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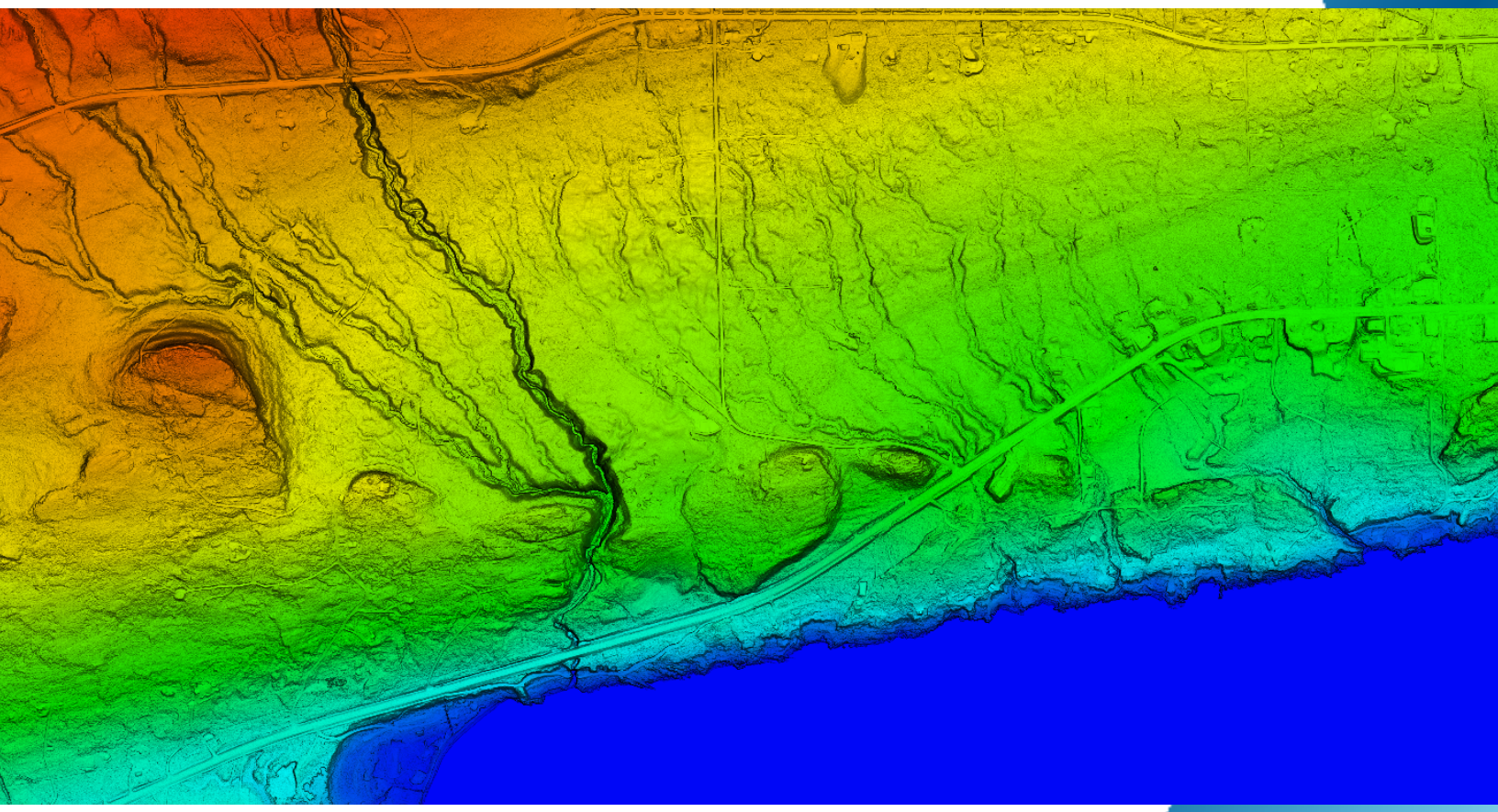

MN_RAINYLAKE_2020_B20 LIDAR PROCESSING REPORT

2022

Project ID: 197392
Work Unit: 300017

Submitted: September 14, 2022

Prepared for:

USGS
science for a changing world

Prepared by:

NV5 GEOSPATIAL

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1. Summary / Scope

1.1. Summary

This report contains a summary of the MN_RainyLake_2020_B20, Work Unit 300017 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on August 26, 2020. The task order yielded a project area covering 5788 square miles over Minnesota. 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
8 pts / m2	1325 m	58.5°	20%	≤ 10 cm

1.3. Coverage

The project boundary covers 5788 square miles over Minnesota. Project extents are shown in Figure 1.

1.4. Duration

Lidar data was acquired from April 4, 2021 to May 08, 2021 in 29 total lifts. See “Section: 2.4. Time Period” for more details.

1.5. Issues

A total of 9 tiles are located over water and contains no deliverable points. Because of this, there are 9 fewer LAS and intensity deliverables than the 15,402 that appear in the tile index.

MN_RainyLake_2020_B20 Work Unit 300017 Projected Coordinate System: UTM Horizontal Datum: NAD 1983 (2011) Vertical Datum: NAVD88 (GEOID 18) Units: Meters	
Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	• 0.5-meter Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format • 0.5-meter Intensity images in GeoTIFF format • 0.5-meter Height Separation Raster in GeoTiff format • 0.5-meter Maximum Surface Height Raster in GeoTIFF format
Vectors	Shapefiles (*.shp) • Project Boundary • Lidar Tile Index • Calibration and QC Checkpoints(NVA/VVA) Geodatabase (*.gdb) • Continuous Hydro-flattened Breaklines • Flight Index
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 • Height Separation

MN_RainyLake_2020_B20
Work Unit 300017 Boundary

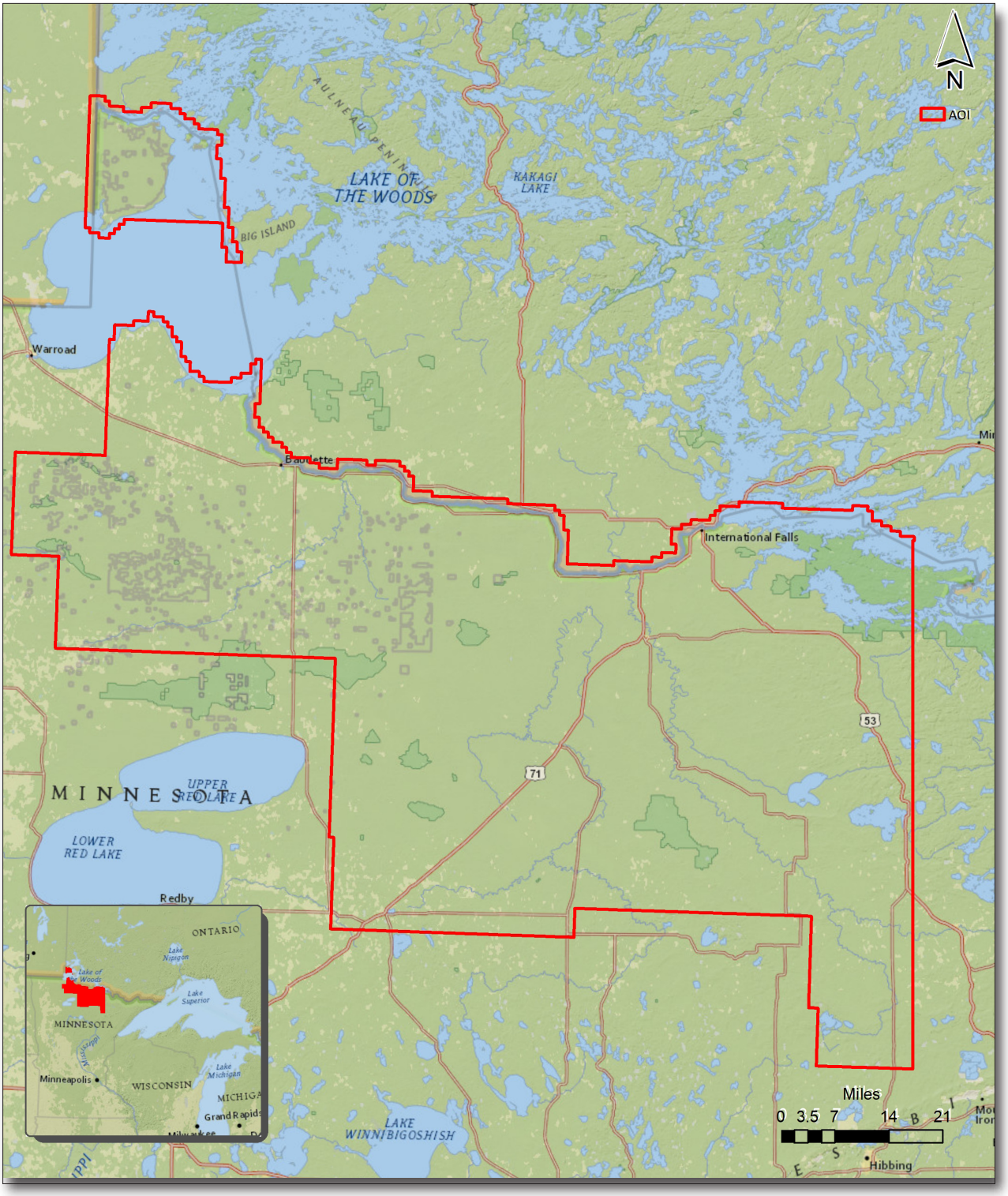


Figure 1. Work Unit Boundary

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 VQ780ii, VQ1560i, and VQ1560ii lidar sensors (Figure 2), serial numbers 3544, 3368, 3543, 3544, 4040, and 4051 for data acquisition.

The Riegl 780ii 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 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.

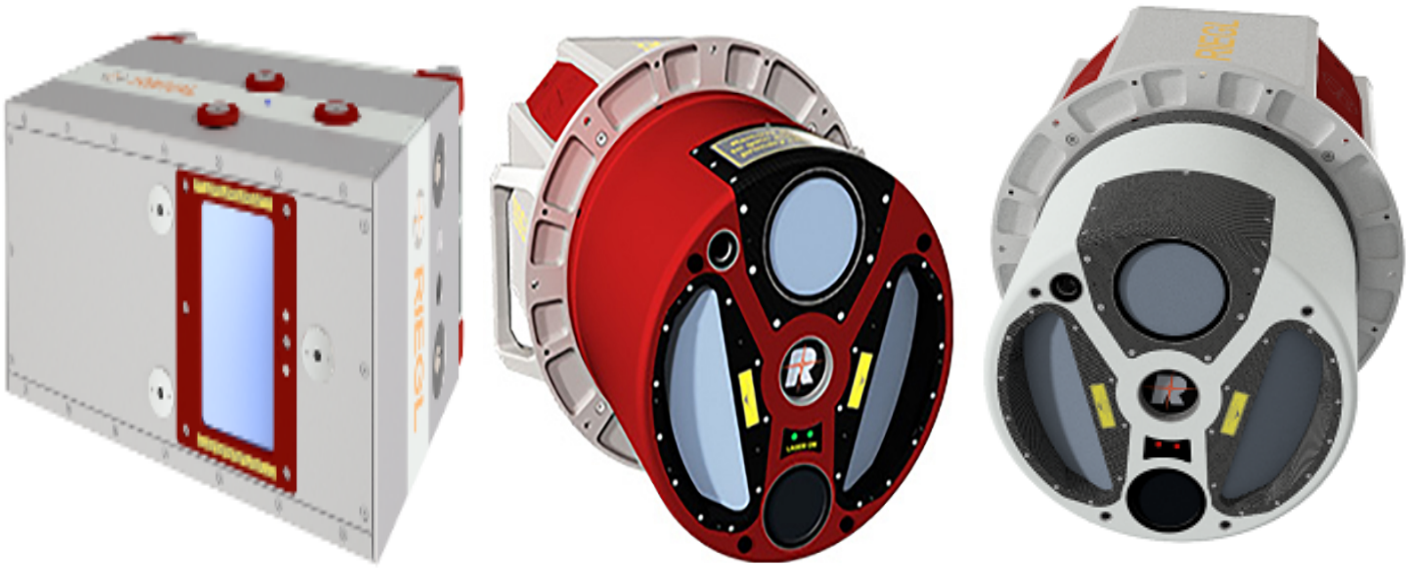
The Riegl 1560ii system is a dual channel waveform processing airborne scanning system. It has a laser pulse repetition rate of up to 4 MHz resulting in up to 2.66 million measurements per second. The system utilizes a Multi-Pulse in the Air option (MPIA) and an integrated IMU/GNSS unit.

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 VQ-780ii	Riegl VQ-1560i	Riegl VQ-1560ii
Terrain and Aircraft Scanner	Flying Height	1050 m	1326 m	1500 m
	Recommended Ground Speed	180 kts	180 kts	160 kts
Scanner	Field of View	60°	58.5°	60°
	Scan Rate Setting Used	300 Hz	400 Hz	350 Hz
Laser	Laser Pulse Rate Used	2000 kHz	2000 kHz	2000 kHz
	Multi Pulse in Air Mode	Yes	Yes	Yes
Coverage	Full Swath Width	1300 m	1484 m	1275-1700 m
	Line Spacing	970 m	1190 m	1107 m
Point Spacing and Density	Average Point Spacing	.290 m	.459 m	.419 m
	Average Point Density	11.90 pts / m^2	9.70 pts / m^2	9.64 pts / m^2

Figure 2. Riegl VQ-780ii, 1560i, 1560ii Lidar Sensors



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

- Piper PA-31 (piston-multi), Tail Numbers: N22GE, C-FFRY, C-GKSX, C-GMEC

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 lidar system. 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 April 4, 2021 to May 8, 2021. 29 aircraft lifts were completed. Accomplished lifts are listed below.

Lift	Start UTC	End UTC
04042021A (SN3543,C-FFRY)	4/04/2021 3:24:24 PM	4/04/2021 4:15:54 PM
04162021A (SN3543,C-FFRY)	4/16/2021 2:11:38 PM	4/16/2021 7:12:35 PM
04162021B (SN4040,N22GE)	4/16/2021 6:58:56 PM	4/16/2021 8:06:14 PM
04172021A (SN3543,C-FFRY)	4/17/2021 2:36:35 PM	4/17/2021 5:39:21 PM
04172021A (SN4040,N22GE)	4/17/2021 1:13:48 PM	4/17/2021 6:03:52 PM
04172021B (SN4040,N22GE)	4/17/2021 7:17:31 PM	4/17/2021 9:41:49 PM
04182021A (SN2238,C-GMEC)	4/18/2021 11:30:40 AM	4/18/2021 2:55:35 PM
04182021A (SN3543,C-FFRY)	4/18/2021 11:04:18 AM	4/18/2021 1:30:45 PM
04182021A (SN4040,N22GE)	4/18/2021 12:55:56 PM	4/18/2021 3:46:36 PM
04192021A (SN4040,N22GE)	4/19/2021 8:58:28 PM	4/20/2021 12:39:36 AM
04222021A (SN2238,C-GMEC)	4/22/2021 12:11:21 PM	4/22/2021 5:18:02 PM
04222021A (SN3543,C-FFRY)	4/22/2021 11:39:36 AM	4/22/2021 4:35:52 PM
04222021A (SN4040,N22GE)	4/22/2021 1:39:59 PM	4/22/2021 6:19:06 PM
04222021A (SN4051,C-GKSX)	4/22/2021 12:18:53 PM	4/22/2021 5:47:36 PM
04242021A (SN3543,C-FFRY)	4/24/2021 4:24:20 PM	4/24/2021 6:31:27 PM
04242021A (SN4040,N22GE)	4/24/2021 10:58:13 PM	4/25/2021 12:55:05 AM
04242021A (SN4051,C-GKSX)	4/24/2021 3:34:57 PM	4/24/2021 6:23:51 PM

Lift	Start UTC	End UTC
04252021A (SN3543,C-FFRY)	4/25/2021 12:18:04 PM	4/25/2021 5:49:34 PM
04252021A (SN4051,C-GKSX)	4/25/2021 1:13:26 PM	4/25/2021 6:27:43 PM
04252021B (SN2238,C-GMEC)	4/25/2021 2:09:19 PM	4/25/2021 6:16:27 PM
04252021C (SN4040,N22GE)	4/25/2021 7:53:31 PM	4/25/2021 11:33:02 PM
04282021A (SN4051,C-GKSX)	4/28/2021 2:10:20 PM	4/28/2021 3:13:26 PM
04282021B (SN4051,C-GKSX)	4/28/2021 7:59:01 PM	4/28/2021 11:12:32 PM
04302021A (SN4040,N22GE)	4/30/2021 2:25:37 PM	4/30/2021 6:52:58 PM
04302021B (SN4040,N22GE)	4/30/2021 8:03:51 PM	4/30/2021 10:29:13 PM
05012021A (SN4040,N22GE)	5/01/2021 2:21:24 PM	5/01/2021 7:28:14 PM
05022021A (SN4040,N22GE)	5/02/2021 1:59:37 PM	5/02/2021 4:16:42 PM
05052021A (SN4051,C-GKSX)	5/05/2021 2:32:03 PM	5/05/2021 6:58:46 PM
05082021A (SN4051,C-GKSX)	5/08/2021 2:07:38 PM	5/08/2021 6:52:41 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).

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 2.1 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.
22	Temporal Exclusion	Points that are excluded due to differences in collection dates

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 0.5 meter 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 0.5 meter 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 Processing

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 0.5-meter.

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. Intensity Image Processing

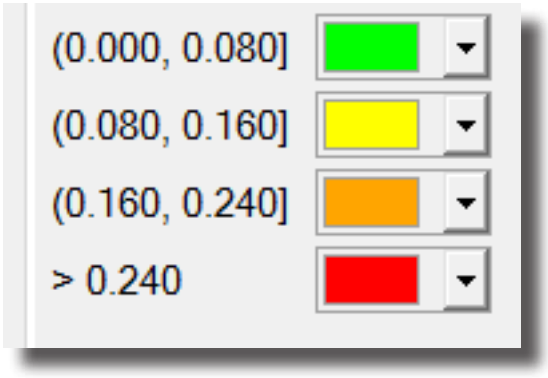
GeoCue software was used to create the deliverable intensity images. All withheld points were ignored during this process. This helps to ensure a more aesthetically pleasing image. The GeoCue software was then used to verify full project coverage as well. GeoTIFF files with a cell size of 0.5 meter were then provided as the deliverable for this dataset requirement.

3.8. Height Separation Raster Processing

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 0.5-meter 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 (Figure 4) 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.

Figure 4. Intervals for Swath Separation Images



3.9. 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 0.5-meter.

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.

MN_RainyLake_2020_B20
Work Unit 300017 Tile Layout

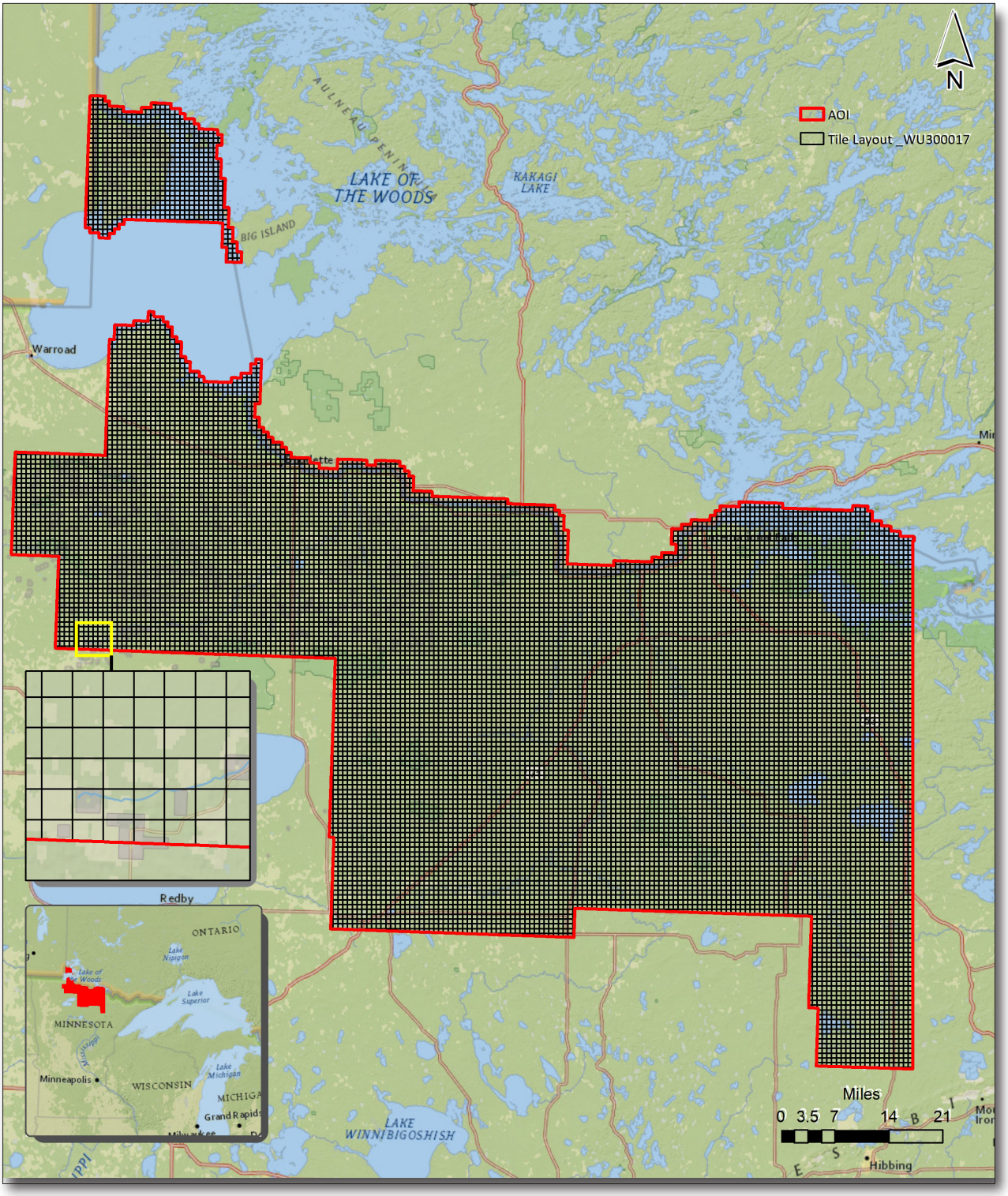


Figure 5. Lidar Tile Layout

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 6.

MN_RainyLake_2020_B20
Work Unit 300017 Lidar Coverage

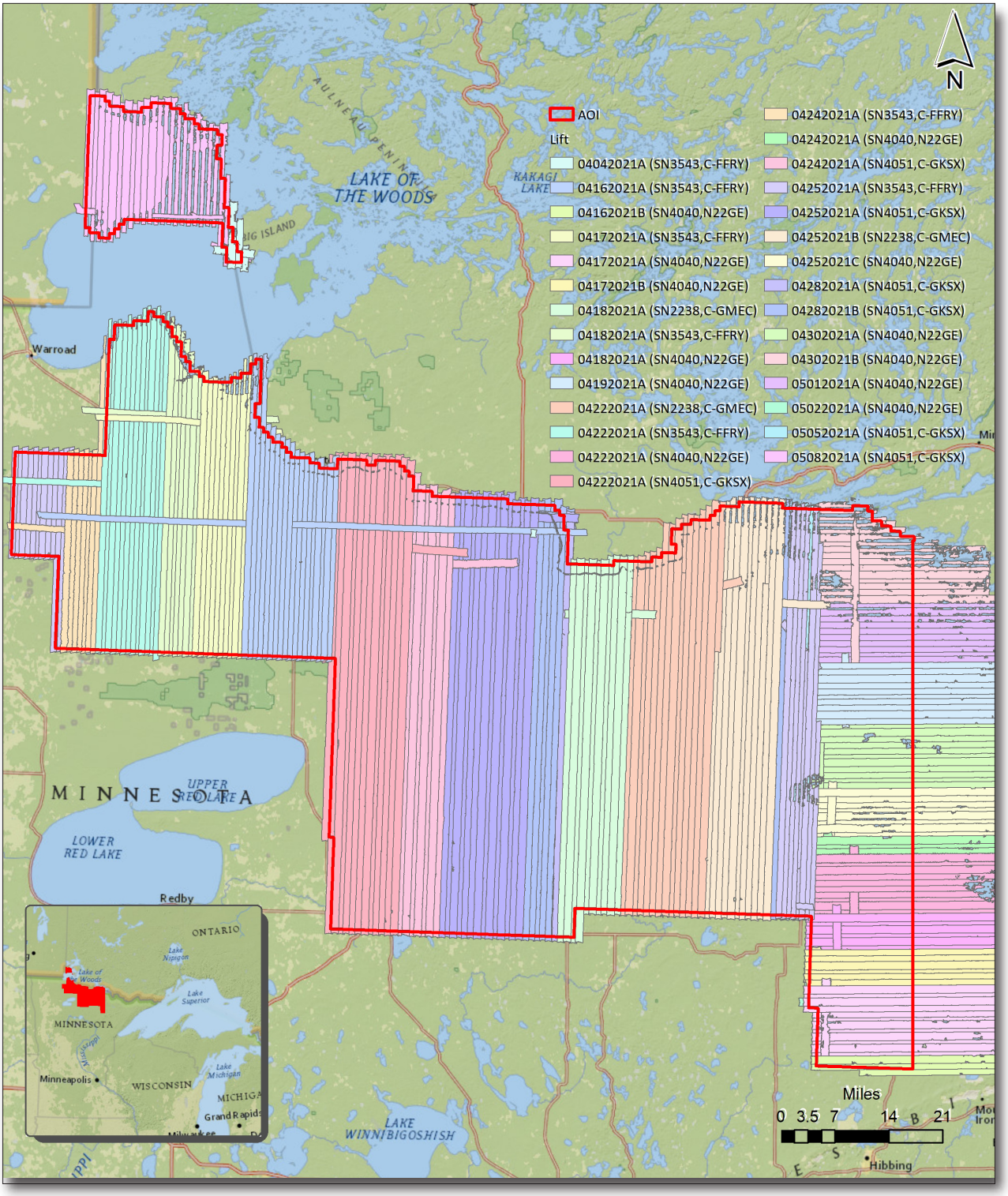


Figure 6. Lidar Coverage

5. Ground Control and Check Point Collection

On behalf of NV5 Geospatial, Ayres completed the field survey. Ground control (calibration) points, along with NVA and VVA points, were collected as a part of the survey.

MNCORS Network through VRS connection was the origination of the control used with checks and calibration as discussed. GPS methods were used where VRS connection and obstructions permitted. Other areas used control set by VRS RTK methods and robotic total station methods were used. OPUS observations of a 45 minute minimum were taken on control points where necessary.

All work was performed in and referenced to NAD83 (2011), NAVD 88(2018), Geoid 18, UTM Zone 15N, in meters.

Established horizontal and vertical coordinate values on the points by a minimum of two – 180 epoch observations with separate initializations using RTK GPS and the MNCORS network. The resultant coordinates and elevations provided in the deliverables are an average of the two observations. Check shots were taken on numerous NGS control points (see field notes) to verify that the values obtained are consistent with the datum/adjustment as described herein and meet the ±3 centimeter vertical accuracy requirement at the 95% confidence level.

For more information, see the Survey Report.

5.1. Calibration Control Point Testing

Figure 7 shows the location of each bare earth calibration point for the project area. TerraScan was used to perform a quality assurance check using the lidar bare earth calibration points. The results of the surface calibration are not an independent assessment of the accuracy of these project deliverables, but the statistical results do provide additional feedback as to the overall quality of the elevation surface.

5.2. Point Cloud Testing

The project specifications require that only Non-Vegetated Vertical Accuracy (NVA) be computed for raw lidar point cloud swath files. The required accuracy (ACCz) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the “bare earth” and “urban” land cover classes. The NVA was tested with 226 checkpoints located in bare earth and urban (non-vegetated) areas. These check points were not used in the calibration or post processing of the lidar point cloud data. The checkpoints were distributed throughout the project area and were surveyed using GPS techniques. See survey report for additional survey methodologies.

Elevations from the unclassified lidar surface were measured for the x,y location of each check point. Elevations interpolated from the lidar surface were then compared to the elevation values of the surveyed

control points. AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using RMSE(z) x 1.9600 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines.

5.3. Digital Elevation Model (DEM) Testing

The project specifications require the accuracy (ACCz) of the derived DEM be calculated and reported in two ways:

1. The required NVA is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the “bare earth” and “urban” land cover classes. This is a required accuracy. The NVA was tested with 226 checkpoints located in bare earth and urban (non-vegetated) areas. See Figure 8.
2. Vegetated Vertical Accuracy (VVA): VVA shall be reported for “brushlands/low trees” and “tall weeds/crops” land cover classes. The target VVA is: 29.4 cm at the 95th percentile, derived according to ASPRS Guidelines, Vertical Accuracy Reporting for lidar Data, i.e., based on the 95th percentile error in all vegetated land cover classes combined. This is a target accuracy. The VVA was tested with 160 checkpoints located in tall weeds/crops and brushlands/low trees (vegetated) areas. The checkpoints were distributed throughout the project area. See Figure 9.

AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using RMSE(z) x 1.9600 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASRPS Guidelines.

A brief summary of results are listed below.

	Target	Measured	Point Count
Raw NVA	0.196 m	0.0683 m	226
NVA	0.196 m	0.0661 m	226
VVA	0.294 m	0.1131 m	160

MN_RainyLake_2020_B20
Calibration Points

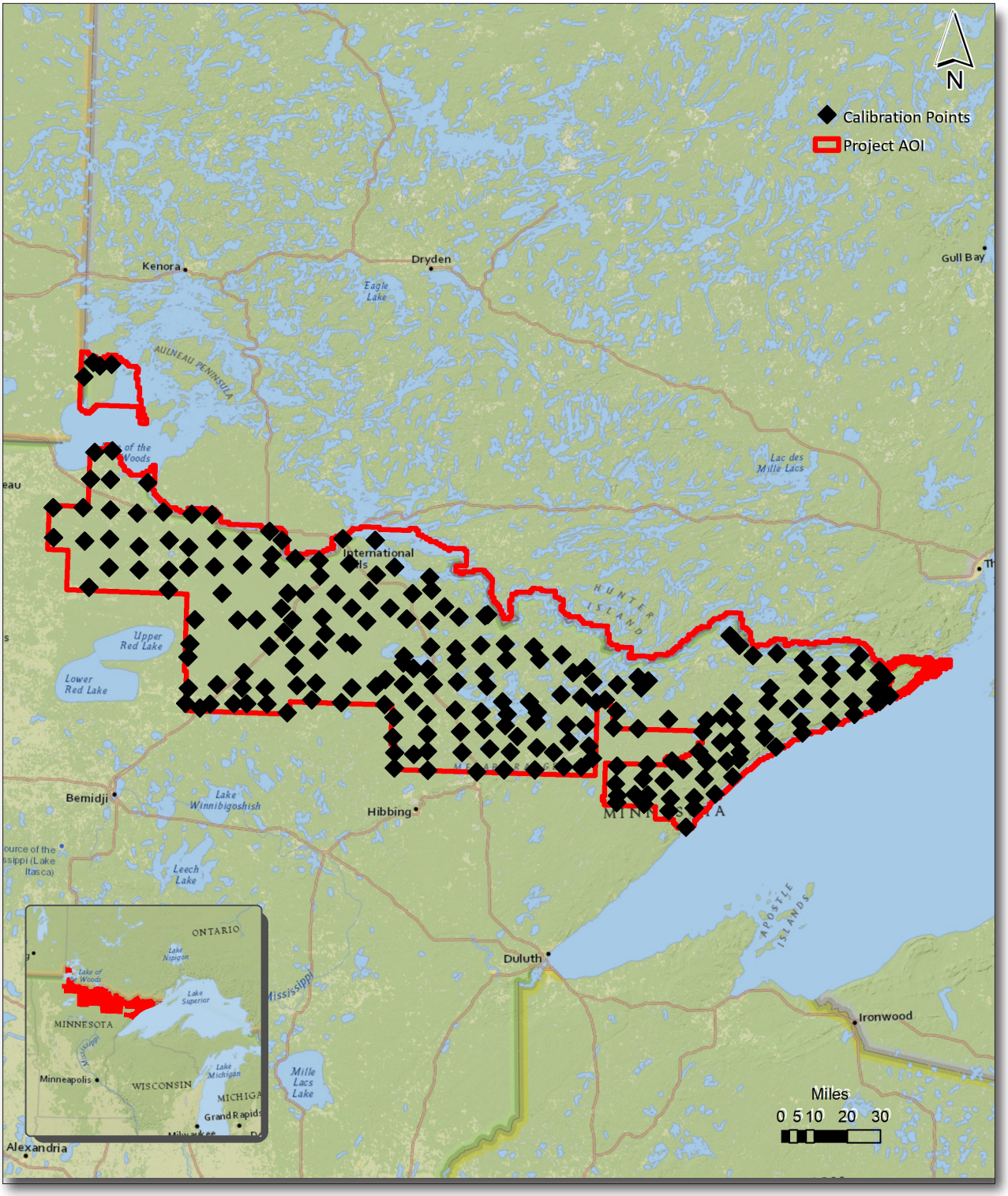


Figure 7. Calibration Control Point Locations

MN_RainyLake_2020_B20
NVA Points

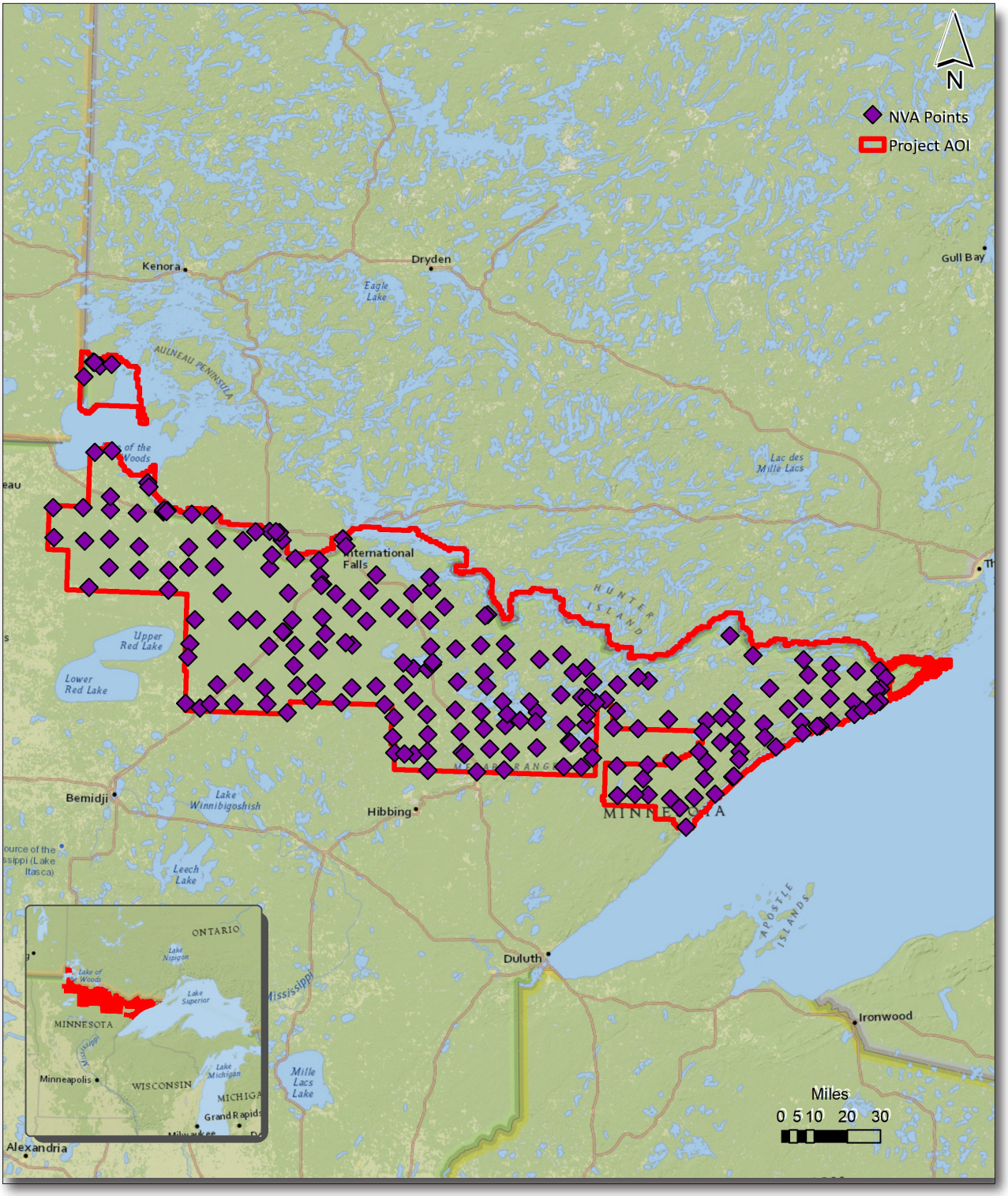


Figure 8. QC Checkpoint Locations - NVA

MN_RainyLake_2020_B20
VVA Points

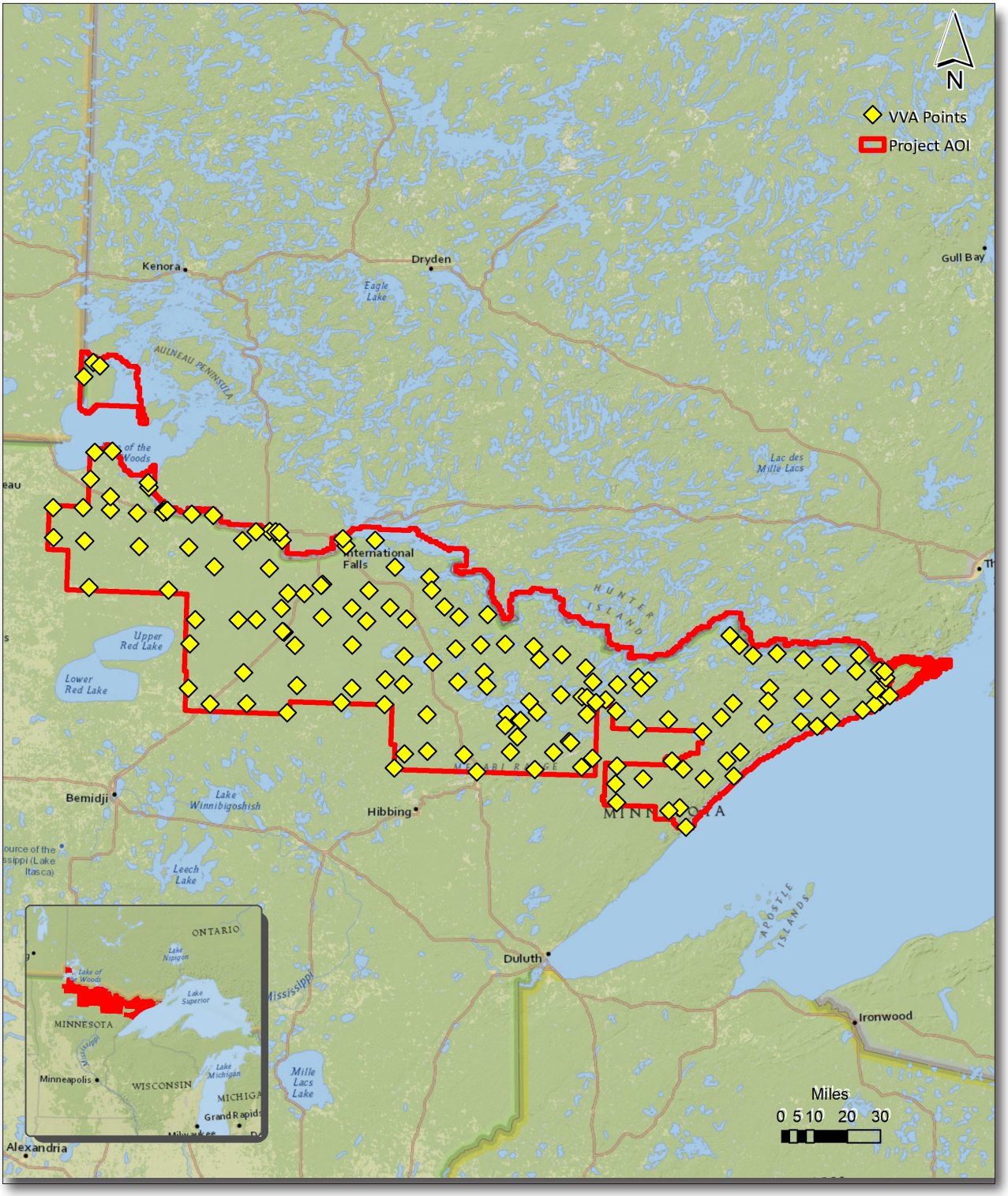


Figure 9. QC Checkpoint Locations - VVA

6. Geometric Accuracy

6.1. Horizontal Accuracy

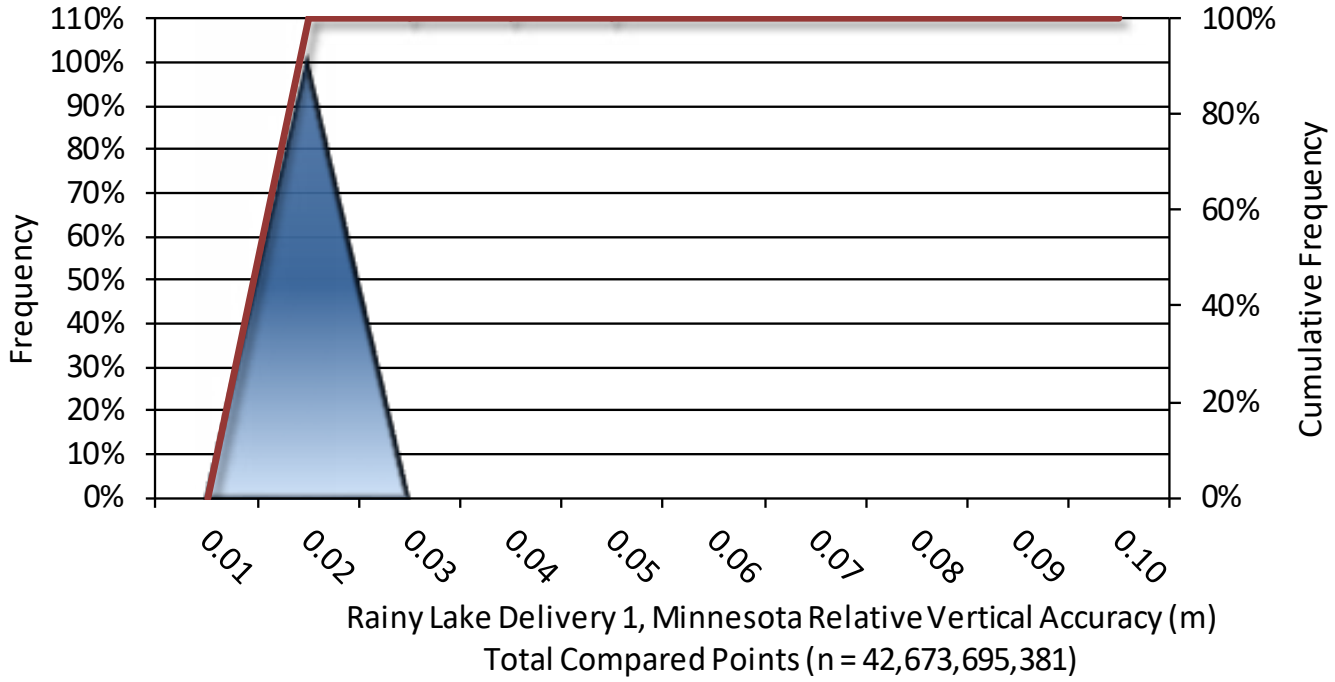
Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained $RMSE_r$ value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial 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 1825 meters, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters, this project was compiled to meet 0.2 meter horizontal accuracy at the 95% confidence level. A summary is shown below.

Horizontal Accuracy	
$RMSE_r$	0.38 ft
	0.11514 m
ACC_r	0.65 ft
	0.2 m

6.2. 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 MN_RainyLake_2020_B20 project was 0.045 feet (0.014 meters). A summary is shown below.

Relative Vertical Accuracy	
Sample	432 flight line surfaces
Average	0.045 ft
	0.014 m
Median	0.045 ft
	0.014 m
RMSE	0.046 ft
	0.014 m
Standard Deviation (1σ)	0.004 ft
	0.001 m
1.96σ	0.007 ft
	0.002 m



Project Report Appendices

The following section contains the appendices as listed in the MN_RainyLake_2020_B20 Lidar Project Report.

Appendix A

Flight Logs

Julian Day 094	Flight A

LIDAR Flight Log

Date	April 4, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

Flight test for Snapshot +burn off fuel for landing +inspect northern most area inaccessible from ground.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

System test:
No change on pilot display of l
on/off status.
NOT auto-recording.

Time to next maintenance: 42

Aircraft Block Time				
Engine On	14:57	**Takeoff**	15:15	
Engine Off	16:56	**Landing**	16:50	
Total	2.0 hrs	**Total**	1.6 hrs	

Mission Plan			
AGL Height	1500 m	**Pulse Rate**	1000 kHz
Target Speed	160 kts	**Scan Rate**	175 (in plane)
Laser Current	100 %	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210404	
			Start	End	Time	nmi to End		
TEST		270	15:24	270			152423	
TEST2		300	15:36	15:36			153605	
S-TURN		X	15:43	15:47			X	
CROSSTIE	432109401	270	15:48	15:50			154842	
1026	432109402	360	16:00	16:03			160033	
1025	432109403	180	16:06	16:07			160604	
1024	432109404	360	16:12	16:16			161236	
FIGURE 8		X	16:16	16:20			X	

Julian Day 094	Flight A

LIDAR Flight Log

Date	April 4, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

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Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210404	

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Julian Day 094	Flight A

LIDAR Flight Log

Date	April 4, 2021	**Aircraft**	C-FFRY
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Location	KINL	**Operator**	T. Cooper

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Static Alignment	
Pre Mission	
Post Mission	

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v 20200520

Julian Day 094	Flight A

LIDAR Flight Log

Date	April 4, 2021	**Aircraft**	C-FFRY
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Location	KINL	**Operator**	T. Cooper

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Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210404	

v 20200520

Julian Day 094	Flight A

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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210404	

v 20200520

Julian Day 106	Flight A

LIDAR Flight Log

Date	April 16, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

0c, 65%, 1023hpa. 25knt NW
Flight special configured with only Lazer2.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Single channel due to fault.

Time to next maintenance: 31

Aircraft Block Time		
Engine On 13:46	**Takeoff** 14:00	
Engine Off 19:51	**Landing** 19:40	
Total 6.1 hrs	**Total** 5.7 hrs	

Mission Plan			
AGL Height	1200 m	**Pulse Rate**	2000Khz
Target Speed	160 kts	**Scan Rate**	280 (in plane)
Laser Current	100 %	**FOV**	60 degs

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210416	
			Start	End	Time	nmi to End		
TEST		270	14:07	14:07			140709	
FIGURE 8		x	14:07	14:12			x	
Crosstie		270	14:11	14:38			141138	
6066		180	14:56	15:05			145636	
6065		360	15:08	15:17			150856	
6064		180	15:21	15:29			152110	
6063		360	15:33	15:42			153311	
6062		180	15:45	15:54			154532	
6061		360	15:58	16:07			155804	
6060		180	16:11	16:20			161119	
6059		360	16:24	16:34			162426	
6058		180	16:37	16:38			163707	
6058		180	16:43	16:53			164346	
6057		360	16:57	17:07			165722	
6056		180	17:10	17:20			171024	

Julian Day 106	Flight A

LIDAR Flight Log

Date	April 16, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

0c, 65%, 1023hpa. 25knt NW
Flight special configured with only Lazer2.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Single channel due to fault.

Time to next maintenance: 31

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Mission Plan					
AGL Height	1200	**m**	**Pulse Rate**	2000Khz	
Target Speed	160	**kts**	**Scan Rate**	280 (	in plane)
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210416	
			Start	End	Time	nmi to End		
6055		360	17:23	17:33			172338	
6054		180	17:36	17:47			173654	
6053		360	17:50	18:01			175023	
6052		180	18:04	18:14			180414	
6052		360	18:16	18:20	18:20		181640	re
6051		360	18:26	18:38			182609	
6050		180	18:42	18:58			184257	
6049		360	18:59	19:12			185921	
figure 8		x	19:12	19:19			x	

Julian Day 106	Flight A

LIDAR Flight Log

Date	April 16, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

0c, 65%, 1023hpa. 25knt NW
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Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210416	

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Julian Day 106	Flight A

LIDAR Flight Log

Date	April 16, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

0c, 65%, 1023hpa. 25knt NW
Flight special configured with only Lazer2.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
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Scanner 2 Drive	A1

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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210416	

v 20200520

Julian Day 106	Flight A

LIDAR Flight Log

Date	April 16, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210416	

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

Date: 4

(email log daily to flight_log_distribution_list@quantumspatial.com)

Lift: (A) B C

Project: Ruby Lake Proj #: 36740 Flight Mgmt File: 20210416_4040_3

Aircraft: 22TE Begin Hobbs: End Hobbs: 5982.3 Total: 6.1 Pilot: Kruder Co-Pilot:

Dep Apt: EAU Dep Time (Lcl): (Z): Arr Apt: H13 Arr Time (Local): 717 (Z): To

CORS: Y / (N) Sta 1: 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: 89 °c End: °c OAT beg: °c End: °c Altimeter begin: 30,07 end:

LiDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	156011	4040	1500M			160	
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM
	58	1000				100%	8

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial,
XTie	N	1827	—	131	.8/27	6618		0	XTie = unplanned S-TURN SLC NO
97	272	183214	183714	150	.8/27	6430		0	
96	092	184445	185648	158	.8/27	6191		0	
95	272	185856	191750	154	.8/28	6191		2	SNOW on Ski Hill 23 m
94	092	192105	194330	145	.8/26	6285		2	
93	272	194507	200615	152	.8/29	6279		2	
									S-TURN
									1.2

Total Proj Lines: 97 Lines Flown: 5 Lines Remain: 92 OnLine Time: 1.5 Mob Time: 1.1 Notes:

Scanned wi

Julian Day 107	Flight A

LIDAR Flight Log

Date	April 17, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

Laser 1 known error 2505. lower alt single laser.
-1c, 83%, 1020hpa.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

wind 20knt N.
Ending due to too much turb.

Time to next maintenance: 27

Aircraft Block Time				
Engine On	13:55	**Takeoff**	14:10	
Engine Off	18:26	**Landing**	18:19	
Total	4.5 hrs	**Total**	4.2 hrs	

Mission Plan			
AGL Height	1200 m	**Pulse Rate**	2000 kHz
Target Speed	160 kts	**Scan Rate**	285 (in plane)
Laser Current	100 %	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210417	
			Start	End	Time	nmi to End		
Figure 8		x	14:35	14:35			x	
Test		270	14:35	14:35			143540	
crosstie	432110701	270	14:36	14:45			143634	
6048	432110702	180	14:55	15:08			145514	
6047	432110703	360	15:11	15:25			151131	
6046	432110704	180	15:27	15:40			152740	
6045	432110705	360	15:43	15:55			154310	
6044	432110706	180	15:58	16:11			155851	
6043	432110707	360	16:14	16:27			161459	
6042	432110708	180	16:30	16:42			163029	
6041	432110709	360	16:46	17:00			164650	
6040	432110710	180	17:03	17:15			170322	
6040	432110711	360	17:19		17:21		171929	
6039	432110712	360	17:26	17:39			172646	*
figure 8		x	17:40	17:45			x	

Julian Day 107	Flight A

LIDAR Flight Log

Date	April 17, 2021	**Aircraft**	C-FFRY
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Post Mission	

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v 20200520

Julian Day 107	Flight A

LIDAR Flight Log

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Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210417	

v 20200520

Julian Day 107	Flight A

LIDAR Flight Log

Date	April 17, 2021	**Aircraft**	C-FFRY
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Post Mission	

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			Start	End	Time	nmi to End	Time Stamp 210417	

v 20200520

Julian Day 107	Flight A

LIDAR Flight Log

Date	April 17, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

Laser 1 known error 2505. lower alt single laser.
-1c, 83%, 1020hpa.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

wind 20knt N.
Ending due to too much turb.

Time to next maintenance: 27

Aircraft Block Time				
Engine On	13:55	**Takeoff**	14:10	
Engine Off	18:26	**Landing**	18:19	
Total	4.5 hrs	**Total**	4.2 hrs	

Mission Plan			
AGL Height	1200 m	**Pulse Rate**	2000 kHz
Target Speed	160 kts	**Scan Rate**	285 (in plane)
Laser Current	100 %	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210417	

v 20200520

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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 4

Lift: (A) B C D

Project: Rainy Lake **Proj #:** 36740 **Flight Mgmt File:** 20210417_4040_

Aircraft: 22TE **Begin Hobbs:** 5982.3 **End Hobbs:** 5987.6 **Total:** 5.3 **Pilot:** Braden **Co-Pilot:**

Dep Apt: HIB **Dep Time (Lcl):** 0800 **(Z):** **Arr Apt:** HIB **Arr Time (Local):** 116 **(Z):** **Tot**

CORS: Y / (N) **Sta 1:** **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:** 30.03 **end:**

LiDAR						
	Type 1560 II	Serial # 4040	Alt AGL 1500m	Alt AMSL	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing
	FOV 58	Scan Freq 1000	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100%	PPSM 8

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, et
92	090	131348	133530	150	.8/26	6273		0	SKC – S-TWN
91	272	133724	135936	145	.8/25	6246		0	
90	090	140129	142316	147	.9/24	6250		0	
89	272	142514	144721	143	1.1/23	6243		0	
88	090	144923	151059	152	.9/26	6223		0	
87	272	151252	153500	144	1.1/24	6223		1	
86	090	153704	155818	155	.8/30	6214		2	SKT 8000+
85	272	160008	162221	143	.8/29	6201		3	
84	090	162420	164534	158	1.0/27	6194		4	Mod Turbulence
83	272	164714	171004	142	.9/26	6194		4	
82	090	171158	173305	160	.8/27	6194		4	0° zero 6 :)
81	272	173453	175728	145	.9/29	6191		4	→ xtra turbulence S-TWN
X Tie	5	1800	1802						

Total Proj Lines: **Lines Flown:** 12 **Lines Remain:** **Online Time:** 4.9 **Mob Time:** 0.4 **Notes:**

Scanned wi

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

(email Log daily to flight_log_distribution_list@quantumspatial.com)

Date:

Lift: A (B)

Project: Rainy Lake Proj #: 36740 Flight Mgmt File: 2021CM17B_4

Aircraft: 22TE Begin Hobbs: 5487.6 End Hobbs: 5490.4 Total: 2.8 Pilot: Rocken Co-Pilot:

Dep Apt: 4I0 Dep Time (Lcl): 202 (Z): Arr Apt: 4I3 Arr Time (Local): 454 (Z):

CORS: Y / (N) Sta 1: 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 1560/1	Serial # 4240	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing
	FOV 58	Scan Freq 100	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100	PPSM 8

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0,-,+)	FLIGHT LINE NOTES – visibility, clouds, smoke, partic
80	090	191727	193817	154	.8/29	6184		3	S Turn Sky 8000+
79	272	194326	200302	149	.9/27	6184		3	Mod Turbulence
78	090	200459	202548	151	.8/26	6184		3	
77	272	202749	205108	145	.9/28	6174		3	
76	090	205255	211338	161	.8/30	6171		3	
75	272	211534	213825	145	.8/31	6168		4	Re-Loc S/N/A FWE
XTie	S	214001	214149	164	.8/30	6340		2	X-Tie Unplanned S-Turn

Total Proj Lines: Lines Flown: Lines Remain: Online Time: 2.4 Mob Time: 0.4 Notes:

Scanned wi

Julian Day	108	Flight	A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time				
Engine On	10:44	**Takeoff**	11:02	
Engine Off	15:15	**Landing**	15:05	
Total	4.5 hrs	**Total**	4.1 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000khz	
Target Speed	160	**kts**	**Scan Rate**	179lps	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210418	
			Start	End	Time	nmi to End		
F8			1109	1116				
x-tie	382110801	W	1130	1135			113039	
3093	382110802	S	1140	1156			114026	
3094	382110803	N	1200	1214			120051	
3095	382110804	S	1220	1235			122048	
3096	382110805	N	1241	1257			124123	
3097	382110806	S	1301	1317			130118	
3098	382110807	N	1320	1335			132020	
3099	382110808	S	1338	1353			133836	
3100	382110809	N	1357	1413			135716	
3101	382110810	S	1416	1431			141602	
3102	382110811	N	1434	1447		7	143429	parti
3102	382110812	N	1452	1455				
F8			1455	1501				

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time				
Engine On	10:44	**Takeoff**	11:02	
Engine Off	15:15	**Landing**	15:05	
Total	4.5 hrs	**Total**	4.1 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000khz	
Target Speed	160	**kts**	**Scan Rate**	179lps	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time			
Engine On	10:44	**Takeoff** 11:02	
Engine Off	15:15	**Landing** 15:05	
Total	4.5 hrs	**Total** 4.1 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000khz	
Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time			
Engine On	10:44	**Takeoff** 11:02	
Engine Off	15:15	**Landing** 15:05	
Total	4.5 hrs	**Total** 4.1 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000khz	
Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time			
Engine On	10:44	**Takeoff** 11:02	
Engine Off	15:15	**Landing** 15:05	
Total	4.5 hrs	**Total** 4.1 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000khz	
Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

early flight for weather window.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Ending due to virga, storm mo

Time to next maintenance: 23

Aircraft Block Time				
Engine On	10:24	**Takeoff**	10:39	
Engine Off	14:08	**Landing**	14:02	
Total	3.7 hrs	**Total**	3.4 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000
Target Speed	160	**kts**	**Scan Rate**	285 in plane)
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210418	
			Start	End	Time	nmi to End		
TEST		270	10:45	10:45			104543	
FIGURE 8		x	10:57	11:02			x	
crosstie	432110801	270	11:04	11:14			110417	
6039	432110802	180	11:20	11:32			112038	
6038	432110803	360	11:38	11:50			113808	
6037	432110804	180	11:53	11:53			115337	
6036	432110805	360	12:08	12:23			120840	
6035	432110806	180	12:26	12:39			122618	
6034	432110807	360	12:42	12:56			124248	
6033	432110808	180	12:59	13:13			125918	
6032	432110809	360	13:16	13:30			131640	
Figure 8		x	13:33	13:37			x	

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

early flight for weather window.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Ending due to virga, storm mo

Time to next maintenance: 23

Aircraft Block Time				
Engine On	10:24	**Takeoff**	10:39	
Engine Off	14:08	**Landing**	14:02	
Total	3.7 hrs	**Total**	3.4 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000
Target Speed	160	**kts**	**Scan Rate**	285 in plane)
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

early flight for weather window.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Ending due to virga, storm mo

Time to next maintenance: 23

Aircraft Block Time				
Engine On	10:24	**Takeoff**	10:39	
Engine Off	14:08	**Landing**	14:02	
Total	3.7 hrs	**Total**	3.4 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000
Target Speed	160	**kts**	**Scan Rate**	285 in plane)
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

early flight for weather window.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Ending due to virga, storm mo

Time to next maintenance: 23

Aircraft Block Time				
Engine On	10:24	**Takeoff**	10:39	
Engine Off	14:08	**Landing**	14:02	
Total	3.7 hrs	**Total**	3.4 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000
Target Speed	160	**kts**	**Scan Rate**	285 in plane)
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

Julian Day 108	Flight A

LIDAR Flight Log

Date	April 18, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

early flight for weather window.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

Ending due to virga, storm mo

Time to next maintenance: 23

Aircraft Block Time				
Engine On	10:24	**Takeoff**	10:39	
Engine Off	14:08	**Landing**	14:02	
Total	3.7 hrs	**Total**	3.4 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000
Target Speed	160	**kts**	**Scan Rate**	285 in plane)
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210418	

v 20200520

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

Date: 4

Lift: A B C D E

(email Log daily to flight_log_distribution_list@quantumspatial.com)

Project: Rainy Lake Proj #: 36740 Flight Mgmt File: 20210418_4040_367

Aircraft: 227P Begin Hobbs: 5940.4 End Hobbs: 5993.9 Total: 3.5 Pilot: Graham Co-Pilot:

Dep Apt: HIB Dep Time (Lcl): 731 (Z): Arr Apt: HIB Arr Time (Local): 1102 (Z): Tot T

CORS: Y / (N) Sta 1: 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: 29.77 end:

LiDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	JG011	4040	1500			160	
	FOV 58	Scan Freq 100	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100	PPSM 8

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
74	090	125557	131554	165	.8/28	6158		1	S-Turn OVC 8000-
73	272	131821	134234	136	.9/25	6158		0	
72	090	134442	140421	169	.8/27	6161		0	
71	272	140632	—	134	.9/28	6148		0	Lazaw Rec stopped 39. FWE
R 71	272	142516	144950	134	1.0/25	6148		0	
70	090	145201	151248	172	.9/27	6145		0	21 Haze
69	272	151506	154140	138	.9/28	6145		0	LT Sailing Full QT most end - 3 m
X Tie	S	154425	154637	150	.9/29	5992		0	X Tie Unplanned
									S-Turn

Total Proj Lines: Lines Flown: 6 Lines Remain: On-line Time: 2.7 Mob Time: 0.8 Notes:

Scanned wi

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

Date: 4

(email log daily to flight_log_distribution_list@quantumspatial.com)

Lift: (A) B C

Project:	Rainy Lake	Proj #:	J6740	Flight Mgmt File:	20210419_4040		
Aircraft:	22TE	Begin Hobbs:	5993.9	End Hobbs:	5998.1	Total:	Pilot: Larosse Co-Pilot:
Dep Apt:	H18	Dep Time (Lcl):	327 (Z):	Arr Apt:	H18	Arr Time (Local):	801 (Z): T
CORS:	Y / (N)	Sta 1:		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	1560 II	Serial #	4040	Alt AGL	1500	Alt AMSL	Avg Terr Ht	Max Gdspd 160 / Avg Pt Spacing
FOV	58	Scan Freq	1000	MpiA Y / N		Pulses In Air	Pulse Rate	Power 100 / PPSM 6

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial
36	090	200829	201925	139	.9/26	6020		3	STWN SCT - 7000 Turbule
35	272	212206	213315	135	.9/26	6020		2	LT Snow in shadow areas
34	090	214600	220508	151	1.0/25	6020		2	
33	272	220757	222711	148	.9/26	6023		3	Turning X RLOC 12-10
32	090	222956	224821	151	.9/26	6023		2	Gusty winds
31	272	225118	231039	138	.8/31	6023		2	
30	090	231310	233111	144	.9/29	6017		1	
29	272	233337	235214	134	.8/31	6023		1	LT Haze 25 m FWE TO WFE
28	090	235447	001245	150	.9/30	6023		1	LT Haze
27	272	001502	003124	145	1.0/27	6023		1	LT Haz Cloud Fog - Sun Fo
XTie	S	003627	003937	160	1.1/27	5237		2	X Tie unplanned LT Snow Fall at
									Scattered

Total Proj Lines:	Lines Flown:	Lines Remain:	Online Time:	Mob Time:	Notes:

Scanned wi

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Flight called early due to turbu
wind conditions

Time to next maintenance: _____

Aircraft Block Time				
Engine On	11:36	**Takeoff**	11:54	
Engine Off	17:38	**Landing**	17:29	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000khz	
Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210422	
			Start	End	Time	nmi to End		
F8			1202	1208				
XTIE	382111201		1211	1217			121121	
3103	382111202		1224	1240			122426	
3104	382111203		1243	1257			124322	
3105	382111204		1302	1318			130243	
3106	382111205		1321	1338			132148	
3107	382111206		1341	1357			134105	
3108	382111207		1400	1417			140014	
3109	382111208		1420	1437			142044	
3110	382111209		1441	1458			144106	
3111	382111210		1502	1506	1506	40	150207	partial
3111	382111211		1510	1525			151018	
3112	382111212		1528	1545			152823	
3113	382111213		1549	1605			160908	
3114	382111214		1609	1626			160908	

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Flight called early due to turbu
wind conditions

Time to next maintenance: _____

Aircraft Block Time				
Engine On	11:36	**Takeoff**	11:54	
Engine Off	17:38	**Landing**	17:29	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000khz	
Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	
3115	382111215		1629	1647			162957	
3116	382111216		1650	1708			165047	
3117	382111217		1711	1719	1719	75%	171145	
F8			1719	1724				

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Flight called early due to turbu
wind conditions

Time to next maintenance: _____

Aircraft Block Time				
Engine On	11:36	**Takeoff**	11:54	
Engine Off	17:38	**Landing**	17:29	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan				
AGL Height	1500	m	**Pulse Rate**	1000khz
Target Speed	160	kts	**Scan Rate**	179lps
Laser Current	100	%	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Flight called early due to turbu
wind conditions

Time to next maintenance: _____

Aircraft Block Time				
Engine On	11:36	**Takeoff**	11:54	
Engine Off	17:38	**Landing**	17:29	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan				
AGL Height	1500	m	**Pulse Rate**	1000khz
Target Speed	160	kts	**Scan Rate**	179lps
Laser Current	100	%	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar
Mission Objective			

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Flight called early due to turbu
wind conditions

Time to next maintenance: _____

Aircraft Block Time				
Engine On	11:36	**Takeoff**	11:54	
Engine Off	17:38	**Landing**	17:29	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan				
AGL Height	1500	m	**Pulse Rate**	1000khz
Target Speed	160	kts	**Scan Rate**	179lps
Laser Current	100	%	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan			
AGL Height	1500 m	**Pulse Rate**	1000 KHz
Target Speed	160 kts	**Scan Rate**	175/179 plane
Laser Current	100 %	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210422	
			Start	End	Time	nmi to End		
							210422_114919	
Figure 8		8	12:13	12:18				
X-Tie_52-65	522111201	272.0 +/-	12:23	12:25			121852	
3052	522111202	181.0	12:32	12:40			123219	589
3053	522111203	001.0	12:50	13:07			125040	
3054	522111204	181.1	13:10	13:29			131027	
3055	522111205	001.0	13:33	13:54			133317	
3056	522111206	181.2	13:57	14:17			135733	
3057	522111207	001.1	14:21	14:41			142109	
3058	522111208	181.2	14:44	15:04			144419	
3059	522111209	001.1	15:07	15:27			150725	
3060	522111210	181.3	15:30	15:51			153057	
3061	522111211	001.2	15:54	16:14			155417	
3062	522111212	181.4	16:18	16:37			161807	
3063	522111213	001.2	16:41	17:01			164111	

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz	
Target Speed	160	**kts**	**Scan Rate**	175/179 plane	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210422	
			Start	End	Time	nmi to End		
3064	522111214	181.4	17:04	17:24			210422_170435	
3065	522111215	001.3	17:27	17:47			172729	
Figure 8		8	17:47	17:51				

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179 plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179 plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179 plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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

(email Log daily to flight_Log_distribution_List@quantumspatial.com)

Date: 4 2

Lift: (A) B C D E

Project: Rainy NW Proj #: 36740 Flight Mgmt File: 20210422A-4902

Aircraft: 22[illegible]-E Begin Hobbs: 5998.4 End Hobbs: 6003.6 Total: 5.2 Pilot: Larosa Co-Pilot:

Dep Apt: H18 Dep Time (Lcl): 817 (Z): Arr Apt: H18 Arr Time (Local): 133 (Z): Tot Ti

CORS: Y / (N) Sta 1: 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: 29.84 end:

LiDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	156011	4040	6500 M			160	
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM
	58	100				100	8

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
68	090	133954	140231	159	.9/27	6138		0	HAF S-Turn - 5KC Lt Haze
67	272	140543	143041	135	1.0/25	6138		0	
66	090	145508	145535	159	.9/28	6125		0	
65	272	145826	152317	137	.9/28	6122		0	
64	090	152607	154833	155	.9/2	6115		0	
63	272	155118	161406	143	.8/30	6115		0	
62	090	161839	164103	155	.8/31	6119		0	
61	272	164343	X	145	.9/30	6132		0	Lost connection LAN Pilot Display
61	272	165218	171709	147	.9/32	6132		2	
60	090	171952	174221	157	.9/31	6132		2	S-Turn 17 NM FAF
59	272	174507	181128	138	.8/31	6178		3	
X-Tie	S	181520	184911	126	.8/30	6342		4	X Tie - unplanned
									Pilot Did not want to fly a second

Total Proj Lines: 97 Lines Flown: 11 Lines Remain: On-line Time: 4.5 Mob Time: 0.7 Notes:

Scanned wi

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan			
AGL Height	1500 m	**Pulse Rate**	1000 KHz
Target Speed	160 kts	**Scan Rate**	175/179 plane
Laser Current	100 %	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210422	
			Start	End	Time	nmi to End		
							210422_114919	
Figure 8		8	12:13	12:18				
X-Tie_52-65	522111201	272.0 +/-	12:23	12:25			121852	
3052	522111202	181.0	12:32	12:40			123219	589
3053	522111203	001.0	12:50	13:07			125040	
3054	522111204	181.1	13:10	13:29			131027	
3055	522111205	001.0	13:33	13:54			133317	
3056	522111206	181.2	13:57	14:17			135733	
3057	522111207	001.1	14:21	14:41			142109	
3058	522111208	181.2	14:44	15:04			144419	
3059	522111209	001.1	15:07	15:27			150725	
3060	522111210	181.3	15:30	15:51			153057	
3061	522111211	001.2	15:54	16:14			155417	
3062	522111212	181.4	16:18	16:37			161807	
3063	522111213	001.2	16:41	17:01			164111	

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz	
Target Speed	160	**kts**	**Scan Rate**	175/179 plane	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210422	
			Start	End	Time	nmi to End		
3064	522111214	181.4	17:04	17:24			210422_170435	
3065	522111215	001.3	17:27	17:47			172729	
Figure 8		8	17:47	17:51				

Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179 plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179 plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

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Julian Day 112	Flight A

LIDAR Flight Log

Date	April 22nd, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A. Murray
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.237-290
Rough/turbulent.

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	11:38	**Takeoff**	11:58	
Engine Off	18:14	**Landing**	18:06	
Total	6.6 hrs	**Total**	6.1 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179 plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210422	

v 20200520

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

2c, 50%, 1020hpa. 15-30knt all direction.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

ending due to turb. refly 6012.

Time to next maintenance: 20

Aircraft Block Time				
Engine On	15:55	**Takeoff**	16:07	
Engine Off	19:14	**Landing**	19:07	
Total	3.3 hrs	**Total**	3.0 hrs	

Mission Plan					
AGL Height	1200	**m**	**Pulse Rate**	2000khz	
Target Speed	160	**kts**	**Scan Rate**	285	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210424	
			Start	End	Time	nmi to End		
TEST		270	16:24	16:24			162419	
FIGURE 8		x	16:30	16:35			x	
crosstie	432111401	270	16:35	16:42			163548	
6018	432111402	180	16:56	17:12			165635	
6017	432111403	360	17:15	17:26			171557	
6016	432111404	180	17:29	17:39			172920	
6015	432111405	360	17:42	17:52			174243	
6014	432111406	180	17:55	18:06			175557	
6013	432111407	360	18:10	18:20			181006	
6012	432111408	180	18:23	18:29			182304	
Figure 8		x	18:32	18:37			x	

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

2c, 50%, 1020hpa. 15-30knt all direction.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

ending due to turb. refly 6012.

Time to next maintenance: 20

Aircraft Block Time				
Engine On	15:55	**Takeoff**	16:07	
Engine Off	19:14	**Landing**	19:07	
Total	3.3 hrs	**Total**	3.0 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000khz
Target Speed	160	**kts**	**Scan Rate**	285
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

2c, 50%, 1020hpa. 15-30knt all direction.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

ending due to turb. refly 6012.

Time to next maintenance: 20

Aircraft Block Time				
Engine On	15:55	**Takeoff**	16:07	
Engine Off	19:14	**Landing**	19:07	
Total	3.3 hrs	**Total**	3.0 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000khz
Target Speed	160	**kts**	**Scan Rate**	285
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

v 20200520

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

2c, 50%, 1020hpa. 15-30knt all direction.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

ending due to turb. refly 6012.

Time to next maintenance: 20

Aircraft Block Time				
Engine On	15:55	**Takeoff**	16:07	
Engine Off	19:14	**Landing**	19:07	
Total	3.3 hrs	**Total**	3.0 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000khz
Target Speed	160	**kts**	**Scan Rate**	285
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

v 20200520

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24, 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

2c, 50%, 1020hpa. 15-30knt all direction.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

ending due to turb. refly 6012.

Time to next maintenance: 20

Aircraft Block Time				
Engine On	15:55	**Takeoff**	16:07	
Engine Off	19:14	**Landing**	19:07	
Total	3.3 hrs	**Total**	3.0 hrs	

Mission Plan				
AGL Height	1200	**m**	**Pulse Rate**	2000khz
Target Speed	160	**kts**	**Scan Rate**	285
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

v 20200520

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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 4/24/2021

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

Project: MN Rainy Lake **Proj #:** 36740 **Flight Mgmt File:** 36740 MN Rainy Lake

Aircraft: 22TE **Begin Hobbs:** 6003.6 **End Hobbs:** 6006.2 **Total:** 2.6 **Pilot:** Jamon Nelson **Co-Pilot:** **Tech:** Spencer Beck

Dep Apt: KHIB **Dep Time (Lcl):** 05:30 **(Z):** **Arr Apt:** KHIB **Arr Time (Local):** 08:09 **(Z):** **Tot Time Aloft:** 2.6

CORS: Y / (N) **Sta 1:** **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 # 4040	Alt AGL 4921	Alt AMSL ~~8000~~	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing	Beg GB	Storage Name/#
FOV 58.52	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate 1000 KHz	Power 100	PPSM 8	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.
1056									last line of mission
1057									PD Froze, flew through bps midnight - refly?
1058					0.93				
1069									

Total Proj Lines:	Lines Flown:	Lines Remain:	OnLine Time:	Mob Time:	Notes:

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A.M / L.B
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.291-322

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	15:01	**Takeoff**	15:20	
Engine Off	19:02	**Landing**	18:46	
Total	4.0 hrs	**Total**	3.4 hrs	

Mission Plan				
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz
Target Speed	160	**kts**	**Scan Rate**	175/179plane
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210424	
			Start	End	Time	nmi to End		
							210424_151145	
Figure 8		8	15:30	15:34				
X-Tie_66-72	512111401	274.0 +/-	15:34	15:39			153456	
3066	512111402	181.4	15:46	16:05			154623	
3067	512111403	001.5	16:09	16:29			160906	
3068	512111404	181.5	16:32	16:52			163222	
3069	512111405	001.4	16:55	17:15			165521	
3070	512111406	181.5	17:18	17:38			171857	
3071	512111407	001.4	17:42	18:02			174207	
3072	512111408	181.6	18:04	18:23			180458	
Figure 8		8	18:28	18:32				59

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A.M / L.B
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.291-322

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	15:01	**Takeoff**	15:20	
Engine Off	19:02	**Landing**	18:46	
Total	4.0 hrs	**Total**	3.4 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

v 20200520

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A.M / L.B
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.291-322

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	15:01	**Takeoff**	15:20	
Engine Off	19:02	**Landing**	18:46	
Total	4.0 hrs	**Total**	3.4 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz	
Target Speed	160	**kts**	**Scan Rate**	175/179plane	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A.M / L.B
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.291-322

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	15:01	**Takeoff**	15:20	
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Total	4.0 hrs	**Total**	3.4 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz	
Target Speed	160	**kts**	**Scan Rate**	175/179plane	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

Julian Day 114	Flight A

LIDAR Flight Log

Date	April 24th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	A.M / L.B
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

CP780.291-322

Time to next maintenance: 5.8

Aircraft Block Time				
Engine On	15:01	**Takeoff**	15:20	
Engine Off	19:02	**Landing**	18:46	
Total	4.0 hrs	**Total**	3.4 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz	
Target Speed	160	**kts**	**Scan Rate**	175/179plane	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210424	

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 15 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

-08c, 80%, 1020hpa.
refly line 6012 from last mission. Western section complete.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

issue connecting filezilla to 192.168.0.124. px:applanix. Issue with data recorder again rate out of range" required reb

Time to next maintenance: 11

Aircraft Block Time				
Engine On	11:35	**Takeoff**	11:50	
Engine Off	18:10	**Landing**	18:03	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1200	m	**Pulse Rate**	2000khz	
Target Speed	160	kts	**Scan Rate**	285	
Laser Current	100	%	**FOV**	60	degs

Static Alignment
Pre Mission
Post Mission

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210425	
			Start	End	Time	nmi to End		
FIGURE 8		X	12:12	12:18			X	
TEST		270	12:18	12:18			121804	
crosstie	432111501	270	12:19	12:25			121956	
6012	432111502	180	12:32	12:42			123241	
6011	432111503	360	12:44	12:53			124451	
6010	432111504	180	12:56	13:07			125644	
6009	432111505	360	13:10	13:15			131032	
6008	432111506	180	13:18	13:23			131826	
6007	432111507	360	13:26	13:32			132607	
6006	432111508	180	13:34	13:38			133405	
6005	432111509	360	13:41	13:48			134116	
6004	432111510	180	13:49	13:54			134907	
6003	432111511	360	13:56	14:01			135603	
6002	432111512	180	14:03	14:08			140329	
6001	432111513	360	14:10	14:16			141057	

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 15 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

-08c, 80%, 1020hpa.
refly line 6012 from last mission. Western section complete.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

issue connecting filezilla to 192.168.0.124. px:applanix. Issue with data recorder again rate out of range" required reb

Time to next maintenance: 11

Aircraft Block Time				
Engine On	11:35	**Takeoff**	11:50	
Engine Off	18:10	**Landing**	18:03	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1200	m	**Pulse Rate**	2000khz	
Target Speed	160	kts	**Scan Rate**	285	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210425	
			Start	End	Time	nmi to End		
Figure 8		x	14:11	14:16			x	
Figure 8		x	14:56	15:01			x	
crosstie	432111514	150	15:01	15:05			150156	
6171	432111515	180	15:06	15:15			150642	
6170	432111516	360	15:18	15:35			151807	
6169	432111517	180	15:38	15:56			153843	
6168	432111518	360	15:59	16:02	16:02		155936	
6168	432111519	360	16:07	16:23			160703	
6167	432111520	180	16:25	16:43			162537	
6166	432111521	360	16:46	17:03			164628	
6165	432111522	180	17:06	17:25			170622	
crosstie	432111523	270	17:28	17:30			172811	
6164	432111524	360	17:32	17:49			173237	
figure 8		x	17:49	17:54			x	

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 15 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

-08c, 80%, 1020hpa.
refly line 6012 from last mission. Western section complete.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

issue connecting filezilla to 192.168.0.124. px:applanix. Issue with data recorder again rate out of range" required reb

Time to next maintenance: 11

Aircraft Block Time				
Engine On	11:35	**Takeoff**	11:50	
Engine Off	18:10	**Landing**	18:03	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1200	m	**Pulse Rate**	2000khz	
Target Speed	160	kts	**Scan Rate**	285	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

v 20200520

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 15 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

-08c, 80%, 1020hpa.
refly line 6012 from last mission. Western section complete.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

issue connecting filezilla to 192.168.0.124. px:applanix. Issue with data recorder again rate out of range" required reb

Time to next maintenance: 11

Aircraft Block Time				
Engine On	11:35	**Takeoff**	11:50	
Engine Off	18:10	**Landing**	18:03	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1200	m	**Pulse Rate**	2000khz	
Target Speed	160	kts	**Scan Rate**	285	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

v 20200520

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 15 2021	**Aircraft**	C-FFRY
Project	3220_QSI_RainyLake_2021	**Pilot**	N. Boyda
Location	KINL	**Operator**	T. Cooper

Mission Objective

-08c, 80%, 1020hpa.
refly line 6012 from last mission. Western section complete.

System	VQ-1560ii
Unit	43
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A1
Scanner 2 Drive	A1

Additional Notes

issue connecting filezilla to 192.168.0.124. px:applanix. Issue with data recorder again rate out of range" required reb

Time to next maintenance: 11

Aircraft Block Time				
Engine On	11:35	**Takeoff**	11:50	
Engine Off	18:10	**Landing**	18:03	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1200	m	**Pulse Rate**	2000khz	
Target Speed	160	kts	**Scan Rate**	285	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

v 20200520

axis geospatial		AXIS GeoAviation				LiDA
Pilot:		**JT**				**Pro**
Operator:		**AC**				**Pr**
Aircraft:		**223TC**				**Hob**
LiDAR Unit:		**3) VQ-1560i S2223544**		**Scan Rate:**		
MTA Zones:		**8 TO 12**		**Grnd Spd Max (kts):**		
PRR (kHz):		**2x1000**		**Altitude (feet AMT):**		
Laser Power (%):		**100**		**Point Spacing (m):**		
		Camera Counter		**Line Start/Stop**		
Line #	**Direction**	**To**	**From**	**Start Time UTC**	**Stop Time UTC**	**Altitude (Planned)**
85	**NE**			**8:17**	**8:30**	**5655+-**
84	**SW**			**8:33**	**8:46**	
83	**NE**			**8:50**	**9:03**	
82	**SW**			**9:06**	**9:18**	
81	**NE**			**9:21**	**9:34**	
80	**SW**			**9:37**	**9:48**	
79	**NE**			**9:51**	**9:57**	
78	**SW**			**10:00**	**10:05**	
77	**NE**			**10:08**	**10:13**	
76	**SW**			**10:15**	**10:18**	

63	W			11:43	11:50	
64	E			11:53	12:00	
65	W			12:03	12:09	
66	E			12:11	12:17	
67	W			12:19	12:25	
68	E			12:28	12:34	
69	W			12:36	12:41	
70	E			12:44	12:49	
95 XTIE	NE			14:16	14:22	
40	E			14:28	14:41	
41	W			14:43	14:56	
42	E			14:59	15:12	
43	W			15:16	15:26	
44	E			15:29	15:40	
45	W			15:42	15:52	

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 25th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
3073-3092 left to do.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	C1
Scanner 2 Drive	C1

Additional Notes

CP780.323-371
Very Rough on later flight.

Time to next maintenance: 2.4 +/

Aircraft Block Time				
Engine On	12:45	**Takeoff**	13:02	
Engine Off	18:49	**Landing**	18:41	
Total	6.1 hrs	**Total**	5.7 hrs	

Mission Plan				
AGL Height	1500 m	**Pulse Rate**	1000 KHz	
Target Speed	160 kts	**Scan Rate**	175/179plane	
Laser Current	100 %	**FOV**	60 degs	

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210425	
			Start	End	Time	nmi to End		
							210425_125233	
Figure 8		8	13:07	13:12				
X-Tie_73-86	512111501	272.0 +/-	13:13	13:18			210425_131326	
3073	512111502	181.7	13:22	13:40			132200	
3074	512111503	001.5	13:43	14:02			134346	
3075	512111504	181.7	14:05	14:24			140548	
3076	512111505	001.6	14:27	14:46			142737	
3077	512111506	181.8	14:50	15:09			145013	
3078	512111507	001.6	15:12	15:30			151209	
3079	512111508	181.8	15:33	15:52			153349	
3080	512111509	001.7	15:55	16:13			155518	
3081	512111510	181.9	16:17	16:36			161702	
3082	512111511	001.7	16:39	16:58			163932	
3083	512111512	181.9	17:01	17:21			170155	
3084	512111513	001.8	17:24	17:42			172418	

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 25th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
3073-3092 left to do.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	C1
Scanner 2 Drive	C1

Additional Notes

CP780.323-371
Very Rough on later flight.

Time to next maintenance: 2.4 +/

Aircraft Block Time				
Engine On	12:45	**Takeoff**	13:02	
Engine Off	18:49	**Landing**	18:41	
Total	6.1 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	
3085	512111514	181.9	17:46	18:05			210425_174620	
3086	512111515	001.8	18:08	18:27			180849	
Figure 8		8	18:27	18:32				

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 25th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
3073-3092 left to do.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	C1
Scanner 2 Drive	C1

Additional Notes

CP780.323-371
Very Rough on later flight.

Time to next maintenance: 2.4 +/

Aircraft Block Time					
Engine On	12:45	**Takeoff**	13:02		
Engine Off	18:49	**Landing**	18:41		
Total	6.1 hrs	**Total**	5.7 hrs		

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

v 20200520

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 25th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
3073-3092 left to do.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	C1
Scanner 2 Drive	C1

Additional Notes

CP780.323-371
Very Rough on later flight.

Time to next maintenance: 2.4 +/

Aircraft Block Time					
Engine On	12:45	**Takeoff**	13:02		
Engine Off	18:49	**Landing**	18:41		
Total	6.1 hrs	**Total**	5.7 hrs		

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

v 20200520

Julian Day 115	Flight A

LIDAR Flight Log

Date	April 25th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
3073-3092 left to do.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	C1
Scanner 2 Drive	C1

Additional Notes

CP780.323-371
Very Rough on later flight.

Time to next maintenance: 2.4 +/

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Engine On	12:45	**Takeoff**	13:02		
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Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

v 20200520

Julian Day 115	Flight B

LIDAR Flight Log

Date	April 25, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar

Mission Objective
Note: post mission static was done in air

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes
Quadtree memory issue at 17:
still writing to discs so I believe
can't see swath in RicAquire.
RiAcquire completely froze at

Time to next maintenance: _____

Aircraft Block Time					
Engine On	13:38	**Takeoff**	13:50		
Engine Off	19:08	**Landing**	19:02		
Total	5.5 hrs	**Total**	5.2 hrs		

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000khz	
Target Speed	160	**kts**	**Scan Rate**	179lps	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	
F8			13:58	14:05				
Xtie	382111501		1409	1412			140918	
3117	382111502		1421	1439			142123	
3118	382111503		1442	1500			144224	
3119	382111504		1503	1521			150317	
3120	382111505		1524	1542			152413	
3121	382111506		1545	1603			154512	
3122	382111507		1606	1624			160607	
3123	382111508		1627	1646			162703	
3124	382111509		1648	1706			164805	
3125	382111510		1709	1714	1714			
3125	382111511		1719	1735			171900	
3126	382111512		1736	1755			173635	
3127	382111513		1757	1815			175742	
3128			1819	1821			181924	

Julian Day 115	Flight B

LIDAR Flight Log

Date	April 25, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar

Mission Objective

Note: post mission static was done in air

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

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Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000khz	
Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	
3128	382111514		?	1841				RiAc
F8			1841	1846				

Julian Day 115	Flight B

LIDAR Flight Log

Date	April 25, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar

Mission Objective

Note: post mission static was done in air

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

Julian Day 115	Flight B

LIDAR Flight Log

Date	April 25, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar

Mission Objective

Note: post mission static was done in air

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IMU	Applanix AP50
GPS Rx	Trimble GNSS17
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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

Julian Day 115	Flight B

LIDAR Flight Log

Date	April 25, 2021	**Aircraft**	C-GMEC
Project	3220_QSI_RaineyLake	**Pilot**	U.Farooq
Location	International Falls	**Operator**	C.Edgar

Mission Objective

Note: post mission static was done in air

System	VQ1560II
Unit	38
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

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Target Speed	160	kts	**Scan Rate**	179lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210425	

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

Date: 4/25/20

(email log daily to flight_log_distribution_list@quantumspatial.com)

Lift: A B C D E

Project: MN Rainy Lake Proj #: 36740 Flight Mgmt File: 36740 MN Rainy lake

Aircraft: 22TE Begin Hobbs: 6010.2 End Hobbs: 6014.6 Total: 4.4 Pilot: Jamon Nelson Co-Pilot: T

Dep Apt: KHIB Dep Time (Lcl): 02:31 (Z): Arr Apt: KHIB Arr Time (Local): 06:54 (Z): Tot Time

CORS: Y / N Sta 1: 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	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	1560ii	4040	4921			160 KTS	
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM
	58.52				1000 KHz	100	8

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
1048									last line of mission
1049									
1050									
1051									overcast above
1052									
1053									
1054									Moderate turb, sensor Kett recording after line en
1055									First line of mission

Julian Day 118	Flight A

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.372-390

Time to next maintenance: 50 +/-

Aircraft Block Time				
Engine On	13:27	**Takeoff**	13:41	
Engine Off	15:48	**Landing**	15:40	
Total	2.4 hrs	**Total**	2.0 hrs	

Mission Plan				
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz
Target Speed	160	**kts**	**Scan Rate**	175/179plane
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210428	
			Start	End	Time	nmi to End		
							210428_133310	
Figure 8		8	14:03	14:07				
1026	512111801	000.9	14:10	14:11			210428_141019	
1025	512111802	180.9	14:15	14:17			141521	
1024	512111803	000.8	14:20	14:23			142044	
X-Tie_24-26	512111804	087.5	14:27	14:28			142743	
Figure 8		8	14:29	14:33				
Figure 8		8	14:46	14:50				
***3092		181.8	14:55	15:13			145541	
Figure 8		8	15:16	15:20				
								1

Julian Day 118	Flight A

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.372-390

Time to next maintenance: 50 +/-

Aircraft Block Time				
Engine On	13:27	**Takeoff**	13:41	
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Mission Plan				
AGL Height	1500	**m**	**Pulse Rate**	1000 KHz
Target Speed	160	**kts**	**Scan Rate**	175/179plane
Laser Current	100	**%**	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

Julian Day 118	Flight A

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.372-390

Time to next maintenance: 50 +/-

Aircraft Block Time					
Engine On	13:27	**Takeoff**	13:41		
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Total	2.4 hrs	**Total**	2.0 hrs		

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AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

Julian Day 118	Flight A

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.372-390

Time to next maintenance: 50 +/-

Aircraft Block Time					
Engine On	13:27	**Takeoff**	13:41		
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Target Speed	160	kts	**Scan Rate**	175/179plane	
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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

Julian Day 118	Flight A

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.372-390

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Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

Julian Day 118	Flight B

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.391-422

Extremely rough, Could not fo
well. Apologies on any logshee

Time to next maintenance: 50 +/-

Aircraft Block Time				
Engine On	19:29	**Takeoff**	19:47	
Engine Off	23:32	**Landing**	23:21	
Total	4.1 hrs	**Total**	3.6 hrs	

Mission Plan			
AGL Height	1500 m	**Pulse Rate**	1000 KHz
Target Speed	160 kts	**Scan Rate**	175/179plane
Laser Current	100 %	**FOV**	60 degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	
							210428_193628	
Figure 8		8	19:54	19:58				
X-Tie	512111805	267.0 +/-	19:59	20:00			195900	589
3087	512111806	S	20:04	20:22			200442	
3088	512111807	N	20:25	20:45			202558	
3089	512111808	S	20:48	21:06			204807	
3090	512111809	N	21:09	21:28			210924	
3091	512111810	S	21:31	21:49			213149	
3092	512111811	N	21:53	22:11			215301	
X-Tie	512111812	87 +/-	22:15	22:17			221515	
Figure 8		8						
3128	512111813	S	22:31	22:49			223137	
3129	512111814	N	22:52	23:09			225221	
X-Tie	512111815	271.0	23:11	23:12			231141	
Figure 8		8	23:17				23:17	

Julian Day 118	Flight B

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

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Aircraft Block Time					
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Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
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Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

Julian Day 118	Flight B

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

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Aircraft Block Time					
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Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

Julian Day 118	Flight B

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
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AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

Julian Day 118	Flight B

LIDAR Flight Log

Date	April 28th, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KINL	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
1024-1026

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	B1
Scanner 2 Drive	B1

Additional Notes

CP780.391-422

Extremely rough, Could not fo
well. Apologies on any logshee

Time to next maintenance: 50 +/-

Aircraft Block Time					
Engine On	19:29	**Takeoff**	19:47		
Engine Off	23:32	**Landing**	23:21		
Total	4.1 hrs	**Total**	3.6 hrs		

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210428	

v 20200520

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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 4/30/2021

Lift: A B C D E Pg 1 of 2

Project: MNDOT / Rainy **Proj #:** 38613 / 36740 **Flight Mgmt File:** 20200430_SW4040_A_MN_Projects

Aircraft: 22TE **Begin Hobbs:** 6016.6 **End Hobbs:** **Total:** **Pilot:** Dan Luckett **Co-Pilot:** **Tech:** Noah Edelson

Dep Apt: KHIB **Dep Time (Lcl):** 8:48 **(Z):** 1348 **Arr Apt:** KINL **Arr Time (Local):** 2:10 **(Z):** 1910 **Tot Time Aloft:** 5:22

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									Beg GB	Storage Name/#
	Type 1560 ii	Serial # 4040	Alt AGL 1500 m	Alt AMSL	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing		End GB	
	FOV	Scan Freq 1000 kHz	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100%	PPSM		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.
22	N	140555	141021	122	.41/23	2120	4	0	MNDOT 38613, ~30 kt headwind, smooth air
1047	W	142537	144453	145	.48/21	1860	-6	0	Rainy, line didn't auto trigger, manually started a second or two in, smooth air
1046	E	145105	151418	152	.45/20	1870	7	0	smooth
1045	W	151534	153419	147	.86/21	1860	-7	0	smooth
1044	E	154014	160236	155	.42/20	1870	6	0	few small pockets snow/ice on shady shorelines, smooth
1043	W	160333	162617	145	.81/23	1870	-6	0	smooth
1042	E	162714	164933	154	.86/24	1870	5	0	smooth
1041	W	165037	171312	155	.41/22	1870	-7	0	smooth
1040	E	171413	173654	150	.87/23	1850	4	~0	few small bumps in air
1039	W	173751	180039	146	.86/21	1850	-5	~	sloppy line entry 43 40 FWE few bumps, 26, 3, 25, 19, 18-46, 6-5, 3, 1
1038	E	180140	182400	155	.80/22	1840	3	~	FWE 55, 52.5, 51, 49, 48, 44.5, 40.5, 39, 37, 32, 19-16.5, 13.5, 12, 7
1037	W	182645	184740	150	.78/22	1840	-3	~	FWE 48, 43.5-42, 26-16.15
x-line	S	184923	185304						

Total Proj Lines: 99 **Lines Flown:** 11 **Lines Remain:** 32 **OnLine Time:** 4.6 **Mob Time:** .8 **Notes:**

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

(email log daily to flight_Log_distribution_list@quantumspatial.com)

Date: 4/30/2021 Lift: A B C D E Pg 2 of 3

Project: Rainy **Proj #:** 36740 **Flight Mgmt File:** 20210430_SN4040_B_36740

Aircraft: 22TE **Begin Hobbs:** 6022.0 **End Hobbs:** 6024.9 **Total:** 2.9 **Pilot:** Dan Luckett **Co-Pilot:** **Tech:** Noah Edelson

Dep Apt: KINL **Dep Time (Lcl):** 2:53 **(Z):** 19:53 **Arr Apt:** KHIB **Arr Time (Local):** 5:50 **(Z):** 2250 **Tot Time Aloft:** 2:57

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									Beg GB	Storage Name/#
	Type 1560ii	Serial # 4040	Alt AGL 1500 m	Alt AMSL	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing		End GB	
	FOV	Scan Freq 1000 kHz	MpIA Y / N	Pulses In Air	Pulse Rate	Power 100 %	PPSM 8		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.
1001	E	200350	200635	154	.90/23	1830	-1	0	smooth
1002	W	200746	201058	143	.87/	1835	2	0	Smooth
1003	E	201158	201510	160	.87/24	1825	-1	0	smooth
1004	W	201635	202041	142	.87/24	1830	2	0	Smooth
1005	E	202133	202539	154	.88/24	1840	-1	0	stopping line entry, Smooth air
1006	W	202739	203117	142	.87/24	1830	2		minor turb
1007	E	203406	203932	151	.93/23	1840	-4		
1008	W	204303	205121	145	.89/22	1840	2		
1009	E	205215	205751	152	.98/20	1835	-3		light turb
1010	W	210045	210928	138	.93/20	1830	5		
1011	E	211012	211756	154	.95/20	1840	-4		
1012	W	211852	212728	137	.94/20	1830	6.5		
1013	E	212814	213605	160	.87/20	1840	-3		
1014	W	213705	214542	140	.85/21	1830	5		turb
1015	E	214628	215415	153	.88/20	1840	-3		6 GPS sats started line, 29 total
1016	W	215655	220733	140	.85/22	1840	5		6 GPS sats most line
1017	E	221334	222113	136	.91/23	1840	-4		

Total Proj Lines: 44 **Lines Flown:** 17 **Lines Remain:** 32 **OnLine Time:** 2.3 **Mob Time:** .6 **Notes:**

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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 5/1/21

Lift: (A) B C D E Pg 1 of 7

Project: Rainy MN **Proj #:** 36140 **Flight Mgmt File:** 20210501_SN4040_A_36740

Aircraft: 22TE **Begin Hobbs:** 6024.9 **End Hobbs:** 6030.9 **Total:** **Pilot:** Dan Luckett **Co-Pilot:** **Tech:** Noah Edelson

Dep Apt: KHIB **Dep Time (Lcl):** 8:42 **(Z):** 1342 **Arr Apt:** **Arr Time (Local):** 2:39 **(Z):** 1939 **Tot Time Aloft:**

CORS: Y / N **Sta 1:** MP **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 # 4040	Alt AGL 1500m	Alt AMSL	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing		
FOV	Scan Freq 1000/112	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100%	PPSM 8		

Storage	Beg GB	End GB	Tot GB	Name/#

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/# Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
1099	N	135908	135948	137	.97/21	1900	13	0	30 knot X-wind from W, smooth air, sunny
1026	W	142124	144239	120	.95/21	1840	-5	0	
1025	E	144333	150010	155	.92/22	1840	10	0	
1024	W	150229	152218	125	.91/23	1835	-8	0	
1023	E	152315	153338	155	.96/22	1840	13	0	
1022	W	153437	154742	126	.98/20	1840	-8	0	
1021	E	154838	155843	158	.93/20	1840	13	0	
1020	W	155947	161217	128	.94/20	1840	-4	0	
1019	E	161314	162312	160	.89/21	1840	11	0	
1018	W	162422	163615	130	.88/21	1835	-8	0	
1017	E	163712	164656	155	.98/20	1840	10	0	
x-line	S	165127	165544					0	
1024	E	165843						0	Gimbal locked/frozen, smooth conditions, a/c refly line
1028	W	170302	170711	135	.94/20	1835	-7	0	Gimbal locked/frozen, smooth air, a/c refly line
1027	E	170833	171124	157	.97/14	1840		0	Gimbal on, refly of partial line
1031	W	171355	171947	140	1.00/18	1840	-7	0	refly of partial line
1032	E	172351	173421	156	.93/19	1840	9	0	refly line
1033	W	173059	181536	125	.99/19	1880	-7	+	light turb, refly line

Total Proj Lines: 11 **Lines Flown:** 22 **Lines Remain:** 11 **Online Time:** 5.4 **Mob Time:** .6 **Notes:**

Line #	Hdg	Start	Stop	Gd speed	PDOP/sats	GPS alt	Crab	Turb	Notes
1077	E	181646	183720	160	91/20	1880	6	+	turb
1078	W	183825	190215	130	88/21	1880	-2	+	turb
1076	E	140321	142113		91/20	1880	3	+	turb
1073	W	141921	142815	135	87/20	1910	0	+	turb

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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 5/2/2021

Lift: A B C D E Pg 1 of __

Project: Rainy QSI **Proj #:** 36740 **Flight Mgmt File:** 20210502_SN4040_A_36740

Aircraft: 227E **Begin Hobbs:** 6030.9 **End Hobbs:** 6034.3 **Total:** 3.4 **Pilot:** Dan Lullett **Co-Pilot:** **Tech:** Noah Edelson

Dep Apt: KHIB **Dep Time (Lcl):** 9:46 **(Z):** 1346 **Arr Apt:** KHIB **Arr Time (Local):** 12:10 **(Z):** 1710 **Tot Time Aloft:** 3:24

CORS: Y / N **Sta 1:** MPP **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									Beg GB	Storage Name/#
	Type 1560ii	Serial # 4040	Alt AGL 1500m	Alt AMSL	Avg Terr Ht	Max Gdspd 160	Avg Pt Spacing		End GB	
	FOV	Scan Freq 1000kHz	MpiA Y / N	Pulses In Air	Pulse Rate	Power 100%	PPSM 8		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.
1085	W	135937	140254	153	.95/21	1890	-2	0	2-9 FWE
1087	E	140425	140730	150	.94/21	1890	3	0	8-11 FWE
1086	W	140919	141414	154	.98/20	1890	-1	0	2-11 FWE
1084	E	141604	142851	150	1.05/18	1890	3	0	24 FWE
1083	W	143152	144626	148	.98/20	1890	-1	0	34 FWE
1082	E	144747	150425	149	.92/19	1890	2	0	Full refly
1081	W	151020	153145	149	.89/20	1890	0	0	reflew full line
1080	E	153251	155428	151	.93/19	1890	3	0	reflew full line
1079	W	155529	161642	153	1.02/18	1890	-2	0	reflew full line
1078	E	162631	162822	152	1.00/19	1890	4	0	16-18 FWE
1077	E	162923	167130		1.06/18	1890	5	0	22-24 FWE
1058	E	167608		150	1.00/19	1890	4	0	10-17 FEE
164309									x-line
165229									x-line

Total Proj Lines: 49 **Lines Flown:** 11 **Lines Remain:** 0 **Online Time:** 2.8 **Mob Time:** .6 **Notes:**

Julian Day 125	Flight B

LIDAR Flight Log

Date	May 5 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KDLH	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
Reflight of lines.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A!
Scanner 2 Drive	A1

Additional Notes

CP780.578-
*UNFORCASTED LOW CLOU
5000-6000 FT

Time to next maintenance: 26.3 +

Aircraft Block Time				
Engine On	13:30	**Takeoff**	13:47	
Engine Off	19:40	**Landing**	19:31	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210505	
			Start	End	Time	nmi to End		
							210505_133712	
Figure 8		8	14:22	14:27				
3092	512112501	002.1	14:32	14:51			210505_143202	
S-Turn		S	14:52	14:56				6000
X-Tie_3092	512112502	232.0 +/-	15:00	15:01			150018	
Figure 8		8	15:22	15:27				
X-Tie_14-15	512112503	285.0+/-	15:28	15:29			152830	
3014	512112504	180.1	15:32	15:39			153251	
3015	512112505	0.00	15:42	15:49			154241	
Figure 8		8	15:49	15:53				
								Ove

Julian Day 125	Flight B

LIDAR Flight Log

Date	May 5 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KDLH	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
Reflight of lines.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A!
Scanner 2 Drive	A1

Additional Notes

CP780.578-
*UNFORCASTED LOW CLOU
5000-6000 FT

Time to next maintenance: 26.3 +

Aircraft Block Time				
Engine On	13:30	**Takeoff**	13:47	
Engine Off	19:40	**Landing**	19:31	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210505	
			Start	End	Time	nmi to End		
Figure 8		8	16:40	16:44				
3133	512112506	003.2	16:48	17:07			210505_164853	5899
								Had t
3132	512112507	183..3	17:10	17:28			171057	
3131	512112508	003.1	17:32	17:50			173227	
3130	512112509	183.2	17:53	18:11			175337	
3129	512112510	003.1	18:14	18:33			181450	589
3128	512112511	183.2	18:36	18:54			183643	not e
X-Tie_28-33	512112512	085.0 +/-	18:56	18:58			185657	
Figure 8		8	18:59	19:03				

Julian Day 125	Flight B

LIDAR Flight Log

Date	May 5 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KDLH	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
Reflight of lines.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A!
Scanner 2 Drive	A1

Additional Notes

CP780.578-
*UNFORCASTED LOW CLOU
5000-6000 FT

Time to next maintenance: 26.3 +

Aircraft Block Time				
Engine On	13:30	**Takeoff**	13:47	
Engine Off	19:40	**Landing**	19:31	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210505	

Julian Day 125	Flight B

LIDAR Flight Log

Date	May 5 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KDLH	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
Reflight of lines.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A!
Scanner 2 Drive	A1

Additional Notes

CP780.578-
*UNFORCASTED LOW CLOU
5000-6000 FT

Time to next maintenance: 26.3 +

Aircraft Block Time				
Engine On	13:30	**Takeoff**	13:47	
Engine Off	19:40	**Landing**	19:31	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210505	

Julian Day 125	Flight B

LIDAR Flight Log

Date	May 5 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RainyLake_QL1	**Pilot**	L. Bastien
Location	KDLH	**Operator**	R. Gemmel

Mission Objective

-Holding +02.00 pitch O/S as per management.
Reflight of lines.

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	A!
Scanner 2 Drive	A1

Additional Notes

CP780.578-
*UNFORCASTED LOW CLOU
5000-6000 FT

Time to next maintenance: 26.3 +

Aircraft Block Time				
Engine On	13:30	**Takeoff**	13:47	
Engine Off	19:40	**Landing**	19:31	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 KHz	
Target Speed	160	kts	**Scan Rate**	175/179plane	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	
			Start	End	Time	nmi to End	Time Stamp 210505	

Julian Day 128	Flight A

LIDAR Flight Log

Date	May 8, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RaineyLake	**Pilot**	L. Bastien
Location	International Fals, MN	**Operator**	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time				
Engine On	13:43	**Takeoff**	13:58	
Engine Off	19:36	**Landing**	19:28	
Total	5.9 hrs	**Total**	5.5 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 khz/ch	
Target Speed	160	kts	**Scan Rate**	179 hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210508	
			Start	End	Time	nmi to End		
Figure 8		-	14:01	14:05			-	
3102	512112801	182°	14:07	14:15			140737	
3100	512112802	182°	14:19	14:21			141901	
3099	512112803	2°	14:25	14:28			142530	
Figure 8		-	15:01	15:05			-	
1001	512112804	0°	15:08	15:15			150842	
1002	512112805	180°	15:18	15:25			151855	
1013	512112806	0°	15:30	15:36			153037	
1012	512112807	180°	15:40	15:45			154011	
1014	512112808	0°	15:48	15:54			154806	
1015	512112809	180°	15:57	16:02			155709	
1016	512112810	0°	16:05	16:11			160538	
1017	512112811	180°	16:14	16:19			161418	
1018	512112812	0°	16:22	16:27			162210	
1019	512112813	180°	16:30	16:34			163013	

Julian Day 128	Flight A

LIDAR Flight Log

Date	May 8, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RaineyLake	**Pilot**	L. Bastien
Location	International Fals, MN	**Operator**	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time				
Engine On	13:43	**Takeoff**	13:58	
Engine Off	19:36	**Landing**	19:28	
Total	5.9 hrs	**Total**	5.5 hrs	

Mission Plan					
AGL Height	1500	m	**Pulse Rate**	1000 khz/ch	
Target Speed	160	kts	**Scan Rate**	179 hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210508	
			Start	End	Time	nmi to End		
1020	512112814	0°	16:37	16:42			163746	
1021	512112815	180°	16:44	16:48			164442	
1022	512112816	0°	16:52	16:57			165213	
1023	512112817	180°	17:01	17:05			170109	
1024	512112818	0°	17:07	17:10			170754	
1025	512112819	180°	17:14	17:16			171442	
10:26	512112820	0°	17:19	17:20			171933	
X-TIE 1022-26	512112821	280°	17:22	17:24			172248	
X-TIE 1001-21	512112822	270°	17:26	17:32			172645	
1003	512112823	0°	17:36	17:42			173612	
1004	512112824	180°	17:45	17:52			174549	
1005	512112825	0°	17:55	18:01			175515	
1006	512112826	180°	18:04	18:10			180432	
1007	512112827	0°	18:13	18:19			181333	
1008	512112828	180°	18:21	18:27			182155	

Julian Day 128	Flight A

LIDAR Flight Log

Date	May 8, 2021	**Aircraft**	C-GKSX
Project	3220_QSI_RaineyLake	**Pilot**	L. Bastien
Location	International Fals, MN	**Operator**	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560ii
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____

Aircraft Block Time				
Engine On	13:43	**Takeoff**	13:58	
Engine Off	19:36	**Landing**	19:28	
Total	5.9 hrs	**Total**	5.5 hrs	

Mission Plan					
AGL Height	1500	**m**	**Pulse Rate**	1000 khz/ch	
Target Speed	160	**kts**	**Scan Rate**	179 hz/ch	
Laser Current	100	**%**	**FOV**	60	degs

Static Alignment	
Pre Mission	
Post Mission	

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 210508	
			Start	End	Time	nmi to End		
1009	512112829	0°	18:30	18:35			183017	
1010	512112830	180°	18:38	18:43			183823	
1011	512112831	0°	18:46	18:52			184650	
Figure 8		-	18:53	18:57			-	

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