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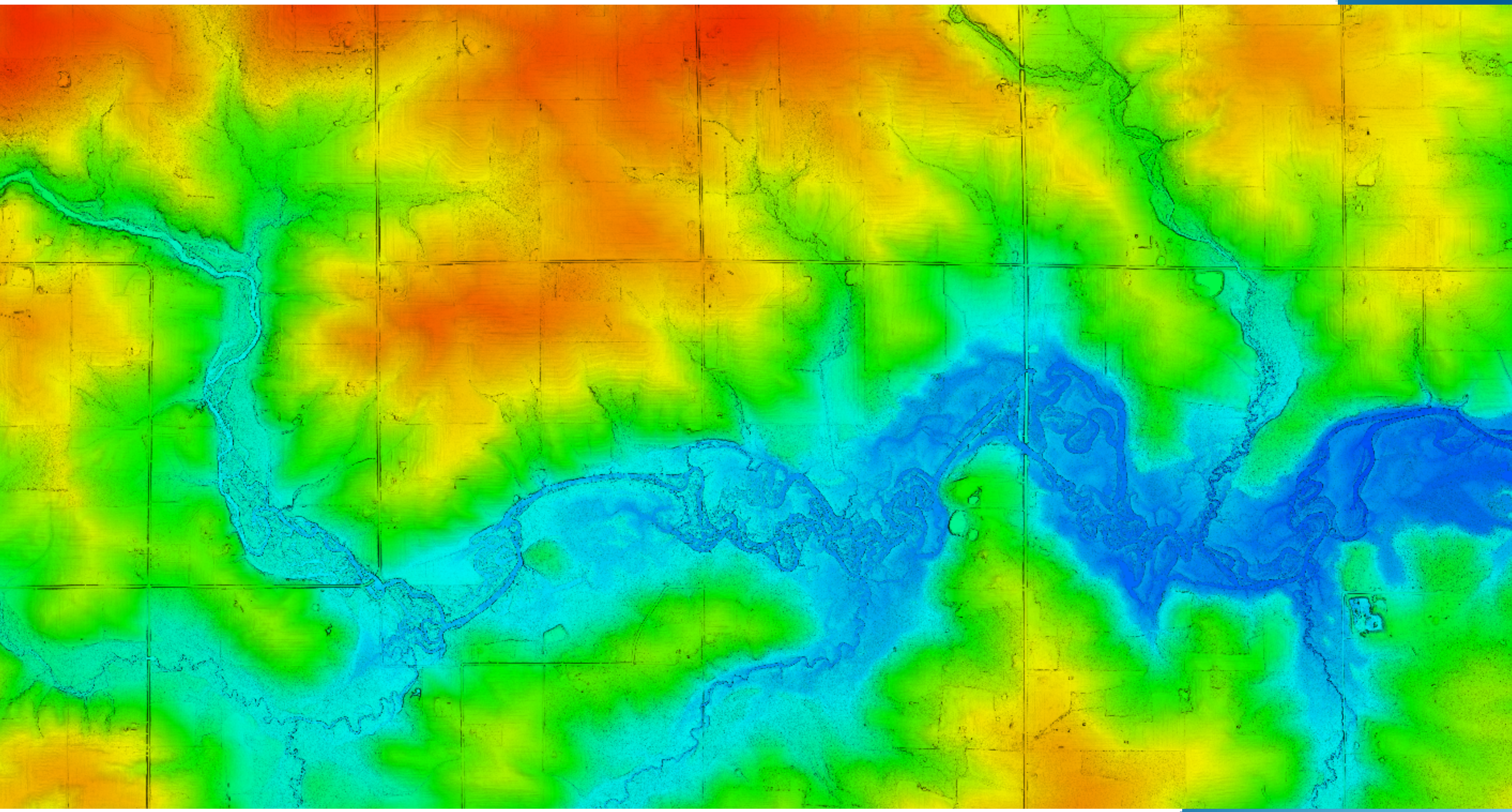

Submitted: November 4, 2022

37876_WI_Statewide_2021_B21 LIDAR PROCESSING REPORT

2022

Project ID: 218064
Work Unit: 300038

Prepared for:

USGS
science for a changing world

National Map Help Desk: tnm_help@usgs.gov

Prepared by:

NV5 GEOSPATIAL

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Contents

List of Figures

List of Tables

List of Appendices

1. Summary / Scope

1.1. Summary

This report contains a summary of the 37876_WI_Statewide_2021_B21, Work Unit 300038 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on April 8, 2021. The task order yielded a project area covering 6,730 square miles across 8 counties in Wisconsin with work unit 300038 accounting for 813 square miles in Juneau. The intent of this document is only to provide specific validation information for the data acquisition/collection, processing, and production of deliverables completed as specified in the task order.

1.2. Scope

Aerial topographic lidar was acquired using state of the art technology along with the necessary surveyed ground control points (GCPs) and airborne GPS and inertial navigation systems. The aerial data collection was designed with the following specifications listed in Table 1 below.

Table 1. Originally Planned Lidar Specifications

Average Point Density	Flight Altitude (AGL)	Field of View	Minimum Side Overlap	RMSEz
2 pts / m^2	2,300 m	60°	20%	≤ 10 cm

1.3. Coverage

The project boundary covers 813 square miles over Wisconsin. Project extents are shown in Figure 1.

1.4. Duration

Lidar data was acquired from March 29, 2021 to April 22, 2021 in 4 total lifts. See “Section: 2.4. Time Period” for more details.

1.5. Issues

There were no issues to report.

37876_WI_Statewide_2021_B21 Work Unit 300038 Projected Coordinate System: NAD_1983_2011_WISCRS_Adams_and_Juneau_Feet Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID 18) Units: US Survey Feet	
Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	• 2-foot Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format • 2-foot Intensity images in GeoTIFF format
Vectors	Shapefiles (*.shp) • Project Boundary • Lidar Tile Index • Calibration and QC Checkpoints (NVA/VVA) • Continuous Hydro-flattened Breaklines
Reports	Reports in PDF format • Focus on Delivery • Focus on Accuracy • Survey Report • Processing Report
Metadata	XML Files (*.xml) • Breaklines • Classified Point Cloud • DEM • Intensity Imagery

37876_WI_Statewide_2021_B21 Juneau
Work Unit 300038 Boundary

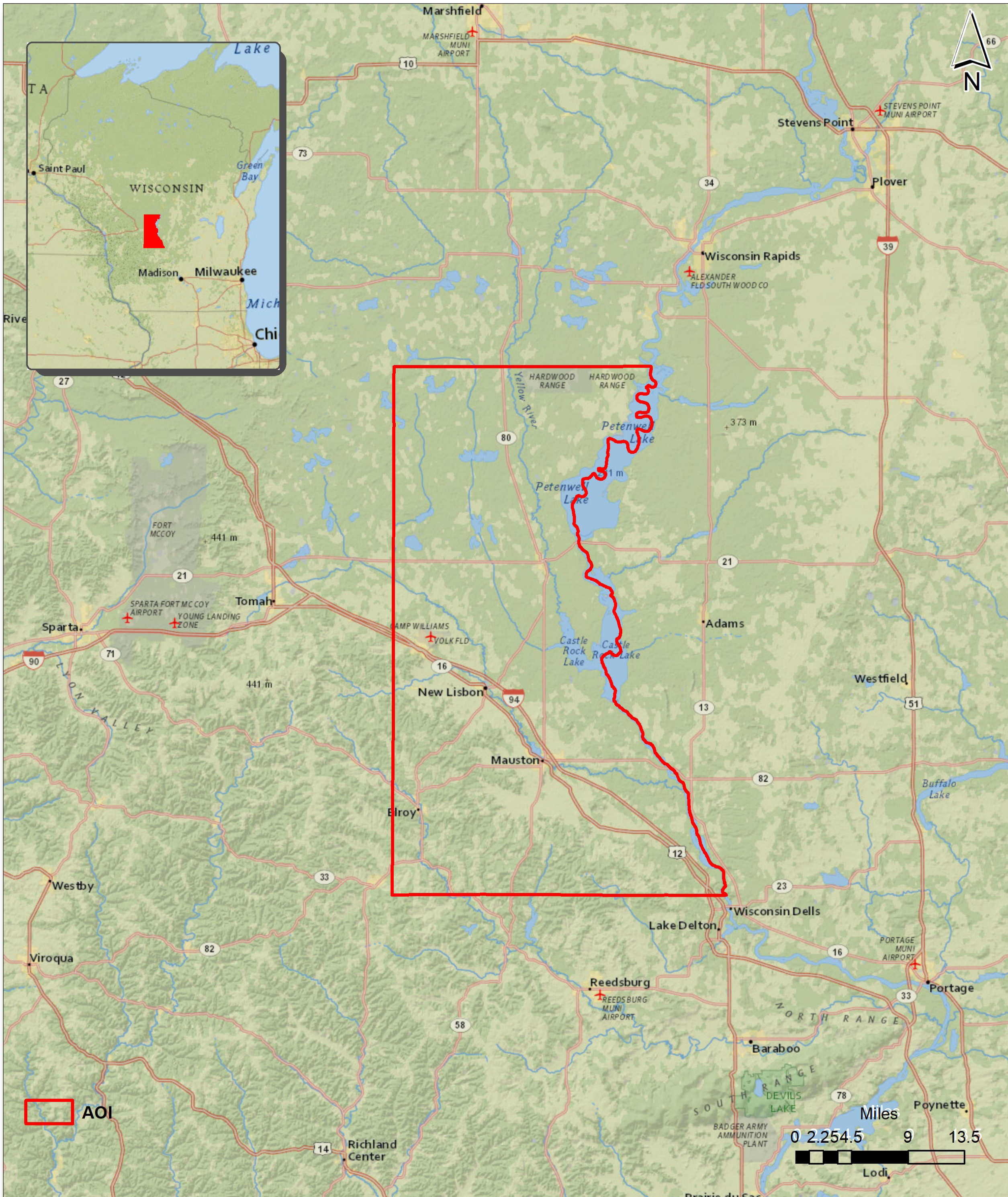


Figure 1. Work Unit Boundary

2. Planning / Equipment

2.1. Flight Planning

Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount / type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity.

Detailed project flight planning calculations were performed for the project using RiParameter planning software.

2.2. Lidar Sensor

NV5 Geospatial utilized Riegl lidar sensors (Figure 2), serial number(s) 4040 for data acquisition.

The Riegl 1560i system has a laser pulse repetition rate of up to 2 MHz resulting in more than 1.3 million measurements per second. The system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to an unlimited number of targets per pulse from the laser.

A brief summary of the aerial acquisition parameters for the project are shown in the lidar System Specifications in Table 2.

Table 2. Lidar System Specifications

		Riegl VQ1560i (SN4040)
Terrain and Aircraft Scanner	Flying Height	2300 m
	Recommended Ground Speed	180 kts
Scanner	Field of View	58.5°
	Scan Rate Setting Used	2 x 160 Hz
Laser	Laser Pulse Rate Used	1000 kHz
	Multi Pulse in Air Mode	yes
Coverage	Full Swath Width	2577 m
	Line Spacing	0.558 m
Point Spacing and Density	Average Point Spacing	0.71 m
	Average Point Density	2 x 1.16 pts / m^2

Figure 2. Riegl VQ1560i Lidar Sensor

2.3. Aircraft

All flights for the project were accomplished through the use of customized planes. Plane type and tail numbers are listed below.

Lidar Collection Planes

- Cessna Conquest 2, Tail Number(s): N441CJ

These aircraft provided an ideal, stable aerial base for lidar acquisition. These aerial platforms have relatively fast cruise speeds, which are beneficial for project mobilization / demobilization while maintaining relatively slow stall speeds, proving ideal for collection of high-density, consistent data posting using a state-of-the-art Riegl VQ1560i, VQ1560ii, LMS-Q1560 lidar systems. Some of NV5 Geospatial's operating aircraft can be seen in Figure 3 below.

Figure 3. Some of NV5 Geospatial's Planes

2.4. Time Period

Project specific flights were conducted between March 29, 2021 to April 02, 2021. Four aircraft lifts were completed. Accomplished lifts are listed below.

Lift	Start UTC	End UTC
03292021A (SN4040,N441CJ)	3/29/2021 1:31:58 PM	3/29/2021 4:12:17 PM
04012021B (SN4040,N441CJ)	4/01/2021 2:38:51 PM	4/01/2021 6:19:37 PM
04012021C (SN4040,N441CJ)	4/01/2021 8:35:51 PM	4/01/2021 10:38:25 PM
04022021A (SN4040,N441CJ)	4/02/2021 2:08:51 PM	4/02/2021 6:17:38 PM

3. Processing Summary

3.1. Flight Logs

Flight logs were completed by Lidar sensor technicians for each mission during acquisition. These logs depict a variety of information, including:

- Job / Project #
- Flight Date / Lift Number
- FOV (Field of View)
- Scan Rate (HZ)
- Pulse Rate Frequency (Hz)
- Ground Speed
- Altitude
- Base Station
- PDOP avoidance times
- Flight Line #
- Flight Line Start and Stop Times
- Flight Line Altitude (AMSL)
- Heading
- Speed
- Returns
- Crab

Notes: (Visibility, winds, ride, weather, temperature, dew point, pressure, etc). Project specific flight logs for each sortie are available in Appendix A.

3.2. Lidar Processing

Applanix + POSPac software was used for post-processing of airborne GPS and inertial data (IMU), which is critical to the positioning and orientation of the lidar sensor during all flights. Applanix POSPac combines aircraft raw trajectory data with stationary GPS base station data yielding a “Smoothed Best Estimate Trajectory” (SBET) necessary for additional post processing software to develop the resulting geo-referenced point cloud from the lidar missions.

During the sensor trajectory processing (combining GPS & IMU datasets) certain statistical graphs and tables are generated within the Applanix POSPac processing environment which are commonly used as indicators of processing stability and accuracy. This data for analysis include: max horizontal / vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory.

Point clouds were created using the RiPROCESS software. The generated point cloud is the mathematical three dimensional composite of all returns from all laser pulses as determined from the aerial mission. The point cloud is imported into GeoCue distributive processing software. Imported data is tiled and then calibrated using TerraMatch and proprietary software. Using TerraScan, the vertical accuracy of the surveyed ground control is tested and any bias is removed from the data. TerraScan and TerraModeler software packages are then used for automated data classification and manual cleanup. The data are manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler.

DEMs and Intensity Images are then generated using proprietary software. In the bare earth surface model, above-ground features are excluded from the data set. Global Mapper is used as a final check of the bare earth dataset.

Finally, proprietary software is used to perform statistical analysis of the LAS files.

Software	Version
Applanix + POSPac	8.6
RiPROCESS	1.8.6
GeoCue	2020.1.22.1
Global Mapper	19.1;20.1
TerraModeler	21.008
TerraScan	21.016
TerraMatch	21.007

3.3. LAS Classification Scheme

The classification classes are determined by Lidar Base Specifications 2020, Revision A and are an industry standard for the classification of lidar point clouds. All data starts the process as Class 1 (Unclassified), and then through automated classification routines, the classifications are determined using TerraScan macro processing.

The classes used in the dataset are as follows and have the following descriptions:

Table 3. LAS Classifications

	Classification Name	Description
1	Processed, but Unclassified	Laser returns that are not included in the ground class, or any other project classification
2	Bare earth	Laser returns that are determined to be ground using automated and manual cleaning algorithms
7	Low Noise	Laser returns that are often associated with scattering from reflective surfaces, or artificial points below the ground surface
9	Water	Laser returns that are found inside of hydro features
17	Bridge Deck	Laser returns falling on bridge decks
18	High Noise	Laser returns that are often associated with birds or artificial points above the ground surface
20	Ignored Ground	Ground points that fall within the given threshold of a collected hydro feature.

3.4. Classified LAS Processing

The bare earth surface is then manually reviewed to ensure correct classification on the Class 2 (Ground) points. After the bare- earth surface is finalized; it is then used to generate all hydro-breaklines through heads-up digitization.

All ground (ASPRS Class 2) lidar data inside of the Lake Pond and Double Line Drain hydro flattening breaklines were then classified to water (ASPRS Class 9) using proprietary tools. A buffer of 3 feet was also used around each hydro flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 20). All Lake Pond Island and Double Line Drain Island features were checked to ensure that the ground (ASPRS Class 2) points were reclassified to the correct classification after the automated classification was completed.

Any noise that was identified either through manual review or automated routines was classified to the appropriate class (ASPRS Class 7 and/or ASPRS Class 18) followed by flagging with the withheld bit.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper is used as a final check of the bare earth dataset. GeoCue was then used to create the deliverable industry-standard LAS files for all point cloud data. NV5 Geospatial's proprietary software was used to perform final statistical analysis of the classes in the LAS files, on a per tile level to verify final classification metrics and full LAS header information.

3.5. Hydro-Flattened Breakline Processing

Class 2 lidar was used to create a bare earth surface model. The surface model was then used to heads-up digitize 2D breaklines of Inland Streams and Rivers with a 100 foot nominal width and Inland Ponds and Lakes of 2 acres or greater surface area.

Elevation values were assigned to all Inland streams and rivers using NV5 Geospatial's proprietary software.

All ground (ASPRS Class 2) lidar data inside of the collected inland breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 3 feet was also used around each hydro-flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 20).

The breakline files were then translated to Esri file geodatabase format using Esri conversion tools.

Breaklines are reviewed against lidar intensity imagery to verify completeness of capture. All breaklines are then compared to TINs (triangular irregular networks) created from ground only points prior to water classification. The horizontal placement of breaklines is compared to terrain features and the breakline elevations are compared to lidar elevations to ensure all breaklines match the lidar within acceptable tolerances. Some deviation is expected between breakline and lidar elevations due to monotonicity, connectivity, and flattening rules that are enforced on the breaklines. Once completeness, horizontal placement, and vertical variance is reviewed, all breaklines are reviewed for topological consistency and data integrity using a combination of Esri Data Reviewer tools and proprietary tools.

3.6. Hydro-Flattened Raster DEM Processng

Hydro-Flattened DEMs (topographic) represent a lidar-derived product illustrating the grounded terrain and associated breaklines (as described above) in raster form. NV5 Geospatial's proprietary software was used to take all input sources (bare earth lidar points, bridge and hydro breaklines, etc.) and create a Triangulated Irregular Network (TIN) on a tile-by-tile basis. Data extending past the tile edge is incorporated in this process so that proper triangulation can occur. From the TIN, linear interpolation is used to calculate the cell values for the raster product. The raster product is then clipped back to the tile edge so that no overlapping cells remain across the project area. A 32-bit floating point GeoTIFF DEM was generated for each tile with a pixel size of 2-foot. NV5 Geospatial's proprietary software was used to write appropriate horizontal and vertical projection information as well as applicable header values into the file during product generation. Each DEM is reviewed in Global Mapper to check for any surface anomalies and to ensure a seamless dataset. NV5 Geospatial ensures there are no void or no-data values (-999999) in each derived DEM. This is achieved by using propriety software checking all cell values that fall within the project boundary. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the DEMs against what is required before final delivery.

3.7. Swath Separation Raster Processng

Swath Separation Images are rasters that represent the interswath alignment between flight lines and provide a qualitative evaluation of the positional quality of the point cloud. NV5 Geospatial proprietary software generated 2-foot raster images in GeoTIFF format using last returns, excluding points flagged with the withheld bit, and using a point-in-cell algorithm. Images are generated with a 75% intensity opacity and (4) absolute 8-cm intervals, see below for interval coloring. Intensity images are linearly scaled to a value range specific to the project area to standardize the images and reduce differences between individual tiles. Appropriate horizontal projection information as well as applicable header values are written to the file during product generation. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the images against what is required before final delivery.

(green)	0-8cm
(yellow)	8-16cm
(orange)	16-24cm
(red)	>24cm

3.8. Maximum Surface Height Raster Processing

Maximum Surface Height rasters (topographic) represent a lidar-derived product illustrating natural and built-up features. NV5 Geospatial's proprietary software was used to take all first-return classified lidar points, excluding those flagged with a withheld bit, and create a Triangulated Irregular Network (TIN) on a tile-by-tile basis. Data extending past the tile edge is incorporated in this process so that proper triangulation can occur. From the TIN, linear interpolation is used to calculate the cell values for the raster product. The raster product is then clipped back to the tile edge so that no overlapping cells remain across the project area. A 32-bit floating point GeoTIFF was generated for each tile with a pixel size of 2-foot. NV5 Geospatial's proprietary software was used to write appropriate horizontal and vertical projection information as well as applicable header values into the file during product generation. Each maximum surface height raster is reviewed in Global Mapper to check for any anomalies and to ensure a seamless dataset. NV5 Geospatial ensures there are no void or no-data values (-999999) in each derived raster. This is achieved by using propriety software checking all cell values that fall within the project boundary. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the DEMs against what is required before final delivery.

37876_WI_Statewide_2021_B21 Juneau Work Unit 300038 Tile Layout

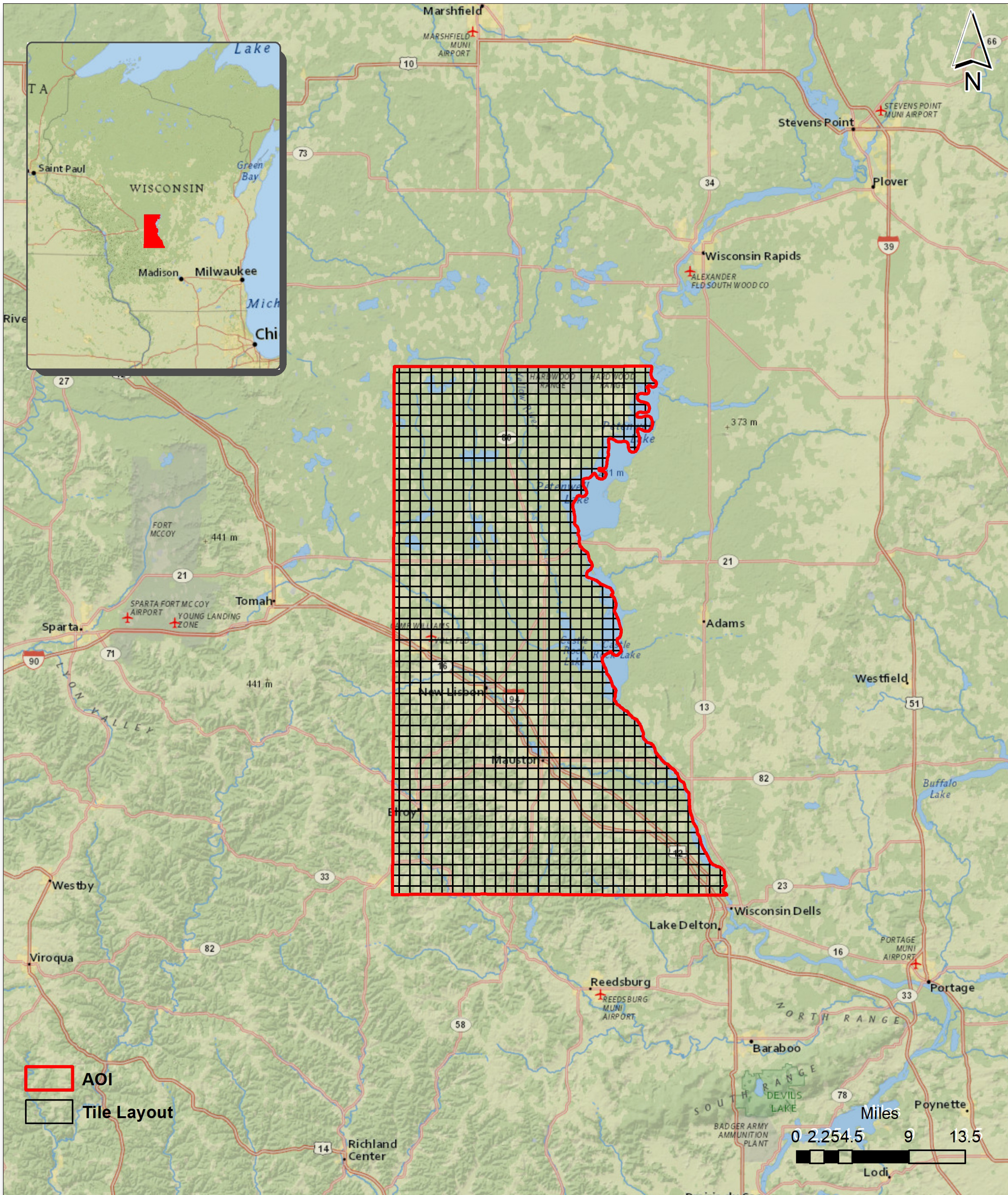


Figure 4. Lidar Tile Layout

4. Project Coverage Verification

Coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 5.

37876_WI_Statewide_2021_B21 Juneau Work Unit 300038 Lidar Coverage

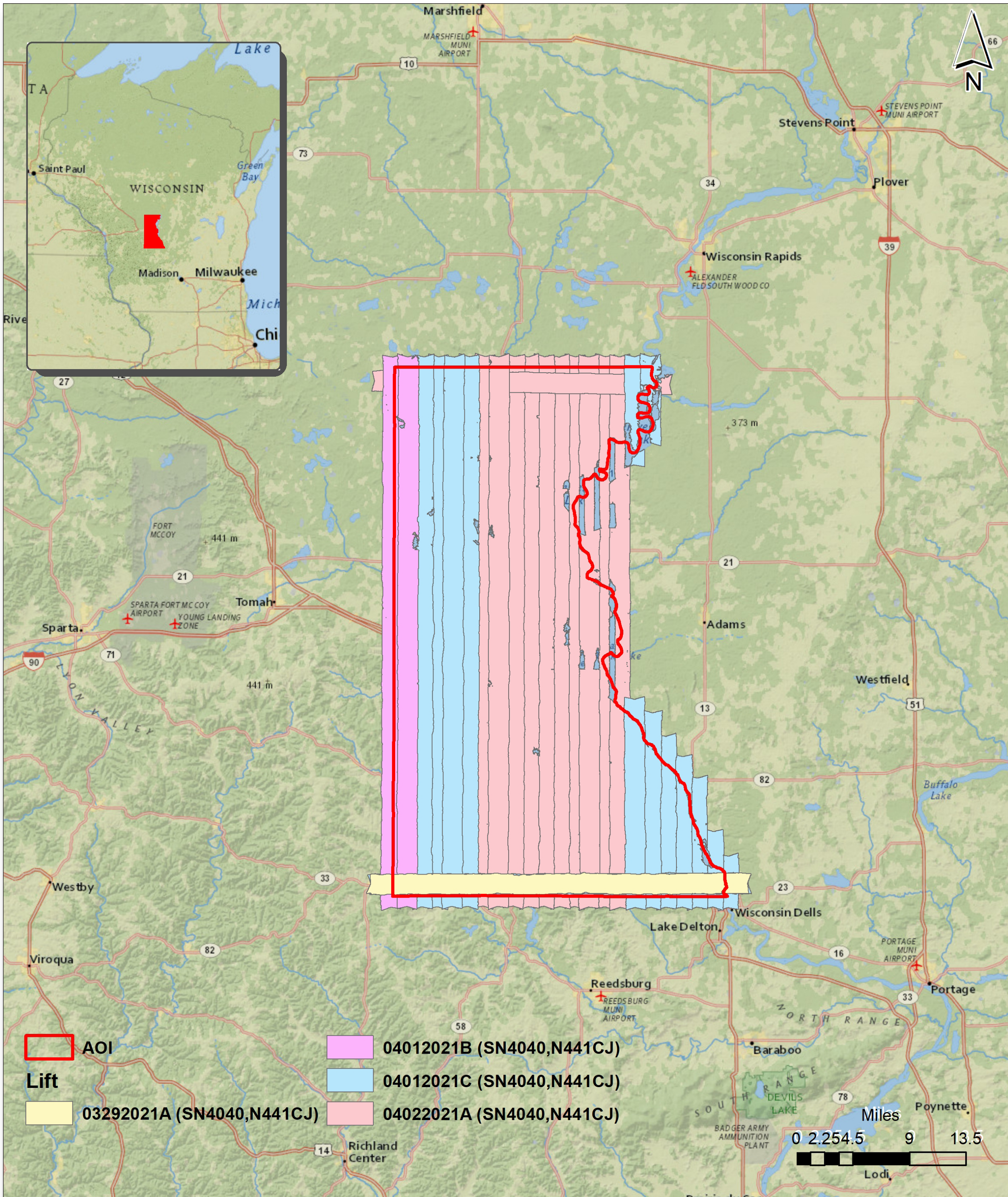


Figure 5. Lidar Coverage

5. Geometric Accuracy

5.1. Horizontal Accuracy

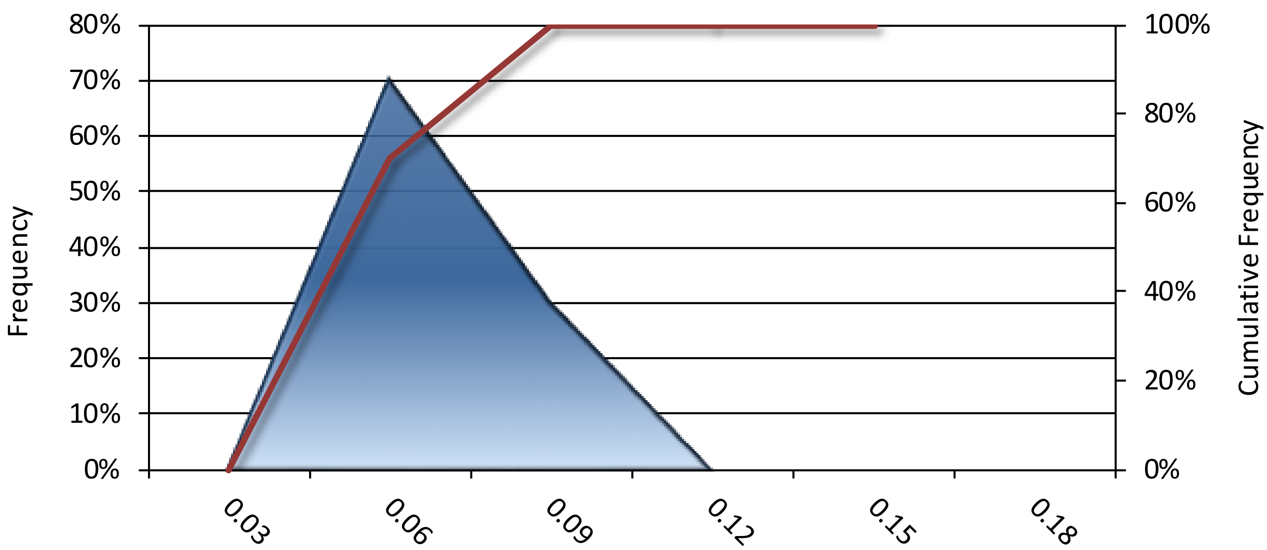
Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained RMSEr value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial Data Accuracy (NSSDA) reporting standard where a theoretical point will fall within the obtained radius 95% of the time. Based on a flying altitude of 7,545 feet, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters (0.049 ft), this project was compiled to meet 0.25 (0.82 ft) meter horizontal accuracy at the 95% confidence level. A summary is shown below.

Horizontal Accuracy	
$RMSE_r$	0.47 ft
	0.14 m
ACC_r	0.82 ft
	0.25 m

5.2. Relative Vertical Accuracy

Relative vertical accuracy refers to the internal consistency of the data set as a whole: the ability to place an object in the same location given multiple flight lines, GPS conditions, and aircraft attitudes. When the lidar system is well calibrated, the swath-to-swath vertical divergence is low (<0.10 meters). The relative vertical accuracy was computed by comparing the ground surface model of each individual flight line with its neighbors in overlapping regions. The average (mean) line to line relative vertical accuracy for the WI_Statewide_2021_B21 project was 0.050 feet (0.015 meters). A summary is shown below.

Relative Vertical Accuracy	
Sample	117 flight line surfaces
Average	0.050 ft
	0.015 m
Median	0.046 ft
	0.014 m
RMSE	0.052 ft
	0.016 m
Standard Deviation (1σ)	0.012 ft
	0.003 m
1.96σ	0.023 ft
	0.007 m



Juneau County, Wisconsin Relative Vertical Accuracy (ft) Total Compared Points (n = 10,446,343,727)

Project Report Appendices

The following section contains the appendices as listed in the 37876_WI_8_Counties Lidar Project Report.

Appendix A

Flight Logs

Julian Day	112	Flight	A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Krista R
Location	Eau Claire WI Airport	**Operator**	Daniel A
Mission Objective			

System	Riegl Q1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- -3C
H- 86%
AMLS- 278m
Hpa-1016

Time to next maintenance: ________ ○ 50 hr ⦿ 100 hr

Aircraft Block Time				
Engine On	13:10	**Takeoff**	13:30	
Engine Off	18:59	**Landing**	18:49	
Total	5.8 hrs	**Total**	5.3 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1317	1322
Post Mission	1851	1856

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	
F8		-	1345	1350			-	
1028		092	1403	1422			140330	
X-Tie		-	1425	1427			142544	
1006		274	1439	1458			143928	
1005		092	1505	1521			150504	
1004		274	1527	1545			152737	
1003		092	1549	1606			154958	
1002		274	1612	1629			161217	
1001		092	1634	1651			163415	
X-Tie		-	1655	1658			165537	
F8		-	1658	1703			-	
F8		-	1752	1757			-	
X-Tie		-	1800	1801			180020	
1062		181	1808	1823			180845	
F8		-	1823	1828			-	

Julian Day 112	Flight A

LIDAR Flight Log

A I R B O R N E IMAGING
A Clean Harbors Company

Date April 22, 2021	**Aircraft** C-GJMT		
Project 3218_QSI_PierceMarathon	**Pilot** Krista R		
Location Eau Claire WI Airport	**Operator** Daniel A		
Mission Objective			

System	Riegl Q1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

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Static Alignment	GPS Time	
	Start	End
Pre Mission	1317	1322
Post Mission	1851	1856

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	
		-					-	

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Julian Day	112	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date April 22, 2021		**Aircraft**	C-GJMT
Project 3218_QSI_PierceMarathon		**Pilot**	Krista R
Location Eau Claire WI Airport		**Operator**	Daniel A
Mission Objective			

System	Riegl Q1560
Unit	64
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GPS Rx	Trimble GNSS17
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Scanner 2 Drive	

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Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ______	

Julian Day 112	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	April 22, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Krista R
Location	Eau Claire WI Airport	**Operator**	Daniel A
Mission Objective			

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Flight Line	**LiDAR File Name**	**Flight Direction**	**GPS Time**		**Line Aborted**		**Mission ID**	**Comments**
			Start	**End**	**Time**	**nmi to End**	Time Stamp ________	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Krista R
Location	Eau Claire WI Airport	**Operator**	Daniel A
Mission Objective			

System	Riegl Q1560
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Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 4/1/2021 Lift: (A) B C D E Pg 1 of 1

Project: WI 3DEP Proj #: 37876 Flight Mgmt File: 20210401_5N4045_A_37876

Aircraft: 473TW Begin Hobbs: 5794.0 End Hobbs: 5800.3 Total: 6.3 Pilot: Dan Luckett Co-Pilot: Tech: Noah Edelson

Dep Apt: KLSE Dep Time (Lcl): 10:06 (Z): 15:06 Arr Apt: KCMT Arr Time (Local): 4:29 (Z): 2129 Tot Time Aloft: 6:23

CORS: (Y) / N Sta 1: WN Sta 2: Flyovers: Y / N If Y, times: Sta1) Sta2)

GPS Unit: Y / N Sta 1: Sta 2: Flyovers: Y / N If Y, times: Sta1) Sta2)

Gd Temp beg: °c End: °c OAT beg: °c End: °c Altimeter begin: end:

LiDAR								
Type 1560ii	Serial # 4045	Alt AGL 2300	Alt AMSL	Avg Terr Ht	Max Gdspd 180, flew 140	Avg Pt Spacing	Beg GB 0	Storage Name/# 316
FOV 58.52	Scan Freq 500kHZ	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100%	PPSM 2	End GB 200	
							Tot GB 200	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
1	N	164431	165434	130	.45/17	8700ft	2	0	Full sun, calm air
2	S	165602	170518	152	.46/21	2660m	-2	0	tailwind, started line ~160, slowed 140 1/3 in
3	N	170646	171648	132	.45/21	2665	3	0	headwind
4	S	171810	172750	133	.48/19	2635	-3	0	less than 7sats warning mid line
5	N	172845	173033	132	.42/21	2610	3	0	
6	S	173928	175313	145	.44/20	2580	0	0	Some lakes still have ice, ground looks snowfree
7	N	175412	180843	133	.87/21	2575	3	0	less than 7sats warning <1sec end line
8	S	180932	182358	145	.86/22	2570	-3	0	
9	N	182428	183353	135	.91/23	2560	3	0	
10	S	183448	185343	140	.89/21	2555	-3	0	
11	N	185729	191410	134	.46/22	2545	3	0	
12	S	191507	193111	143	.44/22	2540	-2	0	
13	N	193214	194855	140	.43/21	2525	4	0	touched on 200ft low for a second mid line
14	S	194942	200858	142	.83/23	2510	-4	-w-	turb starting mid line, gone by end
15	N	200907	202830	130	.87/21	2495	5	0	
16	S	203125	205323	142	.87/	2500	-5	-w-	off and on light turb last half line
17	N	205220	211352	136	.45/22	2495	5	—	few small turb intervals
X-line	SW	211519	211716						

Total Proj Lines: 125 Lines Flown: 17 Lines Remain: 62 Online Time: 4.5 Mob Time: 1.8 Notes:

4/1/21 B WI 3PEP 37876

Departure 5:27 lcl, 2227 Z from KIMT Arrival KLSE 8:15 local, 115 Z total aloft: 2:48

Line #	HDG	Start	Stop	Speed	PDOP sats	GPS Alt.	Crab	Turb	Notes
120	E	224008	225336	144	.98/23	2530	9	0	Full Sun
18	S	230212	232254	142	.98/22	2500	-3	0	
19	N	232355	234812	138	.85/23	2495	4	———	< 7 GPS sats warning mid line,
20	S	234611	632	148	.87/21	2490	-4		< 7 GPS sats warning first 4-8 miles
4 lines flown	58 remain			1.4 Avg. time	1.5 more	2.9 total			

Storage: 316
start: 200
end 263
total: 61

Same parameters as A

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 4/2/2021

Lift: A B (C) D E   Pg 1 of 1

Project: WI 3DEP   Proj #: 37876   Flight Mgmt File: 20210402_SN4045_C_37876

Aircraft: 473JW   Begin Hobbs: 5204.1   End Hobbs: Total: Pilot: Dan Luckett   Co-Pilot: Tech: Noah Edelson

Dep Apt: KCWA   Dep Time (Lcl): 2:58   (Z): 1958   Arr Apt: KSDM   Arr Time (Local): 8:21   (Z): 121   Tot Time Aloft: 5:23

CORS: (Y) / N   Sta 1: PPP   Sta 2:   Flyovers: Y / N   If Y, times: Sta1)   Sta2)

GPS Unit: Y / N   Sta 1:   Sta 2:   Flyovers: Y / N   If Y, times: Sta1)   Sta2)

Gd Temp beg: °c   End: °c   OAT beg: °c   End: °c   Altimeter begin: end:

LiDAR						
Type 1560ii	Serial # 4045	Alt AGL 2300 m	Alt AMSL	Avg Terr Ht	Max Gdspd 180, set to 158	Avg Pt Spacing
FOV 58.52	Scan Freq 500kHz	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100%	PPSM 2

Beg GB: Storage Name/#:
End GB:
Tot GB:

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
14	E	202550	204116	153	.87/23	2470	-2	0	hazey skies, high broken overcast, <7 Sats GPS warning, had all GPS before/after
35	S	204?62	204728	143	.88/23	2470	-7	0	
34	N	205128	205534	143	.88/23	2465	7	0	
33	S	210327	211352	151	.94/22	2470	-8	0	
32	N	211456	212547	144	.82/25	2475	7	0	<7 GPS sats warning mid line, out of AOI
31	S	213712	212637	155	.85/24	2475	-9	0	
30	N	213817	214407	151	.87/25	2475	8	0	
29	S	215017	220036	155	.83/26	2480	-9	0	<7 GPS sats warning, 6 seconds few miles in
28	N	220139	221940	148	.86/26	2470	9	0	
27	S	222117	223901	152	.84/25	2480	-8	0	
26	N	224006	225800	144	.95/23	2480	7	0	
25	S	225925	231624	150	.91/23	2480	-7	0	line didn't stop recording after line
24	N	231856	233353	151	.84/25	2490	10	0	line didn't trigger automatically, started logging ~3 seconds 2/10 1.1
23	S	233901	2358	148	.85/24	2490	-7	0	<7 GPS Sats warning ~3.5 miles about 10 miles into line
22	N	235421	1834	153	.90/25	2495	8	—	sporadic light turb northern 1/3 line
21	S	1456	3941	152	1.06/22	2500	-9	—	brief light turb same spot as last line, sunset during line
24	N	4134							reflew first 15 seconds to cover the 1st start

Total Proj Lines: Lines Flown: 16.1   Lines Remain: 0   Online Time: 4.3   Mob Time: .8   Notes:

day total: 4.3   1.7

Julian Day 091 | **Flight** A

LIDAR Flight Log

Date	April 01, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S-Krista R
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T---2C
H-37%
AMLS- 278m
Hpa-1035

Time to next maintenance: ______ ○ 50 hr ◉ 100 hr

Aircraft Block Time					
Engine On	15:26	**Takeoff**	15:54		
Engine Off	22:18	**Landing**	22:08		
Total	6.9 hrs	**Total**	6.2 hrs		

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	89	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1537	1542
Post Mission	2211	2216

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp	
Test Strip		-	1602	1603			160220	
X- tie		-	1606	1618			160625	
F8		-	1624	1629			-	
1030		180	1638	1647			163858	
1031		000	1654	1706			165430	
1032		180	1712	1724			174722	
1033		000	1730	1742			173003	
1034		180	1747	1800			174722	
1035		000	1806	1819			180617	
1036		180	1824	1838			182444	
1037		000	1844	1857			184405	
1038		180	1902	1917			190224	
1039		000	1922	1937			192239	
1040		180	1942	1957			194227	
1041		000	2002	2018			200230	

Julian Day 091	Flight A

LIDAR Flight Log

Date	April 01, 2021	Aircraft	C-GJMT
Project	3218_QSI_PierceMarathon	Pilot	Andy. S-Krista R
Location	Eau Claire WI Airport	Operator	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T---2C
H-37%
AMLS- 278m
Hpa-1035

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	15:26	Takeoff	15:54	
Engine Off	22:18	Landing	22:08	
Total	6.9 hrs	Total	6.2 hrs	

Mission Plan					
AGL Height	2300	m	Pulse Rate	800Khz	
Target Speed	160	kts	Scan Rate	89	
Laser Current	100	%	FOV	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1537	1542
Post Mission	2211	2216

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	
1042		180	2022	2037			202209	
1043		000	2042	2058			204254	
1044		180	2102	2118			210256	
1045		000	2123	2138			212330	
F8		-	2139	2144			-	
		-					-	

Julian Day 091	Flight A

LIDAR Flight Log

Date	April 01, 2021	Aircraft	C-GJMT
Project	3218_QSI_PierceMarathon	Pilot	Andy. S-Krista R
Location	Eau Claire WI Airport	Operator	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T---2C
H-37%
AMLS- 278m
Hpa-1035

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time			
Engine On	15:26	Takeoff	15:54
Engine Off	22:18	Landing	22:08
Total	6.9 hrs	Total	6.2 hrs

Mission Plan					
AGL Height	2300	m	Pulse Rate	800Khz	
Target Speed	160	kts	Scan Rate	89	
Laser Current	100	%	FOV	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1537	1542
Post Mission	2211	2216

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

Julian Day	091	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	April 01, 2021	Aircraft	C-GJMT
Project	3218_QSI_PierceMarathon	Pilot	Andy. S-Krista R
Location	Eau Claire WI Airport	Operator	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T---2C
H-37%
AMLS- 278m
Hpa-1035

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	15:26	Takeoff	15:54	
Engine Off	22:18	Landing	22:08	
Total	6.9 hrs	Total	6.2 hrs	

Mission Plan					
AGL Height	2300	m	Pulse Rate	800Khz	
Target Speed	160	kts	Scan Rate	89	
Laser Current	100	%	FOV	60	degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	1537	1542
Post Mission	2211	2216

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

v 20200520

Julian Day 091	Flight A

LIDAR Flight Log

A I R B O R N E I M A G I N G
A Clean Harbors Company

Date	April 01, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S-Krista R
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T---2C
H-37%
AMLS- 278m
Hpa-1035

Time to next maintenance: ________ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 15:26	**Takeoff** 15:54			
Engine Off 22:18	**Landing** 22:08			
Total 6.9 hrs	**Total** 6.2 hrs			

Mission Plan				
AGL Height	2300 m	**Pulse Rate**	800Khz	
Target Speed	160 kts	**Scan Rate**	89	
Laser Current	100 %	**FOV**	60	degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	1537	1542
Post Mission	2211	2216

Flight Line	LiDAR File Name	Flight Direction	GPS Time Start	GPS Time End	Line Aborted Time	Line Aborted nmi to End	Mission ID Time Stamp ________	Comments

Julian Day	092	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING — A Clean Harbors Company

Date	April 02, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--8C
H-47%
AMLS-278m
Hpa-1028

Time to next maintenance: 32hrs ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 12:56	**Takeoff** 13:17			
Engine Off 17:43	**Landing** 17:35			
Total 4.8 hrs	**Total** 4.3 hrs			

Mission Plan				
AGL Height	2300	m	**Pulse Rate**	800Khz
Target Speed	160	kts	**Scan Rate**	178
Laser Current	100	%	**FOV**	60 degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	1304	1308
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp	
X-tie		-	1329	1336			132923	
F8		-	1344	1349			-	
1046		180	1355	1411			135536	
1047		000	1415	1431			141558	
1048		180	1436	1453			143644	
1049		000	1457	1512			145729	
1050		180	1518	1535			151849	
1051		000	1539	1555			153935	
1052		180	1600	1618			160046	
1053		000	1622	1637			162212	
1054		180						DR Crashed while aproching the line
								Full system restart and troubleshooting
								for 20 minutes- Riacquire crashed

Julian Day 092	Flight A

LIDAR Flight Log

A I R B O R N E IMAGING
A Clean Harbors Company

Date	April 02, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--8C
H-47%
AMLS-278m
Hpa-1028

Time to next maintenance: 32hrs ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 12:56	**Takeoff** 13:17			
Engine Off 17:43	**Landing** 17:35			
Total 4.8 hrs	**Total** 4.3 hrs			

Mission Plan				
AGL Height	2300	m	**Pulse Rate**	800Khz
Target Speed	160	kts	**Scan Rate**	178
Laser Current	100	%	**FOV**	60 degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	1304	1308
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time Start	GPS Time End	Line Aborted Time	Line Aborted nmi to End	Mission ID Time Stamp ____	Comments
		-					-	

v 20200520

Julian Day 092 | Flight A

LIDAR Flight Log

A I R B O R N E I M A G I N G
A Clean Harbors Company

Date	April 02, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--8C
H-47%
AMLS-278m
Hpa-1028

Time to next maintenance: 32hrs ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 12:56		**Takeoff** 13:17		
Engine Off 17:43		**Landing** 17:35		
Total 4.8	hrs	**Total** 4.3	hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1304	1308
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

v 20200520

Julian Day	092	Flight	A

LIDAR Flight Log

Date	April 02, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--8C
H-47%
AMLS-278m
Hpa-1028

Time to next maintenance: 32hrs ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	12:56	**Takeoff**	13:17	
Engine Off	17:43	**Landing**	17:35	
Total	4.8 hrs	**Total**	4.3 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1304	1308
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ______	

v 20200520

Julian Day 092 | Flight A

LIDAR Flight Log

Date	April 02, 2021	Aircraft	C-GJMT
Project	3218_QSI_PierceMarathon	Pilot	Andy. S
Location	Eau Claire WI Airport	Operator	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--8C
H-47%
AMLS-278m
Hpa-1028

Time to next maintenance: 32hrs ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	12:56	Takeoff	13:17	
Engine Off	17:43	Landing	17:35	
Total	4.8 hrs	Total	4.3 hrs	

Mission Plan					
AGL Height	2300	m	Pulse Rate	800Khz	
Target Speed	160	kts	Scan Rate	178	
Laser Current	100	%	FOV	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1304	1308
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ____________	

v 20200520

Julian Day	093	Flight	B

LIDAR Flight Log

Date	April 03, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--21C
H-16%
AMLS-278m
Hpa-1018

Time to next maintenance: ________ ○ 50 hr ◉ 100 hr

Aircraft Block Time				
Engine On	20:00	**Takeoff**	20:16	
Engine Off	23:02	**Landing**	22:58	
Total	3.0 hrs	**Total**	2.7 hrs	

Mission Plan				
AGL Height	2300	m	**Pulse Rate**	800Khz
Target Speed	160	kts	**Scan Rate**	178
Laser Current	100	%	**FOV**	60 degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	2006	2011
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time Start	GPS Time End	Line Aborted Time	Line Aborted nmi to End	Mission ID Time Stamp ____	Comments
Test Strip 01		-						Data recorder error- full system
Test Strip 02		--	2048	2049			204836	restart and cable swap
F8		-	2050	2055			-	
1054		180	2101	2117			210103	
1055		000	2121	2138			212113	
1056		180	2143	2159			214306	
1057		000	2204	2221			220425	
1058		180	180	2226	2233		222609	System crashed after 8 minutes on line

Julian Day 093	Flight B

LIDAR Flight Log

Date	April 03, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--21C
H-16%
AMLS-278m
Hpa-1018

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	20:00	**Takeoff**	20:16	
Engine Off	23:02	**Landing**	22:58	
Total	3.0 hrs	**Total**	2.7 hrs	

Mission Plan				
AGL Height	2300	m	**Pulse Rate**	800Khz
Target Speed	160	kts	**Scan Rate**	178
Laser Current	100	%	**FOV**	60 degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	2006	2011
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	
		-					-	

v 20200520

Julian Day 093	Flight B

LIDAR Flight Log

Date	April 03, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--21C
H-16%
AMLS-278m
Hpa-1018

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	20:00	**Takeoff**	20:16	
Engine Off	23:02	**Landing**	22:58	
Total	3.0 hrs	**Total**	2.7 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	2006	2011
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

Julian Day	093	Flight	B

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	April 03, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--21C
H-16%
AMLS-278m
Hpa-1018

Time to next maintenance: ________ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	20:00	**Takeoff**	20:16	
Engine Off	23:02	**Landing**	22:58	
Total	3.0 hrs	**Total**	2.7 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	2006	2011
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

v 20200520

Julian Day 093	Flight B

LIDAR Flight Log

A I R B O R N E IMAGING — A Clean Harbors Company

Date	April 03, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T--21C
H-16%
AMLS-278m
Hpa-1018

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time						
Engine On	20:00		**Takeoff**	20:16		
Engine Off	23:02		**Landing**	22:58		
Total	3.0	hrs	**Total**	2.7	hrs	

Mission Plan					
AGL Height	2300	**m**	**Pulse Rate**	800Khz	
Target Speed	160	**kts**	**Scan Rate**	178	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	2006	2011
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

Julian Day 095 | Flight A

LIDAR Flight Log

Date	April 05, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S- Krista R
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T-6C
H-70%
AMLS-278m
Hpa-1010

Time to next maintenance: ________ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 13:22	**Takeoff** 13:41			
Engine Off 15:53	**Landing** 15:50			
Total 2.5 hrs	**Total** 2.2 hrs			

Mission Plan				
AGL Height	2300	m	**Pulse Rate**	800Khz
Target Speed	160	kts	**Scan Rate**	178
Laser Current	100	%	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1330	1335
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp	
X-Tie		-	1352	1354			135212	
F8		-	1404	1409			-	
1058		180	1413	1429			141350	
1059		000	1434	1450			143404	
1060		180	1455	1511			145534	
1061		000						System crashed just before we
								enter the line- tried to restart while
								in the air but it froze 2 times

v 20200520

Julian Day 095	Flight A

LIDAR Flight Log

A I R B O R N E IMAGING
A Clean Harbors Company

Date	April 05, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S- Krista R
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T-6C
H-70%
AMLS-278m
Hpa-1010

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 13:22	**Takeoff** 13:41			
Engine Off 15:53	**Landing** 15:50			
Total 2.5 hrs	**Total** 2.2 hrs			

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1330	1335
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	
		-					-	

v 20200520

Julian Day 095	Flight A

LIDAR Flight Log

AIRBORNE IMAGING — A Clean Harbors Company

Date	April 05, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S- Krista R
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T-6C
H-70%
AMLS-278m
Hpa-1010

Time to next maintenance: ________ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 13:22	**Takeoff** 13:41	
Engine Off 15:53	**Landing** 15:50	
Total 2.5 hrs	**Total** 2.2 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
Target Speed	160	kts	**Scan Rate**	178	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time Start	GPS Time End
Pre Mission	1330	1335
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

Julian Day 095 | Flight A

LIDAR Flight Log

Date	April 05, 2021	**Aircraft**	C-GJMT
Project	3218_QSI_PierceMarathon	**Pilot**	Andy. S- Krista R
Location	Eau Claire WI Airport	**Operator**	D.Arteaga
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T-6C
H-70%
AMLS-278m
Hpa-1010

Time to next maintenance: ________ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On 13:22		**Takeoff** 13:41		
Engine Off 15:53		**Landing** 15:50		
Total 2.5	hrs	**Total** 2.2	hrs	

Mission Plan				
AGL Height	2300	m	**Pulse Rate**	800Khz
Target Speed	160	kts	**Scan Rate**	178
Laser Current	100	%	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	1330	1335
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	

Julian Day 095	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date April 05, 2021	**Aircraft** C-GJMT		
Project 3218_QSI_PierceMarathon	**Pilot** Andy. S- Krista R		
Location Eau Claire WI Airport	**Operator** D.Arteaga		
Mission Objective			

System	Riegl VQ-1560
Unit	64
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T-6C
H-70%
AMLS-278m
Hpa-1010

Time to next maintenance: ________ ⦿ 50 hr ○ 100 hr

Aircraft Block Time		
Engine On 13:22	**Takeoff** 13:41	
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Mission Plan					
AGL Height	2300	m	**Pulse Rate**	800Khz	
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Static Alignment	GPS Time	
	Start	End
Pre Mission	1330	1335
Post Mission	-	-

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp ________	