	15:05:29	15:14:00	0:08:31	15	0.7	1.3	
12	W	15:16:53	15:26:00	0:09:07	14	0.7	1.3	
13	E	15:28:57	15:38:00	0:09:03	16	0.7	1.1	
14	W	15:40:11	15:49:00	0:08:49	16	0.7	1.2	
15	E	15:51:48	16:01:00	0:09:12	16	0.7	1.2	
16	W	16:02:52	16:12:00	0:09:08	18	0.7	1.1	
17	E	16:14:40	16:23:00	0:08:20	18	0.7	1.2	
18	W	16:25:50	16:35:00	0:09:10	18	0.7	1.2	
19	E	16:37:18	16:46:00	0:08:42	19	0.7	1.1	
20	W	16:48:18	16:57:00	0:08:42	19	0.7	1.2	
21	E	16:59:40	17:08:00	0:08:20	21	0.7	1.1	
22	W	17:10:26	17:20:00	0:09:34	21	0.7	1	
23	E	17:22:26	17:31:00	0:08:34	19	0.7	1.6	
24	W	17:34:14	17:44:00	0:09:46	18	0.7	1.2	
25	E	17:46:19	17:55:00	0:08:41	19	0.7	1.2	
26	W	18:01:15	18:11:00	0:09:45	19	0.7	1.2	
27	E	18:13:52	18:24:00	0:10:08	19	0.7	1.2	
28	W	18:26:48	18:37:00	0:10:12	19	0.7	1.1	CLOUD W/P 23-22
29	E	18:39:40	18:50:00	0:10:20	19	0.7	1.1	CLOUD W/P 7-6
30	W	18:52:16	19:03:00	0:10:44	18	0.7	1.1	CLOUD W/P 44
31	E	19:05:19	19:17:00	0:11:41	20	0.7	1	CLOUD W/P 27-28 48 & 51-55
32	W	19:20:44	19:34:00	0:13:16	19	0.7	1	CLOUD W/P 62-61, 57-56, 51, 47, 27,
33	E	19:36:44	19:47:00	0:10:16	17	0.7	1	ABORT AT W/P 50 DUE TO CLOUDS
34	W	19:49:34	20:01:00	0:11:26	17	0.7	1	MANUAL START AT W/P 50
35	E	20:03:02	20:13:00	0:09:58	17	0.7	1	MANUAL STOP AT W/P 50
36	W	20:15:29	20:20:00	0:04:31	17	0.7	1	MANUAL START AT W/P 50 & STOPPE
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments: Drive #

Figure 2.9: ALS Log Sheet for Day047a, February 16, 2013



Woolpert

Leica LIDAR	Survey Date	Day of Year	Project #	Phase #	Project Name
	2/16/2013	47	73054	2	NOB Lauderdale MS & Magnolia River

Pilot	Sensor Op	Flight #	Take Off Time	Land Time	Base
SIMMONS	N404CP	4824.9	8:27:00	14:07:00	WOOLPERT HN
Plane	**Sensor Type**	**Mission #**	**Mission Start Time**	**Mission End Time**	**Site**
RADER	ALS-710B	4827.3	10:48:00	16:48:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
310 @ 06	10 SM	CLR		2	-1	3024	none	Departing	KMEI
								Arriving	KMEI

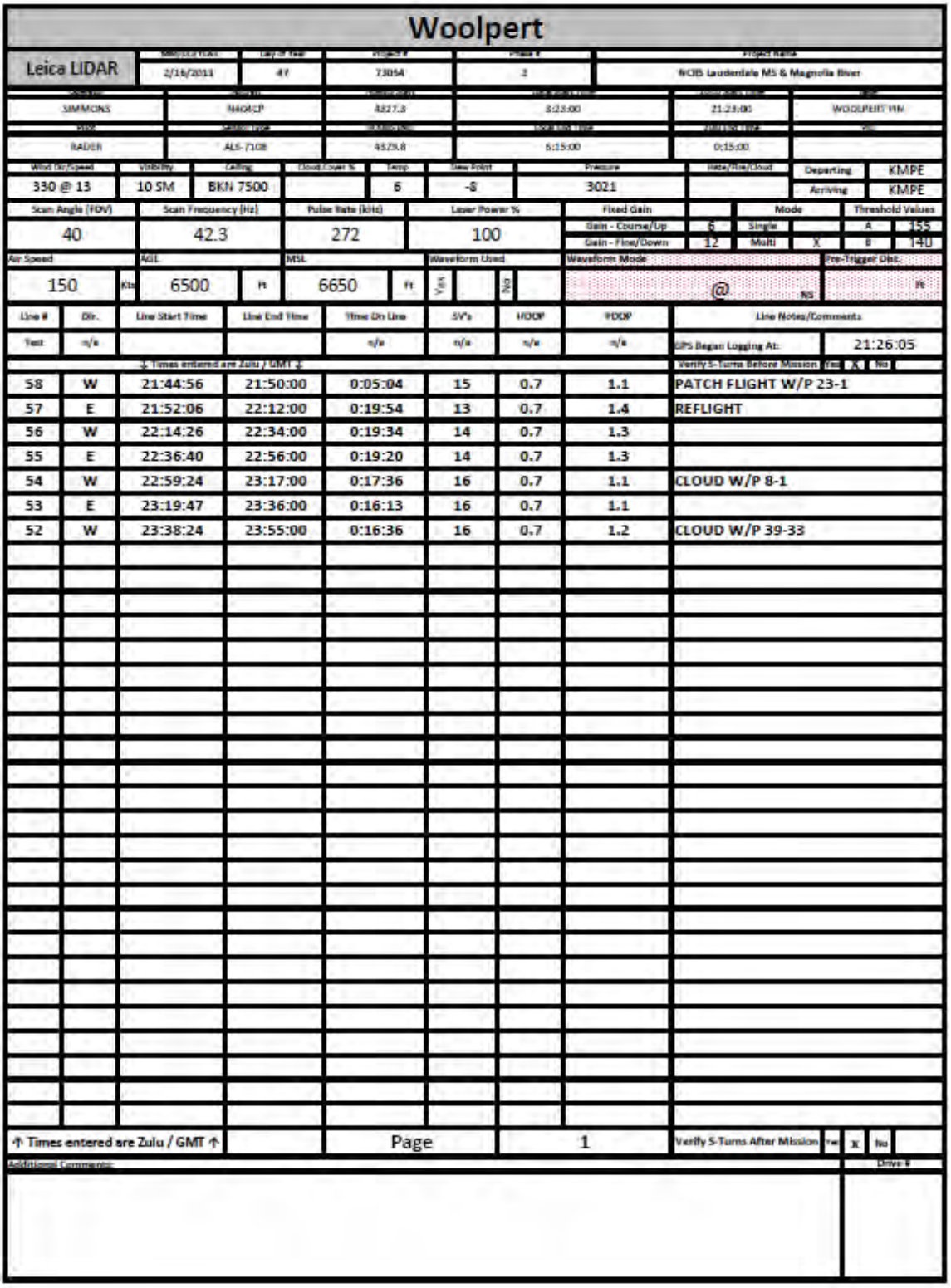
Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain			Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	155
				Gain - Fine/Down	12	Multi	X	B	140

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	6500	ft	6650	ft	Yes		No		@	ns		ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 14:09:04
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission: Yes X No
61	E	14:29:58	14:49:00	0:19:02	14	0.7	1.3	
60	W	14:52:01	15:12:00	0:19:59	15	0.7	1.3	
59	E	15:15:29	15:34:00	0:18:31	14	0.7	1.4	
58	W	15:37:24	15:57:00	0:19:36	17	0.7	1.1	CLOUDS W/P 21-20 & 4-1
57	E	15:59:31	16:19:00	0:19:29	18	0.7	1.1	CLOUDS W/P 1-17 & 36-37 & 43-56 &

↑ Times entered are Zulu / GMT ↑		Page	1	Verify S-Turns After Mission: Yes X No	
Additional Comments:					Drive #

Figure 2.10: ALS Log Sheet for Day047b, February 16, 2013



Woolpert

Leica LIDAR	Julian Date: 2/16/2013	Day of Year: 47	Project #: 73054	Phase #: 2	Project Name: NCIS Lauderdale MS & Magnolia River
Operator: SIMMONS	Aircraft: N404CP	Flight #: 4827.3	Start Log Time: 3:23:00	Stop Log Time: 21:23:00	Base: WOOLPERT HN
Pilot: RADER	Sensor Type: ALS-/50B	Mission No: 4829.8	Total Log Time: 6:15:00	Total Flt Time: 0:15:00	Etc:

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KMPE
330 @ 13	10 SM	BKN 7500		6	-8	3021		Arriving	KMPE

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	155
				Gain - Fine/Down	12	Multi	X	B	140

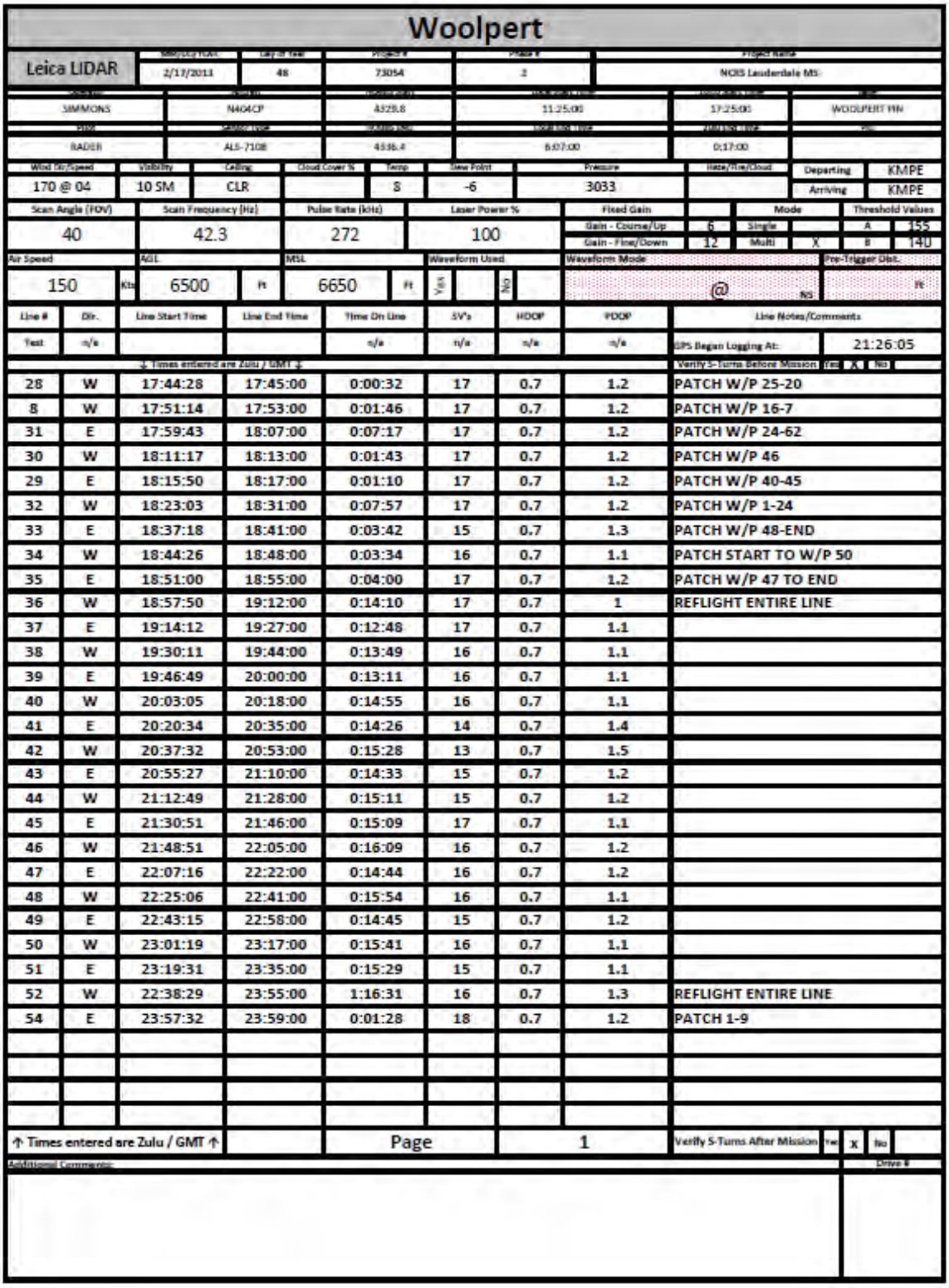
Air Speed		AGL		MSL		Waveform Used			Waveform Mode		Pre-Trigger Dist.	
150	Kts	6500	ft	6650	ft	Yes		No	@	NS		ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	21:26:05
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission	Yes X No
58	W	21:44:56	21:50:00	0:05:04	15	0.7	1.1	PATCH FLIGHT W/P 23-1	
57	E	21:52:06	22:12:00	0:19:54	13	0.7	1.4	REFLIGHT	
56	W	22:14:26	22:34:00	0:19:34	14	0.7	1.3		
55	E	22:36:40	22:56:00	0:19:20	14	0.7	1.3		
54	W	22:59:24	23:17:00	0:17:36	16	0.7	1.1	CLOUD W/P 8-1	
53	E	23:19:47	23:36:00	0:16:13	16	0.7	1.1		
52	W	23:38:24	23:55:00	0:16:36	16	0.7	1.2	CLOUD W/P 39-33	

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

Additional Comments: Drive #:

Figure 2.11: ALS Log Sheet for Day048, February 17, 2013



Woolpert

Leica LIDAR

Date (UTC)	Day of Year	Project #	Phase #	Project Name
2/17/2013	48	73054	2	NCRS Lauderdale MS

Pilot	Aircraft	Flight Log #	Flight Hrs	Hobbs Start Time	Hobbs End Time	Base
SIMMONS	N404CP	4328.8	11:25:00	17:25:00	WOOLPERT FIN	
RADER	ALS-710E	4536.4	6:07:00	0:17:00		

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Rain/Fog/Cloud		
170 @ 04	10 SM	CLR		8	-6	3033		Departing	KMPE
								Arriving	KMPE

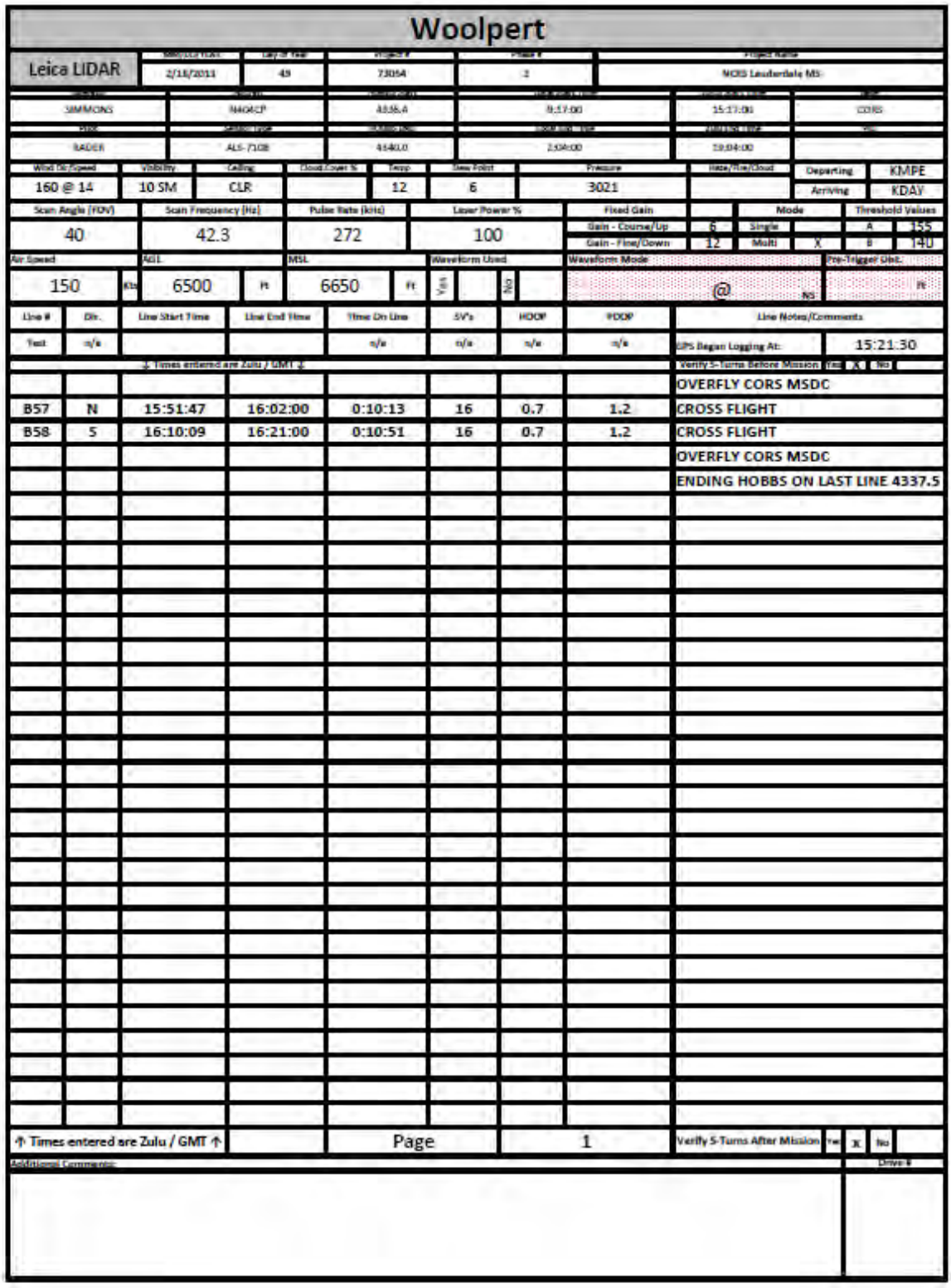
Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	42.3	272	100	Gain - Course/Up	6	Single		A	155
				Gain - Fine/Down	12	Multi	X	B	140

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 Kts	6500 Ft	6650 Ft	Yes		No		@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 21:26:05
		↓ Times entered are Zulu / GMT ↓						Verify S-Turns Before Mission: Yes X No
28	W	17:44:28	17:45:00	0:00:32	17	0.7	1.2	PATCH W/P 25-20
8	W	17:51:14	17:53:00	0:01:46	17	0.7	1.2	PATCH W/P 16-7
31	E	17:59:43	18:07:00	0:07:17	17	0.7	1.2	PATCH W/P 24-62
30	W	18:11:17	18:13:00	0:01:43	17	0.7	1.2	PATCH W/P 46
29	E	18:15:50	18:17:00	0:01:10	17	0.7	1.2	PATCH W/P 40-45
32	W	18:23:03	18:31:00	0:07:57	17	0.7	1.2	PATCH W/P 1-24
33	E	18:37:18	18:41:00	0:03:42	15	0.7	1.3	PATCH W/P 48-END
34	W	18:44:26	18:48:00	0:03:34	16	0.7	1.1	PATCH START TO W/P 50
35	E	18:51:00	18:55:00	0:04:00	17	0.7	1.2	PATCH W/P 47 TO END
36	W	18:57:50	19:12:00	0:14:10	17	0.7	1	REFLIGHT ENTIRE LINE
37	E	19:14:12	19:27:00	0:12:48	17	0.7	1.1	
38	W	19:30:11	19:44:00	0:13:49	16	0.7	1.1	
39	E	19:46:49	20:00:00	0:13:11	16	0.7	1.1	
40	W	20:03:05	20:18:00	0:14:55	16	0.7	1.1	
41	E	20:20:34	20:35:00	0:14:26	14	0.7	1.4	
42	W	20:37:32	20:53:00	0:15:28	13	0.7	1.5	
43	E	20:55:27	21:10:00	0:14:33	15	0.7	1.2	
44	W	21:12:49	21:28:00	0:15:11	15	0.7	1.2	
45	E	21:30:51	21:46:00	0:15:09	17	0.7	1.1	
46	W	21:48:51	22:05:00	0:16:09	16	0.7	1.2	
47	E	22:07:16	22:22:00	0:14:44	16	0.7	1.2	
48	W	22:25:06	22:41:00	0:15:54	16	0.7	1.1	
49	E	22:43:15	22:58:00	0:14:45	15	0.7	1.2	
50	W	23:01:19	23:17:00	0:15:41	16	0.7	1.1	
51	E	23:19:31	23:35:00	0:15:29	15	0.7	1.1	
52	W	22:38:29	23:55:00	1:16:31	16	0.7	1.3	REFLIGHT ENTIRE LINE
54	E	23:57:32	23:59:00	0:01:28	18	0.7	1.2	PATCH 1-9
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Figure 2.12: ALS Log Sheet for Day049, February 18, 2013



Woolpert

Leica LIDAR					
	2/18/2013	49	73054	2	NCRS Lauderdale MS
	SIMMONS	N404CP	4336.4	9:17:00	15:17:00	CORS
	RADER	ALS-710B	4340.0	2:04:00	19:04:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Rain/Fog/Cloud		
160 @ 14	10 SM	CLR		12	6	3021		Departing	KMPE
								Arriving	KDAY

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	155
				Gain - Fine/Down	12	Multi	X	B	140

Air Speed	AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	6500	ft	6650	ft	Yes		No		@	NS	ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 15:21:30
		↓ Times entered are Zulu / GMT ↓						Verify 5-Turns Before Mission: Yes X No
								OVERFLY CORS MSDC
B57	N	15:51:47	16:02:00	0:10:13	16	0.7	1.2	CROSS FLIGHT
B58	S	16:10:09	16:21:00	0:10:51	16	0.7	1.2	CROSS FLIGHT
								OVERFLY CORS MSDC
								ENDING HOBBS ON LAST LINE 4337.5

↑ Times entered are Zulu / GMT ↑		Page	1	Verify 5-Turns After Mission: Yes X No	
Additional Comments:					Drive #

Figure 2.13: ALS Log Sheet for Day058, February 27, 2013

Woolpert

Leica LIDAR	2/27/2013	5813	73054	02	NRCS Lauderdale, MS
GALAMBOS	N3MZ	3364.8	5:53:00	23:53:00	CORS
SWAIN	ALS-7177	3366.8	7:34:00	1:34:00	UNKNOWN

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KMEI
29008g14	10	80Sct	20	16	1	2994	Haze	Arriving	KJAN

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	6650	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	23:49:45	23:50:10	n/a	n/a	n/a	n/a	GPS Began Logging At:	23:21:45
↓ Times entered are Zulu / GMT ↓								Verify S-Turns Before Mission	Yes / No
56	W	23:53:10	0:16:47	1:04:25	18	0.7	1.3	385 ' LOW WEST END	
57	E	0:22:32	0:41:53	0:00:00	20	0.6	1.1	200' low	
56	W	0:47:12	1:09:53	0:00:00	19	0.6	1.2	200' low	
57	E	1:14:08	1:33:34	0:00:00	21	0.6	1	cloud west end	
				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					
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission	Yes x No

Additional Comments: Range Gate 4167-7008 Eyesafe- 1057' KPHK 3380.4 KPBI 3360.6 MEI 3364.8 130227-235307

Drive #: ALS 70-2 #1

Figure 2.14: ALS Log Sheet for Day062, March 3, 2013

Woolpert

Leica LIDAR

3/3/2013 | 6213 | 73054 | 02 | NRCS Lauderdale, MS

GALAMBOS | N3MZ | 3373.8 | 12:12:00 | 18:12:00 | CORS

SWAIN | ALS-7177 | 3376.8 | 12:56:00 | 18:56:00 | UNKNOWN

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KMEI
Calm	10	Clear	0	4	-2	3033		Arriving	KJAN

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: 150 Kts | AGL: 6500 Ft | MSL: 6650 Ft | Waveform Used: Yes ___ No x | Waveform Mode: @ NS | Pre-Trigger Dist.: Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a	18:03:45	18:04:41	n/a	n/a	n/a	n/a	GPS Began Logging At:	16:19:30
↓ Times entered are Zulu / GMT ↓								Verify S-Turns Before Mission Yes X No	[illegible]
56	E	18:12:18	18:32:00	13:32:44	19	0.7	1.2		
57	W	18:35:50	18:56:54	0:00:00	15	0.7	1.2		
				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:

Range Gate 4167-7008 Eyesafe- 1067' KPTN 3373.8 KJAN OverCORS 17:55-56/OverCORS19:03-04 File130303_180346

Drive #: [illegible]

ALS 70-2 #1

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.2.70, Proprietary Software, TerraMatch v. 13.01.

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.13.015.

4. The .LAS files were evaluated through a series of manual QA/QC steps to eliminate remaining artifacts and small undulations from the ground class.
   Software: TerraScan v.13.015.

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.

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

All of 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 survey crew. 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 survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at the Key Field Airport (KMEI) to provide airborne GPS support on days 03213, 03313, 03413, 03713 and 04013.

Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at the Philadelphia Municipal Airport (KMPE) to provide airborne GPS support on days 04513, 04613, 04713 and 04813.

Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at the MSME_CORS to provide airborne GPS support on days 03113 and 05813.

Woolpert survey crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station at the MSDC_CORS to provide airborne GPS support on days 4913 and 06213.

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

Table 3.1: GNSS Base Station

Station	Latitude	Longitude	Ellipsoid Height (L1 Phase Center)
Name	(DMS)	(DMS)	(Meters)
KMEI	N 32° 20 08.32445"	W -88° 44' 36.30934"	60.741
KMPE	N 32° 48 02.50211"	W -89° 07' 30.58053"	107.179
MSDC_CORS	N 32° 26 22.97139"	W -89° 06' 44.44326"	120.977
MSME_CORS	N 32° 22 03.02211"	W -88° 43' 56.77908"	103.297

DATA PROCESSING

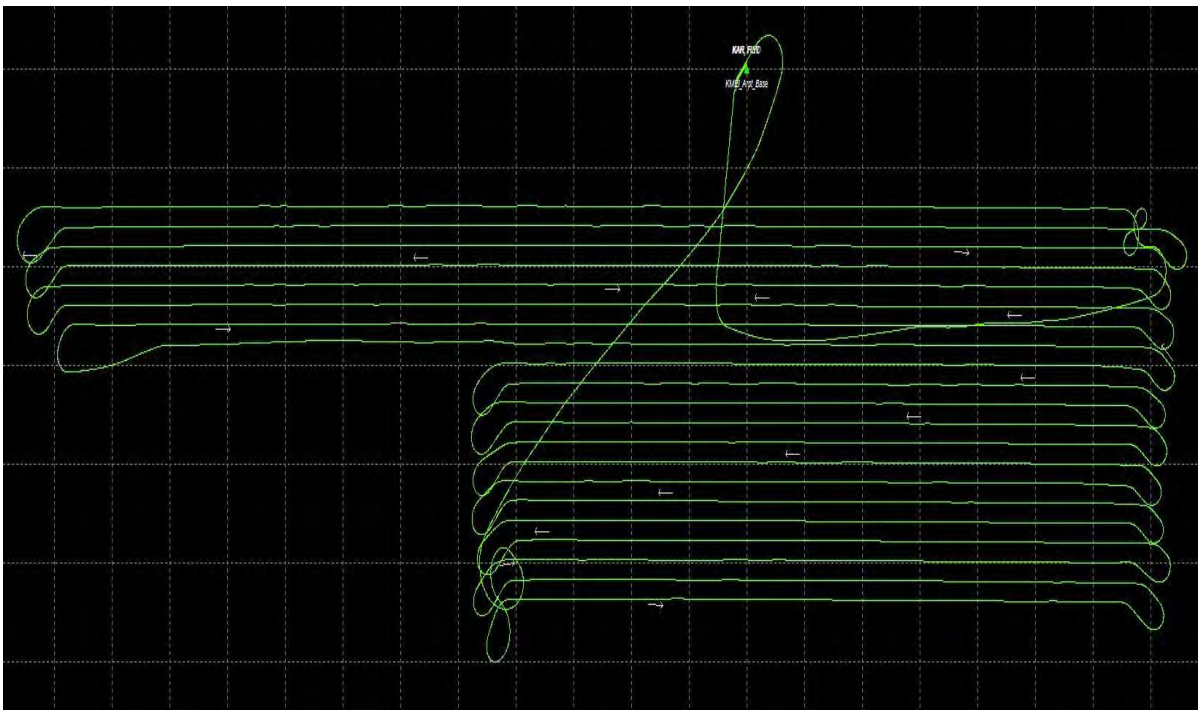
All airborne GNSS and IMU data was post-processed and quality controlled using Applanix 5.3 MMS software. GNSS data was processed at a 1 and 2 Hz data capture rate and the IMU data was processed at 200 Hz.

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. See **Figure 3.1** for the flight trajectory.

Flight Trajectory

Figure 3.1: Representative Graph from Day03213: N7079F



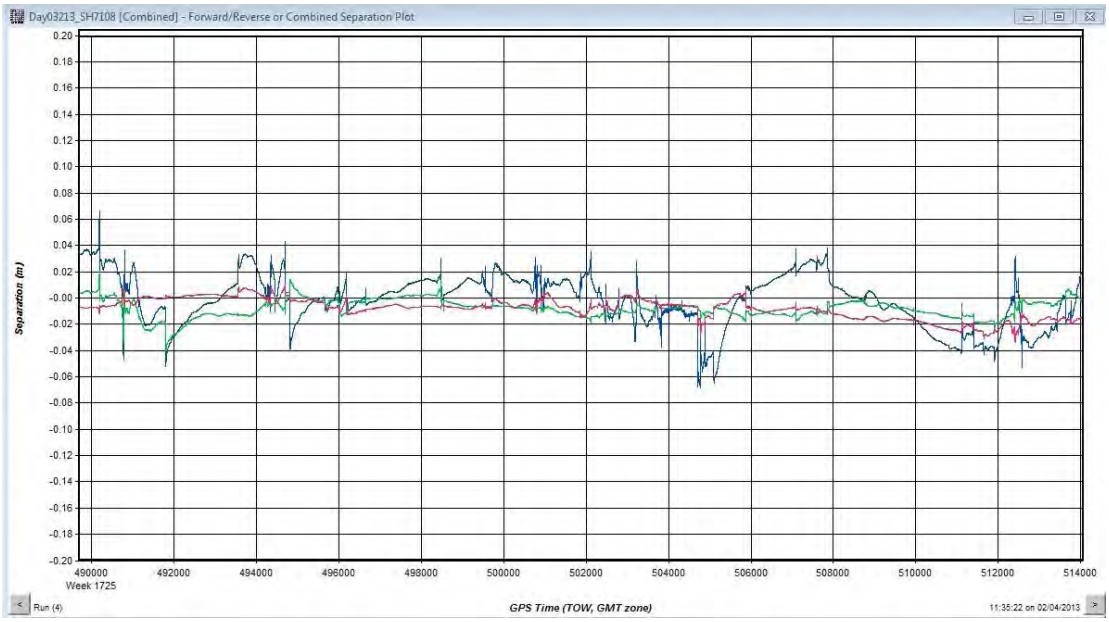
Within the trajectory processing, there are many factors that affect the overall quality, but the most indicative are the Combined Separation, the Estimated Positional Accuracy, and the Positional Dilution of Precision (PDOP).

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. See **Figure 3.2** for the combined separation graph.

Figure 3.2: Representative Graph from Day03213 of Combined Separation

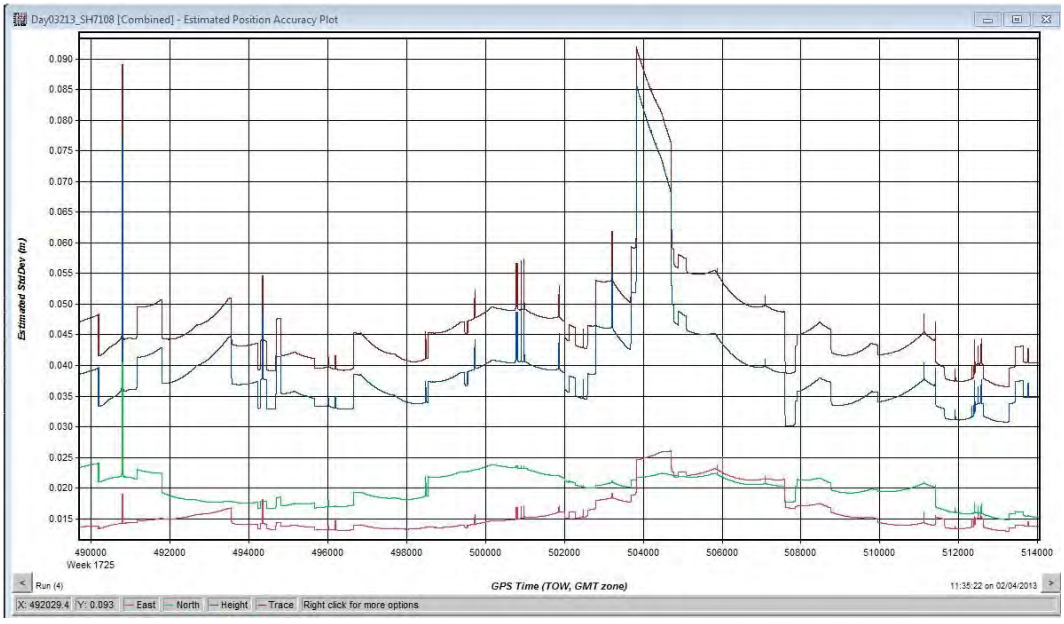


Estimated Positional Accuracy

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.

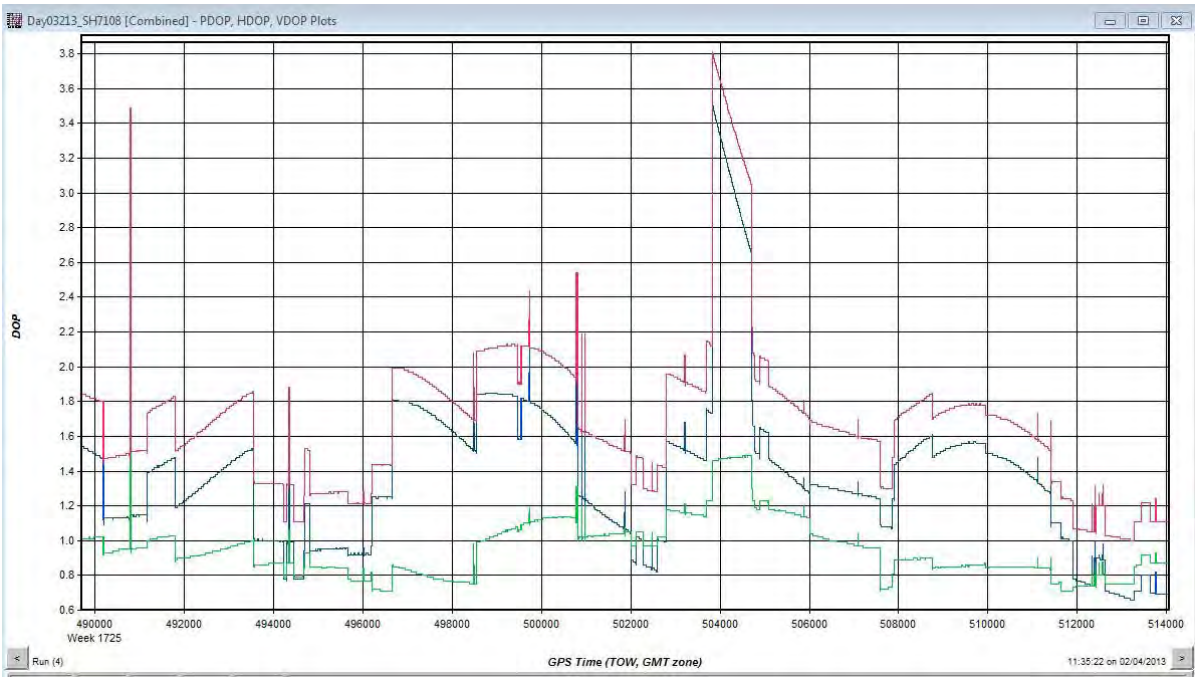
Figure 3.3: Representative Graph from Day03213 of Positional Accuracy



PDOP

Position Dilution of precision (DOP) is a measure of the quality of the GPS data being received from the satellites. Woolpert's goal is to maintain an average PDOP of 3 or less.

Figure 3.4: Representative Graph from Day03213 of PDOP



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 of the task order data was imported and classified, survey ground control data was imported and calculated for an accuracy assessment. As a QA/QC measure, Woolpert has developed a routine to generate accuracy statistical reports by comparison among LiDAR points, ground control, and TINs. The LiDAR is adjusted accordingly to reduce any vertical bias 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 UTM16N American Datum of 1983. Coordinate positions were specified in units of meters. The vertical datum used for the task order was referenced to NAVD 1988, meters, GEOID12A.

SECTION 4: HYDROLOGIC FLATTENING AND FINAL QUALITY CONTROL

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

The NRCS Lauderdale MS 0.7 m NPS LiDAR task order required the compilation of breaklines defining water bodies. The breaklines were used to perform the hydrologic flattening of water bodies. Lakes, reservoirs and ponds, at a minimum size of 2-acres or greater, were compiled as closed polygons. Stream and rivers, with an average width of 100 feet or greater, were compiled as closed polylines.

LIDAR DATA REVIEW AND PROCESSING

Woolpert utilized the following steps to hydrologically flatten the water bodies 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. 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.

4. The streams and rivers, at a minimum of 100 feet in width or greater, were compiled as closed polylines.

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

6. All ground points were reclassified from within a 1.5 meter (5 foot) buffer along the hydrologic feature breaklines to buffered ground, class ten (10).

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

Figure 4.1 **Figure 4.2**

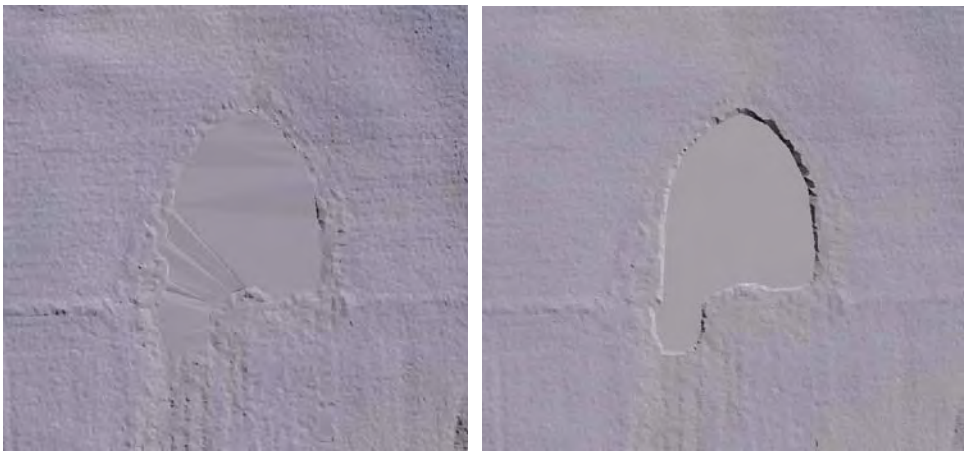


Figure 4.1 reflects a DEM generated from original LiDAR bare earth point data prior to the hydrologic flattening process. Note the "tinning" across the lake surface.

Figure 4.2 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 lake and pond water bodies greater than 2-acres were provided as a PolygonZ file. The breaklines defining the stream and river water bodies were provided as a PolylineZ file.

DATA QA/QC

Initial QA/QC for this task order was performed in Global Mapper v14, by reviewing the grids and hydrologic breakline features.

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

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 QA/QC points.

Table 5.1: Overall Swath Vertical Accuracy Statistics, Lauderdale, MS

Average error	-0.010	meters
Minimum error	-0.146	meters
Maximum error	+0.112	meters
Average magnitude	0.055	meters
Root mean square	0.069	meters
Standard deviation	0.069	meters

Table 5.2: Swath Analysis, UTM 16N, NAD83, NAVD88 GEOID12A, Lauderdale, MS

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Dz (meters)
2000	350209.161	3588703.866	164.915	-0.085
2001	347974.104	3581154.331	156.854	-0.144
2002	348301.907	3559767.202	162.656	0.024
2003	349926.831	3537500.886	88.579	-0.029
2004	301551.88	3591832.619	132.073	-0.073
2005	290570.911	3623767.271	151.913	0.087
2006	288560.407	3603648.090	154.342	0.008
2007	314707.356	3610018.192	156.038	0.112
2008	327847.312	3618540.737	182.781	0.019
2009	323910.495	3663727.960	175.462	0.048
2012	321378.072	3527780.809	135.218	0.022
2014	329113.933	3599967.697	110.883	-0.113
2019	322591.647	3549704.129	80.925	-0.055
2023	335244.765	3610644.480	146.214	0.016
2051	328372.383	3563599.416	76.442	0.008

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Dz (meters)
2052	328352.975	3540402.265	96.836	-0.026
2053	320725.732	3525312.604	137.611	0.009
2054	297459.381	3572915.152	127.936	-0.146
2055	314832.903	3634705.659	148.723	-0.033
2056	286905.341	3638219.734	121.553	0.057
2057	299219.143	3647914.736	158.918	-0.038
2058	290141.279	3659658.984	140.682	0.028
2059	293850.156	3672001.945	148.174	0.106
2096	320933.491	3642310.033	158.393	-0.073
2097	355917.493	3614208.819	100.639	-0.029
2098	342816.526	3634740.779	168.915	0.045

Table 5.3: DEM Analysis, UTM 16N, NAD83, NAVD88 GEOID12A, Lauderdale, MS

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
2000	350209.161	3588703.866	164.915	0.075
2001	347974.104	3581154.331	156.854	0.134
2002	348301.907	3559767.202	162.656	0.024
2003	349926.831	3537500.886	88.579	0.029
2004	301551.880	3591832.619	132.073	0.083
2005	290570.911	3623767.271	151.913	0.057
2006	288560.407	3603648.090	154.342	0.012
2007	314707.356	3610018.192	156.038	0.132
2008	327847.312	3618540.737	182.781	0.039
2009	323910.495	3663727.96	175.462	0.038
2012	321378.072	3527780.809	135.218	0.042

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
2014	329113.933	3599967.697	110.883	0.143
2019	322591.647	3549704.129	80.925	0.055
2023	335244.765	3610644.48	146.214	0.036
2051	328372.383	3563599.416	76.442	0.018
2052	328352.975	3540402.265	96.836	0.016
2053	320725.732	3525312.604	137.611	0.031
2054	297459.381	3572915.152	127.936	0.126
2055	314832.903	3634705.659	148.723	0.033
2056	286905.341	3638219.734	121.553	0.067
2057	299219.143	3647914.736	158.918	0.058
2058	290141.279	3659658.984	140.682	0.002
2059	293850.156	3672001.945	148.174	0.116
2096	320933.491	3642310.033	158.393	0.083
2097	355917.493	3614208.819	100.639	0.029
2098	342816.526	3634740.779	168.915	0.045

VERTICAL ACCURACY CONCLUSIONS

LAS Swath Fundamental Vertical Accuracy (FVA) Tested 0.135 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 0.139 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 5.4: QA/QC Analysis, Bare Earth and Open Terrain, UTM 16N, NAD83, NAVD88 GEOID12A, Lauderdale, MS

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
2000	350209.161	3588703.866	164.915	0.075
2001	347974.104	3581154.331	156.854	0.134
2002	348301.907	3559767.202	162.656	0.024
2003	349926.831	3537500.886	88.579	0.029
2004	301551.880	3591832.619	132.073	0.083
2005	290570.911	3623767.271	151.913	0.057
2006	288560.407	3603648.090	154.342	0.012
2007	314707.356	3610018.192	156.038	0.132
2008	327847.312	3618540.737	182.781	0.039
2009	323910.495	3663727.96	175.462	0.038
2012	321378.072	3527780.809	135.218	0.042
2014	329113.933	3599967.697	110.883	0.143
2019	322591.647	3549704.129	80.925	0.055
2023	335244.765	3610644.48	146.214	0.036
2051	328372.383	3563599.416	76.442	0.018
2052	328352.975	3540402.265	96.836	0.016
2053	320725.732	3525312.604	137.611	0.031
2054	297459.381	3572915.152	127.936	0.126
2055	314832.903	3634705.659	148.723	0.033
2056	286905.341	3638219.734	121.553	0.067
2057	299219.143	3647914.736	158.918	0.058
2058	290141.279	3659658.984	140.682	0.002
2059	293850.156	3672001.945	148.174	0.116

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
2096	320933.491	3642310.033	158.393	0.083
2097	355917.493	3614208.819	100.639	0.029
2098	342816.526	3634740.779	168.915	0.045

ACCURACY CONCLUSIONS

Bare Earth/Open Terrain Land Cover Classification Supplemental Vertical Accuracy (SVA) tested 0.139 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Errors larger than 95th percentile includes:

- Point 2014, Easting 329113.933, Northing 3599967.697, Z-Error 0.143 meters

Table 5.5: QA/QC Analysis, Urban, UTM 16N, NAD83, NAVD88 GEOID12A, Lauderdale, MS

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
3000	357458.648	3596654.419	76.024	0.024
3001	350645.898	3579120.927	148.023	0.073
3002	353967.970	3561272.935	131.197	0.063
3003	348129.396	3539203.142	109.635	0.055
3004	301433.674	3591296.054	128.449	0.059
3005	289663.260	3625683.077	153.278	0.002
3006	283526.339	3611534.540	149.808	0.032
3007	312556.075	3611457.493	166.813	0.007
3008	328596.705	3625245.884	162.469	0.041
3009	319230.960	3661333.467	155.425	0.055
3014	334206.161	3599749.204	111.907	0.117
3019	321697.086	3546667.562	87.062	0.048
3023	342638.372	3604844.393	117.045	0.015
3050	329953.454	3579718.389	106.543	0.113

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
3051	335859.727	3580835.123	93.385	0.065
3052	328476.232	3567289.004	92.938	0.002
3054	328354.787	3525005.611	111.450	0.030
3055	309381.667	3577466.808	99.598	0.028
3056	301500.303	3627938.288	129.513	0.097
3057	290768.421	3642802.708	139.168	0.058
3058	307257.868	3652329.745	150.884	0.074
3060	305546.419	3666791.051	167.844	0.034
3086	329009.141	3639625.478	162.620	0.000
3097	362013.445	3617727.611	62.123	0.143
3098	345099.220	3626816.851	135.434	0.006

ACCURACY CONCLUSIONS

Urban Land Cover Classification Supplemental Vertical Accuracy (SVA) tested 0.135 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Errors larger than 95th percentile includes:

- Point 3097, Easting 362013.445, Northing 3617727.611, Z-Error 0.143 meters

Table 5.6: QA/QC Analysis, Tall Weeds/Crops, UTM 16N, NAD83, NAVD88 GEOID12A,

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
4000	357340.567	3596541.236	78.420	0.090
4001	348280.397	3580582.652	144.412	0.068
4002	358176.754	3562656.636	120.196	0.124
4003	349869.188	3537558.135	88.432	0.228
4004	300924.235	3592297.418	120.757	0.233
4005	291394.325	3626090.008	152.816	0.184

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
4006	292672.812	3603597.646	153.527	0.133
4007	306341.993	3608273.059	174.177	0.103
4009	317444.532	3662898.126	158.246	0.164
4014	323418.932	3604042.386	146.763	0.037
4019	329153.631	3544927.948	74.508	0.282
4023	342270.221	3608898.860	87.954	0.116
4050	335948.915	3580791.704	93.755	0.135
4051	325008.599	3563524.417	112.805	0.035
4053	325871.904	3533047.886	83.063	0.077
4054	302578.039	3588657.042	138.588	0.078
4055	300439.880	3631393.320	136.011	0.079
4056	292284.785	3636655.155	132.194	0.046
4057	293375.334	3651477.558	158.520	0.210
4058	292272.649	3655209.202	171.427	0.073
4059	287837.033	3663583.320	159.673	0.027
4060	300587.580	3672371.572	162.565	0.135
4096	323984.844	3638881.316	142.137	0.293
4097	352106.129	3616308.755	108.249	0.151
4098	348138.983	3630855.28	86.238	0.242

ACCURACY CONCLUSIONS

Tall Weeds/Crops Land Cover Classification Supplemental Vertical Accuracy (SVA) tested 0.289 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Errors larger than 95th percentile includes:

- Point 4096, Easting 323984.844, Northing 3638881.316, Z-Error 0.293 meters

Table 5.7: QA/QC Analysis, Brush Lands and Trees, UTM 16N, NAD83, NAVD88 GEOID12A, Lauderdale, MS

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
5000	350637.960	3592562.938	158.644	0.086
5001	352278.619	3578001.604	124.946	0.104
5002	351306.138	3559376.499	97.558	0.052
5003	350084.013	3535747.530	99.838	0.212
5004	300555.995	3593854.801	130.458	0.022
5006	291486.382	3621408.654	132.602	0.258
5007	308265.501	3612060.746	180.926	0.234
5008	325862.268	3617369.221	154.977	0.143
5009	318710.135	3664248.773	138.972	0.218
5012	324217.284	3532656.995	91.076	0.094
5014	325938.699	3599558.953	140.647	0.007
5019	325341.382	3544075.792	79.100	0.120
5023	337598.522	3607441.758	147.140	0.130
5050	324603.076	3580493.387	119.254	0.016
5051	328202.663	3563381.602	73.970	0.180
5052	322768.282	3542012.184	96.716	0.134
5053	323392.345	3532634.332	93.252	0.188
5054	294025.266	3584010.170	156.520	0.080
5055	312025.479	3635842.686	134.938	0.082
5056	293171.411	3639246.866	128.430	0.030
5057	299056.799	3652577.740	162.259	0.081
5058	285153.339	3657069.548	141.252	0.188
5059	297288.048	3665302.381	162.535	0.195
5086	284991.351	3609245.134	136.762	0.138
5096	323683.877	3645147.588	131.433	0.177

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
5097	345485.663	3617921.900	99.037	0.193
5098	338529.100	3630042.453	127.087	0.133

ACCURACY CONCLUSIONS

Brush Lands and Trees Land Cover Classification Supplemental Vertical Accuracy (SVA) tested 0.248 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Brush Lands and Trees. Errors larger than 95th percentile includes:

- Point 50006, Easting 291486.382, Northing 3621408.654, Z-Error 0.258 meters

Table 5.8: QA/QC Analysis, Forest and Fully Grown, UTM 16N, NAD83, NAVD88 GEOID12A, Lauderdale, MS

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
6000	355782.855	3587110.878	93.872	0.048
6001	355812.593	3587120.662	93.752	0.022
6002	355841.687	3587129.996	93.840	0.010
6003	355870.774	3587141.280	93.579	0.009
6004	355849.891	3587171.731	93.618	0.108
6005	355825.322	3587153.810	93.793	0.043
6006	355798.179	3587133.638	93.938	0.028
6007	345029.766	3550019.055	108.452	0.038
6008	345041.613	3550038.993	109.150	0.030
6009	345054.430	3550059.551	109.688	0.092
6010	345071.106	3550086.347	110.997	0.103
6011	345079.379	3550098.559	111.717	0.027
6012	345054.379	3550128.728	112.194	0.094
6013	345033.591	3550161.267	113.180	0.020

Point ID	Easting (UTM meters)	Northing (UTM meters)	Elevation (meters)	Abs. Dz (meters)
6014	300677.692	3584581.696	112.596	0.034
6015	300674.148	3584552.110	112.728	0.072
6016	300671.826	3584523.129	112.542	0.048
6017	300666.640	3584489.636	112.597	0.033
6018	300654.596	3584454.032	112.647	0.007
6019	300688.019	3584435.765	112.422	0.002
6020	300720.401	3584420.796	112.429	0.011
6021	301656.148	3632305.744	119.849	0.191
6022	301640.191	3632283.195	119.886	0.134
6023	301630.866	3632258.626	120.011	0.051
6024	301618.208	3632235.41	119.916	0.124
6025	301602.126	3632215.081	119.954	0.146
6026	301729.288	3632268.803	120.169	0.101
6027	301723.372	3632239.814	120.206	0.054
6028	301719.249	3632220.827	120.217	0.153
6035	307401.721	3658322.078	150.23	0.02
6036	307377.857	3658383.256	151.637	0.103
6037	307368.73	3658418.058	153.074	0.186
6038	307357.539	3658455.932	154.506	0.044
6039	307351.159	3658491.373	155.852	0.128
6040	307367.434	3658433.737	153.792	0.068
6041	307332.088	3658425.405	152.784	0.046

ACCURACY CONCLUSIONS

Forested and Fully Grown Land Cover Classification Supplemental Vertical Accuracy (SVA) tested 0.186 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Forested and Fully Grown errors larger than 95th percentile include:

- Point 6027, Easting 301656.148, Northing 3632305.7440 Z-Error 0.191 meters

CONSOLIDATED VERTICAL ACCURACY ASSESSMENT

ACCURACY CONCLUSIONS

Consolidated Vertical Accuracy (CVA) tested 0.228 meters consolidated vertical accuracy at the 95th percentile level, derived according to ASPRS Guidelines for Vertical Accuracy Reporting for LiDAR Data. Tested against the DEM. Based on the 95th percentile error in all land cover categories combined. Errors larger than 95th percentile include:

- Point 4004, Easting 300924.235, Northing 3592297.418, Z-Error 0.233 meters
- Point 5007, Easting 308265.501, Northing 3612060.746, Z-Error 0.234 meters
- Point 4098, Easting 348138.983, Northing 3630855.28, Z-Error 0.242 meters
- Point 5006, Easting 291486.382, Northing 3621408.654, Z-Error 0.258 meters
- Point 4019, Easting 329153.631, Northing 3544927.948, Z-Error 0.282 meters
- Point 4096, Easting 323984.844, Northing 3638881.316, Z-Error 0.293 meters

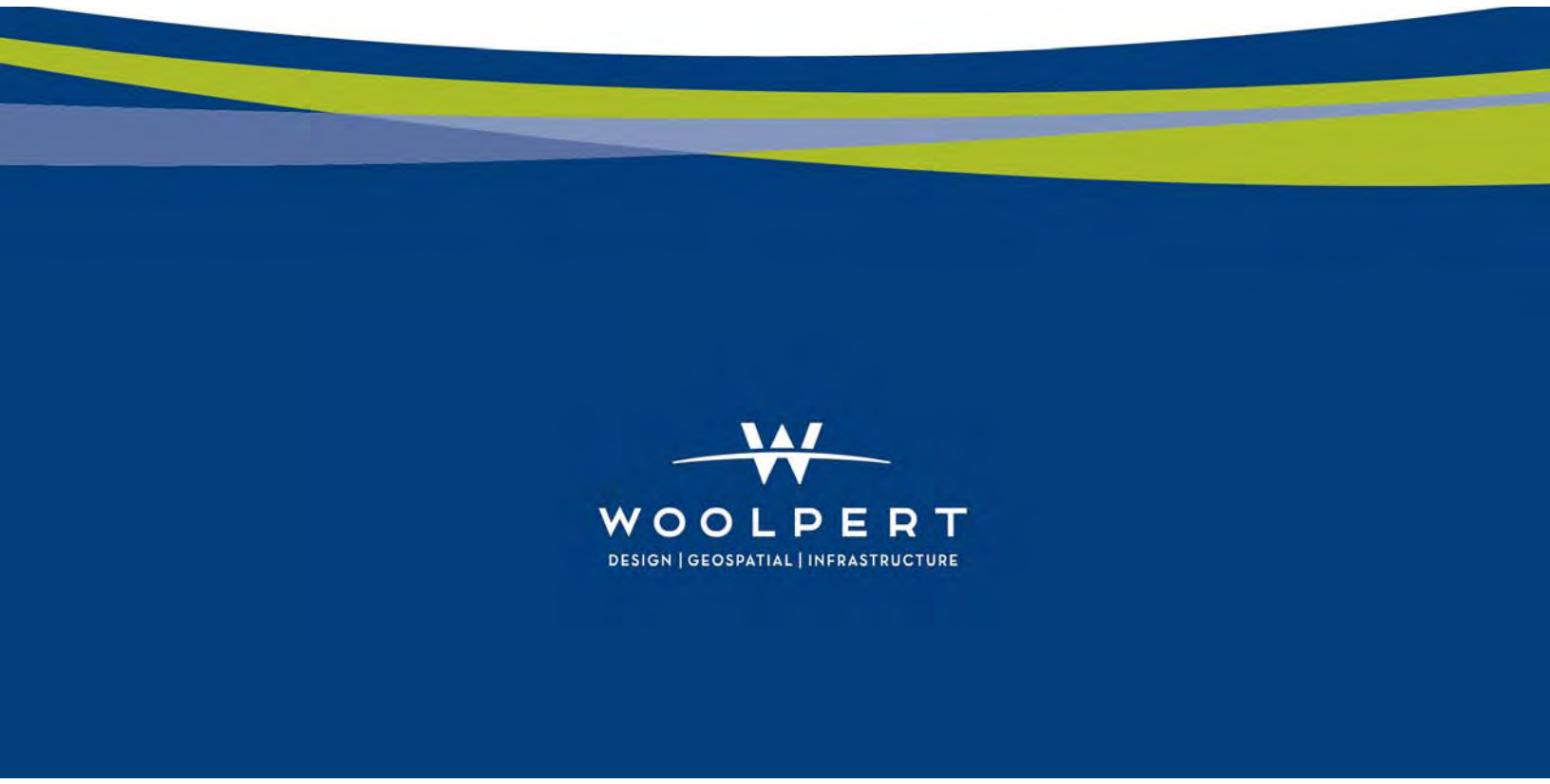
Approved By:			
Title	Name	Signature	Date
Associate LiDAR Specialist Certified Photogrammetrist #1281	Qian Xiao		October 24, 2013

SECTION 6: FINAL DELIVERABLES

FINAL DELIVERABLES

The final LiDAR deliverables are listed below. The final LiDAR data was delivered in a UTM projection tiling format, based on a modular layout. The tiles were clipped to eliminate overlap between adjacent tiles. The 1500 meter x 1500 meter tile file naming was derived from the National Grid naming convention.

- LAS v1.2 classified point cloud NAD83 UTM16 meters, NAVD88 GEOID12A meters
- LAS v1.2 raw unclassified point cloud flight line strips no greater than 2GB NAD83 UTM16 meters, NAVD88 GEOID12A meters
- 1 meter DEM, ERDAS IMG format. NAD83 UTM16 meters, NAVD88 GEOID12A meters
- 8-bit gray scale intensity images, clipped to match the reference tiling scheme
- Hydrologic breaklines in ESRI shape file format
- Tile Layout provided as ESRI shapefile
- Control provided as ESRI shapefile
- FGDC compliant metadata by product in XML format
- LiDAR processing report in pdf format
- Ground control survey report in pdf format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