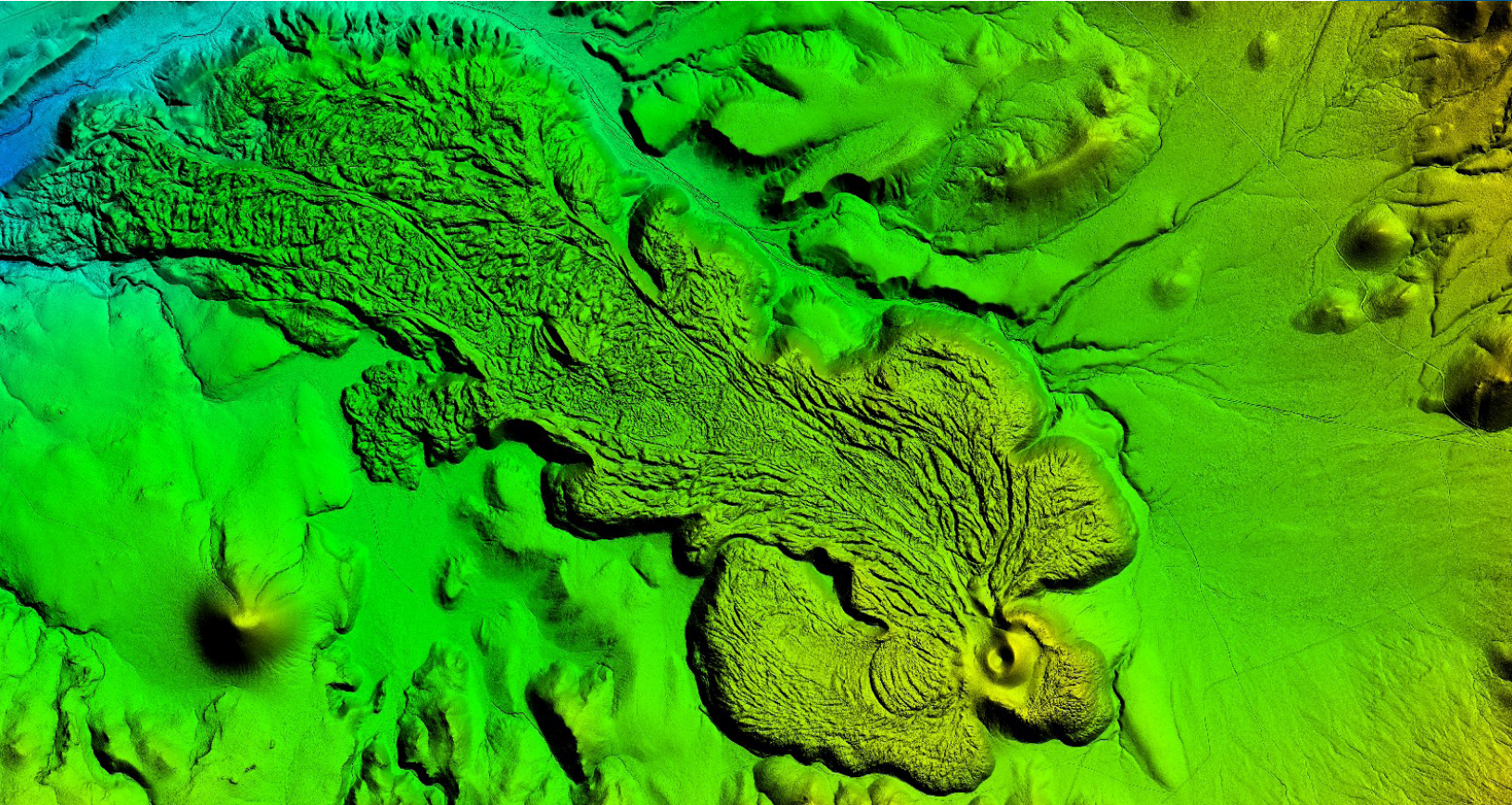


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EarthMRI_2020_D20 LIDAR PROCESSING REPORT

Project ID: 198162
Work Unit: 300013

2022

Submitted: September 13, 2022

Prepared for:



Prepared by:

N|V|5
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Appendix A: Flight Logs

1. Summary / Scope

1.1. Summary

This report contains a summary of the NV_WestCentral_EarthMRI_2020_D20, Work Unit 300013 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on 09/15/2020. The task order yielded a project area covering 4,294 square miles over Nevada. The intent of this document is only to provide specific validation information for the data acquisition/collection, processing, and production of deliverables completed as specified in the task order.

1.2. Scope

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

Table 1. Originally Planned Lidar Specifications

Average Point Density	Flight Altitude (AGL)	Field of View	Minimum Side Overlap	RMSEz
2 pts / m2	2305 m	58.5°	20%	≤ 10 cm

1.3. Coverage

The project boundary covers 4,294 square miles over Nevada. Project extents are shown in Figure 1.

1.4. Duration

Lidar data was acquired from October 15, 2020 and November 02, 2020 in 48 total lifts. See “Section: 2.4. Time Period” for more details.

1.5. Issues

There were no issues to report.

NV_WestCentral_EarthMRI_2020_D20 Work Unit 300013 Projected Coordinate System: UTM Zone 11 Horizontal Datum: NAD83(2011) Vertical Datum: NAVD88 (GEOID 18) Units: Meters	
Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	<ul style="list-style-type: none"> • 1-meter Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format • 1-meter Intensity images in GeoTIFF format
Vectors	Shapefiles (*.shp) <ul style="list-style-type: none"> • Project Boundary • Lidar Tile Index • Calibration and QC Checkpoints (NVA/VVA) • Building Footprint Polygons Geodatabase (*.gdb) <ul style="list-style-type: none"> • Continuous Hydro-flattened Breaklines
Reports	Reports in PDF format <ul style="list-style-type: none"> • Focus on Delivery • Focus on Accuracy • Processing Report
Metadata	XML Files (*.xml) <ul style="list-style-type: none"> • Breaklines • Classified Point Cloud • DEM • Intensity Imagery

NV_WestCentral_EarthMRI_2020_D20

Work Unit 300013 Boundary

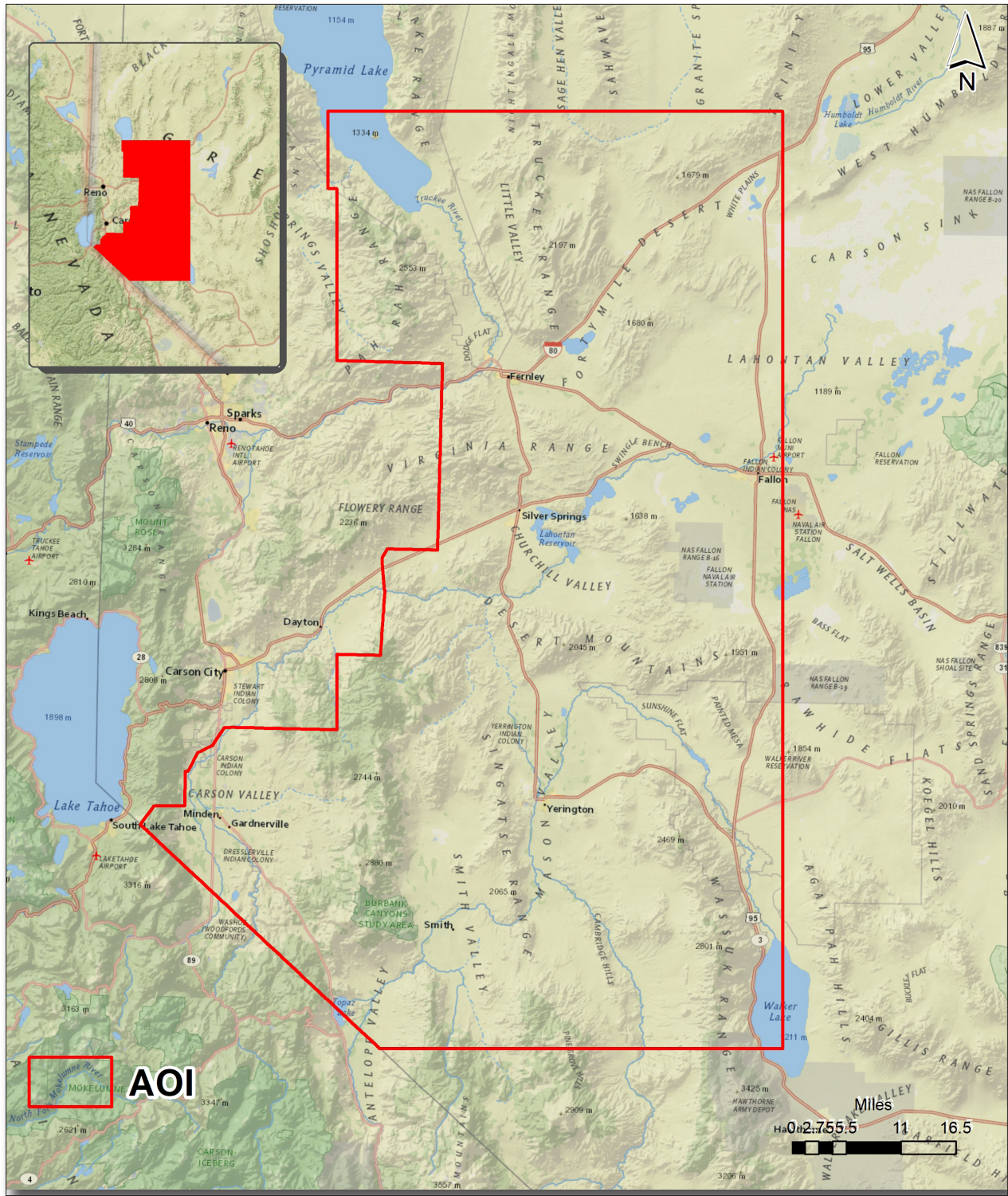


Figure 1. Work Unit Boundary

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 Leica Terrain Mapper and RiParameter planning software.

2.2. Lidar Sensor

NV5 Geospatial utilized Leica Terrain Mapper, Riegl VQ1560i, and Riegl VQ1560ii lidar sensors (Figure 2), serial number(s) SN4040,SN2737, and TM_9054, for data acquisition.

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

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.

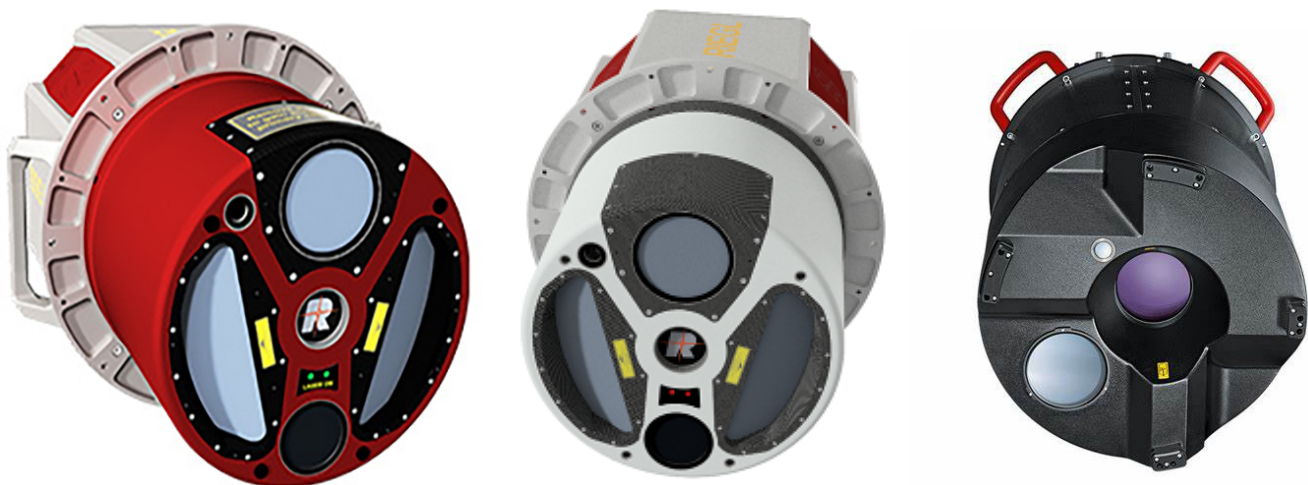
Aerial LiDAR data was collected utilizing a Leica Terrain Mapper. The Terrain Mapper is a discrete return topographic LiDAR mapping system manufactured by Leica Geosystems.

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 VQ1560ii (SN4040)	Riegl VQ1560i (SN2737)	Terra Mapper (TM_9054)
Terrain and Aircraft Scanner	Flying Height	2,305 m	2,200 m	2,800 m
	Recommended Ground Speed	145 kts	150 kts	165 kts
Scanner	Field of View	58.5°	58.5°	40°
	Scan Rate Setting Used	350 Hz	350 Hz	92.3 Hz
Laser	Laser Pulse Rate Used	81 kHz	158 kHz	650 kHz
	Multi Pulse in Air Mode	yes	yes	yes
Coverage	Full Swath Width	2,583 m	2,465 m	2,016 m
	Line Spacing	2,066 m	1,972 m	1,411 m
Point Spacing and Density	Average Point Spacing	0.65 m	0.65 m	0.65 m
	Average Point Density	2.4 pts / m ²	2.4 pts / m ²	2 pts / m ²

Figure 2. Riegl VQ1560ii, Riegl VQ1560i, and Terra Mapper 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

- Cessna Caravan (single-turboprop), Tail Number(s): N704MD
- Piper PA-31, Tail Number(s): C-FKMA
- Cessna Conquest 2 (twin-turboprop), Tail Number(s): N207SS

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

Figure 3. Some of NV5 Geospatial’s Planes



2.4. Time Period

Project specific flights were conducted between October 15, 2020 and November 02, 2020. Forty-Eight aircraft lifts were completed. Accomplished lifts are listed below.

10162020A (SN4040,N704MD)	20201015154055 (TM_9054, N20755)
10172020A (SN4040,N704MD)	20201015214029 (TM_9054, N20755)
10182020A (SN4040,N704MD)	20201016160448 (TM_9054, N20755)
10192020A (SN4040,N704MD)	20201016212443 (TM_9054, N20755)
10212020A (SN4040,N704MD)	20201017153134 (TM_9054, N20755)
10222020A (SN2737,C-FKMA)	20201017233020 (TM_9054, N20755)
10222020A (SN4040,N704MD)	20201018153433 (TM_9054, N20755)
10232020A (SN4040,N704MD)	20201019153450 (TM_9054, N20755)
10242020A (SN2737,C-FKMA)	20201019220635 (TM_9054, N20755)
10242020A (SN4040,N704MD)	20201020153032 (TM_9054, N20755)
10242020B (SN4040,N704MD)	20201020215328 (TM_9054, N20755)
10272020A (SN4040,N704MD)	20201021153349 (TM_9054, N20755)
10282020A (SN4040,N704MD)	20201022190618 (TM_9054, N20755)
10292020A (SN2737,C-FKMA)	20201023011115 (TM_9054, N20755)
10302020A (SN2737,C-FKMA)	20201023045845 (TM_9054, N20755)
10302020B (SN4040,N704MD)	20201023161702 (TM_9054, N20755)
10312020A (SN4040,N704MD)	20201023221044 (TM_9054, N20755)
11022020A (SN2737,C-FKMA)	20201024164840 (TM_9054, N20755)
	20201026163842 (TM_9054, N20755)
	20201027154831 (TM_9054, N20755)
	20201027220902 (TM_9054, N20755)
	20201028152217 (TM_9054, N20755)
	20201028212920 (TM_9054, N20755)
	20201029151957 (TM_9054, N20755)
	20201029212657 (TM_9054, N20755)
	20201030153459 (TM_9054, N20755)
	20201030173615 (TM_9054, N20755)
	20201031155542 (TM_9054, N20755)
	20201031201122 (TM_9054, N20755)
	20201104171729 (TM_9054, N20755)

3. Processing Summary

3.1. Flight Logs

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

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

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

3.2. Lidar Processing

Applanix + POSPac and Inertial Explorer 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 and Inertial Explorer 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 and HxMap 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
Leica Inertial Explorer	8.90
Leica HxMap	2.6.0
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.

3.4. Classified LAS Processing

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

All ground (ASPRS Class 2) lidar data inside of the Lake Pond and Double Line Drain hydro flattening breaklines were then classified to water (ASPRS Class 9) using proprietary tools. A buffer of 3 feet/1 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 3 feet was also used around each hydro-flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 20).

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

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

integrity using a combination of Esri Data Reviewer tools and proprietary tools.

3.6. Hydro-Flattened Raster DEM 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 value-units. Appropriate horizontal and vertical projection information as well as applicable header values are written 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 1-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 1-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 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.

	0-8cm
	8-16cm
	16-24cm
	>24cm

NV_WestCentral_EarthMRI_2020_D20 Work Unit 300013 Tile Layout

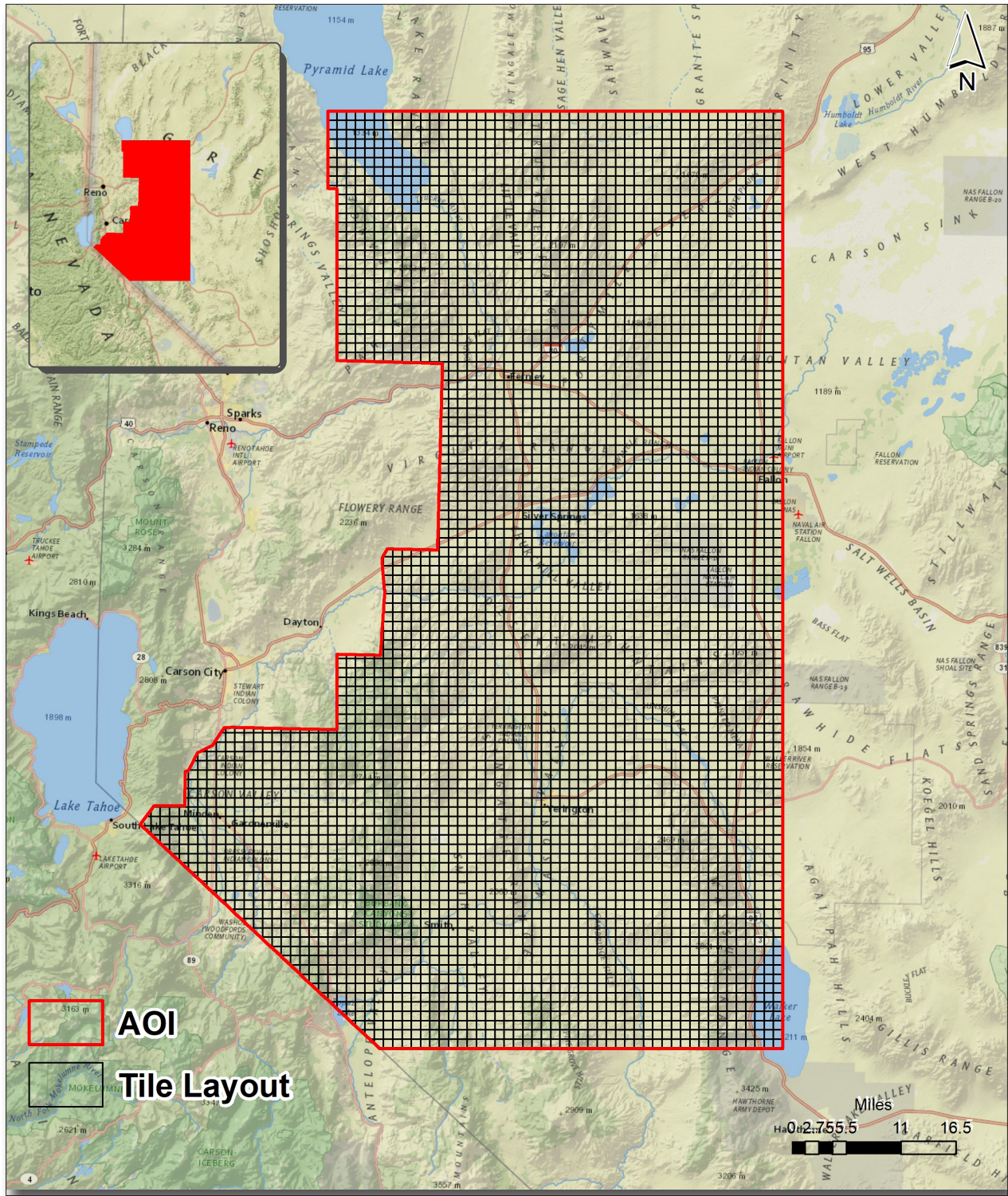


Figure 4. Lidar Tile Layout

4. Project Coverage Verification

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

NV_WestCentral_EarthMRI_2020_D20 Work Unit 300013 Lidar Coverage

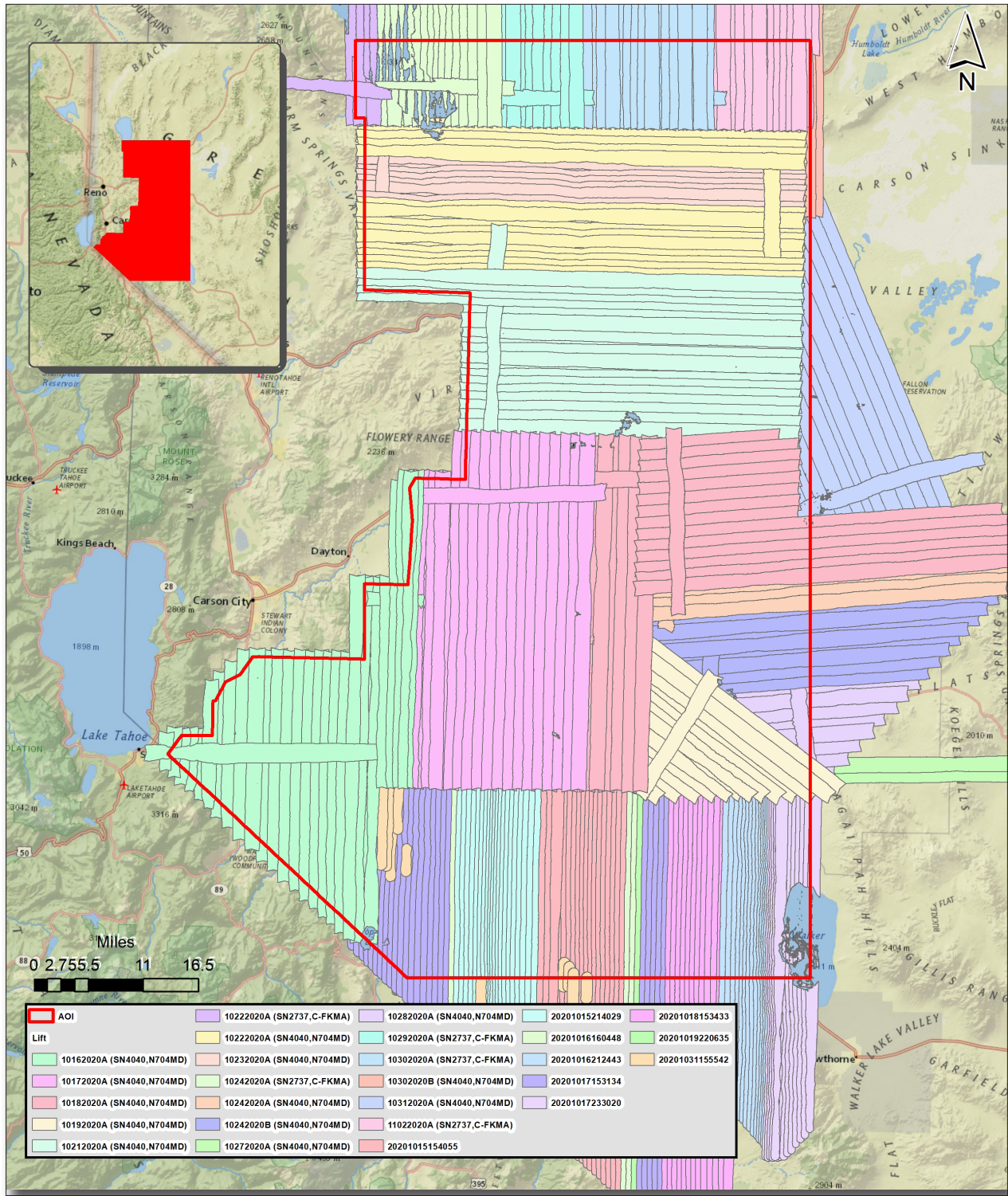


Figure 5. Lidar Coverage

5. Geometric Accuracy

5.1. Horizontal Accuracy

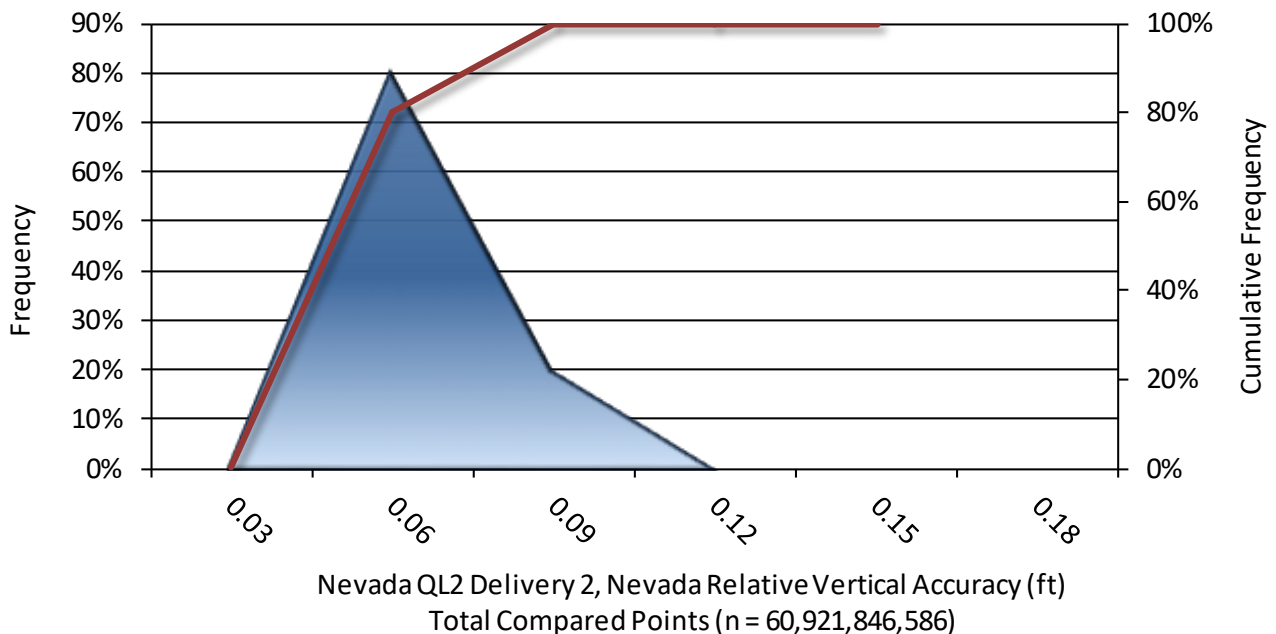
Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained $RMSE_r$ value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial 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 2,800 meters, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters, this project was compiled to meet 0.30 meter horizontal accuracy at the 95% confidence level. A summary is shown below.

Horizontal Accuracy	
$RMSE_r$	0.58 ft
	0.17 m
ACC_r	1 ft
	0.30 m

5.2. Relative Vertical Accuracy

Relative vertical accuracy refers to the internal consistency of the data set as a whole: the ability to place an object in the same location given multiple flight lines, GPS conditions, and aircraft attitudes. When the lidar system is well calibrated, the swath-to-swath vertical divergence is low (<0.10 meters). The relative vertical accuracy was computed by comparing the ground surface model of each individual flight line with its neighbors in overlapping regions. The average (mean) line to line relative vertical accuracy for the NV_WestCentral_EarthMRI_2020_D20 project was 0.051 feet (0.016 meters). A summary is shown below.

Relative Vertical Accuracy	
Sample	398 flight line surfaces
Average	0.051 ft
	0.016 m
Median	0.047 ft
	0.014 m
RMSE	0.051 ft
	0.016 m
Standard Deviation (1σ)	0.009 ft
	0.003 m
1.96σ	0.018 ft
	0.005 m



Project Report Appendices

The following section contains the appendices as listed in the <<Report Name>> Lidar Project Report.

Appendix A

Flight Logs

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

Date: 10-16-20

File: ABCDE Pg 1 of 2

(email log daily to flight-log-distribution_list@quantumspatial.com)

Project: USGS-ENRTH-ART-NEVADA-AL2 Proj #: R037339 Flight Mgmt File: R0201016-SN4040-A-R037339

Aircraft: N704MD Begin Hobbs: 148239 End Hobbs: 148304 Total: 6.5 Pilot: UNANGET Co-Pilot: - Tech: SCHONE

Dep Apt: KRNO Dep Time (Lcl): 09:50 (Z): 16:50 Arr Apt: KRNO Arr Time (Local): 16:22 (Z): 23:22 Tot Time Aloft:

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

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

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

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt	Log	Storage
	FOV	Scan Freq	AGL	AMSL	Ht	Gdspd	Spacing	On	Name/
	156011	4040	2305M		350 KHZ	145	PP3M		

Line #	Hdg	Start Utc	End Utc	Gd Spd	Roll/Pitch	GPS Altitude	Obs	Turb	FLIGHT LINE NOTES - Visibility, clouds, smoke, partial, etc
512	167	17:05	17:19	145	9/27	12404			Skc VIS 1st SPARK AIR
511	347	17:24	17:38	132	9/27	12395			THICK LAYER OF SMOKE MOVED IN SOUTH END
510	167	17:42	17:56	132	9/26	12234			
509	347	18:00	18:14	133	9/26	12234			
508	167	18:21	18:32	143	9/24	12906			
507	347	18:35	18:45	139	10/25	12772			
506	167	18:49	18:59	137	10/26	12667			
505	347	19:02	19:12	144	10/26	12559			
504	167	19:14	19:24	139	10/26	12480			
503	347	19:28	19:36	143	10/26	12395			
502	167	19:40	19:48	141	10/28	12319			
501	347	19:51	20:06	137	9/27	12231			
500	167	20:02	20:10	143	9/28	12119			
499	347	20:13	20:21	137	9/27	12103			
498	167	20:24	20:31	146	8/30	12109			
497	347	20:31	20:40	141	8/29	12126			
496	167	20:43	20:49	145	8/31	12116			
495	347	20:52	20:57	144	9/28	12116			LIGHT TWRB,

Total Proj Lines: 542 Lines Flown: 28 Lines Remain: 514 Online Time: 5.9 Mob Time: 0.6 Notes:

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

Date: 10-16-20

Line: A B C D E

Page 2 of 2

(email log daily to flight_log_distribution_list@quantumspatial.com)

Project: USGS - EARTH-MRI - NEVADA - QLA2 Proj #: R037339 Flight Mgmt File: R0201016-SN4040-A-R037339

Altcraft: N704MD Begin Hobbs: End Hobbs: Total: Pilot: UNANGST Co-Pilot: Tech: Schoone

Dep Apt: Dep Time (Lcl): Zt: Arr Apt: Arr Time (local): Zt: Tot Time Aloft:

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

GPS Unit: Y / (N) Sta 1: PPP 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	Alt	Avg Terr	Max	Avg Pt	Storage
	FOV	Scan Freq	AGL	AVSL	Ht	Cd/epd	Speeding	
	156011	4040	2305ft	MPLA Y / N	350K/12	400'	PRSM	

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POF/ft/s	GPS Altitude	Cab	Turb
494	167	21:01	21:03	143	.9/28	12240		
493	347	21:08	21:10	139	.9/29	13100		
492	167	21:13	21:15	143	.9/29	14000		
491	347	21:19	21:21	134	.9/30	14058		
490	167	21:24	21:25	142	.9/29	13851		
CR055	E	21:29	21:37	150	.9/29			
513	347	21:44	21:52	139	.9/30	2943		
514	167	22:00	22:12	141	.9/32	11765		
515	347	22:15	22:24	131	.9/33	11761		
516	167	22:32	22:44	139	1.0/31	11755		
517	347	22:47	22:59	130	.9/32	11752		
CR055	W	23:06	23:08	131	.9/31			

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

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

Date: 10-17-20

Quantum Spatial

(email log daily to flight_log_distribution_list@quantumspatial.com)

Page 1 of 2

Project: USGS-EARTH-MRI-NEVADA-QL2 Proj #: R037339 Flight Mgmt File: 20201017-SN40510-A-R037339

Aircraft: N704MB Begin Hobbs: 14830.4 End Hobbs: 14836.4 Total: 6.0 Pilot: UNKNGST Co-Pilot: - Tech: Schoone

Dep Apts: KRNO Dep Time (est): 09:23 (Z): 16:23 Arr Apts: KRNO Arr Time (Local): 15:23 (Z): 22:23 Tot Time Aloft:

CORS: Y/N Sta 1: PPP 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: 12 °C End: 25 °C OAT beg: °C End: °C Altimeter begin: 30.3 end: 30.17

LIDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing	Pulse Rate	Power
	1560 II	4040	2305M		350K/12	100%	PPSM		
FOV	Scan Freq		MPLA Y/N	Pulse In Air					

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	Foot/s	GPS Altitude	Crab	Turb (0-4)	Notes
518	347	16:52	17:04	142	9/28	11752			SKC VIS ± 15
519	167	17:07	17:17	143	8/30	11745			
520	347	17:17	17:34	119	8/28	11745			
521	167	17:37	17:17	134	9/26	11739			
522	347	17:17	18:05	132	9/27	11725			SHIP DRIVE: WD-2594
523	167	18:10	18:23	133	10/25	11722			BACKUP: EASY STORE - 064B
524	347	18:27	18:40	137	10/25	11719			
525	167	18:44	18:57	134	10/26	11719			
526	347	19:01	19:14	140	9/27	11719			
527	167	19:17	19:31	138	9/27	11702			
528	347	19:34	19:47	142	9/30	11699			
529	167	19:51	20:01	132	8/32	11699			
530	347	20:08	20:21	139	9/29	11683			
531	167	20:25	20:38	138	9/28	11663			
532	347	20:42	20:55	139	9/30	11637			
533	167	20:58	21:11	147	10/28	11637			
534	347	21:15	21:28	127	10/28	11637			
535	167	21:31	21:44	135	9/28	11640			

Total Proj Line: 542 Lines Flown: 28/19 Lines Remain: 495 Online Time: 5.3 Mob Time: 0.7 Notes:

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Lite B C D E

Pg 1 of 2

Date: 10-18-20

Project: USGS-EARTH.MRI-NEVADA-QLR Proj #: R037339 Flight Mgmt File: 20201018-SJ4040-A-R037339

Aircraft: N709MD Begin Hobbs: 14836.4 End Hobbs: 14841.9 Total: 5.5 Pilot: UJAJJGSR Co-Pilot: - Tech: Schoone

Dep Aft: KRNO Dep Time (Lcl): 08:12Z [Z]: 15:12 Arr Aft: KRNO Arr Time (Local): 13:46 [Z]: 20:46 Tot Time Aloft:

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

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

Gd Temp beg: 7 °C End: 23 °C OAT beg: °C End: °C Altimeter begin: 3013 end: 3018

LIDAR	Type	Serial #	Alt AGL	Alt Aftl	Pulse In Av	Avg Terr Ht	Max Gddpd	Power	Avg Pk Spacing	Big Gd	End Gd	Storage Name
	FOV	Scan Freq	MplA Y / N			Pulse Rate	100%	PPSM		Tot Gd		CRU MR
537	167	15:36	15:49	142	5/30	11687						
538	347	15:52	16:06	118	9/27	11634						
539	167	16:09	16:22	133	9/27	11624						
540	347	16:25	16:38	138	10/25	11624						
541	167	16:42	16:55	142	10/26	11647						
542	347	16:58	17:11	140	9/25	11653						
CR055	03	17:15	17:18	129	8/28	Y						
221	72	17:22	17:28	140	8/28	11443						
222	252	17:31	17:37	130	8/27	11430						
223	72	17:40	17:46	142	8/28	11424						
224	252	17:49	17:55	127	8/28	11420						
225	72	17:57	18:03	143	8/26	11381						
226	252	18:04	18:12	132	10/24	11381						
227	72	18:15	18:21	142	10/24	11391						
228	252	18:24	18:30	140	11/24	11355						
229	72	18:33	18:46	136	12/24	11381						
230	252	18:50	19:04	136	11/25	11378						
231	72	19:07	19:21	145	11/26	11302						

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.

SKC VIS 15+ SHADY AIR

R4803 15 COLD

Total Proj Lines: 542 Lines Flown: 477 / 20 Lines Remain: 475 Online Time: 4.8 Mob Time: 0.7 Notes:



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Date: 10-18-20

Page 2 of 2

Project: USGS-EARTH.MRI-NEVADA.022 Proj #: R037339 Flight Mgmt File: 20201018-SN4040-A.R037339

Aircraft: N704MD Begin Hobbs: End Hobbs: Total: Pilot: UNANGST Co-Pilot: - Tech: Schoone

Dep Apc: Dep Time (Lcl): [Z]: Arr Apc: Arr Time (Local): [Z]: Tot Time Aloft:

CORS: Y / N Sea 1: PPP Sea 2: Flyovers: Y / N If Y, times: Sta1) Sta2)
 GPS Unit: Y / N Sea 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 Gd/dpd	Avg Pt Speeding	Log	Storage Name/le
	FOV	Scan Freq	MPIA Y / N	Pulses In Air	Pulse Rate	Power	PPSM	GA	CRU

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.

Line #	Hgt	Start (UTC)	End (UTC)	Gd Spd	FOO/Faces	GPS Altitude	Crab	Turb (0,-1)	End	GA	Storage Name/le
232	252	19:24	19:39	131	1.1/28	11302					CRU 2019 M8 2/3
233	234	19:41	19:56	138	.8/28	11325					
234	252	19:58	20:13	139	.8/32	11342					
CROSS	N	20:18	20:25	128	.8/33	Y					

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



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Date: 10-21-20

UIC: (A) B C D E Pg 1 of 2

Project: USGS ENRTH MRI NEVADA QLR Proj #: R037339 Flight Mgmt File: 20201021_SNV4040-A-R037339

Aircraft: N704MD Begin Hobbs: 14853.7 End Hobbs: 14959.7 Total: 6.0 Pilot: UNHGST Co-Pilot: — Tech: Schoone

Dep Apt: KRNO Dep Time (Ldt): 09:35 (Z): 16:35 Arr Apt: KRNO Arr Time (Local): 15:42 (Z): 22:42 Tot Time Aloft:

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

GPS Unit: Y / (N) Sta 1: Sta 2: Gd Temp beg: 12 °C End: 23 °C OAT beg: °C End: °C Altimeter begin: 30.17 end: 29.93

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt	Beg	End	Storage
	FOV	Scan	AGL	Atysl	Ht	Gtdpd	Spdng			
		4040	2305M			400		46496	3919	CRU
			MPIA Y / N			100%			73.06	R/3

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POOP/s	GPS Altitude	Grab	Turb
443	77	16:51	17:04	146	.8/28	11394		
444	258	17:07	17:21	128	.8/27	11417		
445	77	17:23	17:36	141	.9/25	11410		
446	258	17:39	17:51	131	.8/28	11410		
447	77	17:54	18:07	147	.9/25	11410		
448	258	18:10	18:22	139	.9/26	11420		
449	77	18:25	18:37	147	1.1/25	11427		
450	258	18:40	18:53	134	1.1/25	11437		
451	77	18:56	19:08	147	1.0/27	11443		
452	258	19:11	19:24	137	.9/28	11437		
453	77	19:26	19:39	148	.8/29	11437		
454	258	19:42	19:54	130	.8/31	11437		
455	77	19:57	20:09	142	.9/30	11437		
456	258	20:12	20:25	136	.9/32	11437		
457	77	20:27	20:40	146	.9/32	11435		
458	258	20:43	20:55	139	.9/30	11430		
CR055	N	20:59	21:07	146	.9/31	Y		
442	77	21:15	21:32	145	.9/32	11394		

SHIP DRIVE; LOD-3545
BACK UP: EASYSTORE-046D

SHAKE VIS 104 SMOKE TO THE SOUTH

Total Proj Lines: 542 Lines Flown: 109/80 Lines Remain: 413 Online Time: 5.7 Mob Time: 0.3 Notes: MISSED G

129

53°F/30.17/47% Hum

Date: 10-22-20

Life A B C D E Pg 1 of 1

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

Project: USGS Earth Map Nevada GR2 Proj #: R037339 Flight Mgmt File: 20201022-SN4040-A-R037339

Aircraft: N704MD Begin Hobbs: 14859.7 End Hobbs: 14865.4 Total: 5.7 Pilot: NELSON Co-Pilot: - Tech: Schoone

Dep Aft: KRND Dep Time (Lcl): 09:42 (Z): 10:42 Arr Aft: KRND Arr Time (local): 15:23 (Z): 22:23 Tot Time Aloft: 5.7

CORS: Y / Sta 1: PPP Sta 2: Flyovers: Y / If Y, times: Sta 1

GPS Unit: Y / Sta 1: Sta 2: Flyovers: Y / If Y, times: Sta 1

Gd Temp beg: 7 °C End: °C OAT beg: °C End: °C Altimeter begin: 30.22 end: °C

LIDAR	Type	Serial #	Alt AGL	Alt ANSL	Avg Terr Ht	Max Gddpd	Avg Ft Spding	Best CS	Storage Name/ls
	FOV	Scan Freq	Mpda Y / N	Pulses in Air	Pulse Rate	Power	PPSM	End CS	CR0
428	77	17:00	17:16	148	.8/30	11368		581.1	CR0
429	258	17:20	17:37	125	.9/27	11368		512.9	2019MR
430	77	17:41	17:57	117	.8/28	11368			
431	258	17:59	18:16	130	.9/27	11368			
432	77	18:18	18:34	150	.9/27	11368			
433	258	18:37	18:53	139	1.0/26	11371			
434	77	18:55	19:19	155	1.0/26	11371			
435	258	19:13	19:29	126	.9/28	11371			
436	77	19:32	19:48	157	.9/29	11378			
437	258	19:50	20:07	130	.9/29	11381			
438	77	20:09	20:24	140	.9/31	11387			
cross	N	20:28	20:35	132	1.0/29	Y			
415	258	20:39	20:55	136	.9/28	11305			
416	77	20:57	21:12	153	1.0/26	11296			
417	258	21:14	21:30	134	.9/31	11296			
418	77	21:33	21:49	143	.9/28	11302			
419	258	21:53	22:09	131	.9/32	11338			

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
 HIGH BIRD CIRCUITS - LOW ~~END~~ START OF PASSAGE

SHIP DRIVE: W.D. 2545
 BACK UP : EASYSTORE 0460

Line #	Hdg	Start (UTC)	End (UTC)	Gd spd	POOF/sms	GPS Altitude	Crab	Turb (0.1-1)
Total Proj Lines: 542								
Lines Flown: 19/14								
Lines Remain: 357								
Online Time: 5.1								
Mob Time: 0.6								
Notes: M155.0N 7								

145

45°/49%/30.2

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UTC (A) B C D E Pg 1 of 1

Date: 10-23-20

Project: USGS EARTH MAT GLR Proj #: R037339 Flight Mgmt File: 20201023 - SN4040-A-R037339

Aircraft: N704MD Begin Hobbs: 148654 End Hobbs: 14870.8 Total: 5.4 Pilot: NEISSAN Co-Pilot: - Tech: Schoone

Dep Aft: KRND Dep Time (Lcl): 09:43 (Z): 16:43 Arr Aft: KRND Arr Time (Local): (Z): Tot Time Aloft:

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

GPS Unit: Y (N) Sta 1: Sta 2: Flyovers: Y (N) If Y, times: Sta 1) Sta 2)

Gd Temp beg: 5 °C End: 14 °C OAT beg: °C End: °C Altimeter begin: 30.16 end: 30.09

LIDAR	Type	Serial #	Alt	Alt AMSL	Avg Terr ht	Max Gdepd	Avg Pt Spacing	Mag	End	Storage Name
	156011	4640	AGL 2305M	MPJA Y / N	350KHz	400	PPSM 2.37	100%	391.97	CR0
	FOV	Scan Freq							91.98	CR0
									45.99	213

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POOF# size	GPS Altitude	Crab	Turn (0--1)	Altitude	Power	PPSM	Mag	End	Storage Name
419	77	16:58	17:00	150	8/29	11338			ABOUT 1.1K - FUDGED 10/22	100%	PPSM	400	391.97	CR0
420	77	17:05	17:21	140	8/28	11364			SKC SMOG AIR	100%	PPSM	400	345.98	CR0
421	258	17:24	17:40	137	8/27	11361				100%	PPSM	400	341.8	CR0
422	77	17:43	18:00	142	10/24	11355				100%	PPSM	400		
423	258	18:04	18:20	132	10/25	11355				100%	PPSM	400		
424	77	18:22	18:38	152	10/26	11355				100%	PPSM	400		
425	258	18:41	18:58	135	10/26	11358				100%	PPSM	400		
426	77	19:01	19:17	151	10/25	11368				100%	PPSM	400		
427	258	19:20	19:37	127	10/27	11368				100%	PPSM	400		
CROSS	N	19:39	19:42	148	8/31	11368				100%	PPSM	400		
384	166	20:22	20:28	145	10/27	12418				100%	PPSM	400		
385	347	20:31	20:37	142	9/29	12408				100%	PPSM	400		
386	167	20:40	20:46	141	10/28	12408				100%	PPSM	400		
387	347	20:50	20:56	140	10/27	12405				100%	PPSM	400		
388	167	21:00	21:07	142	10/28	12401				100%	PPSM	400		
389	347	21:10	21:16	142	10/28	12395				100%	PPSM	400		
CROSS	W	21:19	21:22	132	10/29	12395				100%	PPSM	400		

SHIP DRIVE; SAN DISK - 2507
BACK UP: EASYSTORE - 254D

Total Proj Lines: 542 Lines Flown: 160/14 Lines Remain: 368 Online Time: 4.4 Mob Time: 1.0 Notes: MISSED 8

174

411°/37% / 30.16



Alborne LIDAR Data Collection Log Sheet :: Quantum Spatial, Inc

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Date: 10-24-20
Page 1 of 2

Project: USGS EARTH ARI QLR NEVADA Proj #: R037339 Flight Mgmt File: 20201024-SN4040-A-R037339

Aircraft: A704MD Begin Hobbs: 14870.8 End Hobbs: 14876.3 Total: 5.5 Pilot: NELSON Co-Pilot: - Tech: Schoone

Dep Aft: KRND Dep Time (Lcl): 09:00 (Z): 16:00 Arr Aft: KRND Arr Time (Local): 14:30 (Z): 21:30 Tot Time Aloft:

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

Gd Temp beg: 5 °C End: 21 °C OAT beg: 6 °C End: °C Altimeter begin: 30.05 end: 29.93

LIDAR	Type	Serial #	Alt AGL	Alt AVEL	Pulses In Air	Avg Terr Ht	Max Gdop	Power	Avg Pk Spacing	PPSM	Begin	End	Storage Name
	156011	41040	R305M		MPLA Y / N	350K/12	480	100%		2.37	512.08	456.18	CRU 2019MR 2/3

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POF/Sta	GPS Altitude	Grab	Turb	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
254	73	16:34:27	16:41	148	.9/27	11624			SKC VIS 710 SMOOTH AIR
255	253	16:45	16:56	145	.8/28	11627			
256	73	16:59	17:11	146	.9/25	11640			
257	253	17:14	17:26	148	.9/24	11660			
258	73	17:29	17:40	145	1.0/25	11686			
259	253	17:44	17:56	134	1.0/25	11722			SHIP DRIVE: SANDISK 2567
260	73	17:59	18:11	145	1.0/25	11771			BACKUP : FAS/STURE - 2610
261	253	18:14	18:26	147	.9/27	11824			
262	73	18:29	18:41	145	1.0/27	11880			
263	253	18:45	18:57	142	.9/29	11945			
264	73	19:00	19:12	150	.9/28	12011			
265	253	19:17	19:29	144	.9/28	12085			
266	73	19:33	19:45	150	.9/30	11919			
267	253	19:49	20:02	139	.9/31	11883			
CR055	N	20:08	20:13	151	.9/33	1			
235	253	20:18	20:33	127	.9/32	11387			
236	253	20:36	20:48	150	.9/29	11394			
237	252	20:52	21:06	137	.9/29	11364			

Total Proj Lines: 542 Lines Flown: 192/17 Lines Remain: 333 Online Time: 4.5 Mob Time: 1.0 Notes: MISSION 9
CR055 N 21:08 21:10 209 1 41°F / 53% / 30.05



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Date: 10-24-20
Page 2 of 2

Project: USGS EARTH MRI NEVADA Q22 Proj #: R037339 Flight Mgmt File: 20201024_SN4040-B-R037339

Aircraft: N704MD Begin Hobbs: 14876.3 End Hobbs: 14878.9 Total: 2.6 Pilot: NELSON Co-Pilot: - Tech: Schoone

Dep Apt: KRNO Dep Time (Ldt): 15:38 (Z): 28:38 Arr Apt: KRNO Arr Time (Local): 18:20 (Z): 01:20 Tot Time Aloft: 2.7

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

GPS Unit: Y (N) Sta 1: Sta 2: Flyovers: Y (N) H Y, times: Sta1) Sta2)

Gd Temp beg: 22°C End: 19°C OAT beg: °C End: °C Altimeter begin: 30.02 end: 29.88

LIDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gddpd	Avg Pt Spacing	Bag	End	Storage Name
	FOV	Scan Freq	MPIA Y / N	Pulses In Air	Pulse Rate	Power	PPSM	Tag	Tag	Tag
	1560 11	4040	23054		350 KHZ	100%		456.18	4/32.17	CR0
									24.01	2019HR

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POF/s	GPS Altitude	Grab	Turb (0-+)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
238	72	23:00	23:12	148	.9/29	11364			SKC
239	252	23:14	23:29	135	.9/27	11361			
240	72	23:32	23:43	147	.8/28	11361			
241	252	23:47	23:59	145	.8/28	11361			GPS Rollover
242	72	00:02	00:12	152	.8/28	11374			
243	252	00:16	00:26	137	.9/27	11417			
244	72	00:29	00:38	150	1.2/24	11499			
245	252	00:42	00:51	133	1.1/24	11594			
CR055	N	00:53	00:57	140	1.1/24				

Total Proj Lines: 542 Lines Flown: 209/8 Lines Remain: 325 Online Time: 2.0 Mob Time: 0.6 Notes: MISSION 10 217

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Date: 10-27-20

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Project: USGS EARTH MRI NEVADA Q1/Q2 Proj #: R037339 Flight Mgmt File: 20201027-SN4040-A-R037339

Altcraft: N704YD Begin Hobbs: 14885.2 End Hobbs: 14893.2 Total: 5.2 Pilot: NELSON Co-Pilot: - Tech: Schoone

Dep Aft: KRN D Dep Time (Ld): 09:42 (Z): 16:42 Arr Aft: KRN D Arr Time (Local): 14:53 (Z): 21:53 Tot Time Aloft:

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

GPS Unit: Y (N) Sta 1: Sta 2: Flyovers: Y (N) If Y, time: Sta1) (N) If Y, time: Sta2)

Gd Temp beg: 41 °C End: 15 °C OAT beg: °C End: °C Altimeter begin: 30.31 end: 30.31

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Mix	Avg Pt	Storage Name
	FOV	Scan Freq	AGL	MSL	Ht	Gdspd	Spacing	
	15x20 11	41040				160	PPM	
			MPIA	Y / N				

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POD/s	GPS Altitude	Crab	Turns (0.1)
87	341	17:27	17:34	138	.9/27	10306		
88	161	17:36	17:44	145	1.0/26	10315		
89	341	17:47	17:55	134	1.0/26	10325		
90	161	17:57	18:05	146	1.0/26	10335		
91	341	18:08	18:16	133	1.0/26	10352		
92	161	18:19	18:25	137	.9/28	10368		
93	341	18:29	18:33	133	.9/28	10388		
94	161	18:35	18:40	139	1.0/27	10397		
95	341	18:43	18:48	133	1.0/27	10407		
96	161	18:51	18:56	146	1.0/29	10411		
97	341	18:59	19:04	130	.9/29	10411		
98	161	19:04	19:11	142	.9/29	10420		
99	341	19:13	19:18	144	.8/31	10424		
100	161	19:21	19:25	145	.8/31	10427		
180	341	19:28	19:32	145	.9/31	10427		
CROSS	20	19:34	19:37	146	.8/32	Y		
13	256	19:47	19:50	—	.9/31	11578		
13	256	19:54	20:09	154	.9/31	11578		

Q1) 1925M 145KN 700KHZ 1291PS 100% SKC VIS 10+

SHIP DRIVE: SANDISK 2570
BACK UP: EASYSTORE DCHD

Q1 15 COMPLETE

Q2) 2305M 145KN 350KHZ 811PS 100% GULY 1 C/MYK L WARRKVC - BGRRT

Total Proj Lines: 542 Lines Flown: 249/5 Lines Remain: 888 Online Time: 4.0 Mob Time: 1.2 Notes: MISSION 13

Q12

254

39°F/28% / 30.31



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

Date: 10-28-20

(email log daily to flight_log_distribution_list@quantumspatial.com)

Project: USGS EARTH MRI Nevada Q12 Proj #: R037339 Flight Mgmt File: 20201028-SN4040-A-R037339

Aircraft: N704MD Begin Hobbs: 14893.2 End Hobbs: 14898.7 Total: 5.5 Pilot: Nelson Co-Pilot: Tech: Schoone

Dep Apt: KRND Dep Time(Lcl): 09:52 (Z: 16:50) Arr Apt: KRND Arr Time(Local): 15:22 (Z: 22:20) Tot Time Aloft:

CORS: Y (N) Sta 1: PPP Sta 2: Flyovers: Y (N) If Y, times: Sta 1) Sta 2) GPS Unit: Y (N) Sta 1: Sta 2: Flyovers: Y (N) If Y, times: Sta 1) Sta 2)

Gd Temp beg: 5 °C End: 19 °C OAT beg: °C End: °C Altimeter begin: 30.32 end: 30.29

LIDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr ht	Max Gdspd	Avg Pt Spacing	Scan Freq	MPIA Y / N	Pulses In Air	Pulse Rate	Power	PPM	28%	2.5 FT	Bag	End	Storage
	FOV	Scan Freq	Alt AGL	Pulses In Air	Pulse Rate	Power	PPM	Scan Freq	MPIA Y / N	Pulses In Air	Pulse Rate	Power	PPM	28%	2.5 FT	Bag	End	Storage
1	156011	4040	2305M			400-			MPIA Y / N		35kHZ	100%	2			371.08	326.29	CRU
2	17:22	17:31	142	9/26	12162													
2	17:33	17:45	146	1.0/24	11850													
3	17:49	18:02	136	1.0/24	11788													
4	18:04	18:16	147	1.2/24	11784													
5	18:19	18:32	132	1.1/25	11854													
6	18:34	18:50	135	1.0/26	11683													
7	18:52	19:07	135	9/28	11535													
8	19:10	19:22	158	8/28	11515													
846	19:31	19:39	145	9/31	11663													
247	19:41	19:49	155	8/30	11660													
248	19:52	19:58	136	8/33	11643													
249	20:01	20:06	154	9/30	11452													
250	20:10	20:14	139	9/30	11515													
251	20:17	20:21	154	1.0/28	11529													
252	20:24	20:26	145	1.0/29	11545													
253	20:29	20:31	154	1.1/27	11591													
CR055	N	20:33	20:37	145	1.0/30													
CR055	S	20:44	20:46	150	1.0/30													

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

SHIP DRIVE SANDISK 2570
BACK UP - EASYSTORE 26410

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDOP/sats	GPS Altitude	Cab	Turb	Alt	Altimeter begin	end	Notes
1	75	17:22	17:31	142	9/26	12162				30.32	30.29	SKC
2	256	17:33	17:45	146	1.0/24	11850						
3	75	17:49	18:02	136	1.0/24	11788						
4	256	18:04	18:16	147	1.2/24	11784						
5	75	18:19	18:32	132	1.1/25	11854						
6	256	18:34	18:50	135	1.0/26	11683						
7	75	18:52	19:07	135	9/28	11535						
8	256	19:10	19:22	158	8/28	11515						
846	78	19:31	19:39	145	9/31	11663						
247	252	19:41	19:49	155	8/30	11660						
248	72	19:52	19:58	136	8/33	11643						
249	252	20:01	20:06	154	9/30	11452						
250	72	20:10	20:14	139	9/30	11515						
251	252	20:17	20:21	154	1.0/28	11529						
252	72	20:24	20:26	145	1.0/29	11545						
253	252	20:29	20:31	154	1.1/27	11591						
CR055	N	20:33	20:37	145	1.0/30							
CR055	S	20:44	20:46	150	1.0/30							

Total Proj Lines: 542 Lines Flown: 254/21 Lines Remain: 287 Online Time: 4.4 Mob Time: 1.0 Notes: Mission 14 41°F/46%/30.32



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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 10-28-20
LIFE AYS C D E Pg 2 of 2

Project: USGS EARTH MRI NEVADA QLR Proj #: R037339 Flight Mgmt File: 20201028-SN4040-A-R037339

Aircraft: N704MD Begin Hobbs: End Hobbs: Total: Pilot: NELSON Co-Pilot: Tech: Schoone

Dep Apt: Dep Time (Lcl): [Z]: Arr Apt: Arr Time (Local): [Z]: Tot Time Aloft:

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

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

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

LIDAR	Type	Serial #	Alt AGL	Alt AMSL	Pulse Rate	Max Gddpd	Avg Ft Spacing	Post CA	End CA	Storage Name/le
	FOV	Scan Freq	MplA Y / N	In Alt	350KHz	Power	PSM	CA	CA	2019KR 2/3

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDP/Sec	GPS Altitude	Crab	Turb (0-+)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc									
306	8	21:01	21:02	149	9/32	14239												
159	259	21:07	21:07	140	9/32	14045												
158	78	21:10	21:11	153	9/32	14022												
307	8	21:15	21:25	142	9/33	14015												
306	188	21:27	21:37	154	8/34	13986												
CR055	2	21:41	21:43		1.0/29	✓												

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

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

Date: 10/30/2020

UHF: (A) B C D E Pg 1 of 3

(small log daily to flight_log_distribution_list@quantumspatial.com)

Project: USGS Earth MRI Nevada/GR-Proj #: R037339 Flight Mgmt File: 20201030-SN4040-A R037339

Aircraft: N104MD Begin Hobbs: 14901.1 End Hobbs: 14906.1 Total: 5.0 Pilot: JNEILSON Co-Pilot: Tech: SKROHN

Dep Apt: KRN0 Dep Time (Lcl): 10:36 (Z): 17:36 Arr Apt: KRN0 Arr Time (Local): 15:34 (Z): 22:34 Total Time Aloft: 5.0

CORS: Y (N) Sta 1: Sta 2: Flyovers: Y (N) If Y, time: Sta 1) Sta 2)

GPS Unit: Y (N) Sta 1: Sta 2: Flyovers: Y (N) If Y, time: Sta 1) Sta 2)

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

LIDAR	Type	Serial #	Alt	Alt AMSL	Alt AMSL in Air	Avg Terr Ht	Max Gdspd	Power	Avg Pt Spacing	PSM	Bag	Storage Name
	FOV	Scan Freq	AGL	MPIA	Y N	Pulse Rate					End	
	1560 Li	4040									848.4	
		375 KHz		MPIA	Y N						801.9	
												46.5 X 2

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POH/s	GPS Altitude	Crab	Turb (0-+)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
		17:12	17:17						Static
		17:59	18:02						S-turn
407	346	180507	18:14	142	.98	26	11,348		
408	166	181718	18:26	145	.99	25	11,335		
409	346	183001	18:39	145	.99	26	11,322		
410	166	184200	18:51	139	.89	27	11,312		
411	346	185412	19:02	145	.85	28	11,299		
412	166	190609	19:15	145	.83	29	11,299		
413	346	191814	19:27	158	.87	29	11,299		
	X-tie	257	193159						Record 008
86	048	193848	19:41	145	.85	31	11,588		
87	229	194556	19:48	142	.86	31	11,584		
88	048	195155	19:55	140	.94	29	11,391		
89	229	200057	20:00	136	.91	28	11,332		Shipper Drive: OSI002570
90	048	200816	20:13	150	1.0	27	11,364		B/U Drive: WD myBeak: SJXXV
91	229	201645	20:23	138	"	"	11,335		
92	048	202545	20:33	148	"	"	11,355		
93	229	203536	20:44	142	.9	29	11,355		

Total Proj Lines: Lines Flown: Lines Remain: Online Time: 4.1 Mob Time: .9 Notes:

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

Quantum Spatial

(email log daily to flight_log_distribution_list@quantumspatial.com)

UHF: A B C D E

Pg 2 of 2

Date: 10/30/2020

Project: USGS Earth MRI Nevada/QL2 Proj #: R037339 Flight Mgmt File: 2620103A-SN4040-A-R037339

Aircraft: N704 MD Begin Hobbs: 14901.1 End Hobbs: 14906.1 Total: 5.0 Pilot: Co-Pilot: Tech:

Dep Apt: Dep Time (Lcl): 10:36 (Z): 7:36 Arr Apt: KRNO Arr Time (Local): 5:34 (Z): 22:34 Tot Time Aloft: 5.0

CORS: Y | (N) Sta 1: Sta 2: Flyovers: Y | (N) If Y, times: Sta 1) Sta 2)

GPS Unit: Y | (N) Sta 1: Sta 2: Flyovers: Y | (N) If Y, times: Sta 1) Sta 2)

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

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt	Bag	Storage
	FOV	Scan Freq	AGL	AVSL	Ht	Gdepd	Speeding	GB	Normal
	1560i	4040	MPIA Y N					848.4	
		375kHz						801.9	
								46.5	x2

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	Foot/s	GPS Altitude	Crb	Turn (0 - +)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
94	049	204645	20:56	150	.88	30	11,335		
95	229	205834	21:09	135	.89	31	11,269		
96	048	211232	21:23	147	.91	30	11,269		
97	229	212620	21:38	138			11,348		
98	048	214055	21:53	152	.85	31	11,348		
99	229	215651	22:10	156	"	"	11,342		S-turns
		22:11	22:						

Total Proj Lines: Lines Flown: Lines Remain: Online Time: 41 Mob Time: .9 Notes:

Arborme UDAR Data Collection Log Sheet :: Quantum Spatial, Inc

Date: 10/31/2020

Project: USGS Earth MRI Nevada/SLS Proj #: R057339 Flight Name File: R0201031-SN4040-A-R057339

Aircraft: N704 MD Begin Hobbs: N906.1 End Hobbs: 149116 Total: 5.5 Pilot: JNELSON Co-Pilot: Tach: SEKOHN

Dep Apts: KRNO Dep Time (Lod) 9:22 (Z) 16:22 Arr Apts: KFLX Arr Time (Local) 14:53 (Z) 22:53 Top Time Aloft: 5.5

CONS: Y (N) Sta 1: Sta 2: Flyovers: Y (N) (if Y, time: Sta 1) (if Y, time: Sta 2)

QDR Unit: Y (N) Sta 1: Sta 2:

QATemp beg: °C End: °C OAT bag: °C End: °C Altimeter begin: and: Avg Pt Spacing

UDAR Type: /56011 Serial #: 4040 Alt: MSL Y | N Avg Temp: Max Output Power: Avg Pt Spacing

Line #	Hgt	Start UTM	End UTM	QATemp	Resolution	QDR Altitude	QDR	Top	Notes
		16:13	16:18						Static
		16:49	16:51						S-turn
114		165194	17:03	149	.85	86	11,292	0	8°C
207		170935	17:20	137	.89	25	11,332	0	
206		172348	17:36	136	.89	26	11,325	0	
205		173405	17:51	148	.95	26	11,328	0	
204		175463	18:07	146	.96	26	11,312	0	
203		181003	18:22	148	.89	28	11,382	0	
202		182611	18:38	136	.96	24	11,379	0	
201		184145	18:53	150	.89	29	11,355	0	
200		185752	19:09	155	"	"	11,361	0	
199		191340	19:24	148	.87	29	11,371	0	
198		192642	19:36	139	.91	30	11,381	0	
197		193946	19:48	145	.91	30	11,394	0	
196		195059	19:58	148	.96	28	11,387	0	
195		200116	20:07	152	1.0	27	11,391	0	
194		201021	20:15	140	.9	29	11,384	0	
193		201944	20:23	142	.9	28	11,381	0	

Total Proj Lines: Line Flown: Line Number: Online Time: 4.8 Min Mod Time: 1.7 Min Notes:

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

Quantum Spatial

(email log daily to flight_log_distribution_list@quantumspatial.com)

Life: A B C D E

Page 3 of 3

Date: 10/31/2020

Project: USGS Earth MRI Nevada/ORA Proj #: R037339 Flight Mgmt File: 20201031-SN 4040-A-R037339

Aircraft: N704MD Begin Hobbs: 14906.1 End Hobbs: 14911.6 Total: 6.5 Pilot: JNELSON Co-Pilot: Tech: SKROHN

Dep Apt: KRN0 Dep Time (Lcl): 9:22 (Z): 16:22 Arr Apt: KFLX Arr Time (Local): 14:53 (Z): 22:53 Tot Time Aloft: 5.5

CORS: Y / N Sta 1: Sta 2: Flyovers: Y / N If Y, times: Sta 1) Sta 2)

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

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

LIDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdepd	Power	Avg Pk Spacing	PPSM	Bag CB	End CB	Storage Name
	FOV	Scan Freq	MPIA Y / N	Pulses In Air	Pulse Rate					CB	CB	
	1560ii	4040										

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POPI/s	GPS Altitude	Crab	Turb	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc			
192	323	202615	20:29	149	.98	29	11,368	0				
191	143	203204	20:33	147	.99	29	"	0				
X-tie	053	203616	20:43	150	.95	30	"	0	Record 019			
190	078	207755	20:53	146	.93	30	11,624	0				
189	258	210026	21:10	145	.86	31	11,604	-				
188	078	211249	21:23	141	.83	32	"	0				
187	258	212600	21:36	146	.92	30	11,637	0				
X-tie	171	213902	21:44	141	.93	30	"	0	Record 024			
		21:41	21:44						S-turn			
		22:56	23:01						Static			

Total Proj Lines: Lines Flown: Lines Remain: Online Time: 4.8 Mob Time: 7 Notes:

Julian Day 296 Flight A

LIDAR Flight Log



Date	October 22, 2020	Aircraft	C-FKMA
Project	3204 QSI PyramidLake	Pilot	A. Stepanowich
Location	Reno, NV	Operator	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560i
Unit	37
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes	
Time to next maintenance:	<input type="checkbox"/> 50 hr <input type="radio"/> 100 hr

Aircraft Block Time		
Engine On	14:51	Takeoff 15:05
Engine Off	21:29	Landing 21:19
Total	6.6 hrs	Total 6.2 hrs

Mission Plan			
AGL Height	2200 m	Pulse Rate	700khz
Target Speed	150 kts	Scan Rate	320hz
Laser Current	100 %	FOV	60 degs

Static Alignment	GPS Time	
	Start	End
	Pre Mission	14:54
Post Mission	21:22	21:27

Flight Line	LIDAR File Name	Flight Direction	GPS Time		Line Aborted	Mission ID	Comments
			Start	End			
PPP-8	-	-	15:14	15:18		201022	figure 8
2071		344°	15:21	15:36		152115	
2072		164°	15:39	15:54		153938	
2073		344	15:57	16:12		155751	
2074		164°	16:16	16:31		161614	
2075		344°	16:34	16:49		163447	
2076		164°	16:52	17:07		165259	
2077		344°	17:11	17:26		171134	
2078		164°	17:29	17:44		172948	
2079		344°	17:48	18:03		174825	
2080		164°	18:06	18:21		180651	
2081		344°	18:25	18:41		182548	
2082		164°	18:44	18:59		184415	
2083		344°	19:03	19:18		190302	
2084		164°	19:21	19:37		192121	

Julian Day 298 Flight A

LIDAR Flight Log



**AIRBORNE
IMAGING**
A Clean Harbors Company

Date	October 24, 2020	Aircraft	C-FKMA
Project	3204 QSI PyramidLake	Pilot	A. Stepanowich
Location	Reno, NV	Operator	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560i
Unit	37
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes
 Gimbal/snapshot issues on start up required two system restarts
 Time to next maintenance: _____ ☉ 50 hr ○ 100 hr

Aircraft Block Time	
Engine On 14:45	Takeoff 15:33
Engine Off 22:18	Landing 22:09
Total 7.6 hrs	Total 6.6 hrs

Mission Plan			
AGL Height	2200 m	Pulse Rate	700khz
Target Speed	150 kts	Scan Rate	320hz
Laser Current	100 %	FOV	60 degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	15:22	15:27
Post Mission	22:11	22:16

Flight Line	LIDAR File Name	Flight Direction	GPS Time		Line Aborted	Mission ID	Comments
			Start	End			
PPP-8	-	-	15:41	15:46		201024	figure 8
2089		345°	16:05	16:22			
2090		165°	16:26	16:43			
2091		345°	16:47	17:05			
2092		165°	17:08	17:27			
2093		345°	17:30	17:48			
2094		165°	17:52	18:10			
2095		345°	18:13	18:31			
2096		165°	18:35	18:53			
2097		345°	18:57	19:15			
2098		165°	19:18	19:37			
2099		345°	19:40	19:58			
2100		165°	20:02	20:19			
2101		345°	20:23	20:41			
2102		165°	20:45	21:03			

Julian Day 303 Flight A

LIDAR Flight Log



**AIRBORNE
IMAGING**
A Clean Harbors Company

Date	October 29, 2020	Aircraft	C-FKMA
Project	3204 QSI Pyramidlake	Pilot	G. Toews
Location	Reno, NV	Operator	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560i
Unit	37
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes
 Maintenance in the morning,
 Airport TFR restriction in the evening
 required shorter mission
 Time to next maintenance: _____ @ 50 hr ○ 100 hr

Aircraft Block Time		
Engine On	19:10	Takeoff 19:32
Engine Off	00:10	Landing 23:59
Total	5.0 hrs	Total 4.5 hrs

Mission Plan			
AGL Height	2200 m	Pulse Rate	700khz
Target Speed	150 kts	Scan Rate	320hz
Laser Current	100 %	FOV	60 degs

Static Alignment	GPS Time	
	Start	End
	Pre Mission	19:14
Post Mission	00:03	00:08

Flight Line	LIDAR File Name	Flight Direction	GPS Time		Line Aborted	Mission ID	Comments
			Start	End			
PPP-8			19:46	19:50		201029	Figure 8
2105		345°	19:54	20:12		195427	
2106		165°	20:16	20:34		201617	
2107		345°	20:37	20:56		203752	
2108		165°	20:59	21:18		205943	
2109		345°	21:21	21:39		212141	
2110		165°	21:43	21:11		214324	
2111		345°	22:05	22:23		220505	
2112		165°	22:26	22:44		222637	
2113		345°	22:48	23:06		224806	
2114		165°	23:09	23:27		230926	
X-TIE		255°	23:33	23:36		233321	
PPP-8	-	-	23:41	23:45		-	Figure 8

Julian Day 304 Flight A

LIDAR Flight Log



AIRBORNE
IMAGING
A Clean Harbors Company

Date	October 30, 2020	Aircraft	C-FKMA
Project	3204 QSI PyramidLake	Pilot	G. Toews
Location	Reno, NV	Operator	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560i
Unit	37
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes
TFR restricted takeoff in the AM

Time to next maintenance: _____ ☉ 50 hr ○ 100 hr

Aircraft Block Time	
Engine On	18:01
Takeoff	18:21
Engine Off	01:15
Landing	01:04
Total	7.2 hrs
Total	6.7 hrs

Mission Plan			
AGL Height	2200	m	Pulse Rate
Target Speed	150	kts	Scan Rate
Laser Current	100	%	FOV
			60
			degs

Static Alignment	GPS Time	
	Start	End
Pre Mission	18:06	18:11
Post Mission	01:07	01:12

Flight Line	LIDAR File Name	Flight Direction	GPS Time		Line Aborted	Mission ID	Comments
			Start	End			
PPP-8	-	-	18:39	18:43		-	Figure 8
2115		345°	18:49	19:08		184950	
2116		165°	19:11	19:29		191111	
2117		345°	19:32	19:50		193245	
2118		165°	19:54	20:13		195446	
2119		345°	20:16	20:34		201628	
2120		165°	20:37	20:55		203743	
2121		345°	20:59	21:17		205929	
2122		165°	21:21	21:40		212116	
2123		345°	21:43	22:01		214310	
2124		165°	22:04	22:23		220454	
2125		345°	22:26	22:45		222647	
2126		165°	22:48	23:06		224844	
2127		345°	23:09	23:28		230954	
2128		165°	23:31	23:49		233141	

Julian Day 307 Flight A

LIDAR Flight Log



AIRBORNE IMAGING
A Clean Harbors Company

Date	November 2, 2020	Aircraft	C-FKMA
Project	3204 QSI Pyramidlake	Pilot	G. Toews
Location	Reno, NV	Operator	B. Eisenbart
Mission Objective			

System	Riegl VQ-1560i
Unit	37
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes
 Delay on startup to calibrate replaced sandel
 Time to next maintenance: _____ @ 50 hr ○ 100 hr

Aircraft Block Time		
Engine On	18:35	Takeoff 19:15
Engine Off	02:05	Landing 01:54
Total	7.5 hrs	Total 6.7 hrs

Mission Plan			
AGL Height	2200 m	Pulse Rate	700khz
Target Speed	150 kts	Scan Rate	320hz
Laser Current	100 %	FOV	60 degs

Static Alignment	GPS Time	
	Start	End
	Pre Mission	18:39
Post Mission	01:57	02:02

Flight Line	LIDAR File Name	Flight Direction	GPS Time		Line Aborted	Mission ID	Comments
			Start	End			
PPP-8	-	-	19:33	19:37		-	Figure 8
2131		345°	19:41	20:00		194141	
2132		165°	20:03	20:22		200347	
2133		345°	20:25	20:44		202559	
2134		165°	20:47	21:05		204720	
2135		345°	21:09	21:26		210908	
2136		165°	21:29	21:48		212953	
2137		345°	21:51	22:09		215123	
2138		165°	22:12	22:31		221213	
2139		345°	22:34	22:52		223430	
2140		165°	22:55	23:13		225508	
2141		345°	23:17	23:35		231706	
2142		165°	23:38	23:58		233852	
2143		345°	00:01	00:18		000103	
2144		165°	00:22	00:38		002238	

Project Name: Montana Statewide Phase 2 R036170

Date	Mission ID	Sensor
10/13/2020	20201013_SN3061	Riegl VQ-1560i SN3061
10/16/2020	20201016 SN4040	Riegl VQ-1560i SN4040
10/17/2020	20201017 SN4040	Riegl VQ-1560i SN4040
10/18/2020	20201018 SN4040	Riegl VQ-1560i SN4040
10/19/2020	20201019 SN4040	Riegl VQ-1560i SN4040
10/20/2020	20201020 SN4040	Riegl VQ-1560i SN4040
10/21/2020	20201021 SN4040	Riegl VQ-1560i SN4040
10/21/2020	20201021 SN4046	Riegl VQ-1560ii SN4046
10/22/2020	20201022 SN4040	Riegl VQ-1560i SN4040
10/22/2020	20201022 SN4046	Riegl VQ-1560ii SN4046
10/23/2020	20201023 SN4046	Riegl VQ-1560ii SN4046
10/23/2020	20201023 SN4040	Riegl VQ-1560i SN4040
10/24/2020	20201024 SN4046	Riegl VQ-1560ii SN4046
10/24/2020	20201024 SN4040	Riegl VQ-1560i SN4040
10/25/2020	20201025 SN4040	Riegl VQ-1560i SN4040
10/25/2020	20201025 SN4046	Riegl VQ-1560ii SN4046
10/26/2020	20201026 SN4046	Riegl VQ-1560ii SN4046
10/26/2020	20201026 SN4040	Riegl VQ-1560i SN4040
10/27/2020	20201027 SN4040	Riegl VQ-1560i SN4040
10/28/2020	20201028 SN4040	Riegl VQ-1560i SN4040
10/29/2020	20201029 SN4040	Riegl VQ-1560i SN4040
10/30/2020	20201030 SN4040	Riegl VQ-1560i SN4040
10/30/2020	20201030 SN3061	Riegl VQ-1560i SN3061
10/31/2020	20201031 SN3061	Riegl VQ-1560i SN3061
10/31/2020	20201031 SN4040	Riegl VQ-1560i SN4040
11/1/2020	2020111 SN3061	Riegl VQ-1560i SN3061
11/1/2020	2020111 SN4040	Riegl VQ-1560i SN4040
11/2/2020	2020112 SN4040	Riegl VQ-1560i SN4040
11/2/2020	2020112 SN3061	Riegl VQ-1560i SN3061
11/3/2020	2020113 SN4040	Riegl VQ-1560i SN4040
11/4/2020	2020114 SN4040	Riegl VQ-1560i SN4040
11/5/2020	2020115 SN4040	Riegl VQ-1560i SN4040
11/19/2020	20201119 SN3061	Riegl VQ-1560i SN3061
11/20/2020	20201120 SN3061	Riegl VQ-1560i SN3061

Flight Plan	Lines Flown	# Reflies	Flight 1 Wheels Up
USGS_EARTH_NV_1560I_QL1	1-6, 11-32	0	9:05:00 AM
USGS_EARTH_NEVADA_1560I_QL2	490-517 QL2	0	9:50:00 AM
USGS_EARTH_NEVADA_1560I_QL2	518-536	0	9:23:00 AM
USGS_EARTH_NEVADA_1560I_QL2	537-542, 221-234	0	8:12:00 AM
USGS_EARTH_NEVADA_1560I_QL2	208-220, 14-23	0	9:33:00 AM
USGS_EARTH_NEVADA_1560I_QL2	24-36 & 268-273	0	9:26:00 AM
USGS_EARTH_NEVADA_1560I_QL2	439-458	0	9:35:00 AM
USGS_EARTH_NV_1560I_QL1	QL1 7-10, 33-56, 67-74	0	9:44:00 AM
USGS_EARTH_NEVADA_1560I_QL2	415-419, 428-438	0	9:42:00 AM
USGS_EARTH_NEVADA_1560I_QL2	QL2 119-121, 459-470	0	9:59:00 AM
USGS_EARTH_NEVADA_1560I_QL2	QL2 471-489	0	9:38:00 AM
USGS_EARTH_NEVADA_1560I_QL2	384-389 & 420-427	0	9:43:00 AM
USGS_EARTH_NV_1560I_QL1	QL1 57-66, 102-139	0	8:02:00 AM
USGS_EARTH_NEVADA_1560I_QL2	235-245 & 254-267	0	9:00:00 AM
USGS_EARTH_NEVADA_1560I_QL2	331-340	0	2:50:00 PM
USGS_EARTH_NV_1560I_QL1	QL1 151-161	0	2:39:00 PM
USGS_EARTH_NV_1560I_QL1	QL1 75-86, 140-150, 162-166	0	10:01:00 AM
USGS_EARTH_NEVADA_1560I_QL2	309-330	0	9:47:00 AM
USGS_EARTH_NV_1560I_QL1	87-101 QL1 & 9-13 QL2	0	9:42:00 AM
USGS_EARTH_NEVADA_1560I_QL2	1-8, 158-159, 246-253, 306-308	0	9:50:00 AM
USGS_EARTH_NEVADA_1560I_QL2	407-413	0	11:29:00 AM
USGS_EARTH_NEVADA_1560I_QL2	86-99	0	10:36:00 AM
USGS_EARTH_NEVADA_1560I_QL2	37-53	3	10:40:00 AM
USGS_EARTH_NEVADA_1560I_QL2	341-373	0	9:04:00 AM
USGS_EARTH_NEVADA_1560I_QL2	414, 183-207	0	9:22:00 AM
USGS_EARTH_NEVADA_1560I_QL2	100-118, 156, 160-163, 296-300	0	9:20:00 AM
USGS_EARTH_NEVADA_1560I_QL2	164-166, 167-182	0	9:29:00 AM
USGS_EARTH_NEVADA_1560I_QL2	122-141	0	9:25:00 AM
USGS_EARTH_NEVADA_1560I_QL2	157, 161-163, 301-305, 374-383	0	8:58:00 AM
USGS_EARTH_NEVADA_1560I_QL2	53-66	0	9:15:00 AM
USGS_EARTH_NEVADA_1560I_QL2	67-80	0	12:06:00 AM
USGS_EARTH_NEVADA_1560I_QL2	81-85	0	10:56:00 AM
USGS_EARTH_NEVADA_1560I_QL2	144-155, 274-279, 294-295	0	8:48:00 AM
USGS_EARTH_NEVADA_1560I_QL2	142-143, 280-293, 390-406	0	8:27:00 AM

Flight 1 Wheels Down	Flight 1 Begin Hobbs	Flight 1 End Hobbs	Flight 1 Total Hobbs	Flight 2 Wheels Up	Flight 2 Wheels Down	Flight 2 Begin Hobbs
2:50:00 PM	2350.2	2355.9	5.7			
4:22:00 PM	14823.9	14830.4	6.5			
3:23:00 PM	14830.4	14836.4	6			
1:46:00 PM	14836.4	14841.9	5.5			
3:46:00 PM	14841.9	14848.1	6.2			
3:03:00 PM	14848.1	14853.7	5.6			
3:42:00 PM	14853.7	14859.7	6			
4:05:00 PM	8271.3	8277.7	6.4			
3:23:00 PM	14859.7	14865.4	5.7			
4:20:00 PM	8277.7	8284.1	6.4			
3:55:00 PM	8284.1	8290.4	6.3			
3:10:00 PM	14865.4	14870.8	5.4			
1:20:00 PM	8290.4	8295.7	5.3	2:23:00 PM	5:41:00 PM	8295.7
2:30:00 PM	14870.8	14876.3	5.5	3:38:00 PM	6:20:00 PM	14876.3
6:00:00 PM	14878.9	14882.1	3.2			
5:50:00 PM	8499	8502.2	3.2			
3:52:00 PM	8502.2	8508	5.8			
3:40:00 PM	14882.1	14888	5.9			
2:53:00 PM	14888	14893.2	5.2			
3:20:00 PM	14893.2	14898.7	5.5			
1:55:00 PM	14898.7	14901.1	2.4			
3:34:00 PM	14901.1	14906.1	5			
4:15:00 PM	12417	12422.4	5.4			
3:12:00 PM	12422.4	12428.6	6.2	4:11:00 PM	6:54:00 PM	12428.6
2:53:00 PM	14906.1	14911.6	5.5	4:26:00 PM	6:15:00 PM	14911.6
2:30:00 PM	12431.3	12436.6	5.3	3:32:00 PM	5:00:00 PM	12436.6
2:34:00 PM	14913.5	14918.5	5	3:51:00 PM	5:28:00 PM	14918.5
2:51:00 PM	14920.2	14925.6	5.4			
1:34:00 PM	12438.5	12443.1	4.6			
2:46:00 PM	14925.6	14931.1	5.5			
2:38:00 PM	14931.1	14936.6	5.5			
2:30:00 PM	14936.6	14940.2	3.6			
3:30:00 PM	2500.7	2507.4	6.7			
2:45:00 PM	2507.4	2513.8	6.4	3:25:00 PM	5:50:00 PM	2513.8

Flight 2 End Hobbs	Flight 2 Total Hobbs	Daily Hobbs Total	On-Line Hobbs	MOB Hobbs	Operator
	0	5.70	5.0	0.7	Justen Maxey
	0	6.50	5.9	0.6	Jim Schoone
	0	6.00	5.3	0.7	Jim Schoone
	0	5.50	4.8	0.7	Jim Schoone
	0	6.20	5.3	0.9	Jim Schoone
	0	5.60	4.4	1.2	Jim Schoone
	0	6.00	5.7	0.3	Jim Schoone
	0	6.40	4.9	1.5	Noah Edelson
	0	5.70	5.1	0.6	Jim Schoone
	0	6.40	3.7	1.4	Noah Edelson
	0	6.30	4.7	1.6	Noah Edelson
	0	5.40	4.4	5.4	Jim Schoone
8299	3.3	8.60	6.6	2.0	Noah Edelson
14878.9	2.6	8.10	6.5	1.6	Jim Schoone
	0	3.20	2.2	1.0	Jim Schoone
	0	3.20	2.0	1.2	Noah Edelson
	0	5.80	4.3	1.5	Noah Edelson
	0	5.90			Jim Schoone
	0	5.20	4.0	1.2	Jim Schoone
	0	5.50	4.4	1.0	Jim Schoone
	0	2.40	1.5	0.9	Steve Krohn
	0	5.00	4.1	0.9	Steve Krohn
	0	5.40	3.8	1.6	Miranda Geller
12431.3	2.7	8.90	7.1	1.7	Miranda Geller
14913.5	1.9	7.40	6.0	1.4	Steve Krohn
12438.5	1.9	7.20	5.4	1.9	Miranda Geller
14920.2	1.7	6.70	4.9	1.8	Steve Krohn
	0	5.40	4.2	1.2	Steve Krohn
	0	4.60	3.5	1.0	Miranda Geller
	0	5.50	3.9	1.6	Steve Krohn
	0	5.50	3.8	1.7	Steve Krohn
	0	3.60	1.4	2.2	Steve Krohn
	0	6.7	5.7	1	Spencer Beck
2516.2	2.4	8.8	5.4	3.4	Spencer Beck

Pilot	Base of Operations
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Chris Griffin	KSVE
Chad Unangst	KRNO
Chad Unangst	KRNO
Chad Unangst	KRNO
Chad Unangst	KRNO
Chad Unangst	KRNO
Chad Unangst	KRNO
Nathan Sharp	KRNO
Jamon Neilson	KRNO
Nathan Sharp	KRNO
Nathan Sharp	KRNO
Jamon Neilson	KRNO

Nathan Sharp	KRNO
Jamon Neilson	KRNO
Jamon Neilson	KRNO
Nathan Sharp	KRNO

Nathan Sharp	KMCC
Jamon Neilson	KRNO
Jamon Neilson	KRNO

Jamon Neilson	KRNO
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Jamon Neilson	KRNO
Jamon Neilson	KRNO
Chris LaRosa	KRNO
Chris LaRosa	KRNO
Jamon Neilson	KRNO

Chris LaRosa	KRNO
Jamon Neilson	KRNO
Jamon Neilson	KRNO

Chris LaRosa	KRNO
Jamon Neilson	KRNO

Jamon Neilson	KRNO
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Pat Baumgarten	KRNO
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Dan Braden	KEKO
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Dan Braden	KBDN
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Notes

Good flight on MRI. No issues

Completed 28 lines in QL2 under clear conditions except for smoke on the south end of the first 4 passes.

Conditions clear and smooth.

Conditions clear.

Sky conditions clear. Light turbulence on lines 20-23

Clear skies & smooth air.

All lines completed under clear conditions.

We sipped on fuel with little turbulence and was able to get in a long 6+ hour lift on QL1

High Broken Cirrus

Flight went smooth as could be for the 4 hours.

Perfectly smooth flight, flew everything we wanted to fly without issues

Conditions clear with smooth air.

We took advantage of the restricted airspace surrounding most of the QL1 lines being inactive today and flew a doubleheader with no complications.

Completed lines in R-4810 & R-4804A

Site was clouded over until 2PM. We went on one short hop in the PM

Had to wait until about 1pm for clouds to clear before getting in a short lift in restricted airspace before sunset.

Surprisingly got access to restricted areas after being told they would be hot on the ground and almost finished QL1 before heading to KMCC for maintenance

Completed Restricted area R-4813 A

Completed QL1 & 9-13 on QL2

completed lines in R-4810 & R-4804 a

After some early morning maintenance issues we got up and completed some lines in the QL2 area, but had to call it an early day due to a TFR that popped up.

Reflew the lines from yesterday where channel 2 failed, as well as other lines.

Great day for acq, had to wait to get lift due to TFR and ramp freeze.

Restricted area was cold so we maximized our time by getting two lifts. Beautiful moonrise!

Two lifts today to cover restricted areas only open on weekends.

Got 2 lifts since we had access to restricted area.

Two lifts today to finish out blocks that were in Restricted Areas.

Captured 20 lines on one lift today.

Another nice day in beautiful NV. Got access to restricted area and was able to acq on the 3 lines that were missing ch 2 data from 11/01.

Captured 14 lines in QL2.

We captured 14 lines in one lift on QL2 today.

One short lift today due to military operations in the MOAs and Restricted areas. Capture 5 lines on the QL2 blocks. (Lines 81-85)

One lift for USGS Earth MRI. We collected data on the western portion of the remaining lines. There is just over one full lift left on the project. We were working around patches of clouds all day. We ran into clouds at the end of some long lines and decided to do partial re-flies on those lines. There was a small amount of snow on the tops of ridges that we noted on the flight sheet.

One lift for USGS Earth MRI, project complete. We completed the remaining lines on USGS Earth MRI. There was some snow on the tops of the ridges that is noted in the flight sheet. An f-18 came and checked us out while we were on line. We landed for fuel and moved to Oregon. We intended to land at CVO, but some unexpected fog there caused us to re-route to Bend