LiDAR MAPPING REPORT

WASATCH EAST AERIAL SURVEY

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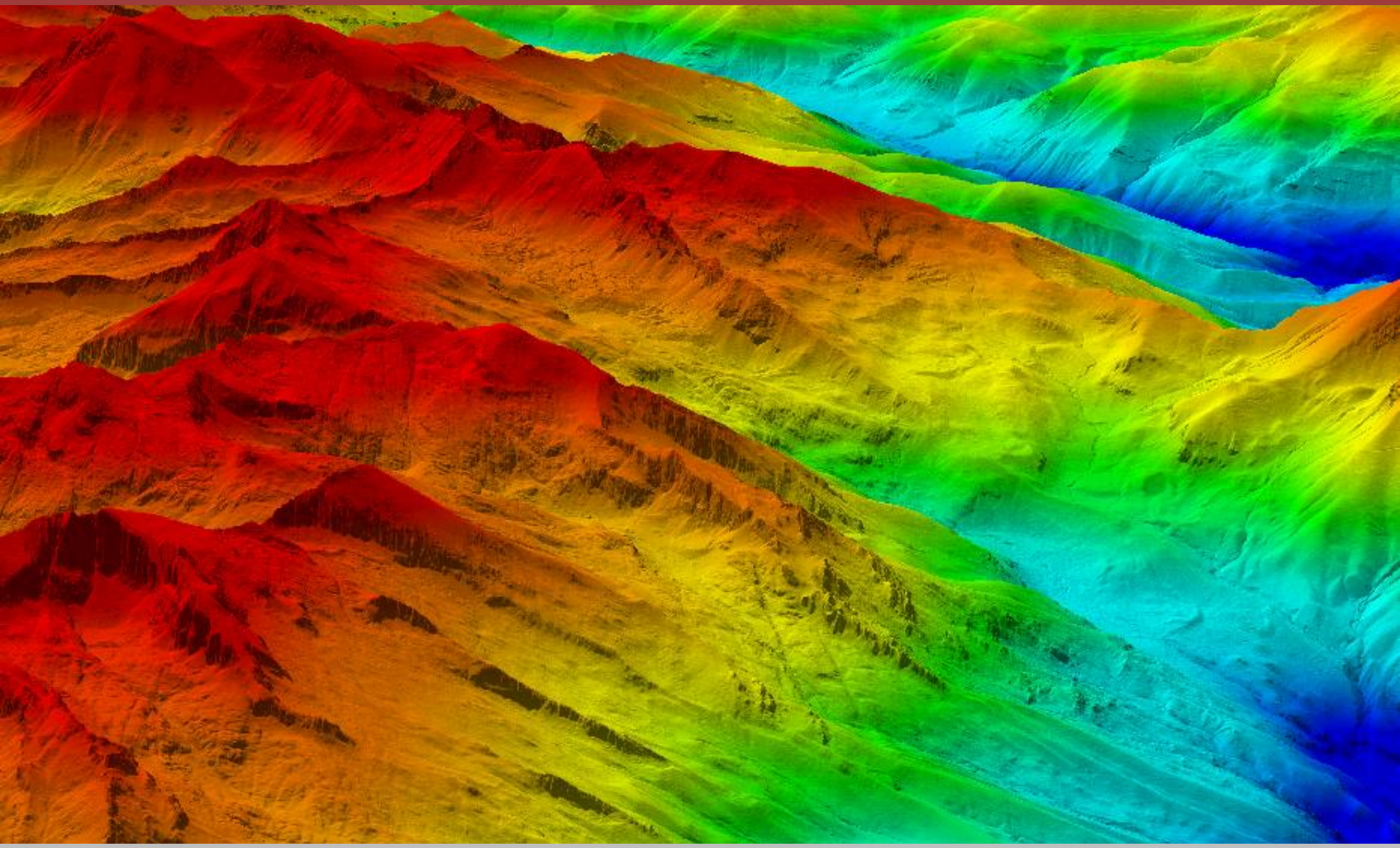

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LiDAR Mapping Report
NV_USFSR4_2_D23 Aerial Survey

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1. OVERVIEW

1.1 PROJECT AREA

Aero-Graphics, Inc., a full-service geospatial firm located in Salt Lake City, Utah, was contracted by the U.S. Geological Survey (USGS) and partners to acquire, process, and deliver aerial lidar data and derivative products that adhere to U.S. Geological Survey (USGS) National Geospatial Program (NGP) Lidar Base Specification 2024, Revision A, QL1 standards. The assigned project area covers approximately 618.5 square miles in Salt Lake, Summit, Utah, and Wasatch County, Utah. Lidar data was delivered as processed Classified LAZ 1.4 files, formatted to 1872 individual 1,000 m x 1,000 m tiles, as tiled Intensity Imagery and DSMs, and as tiled Bare-Earth Hydro Flattened DEMs.

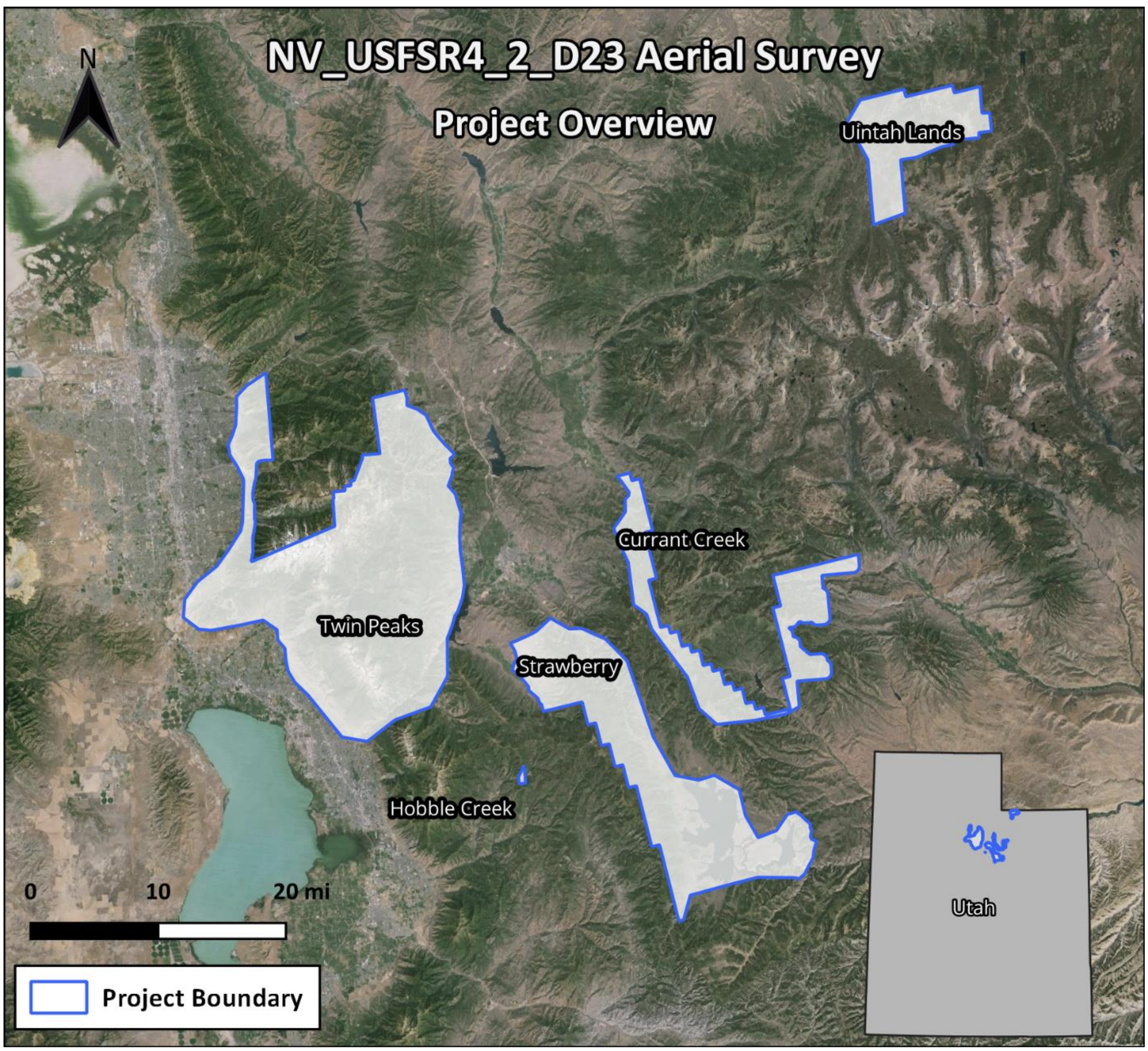
1.2 PROJECT DELIVERABLES

LiDAR Data	▪ Classified point cloud data in LAZ v1.4 format
Raster Data	▪ Bare-earth DEM, Digital Surface Model (DSM), Maximum surface height rasters (MSHR), and intensity imagery in GeoTIFF format ▪ Swath separation images in GeoTIFF format
Vector Data	▪ Breaklines and Building Footprints in SHP format ▪ Flight index, tile index, and AOI in SHP format ▪ Surveyed GCPs and checkpoints in .gpkg format
Report of Survey	▪ Reports and metadata as described in TO

1.3 PROJECTION, DATUM, UNITS

EPSG		6350
Projection		Albers
Datum	Vertical	NAVD88 (GEOID18)
	Horizontal	NAD83 (2011)
Units		Meters

Exhibit 1: NV_USFSR4_2_D23 project boundary



2. Acquisition

2.1 Flight Planning

The Aero-Graphics Aerial Department created a unique flight plan for this project using Optech's Airborne Mission Manager (AMM) flight planning software. AMM simulates flight plans based on the project area's terrain, as well as the sensor's model, mount, and settings. These features helped ensure that all contract specifications are met in the most efficient way possible. Prior to mobilizing the acquisition sites, Aero-Graphics' staff monitored all site conditions and potential weather hazards including wind, rain, snow, and blowing dust. Additionally, Aero-Graphics ensured all airspace clearances were secured by the proper officials before acquisition occurred. A summary of the flight parameters and sensor settings for the NV_USFSR4_2_D23 Aerial Survey are outlined in **Exhibit 2**.

Exhibit 2: Summary of planned flight parameters and sensor settings

Planned Specifications		
Aircraft		Cessna 310
Altitude (ft above ground level)		7000
Speed (kts)		160
LiDAR Sensor		Optech Galaxy T2000
PRF (kHz)		800
Scan frequency (Hz)		87
Laser power		High (Boost)
Scan Angle	Full	42°
	From nadir	± 21°
Planned Average Point Density (p/m²)		9.62
Post Spacing at Nadir	Cross Track (m)	0.44
	Down Track (m)	0.44
Swath Width (m)		1,614
Sidelap (%)		55
No. of Flightlines		183

2.2 Data Acquisition

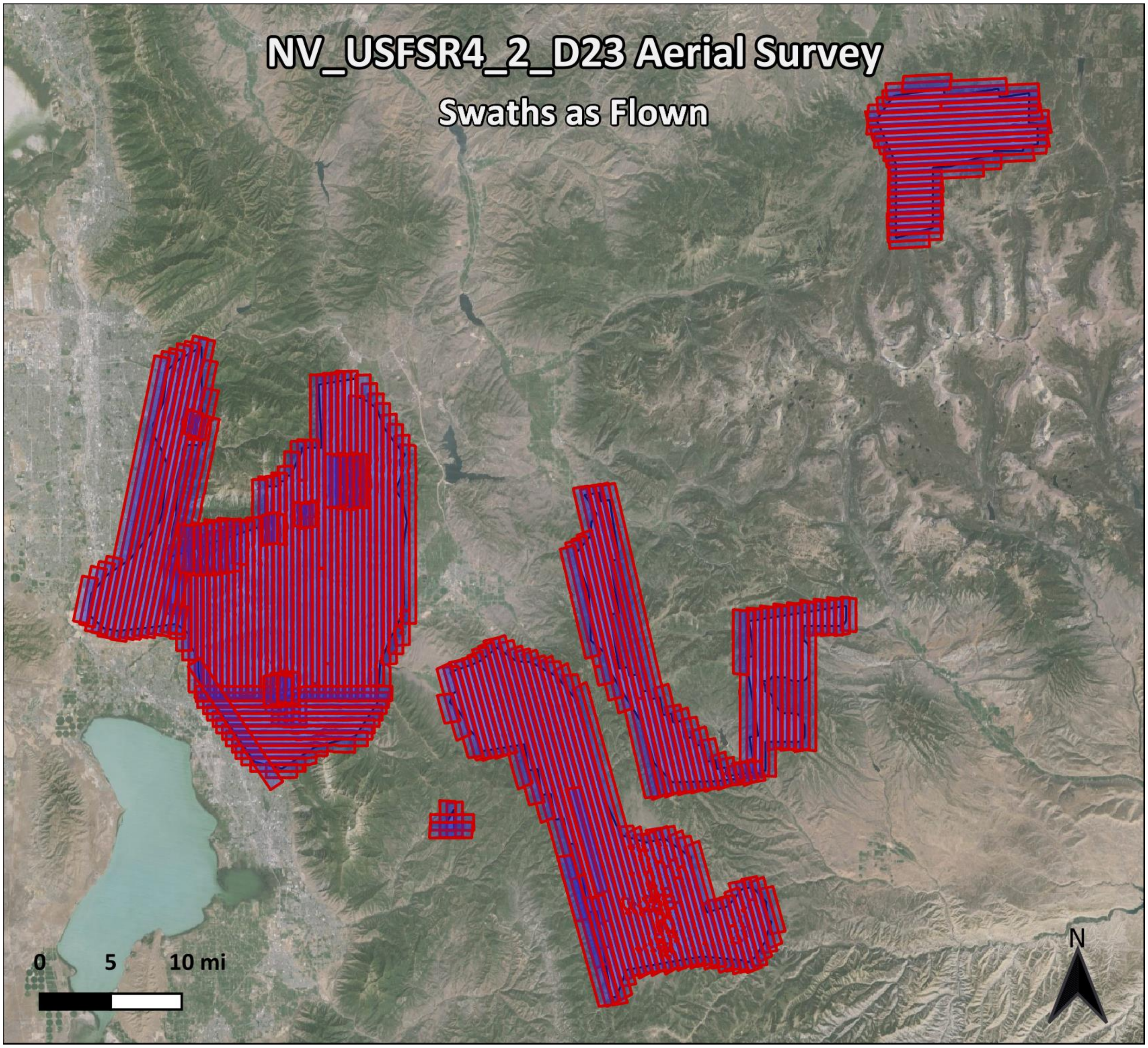
Aero-Graphics acquired LiDAR data from August 25, 2023 to September 9, 2023 with a turbocharged Cessna 310 (**Exhibit 3**). The stability of this platform is ideal for efficient data collection at high and low altitudes and at a variety of airspeeds. Additionally, our Cessna 310 has been customized to house a variety of airborne sensors, and the power system and avionics have been upgraded specifically to meet aerial survey needs.

Exhibit 3: A Cessna 310 was the acquisition platform for this project.

The Optech Galaxy T2000 was selected for this project on account of its high accuracy and efficiency (**Exhibit 4**). This sensor uses SwathTrak technology, which dynamically adjusts the scan field of view in real time to maintain a more consistent swath width over a variety of terrains. It also features up to 8 returns per pulse, which increases the vertical resolution of complex terrains. The sensor is complemented with the use of FMS Nav, which allows the system operator to monitor the point density and swath attributes of this project in real time, ensuring quality data and full coverage, as shown in **Exhibit 5**. More information about point density can be found in Section 4.4.

Exhibit 4: The Optech Galaxy T2000 was used for data acquisition.

Exhibit 5: Swath data for the NV_USFSR4_2_D23 project was recorded and viewed in real-time by the sensor operator.



2.3 Acquisition Summary

Aero-Graphics acquired LiDAR data beginning August 25, 2023, and concluded acquisition on September 9, 2023. Acquisition was completed during periods free of smoke or adverse weather conditions. There were also no equipment malfunctions during the acquisition. Ground conditions during acquisition were mostly snow free, except for patches surrounding the peak of Mt. Timpanogos. The snow was unlikely to melt during 2023 due to record breaking snowfall during the winter. In addition, there is a perpetual snowfield just southeast of the summit that holds snow year-round. After the initial acquisition of the Mt. Timpanogos area on August 26, 2023, the Aero Graphics team identified some side lap gaps which required a reflight. The reflight occurred on September 9, 2023, which allowed more time for additional snow to melt. The lidar data was edited to place the higher elevation snowy surface on class 21 (Snow) so that the lowest elevation surface, nearly entirely free of snow, would be used in the DEM surface. The areas that were edited from this discrepancy in snow height are represented in the low confidence polygons included in the delivery. Two locations were also identified in the Twin Peaks area where excavation caused the ground surface to change in between overlapping swaths (Exhibit 6 and 7). These areas are also delineated in the accompanying low confidence polygons. In both cases the more recent data was chosen as the preferred surface and the older data was classified to class 22 (Temporal Exclusion).

Exhibit 6: Difference in ground surface between flights due to excavation of ground

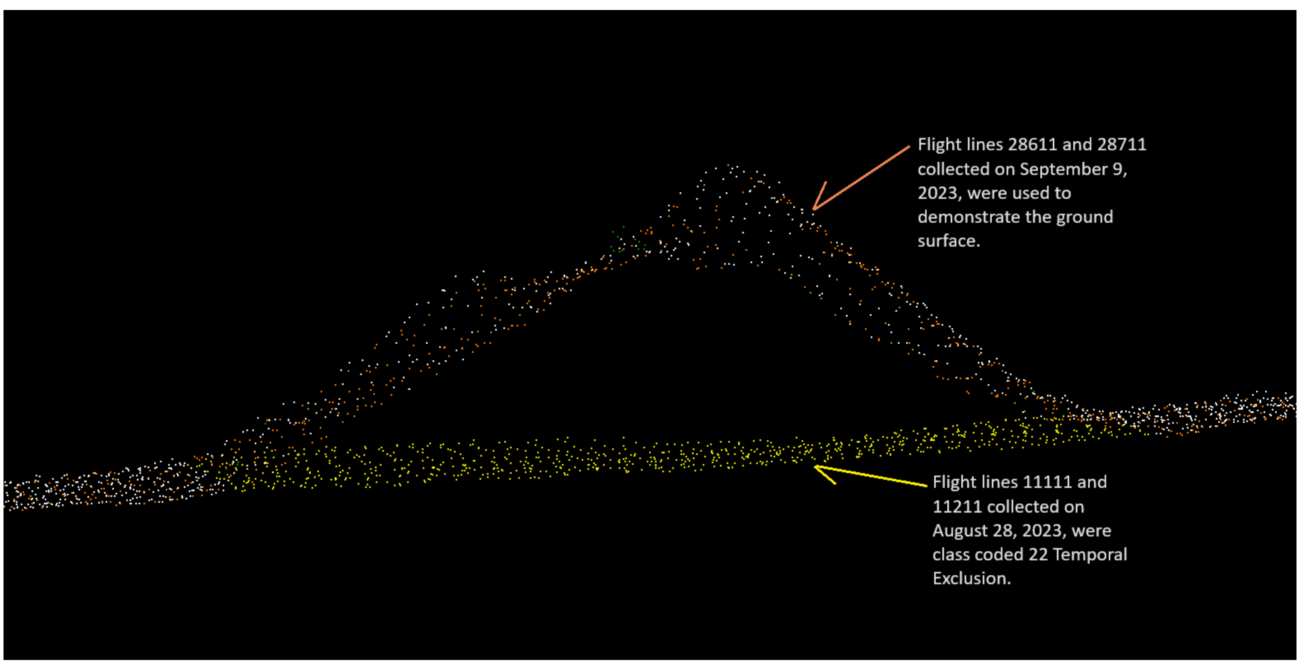
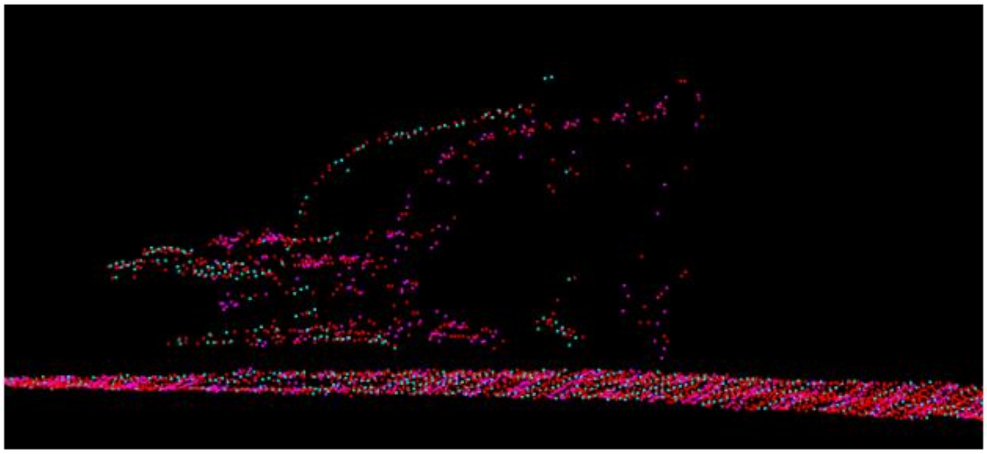
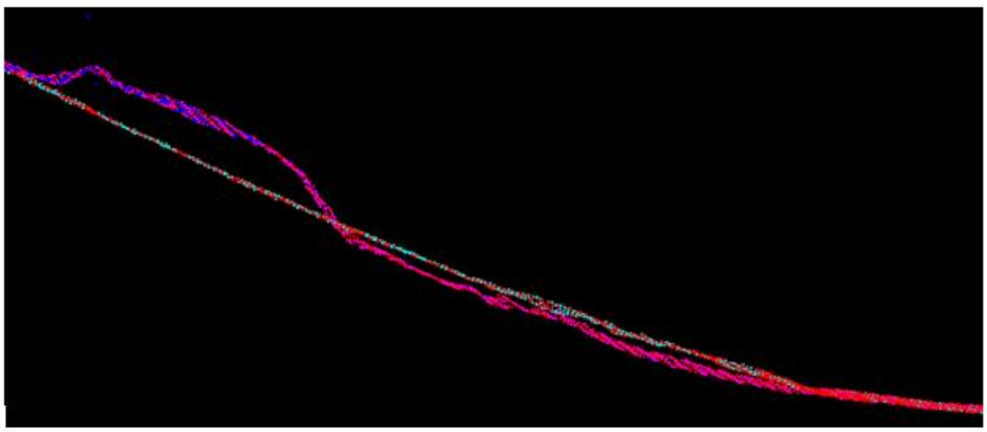


Exhibit 7: Excavators seen close by





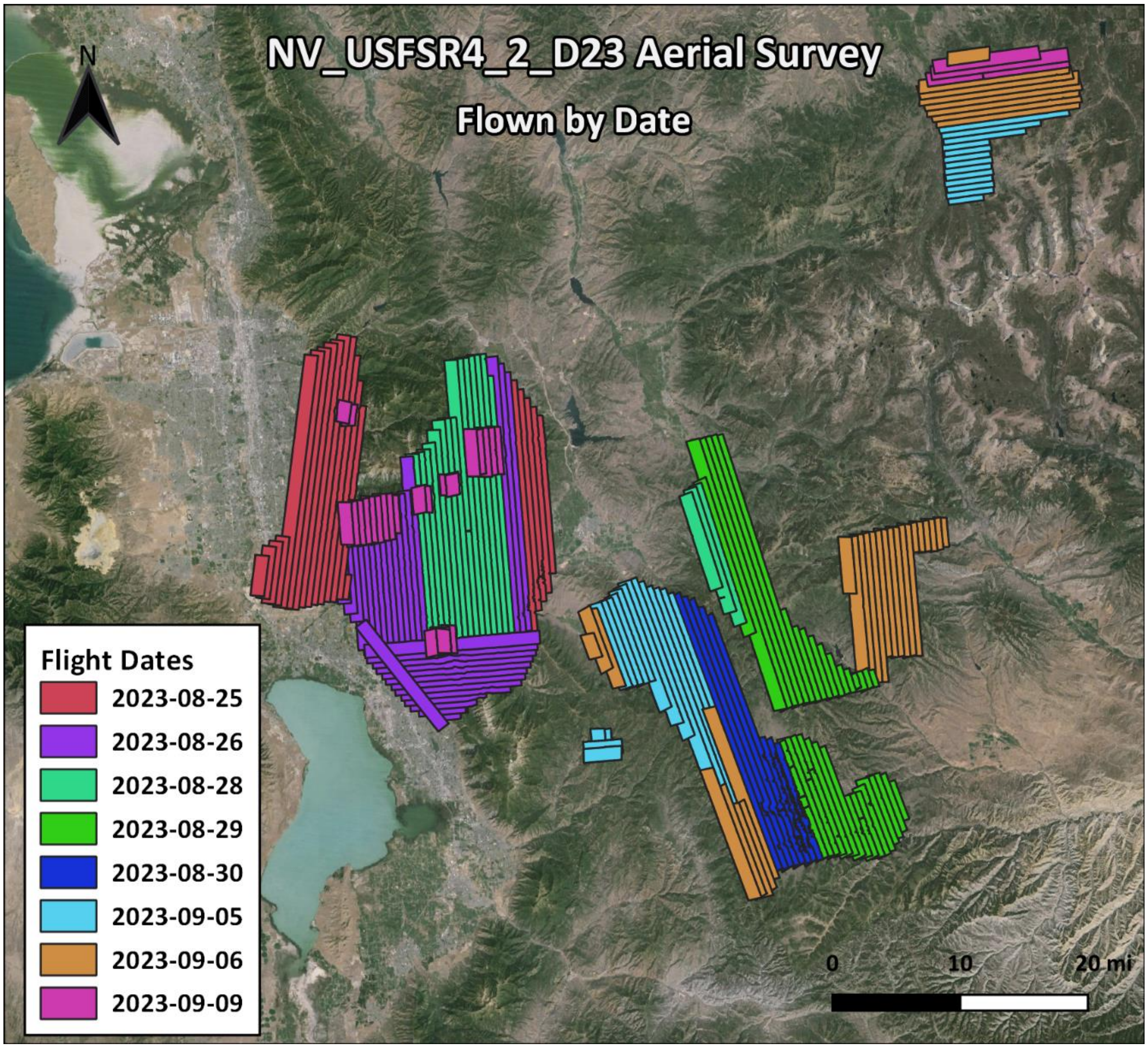


Exhibit 8: Swaths flown by date for the NV_USFSR4_2_D23 project.

2.4 Ground Control and Check Point Survey

Aero-Graphics' professional land surveyor identified, targeted, and surveyed 19 ground control points (**Exhibit 9**) for use in data calibration as well as 36 QC check points (**Exhibit 10**) in vegetated and non-vegetated land cover classification as an independent test of accuracy for this project. A combination of precise GPS surveying methods, including static and RTK observations were used to establish the 3D position of ground control points and QC check points. Ground control coordinates can be found in Appendix A. A summary of LiDAR calibration control vertical accuracy can be found in Section 4.2 with a more detailed report in Appendix B.

<u>Exhibit 9:</u> Surveyed ground control for the NV_USFSR4_2_D23 project.

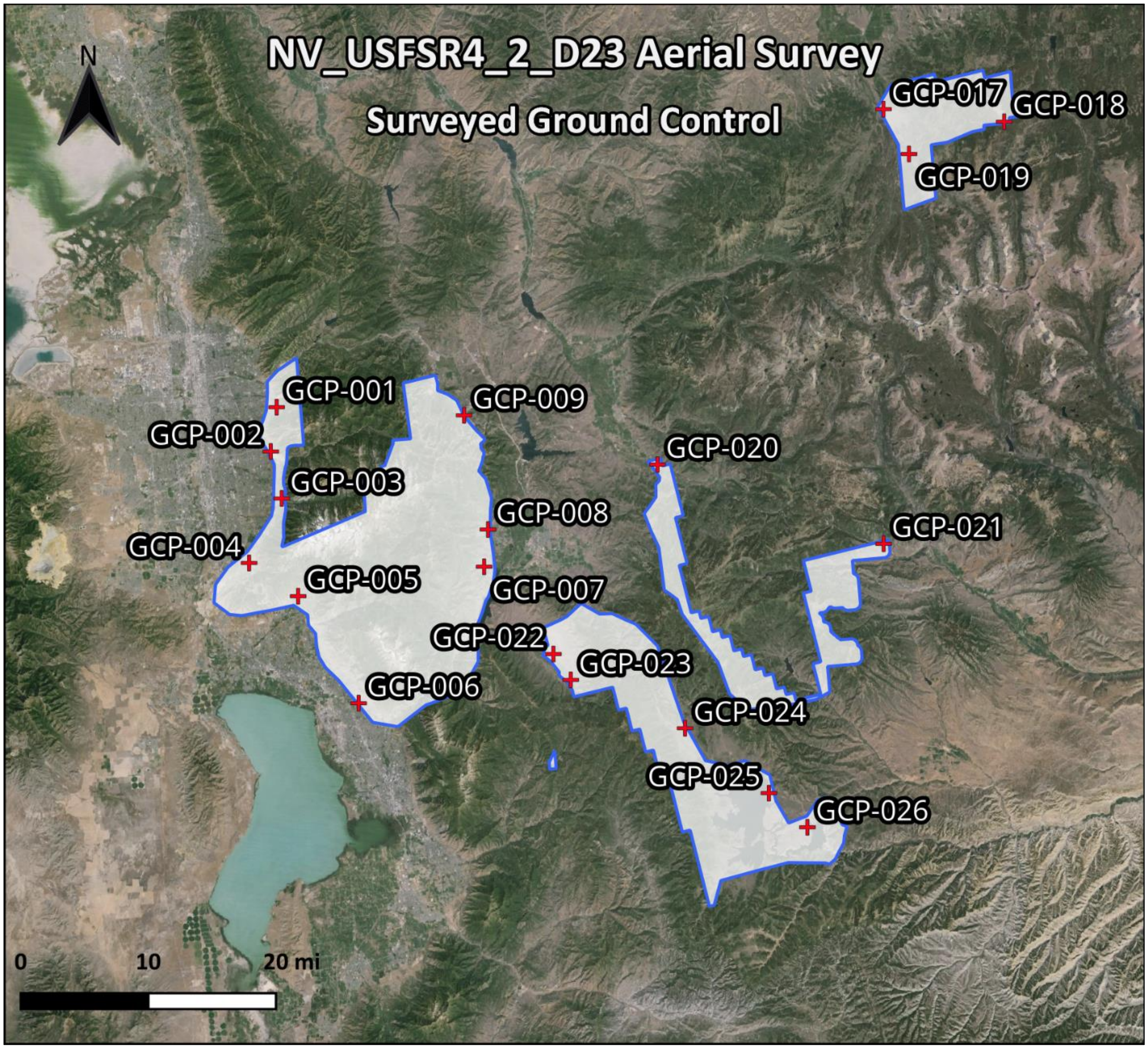
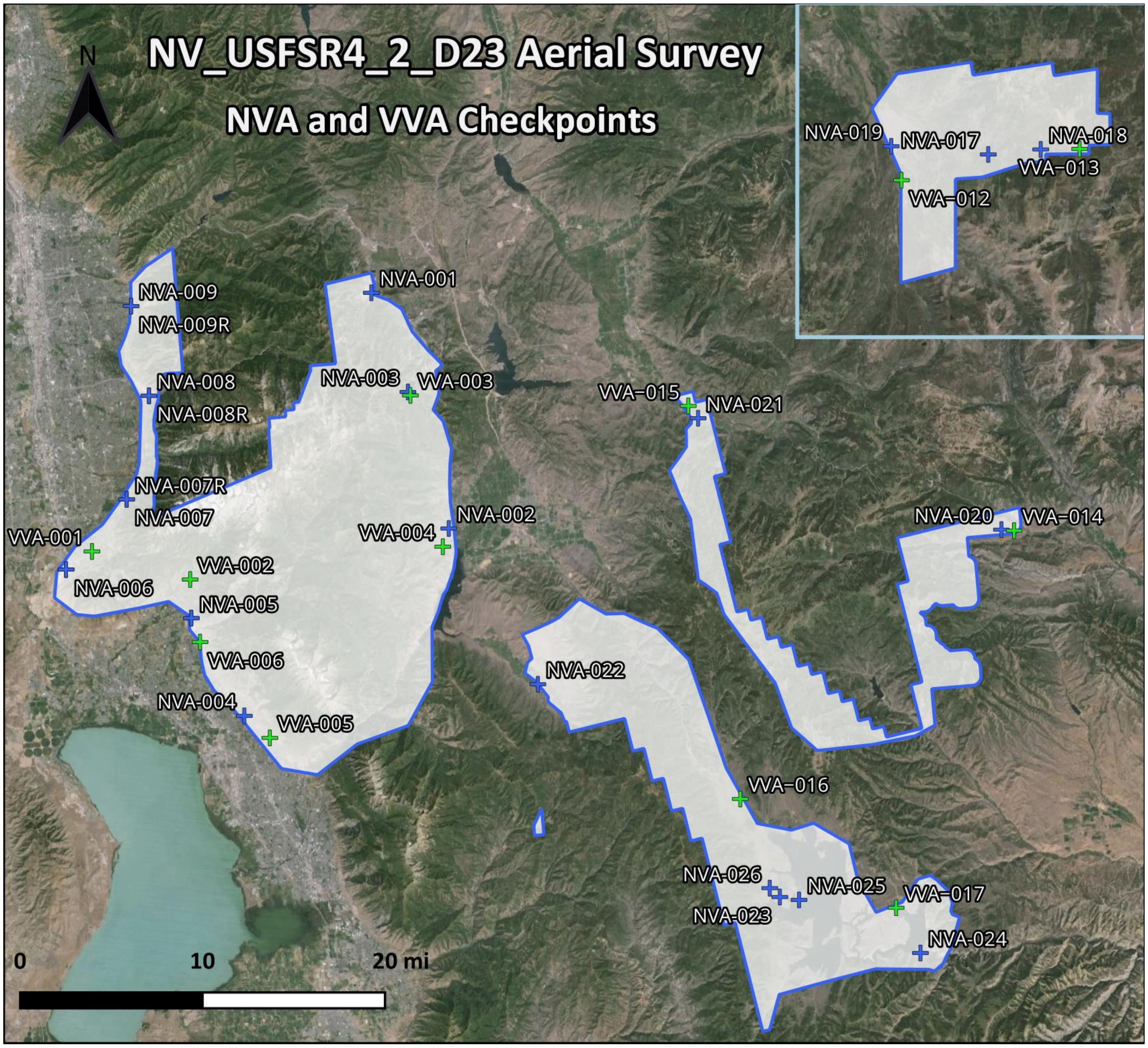


Exhibit 10: **Check Points for the NV_USFSR4_2_D23 project.**



3. LIDAR PROCESSING WORKFLOW

1. **Absolute Sensor Calibration**. Following sensor installation, lever arm values were surveyed. A boresight mission was flown over our fully controlled local range, and when adjusted to the surveyed ground control for roll, pitch, heading, and scale errors, boresight angles were developed for application to the POS processing in subsequent steps.

2. **Kinematic Air Point Processing.** The airborne GPS positions (collected at 1-second intervals) were post-processed using Applanix's POSPac MMS GNSS Inertial software (PP-RTX). A smoothed best estimate of trajectory (SBET) was developed by combining the corrected GPS positions with 1/200-second inertial measurement unit (IMU) data, which tracked the plane's roll, pitch, and yaw throughout the flight.

3. **Raw LiDAR Point Processing (Calibration).** The SBET and LiDAR range data were combined in LMS version 4.6.2 to solve for the real-world positions of each laser point. Point cloud data was produced by flight strip in ASPRS v1.4 LAS format. Flight strips were output in the project's coordinate system. LMS also does some noise filtering which flags likely noise points as Withheld. Points flagged as Withheld by LMS are "rasterized" and inspected during acquisition qc and the noise filtering parameters are adjusted as needed on a lift-by-lift basis. These points are also reviewed during classification and can often be un-flagged if found to be valid data.

4. **Relative Calibration.** Performed relative calibration by correcting for roll, pitch, heading, and scale discrepancies between adjacent flightlines; tested resulting relative accuracy. Aero-Graphics generated swath separation images (SSI) using COTS and open-source software. These images were created from the last return of all points excluding points classified as noise and/or flagged as withheld. SSIs are made by using the Point Insertion surface method and the cell size was set to the deliverable DEM cell size. The SSIs are symbolized by the following ranges:

    i. +/- 0-8 cm: **Green**
    ii. +/- 8-16 cm: **Yellow**
    iii. +/- 16-24 cm: **Orange**
    iv. +/- 24+ cm: **Red**

    The output GeoTIFF rasters were tiled to the project tile grid, clipped to the master DPA, and formatted (including defining the CRS which matches the project CRS) using GDAL software, version 3.7.1. These results are presented in Section 4.1.

a. A **Dz Ortho Raster** was generated as part of this process **(Exhibit 11)**. This raster identifies clusters of large residuals and differences in measured elevations between overlapping flightlines. These errors are usually caused by topographic relief or environmental factors and require manual adjustments to correct. In most cases, multiple iterations of the Dz ortho raster are created to aid in fine tuning relative calibration parameters.

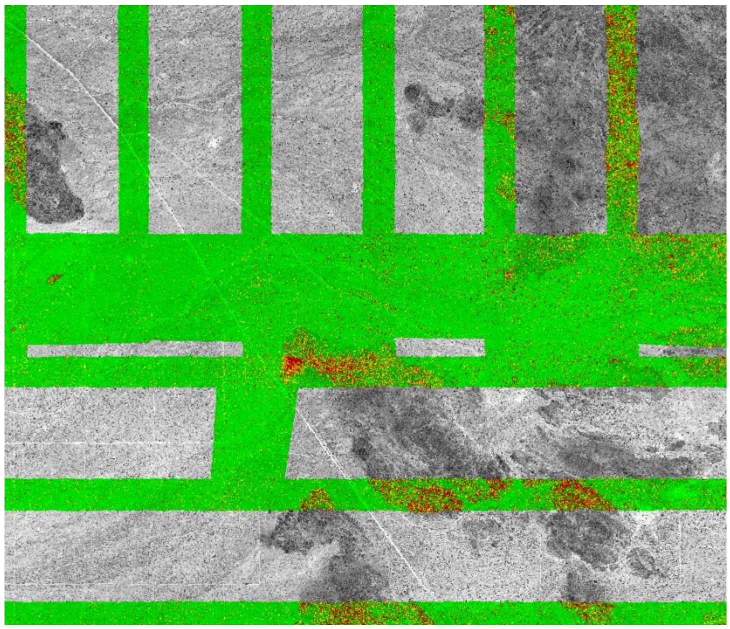


Exhibit 11: A Dz ortho raster sample generated for the Wasatch East project

5. **Calibration QC.** Calibrated data is reviewed to ensure the project meets specifications. File formatting is checked for consistency. The calibrated data is reviewed against control to confirm it meets the required Vertical Accuracy Class (Results are presented in Section 4.2). Point density is analyzed, and questionable areas of overlap are investigated and measured using COTS software.

6. **Long/Short Filtering & Tiling.** After calibrated swaths are reviewed, additional noise filtering is applied if needed and the las swaths are tiled to the project tiling scheme using TerraScan functionality. Extremely long and short returns were also filtered out as outliers and classified to a temporary class to be reclassified to low or high noise after completion of ground point classification.

7. **Classified LAS Processing.** The point classification was performed with the ASPRS classes described in **Exhibit 12**. The bare-earth surface is classified using a combination of TerraScan macro functionality as well as proprietary software. The bare-earth surface is then manually reviewed and corrected to ensure correct classification on the Class 2 (Ground) points. Quality Control (QC) DEMs are then created using COTS software and automated and manual means are used to

generate QC calls. The QC Dems are also symbolized as hillshades in QGIS, and a manual qualitative review is conducted by an Aero-Graphics technician to identify any remaining artifacts. Each resulting QC call is then addressed using functionality provided by TerraScan.

After ground classification is complete lidar points that fall on building rooftops are classified to class 6 using automated Terrascan functionality. Then, a process is run on any remaining unclassified points that filters out powerlines and other linear and planar features from the unclassified data. The rest of the unclassified data is then assigned to the low vegetation class and other proprietary automated methods are used to clean non-vegetation points out of the vegetation class. The building and vegetation classification are reviewed both in raster and native LAS format to create qc calls which are then corrected automatically using Terrascan. Finally, the vegetation is separated into low, medium, and high vegetation depending on the height of the vegetation. These breaks are customized for each project area with the goal of getting roughly ⅓ of the vegetation points in each vegetation class.

Exhibit 12: The ASPRS classes used in lidar point classification

ASPRS Version 1.4 minimum point cloud classification scheme		
CLASS #	**CLASS NAME**	**DESCRIPTION**
1	Processed, but unclassified	Points that do not fit any other classes
2	Bare earth	Bare earth surface
3	Low Vegetation	*Low height vegetation*
4	Medium Vegetation	*Medium height vegetation*
5	High Vegetation	*High height vegetation*
6	Building	Building class
7	Low noise	Low points identified below surface
9	Water	Points inside of lakes/ponds
17	Bridge decks	Points on bridge decks
18	High noise	High points identified above surface
20	Ignored ground	Points near breakline features; ignored in DEM creation process
21	Snow	Snow
22	Temporal Exclusions	Features excluded due to changes over time between collected data

8. **Breakline Collection**. Ground LiDAR points were used to create a bare earth surface model, which was used to heads-up digitize 2D breaklines of inland streams and rivers with a 30-meter nominal width, and inland ponds and lakes of 2 acres or greater surface area. Elevation values were assigned to all inland ponds and lakes, inland pond and lake islands, and inland stream and river islands, using COTS

functionality. Elevation values were assigned to all inland streams and rivers using Aero-Graphics' proprietary software. All ground LiDAR data inside of the collected inland breaklines were then classified to water using TerraScan macro functionality.

Breaklines were collected at bridges but not culverts. The distinction between bridges and culverts was based on the following guidelines: Bridges are structures carrying a road, path, railroad, canal, aircraft taxiway, or any other transit between two locations of higher elevation over an area of lower elevation. A bridge may traverse a river, ravine, road, railroad, or other obstacle. "Bridge" also includes but is not limited to aqueduct, drawbridge, flyover, footbridge, overpass, span, trestle, and viaduct. In mapping, the term "bridge" is distinguished from a roadway over a culvert in that a bridge is an elevated deck that is not underlain with earth or soil. Culverts are a tunnel carrying a stream or open drainage under a road or railroad or through another type of obstruction to natural drainage.

The breakline files were translated to ESRI shapefile format using were reviewed against LiDAR intensity imagery to verify completeness of capture. All breaklines were compared to triangular irregular networks (TINs) created from ground-only points prior to water classification. To ensure the breaklines matched the LiDAR within accepted tolerances, the horizontal placement of breaklines was compared to terrain features, and the breakline elevations were compared to LiDAR elevations. Some deviation is expected between breakline and LiDAR elevations due to monotonicity enforcement, connectivity, and flattening rules that are enforced on the breaklines. Once horizontal placement and vertical variance was reviewed, all breaklines were checked for topological consistency and data integrity using a combination of ESRI ArcMap tools and proprietary tools.

9. **Hydro-Flattened Raster DEM Creation.** A hydro-flattened raster digital elevation model (DEM) was created from a TIN surface generated using ground classified LiDAR points. The hydro-flattened DEMs, clipped to the project tile grid, were generated using COTS software using the hydro and DTM breaklines collected. There are 5 tiles (1297_2072,1298_2072, 1299_2072, 1300_2072, 1301_2072) in the Twin Peaks area that have a y-dimension of 0.007m. These tiles are not large enough to be represented with a 0.5m pixel size, as the height of a single pixel would not be able to fit within the tile. Placeholder text files have been included to represent these rasters in the delivery. The tiled DEMs were reviewed at a scale of 1:5,000 to look for artifacts caused by the DEM generation process and to verify correct and complete hydro-flattening was applied. Upon correction of any outstanding issues, the DEM data was loaded into QGIS for its second review and to verify corrections. Final DEMs are formatted using GDAL software version 3.7.1.

10. **DSM/First Return Raster Creation.** A first-return raster digital surface model (DSM) was created using the first-return LiDAR points, which was then tiled in the GeoTIFF format using COTS software and automated scripting routines. There are 5 tiles (1297_2072,1298_2072, 1299_2072, 1300_2072, 1301_2072) in the Twin Peaks area that have a y-dimension of 0.007m. These tiles are not large enough to be represented with a 0.5m pixel size, as the height of a single pixel would not be able to fit within the tile. Placeholder text files have been included in the delivery to represent these rasters in the delivery. Each surface was reviewed in QGIS to check for any surface anomalies or incorrect elevations found within the surface.

11. **Intensity Raster Creation**. The intensity imagery was created with PDAL software. All noise classes as well as withheld flagged points were ignored during this process. Full project coverage and data review was performed in QGIS.

12. **Maximum Surface Height Rasters Creation**. MSHRs are delivered as tiled GeoTIFFs (32-bit, floating point), with the tile size and naming convention matching the project tile grid. All points, excluding points flagged as withheld, are used to produce MSHRs using PDAL software. The rasters are produced with a binning method in which the highest elevation of all lidar points intersecting each pixel is applied as the pixel elevation in the resulting raster. Final MSHRs are formatted using GDAL software version 3.7.1, spatially defined to match the project CRS, and the cell size equals 2x the deliverable DEM cell size.

13. **LAS and GeoTIFF Formatting.** Las files are formatted using PDAL software. Any extra dimensions generated during classification are removed and the projection wkt string is written to the header. Tif files are compressed, and headers are formatted using a combination of GDAL and proprietary software.

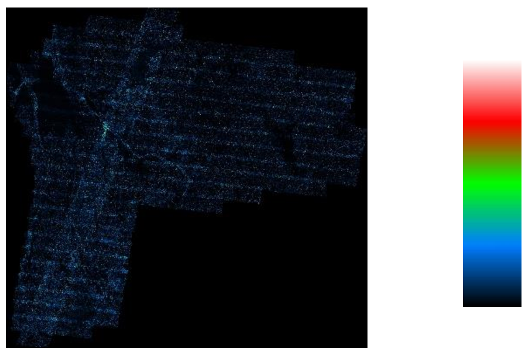
4. Accuracy Testing and Results

4.1 Relative Calibration Accuracy Results

Inter-swath relative accuracy is defined as the elevation difference in the overlapping area of parallel swaths. The elevation difference between these overlapping areas is used to measure the between-swath relative accuracy of the dataset. During calibration, this process is carried out to verify consistency from swath to swath, but as a quality assurance measure it can also point toward the internal consistency of the overall dataset. This testing was performed using COTS which produces an overall DZ ortho, summary statistics for each swath pair, and global statistics. Each of the QC products is inspected by an Aero-Graphics calibration technician who determines if further corrections need to be applied.

The inspection consists of the following steps:

1. The calibration DZ produced by COTS Lidar calibration software is brought into GIS software and compared to satellite imagery. The technician looks for any anomalies and pays close attention to roads as well as roofs and other sloped areas which can indicate issues with the vertical and horizontal alignment. The technician also monitors swath edges closely which may indicate that the Lidar sensor's calibration profile may need a slight adjustment.
    a. The DZ produced during calibration uses a continuous color ramp based on the range of the resulting DZ values.



<u>Exhibit 13:</u> Example of calibration DZ with color ramp

2. The calibration technician then inspects the pair wise statistics to see if any swath pairs are misaligned. Testing for this project was based on a total of 856 pairs covering a total of 2,729 square kilometers. For this project all pairs displayed similar RMS DZ results and were found to be well below acceptable levels.

3. Lastly the calibration technician inspects the global statistics to determine if the overall inter-swath accuracy of the project is within project specifications. A qualitative review of the deliverable swath separation rasters is also done as soon as calibration is complete, and the Lidar data has been tiled for further processing. This is done in order to validate the swath separation rasters as well as identify any potential issues the calibration technician may have missed. This process is described in section 3.4 of this report.

USFS R4 LiDAR – Twin Peaks project area: (501 pairs, 1577 square kilometers)

- Inter-swath relative accuracy **average** of 0.014 m

USFS R4 LiDAR – Strawberry project area: (149 pairs, 610 square kilometers)

- Inter-swath relative accuracy **average** of 0.015 m

USFS R4 LiDAR – Current Creek project area: (127 pairs, 361 square kilometers)

- Inter-swath relative accuracy **average** of 0.012 m

USFS R4 LiDAR –Uintah Lands project area: (69 pairs, 164 square kilometers)

- Inter-swath relative accuracy **average** of 0.009 m

USFS R4 LiDAR – Hobble Creek project area: (10 pairs, 17 square kilometers)

- Inter-swath relative accuracy **average** of 0.032 m

Intra-swath Precision is a measure of the expected precision of the laser ranging measurement. The metric is derived by calculating the variation in elevation values across a smooth flat surface and was calculated using a kernel size of 2 meters around each control point. The intra-swath precision average was found to be 0.020 meters. This was performed in Bayes Strip Align which produces a detailed report of many calibration quality assurance metrics.

4.2 Calibration Control Vertical Accuracy

Vertical absolute accuracy reports were generated as a quality assurance check. The location of each control point is displayed in the Surveyed Ground Control map in **Exhibit 9**. Detailed results for each point are included in **Appendix B**.

Exhibit 14: Calibration control vertical accuracy results summary

Calibration Control Accuracy$_Z$: NV_USFSR4_2_D23 Project Area	
Average Error = -0.007 m	Average Magnitude = 0.055 m
Minimum Error = -0.150 m	RMSE = 0.079 m
Maximum Error = +0.096 m	σ = 0.080 m
Survey Sample Size: n = 19	

4.3 Point Cloud Testing

The project specifications require that Non-Vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA) be computed for raw LiDAR point cloud swath files. NVA is defined as the elevation difference between the LiDAR ground surface and statically surveyed ground control points collected in open terrain (bare soil, sand, rocks, and short grass) as well as urban terrain (asphalt and concrete surfaces). The NVA for this project was tested with 24 check points. The VVA for this project was tested with 10 check points. These check points were not used in the calibration or post-processing of the LiDAR point cloud data. Elevations from the unclassified LiDAR surface were measured for the xy location of each check point. Elevations interpolated from the LiDAR surface were then compared to the elevation values of the surveyed control points.

The bare-earth LiDAR dataset was designed to meet or exceed ASPRS Positional Accuracy Standards at the 10 cm vertical accuracy class. Absolute accuracy for non-vegetated areas (NVA) must be accurate within 10.0 cm (0.32 ft). The tested NVA for this dataset was found to be accurate within 6.3 cm (0.21 ft) in terms of the $RMSE_v$. Therefore, this dataset meets the required NVA of 10.0 cm. The tested VVA for the dataset was found to be 9.6cm (0.31 ft). This data set was produced to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data, Edition 2 (2023) for a 41.1cm (1.35 ft) $RMSE_h$ horizontal positional accuracy class.

4.4 Digital Elevation Model Testing

The project specifications require the accuracy of the derived DEM be calculated and reported in two ways: (1) Non-Vegetated Vertical Accuracy (NVA) points collected within "bare earth" and "urban" land cover classes and (2) Vegetated Vertical Accuracy (VVA) in all vegetated land cover classes. The NVA for this project was tested with 23 check points. The VVA was tested with 12 check points. The discrepancy in the number of NVA checkpoints used to calculate accuracy in the point cloud dataset and the DEM dataset is due to the point cloud being tested on full swaths, which happened to encompass an extra VVA checkpoint that was outside of the DEM bounds.

The Non-Vegetated Vertical Accuracy (NVA) for this dataset was tested by sampling the DEM elevation value at each NVA checkpoint and differencing the sampled DEM Value and the statically surveyed NVA checkpoint elevation value. The resulting $RMSE_z$ of the DEM values were found to be 6.6 cm (0.22 ft). Therefore, this dataset meets the required NVA of 10 cm.

The tested Vegetated Vertical Accuracy (VVA) for this dataset captured from the DEM using bi-linear interpolation for all classes was found to be 6.4 cm (0.21 ft). Therefore, this dataset meets the required VVA of 10 cm.

4.5 Data Density

The goal for this project was to achieve a minimum LiDAR point density of 8.0 points per square meter. First return density is the best representation of the quality of the acquisition because the density of first returns is independent of vegetation and other random factors that could increase the overall point density **(Exhibit 15)**. The acquisition mission achieved a first return point density of 13.8 points per square meter for first returns. Please note that ground water and other random factors could decrease the overall point density.

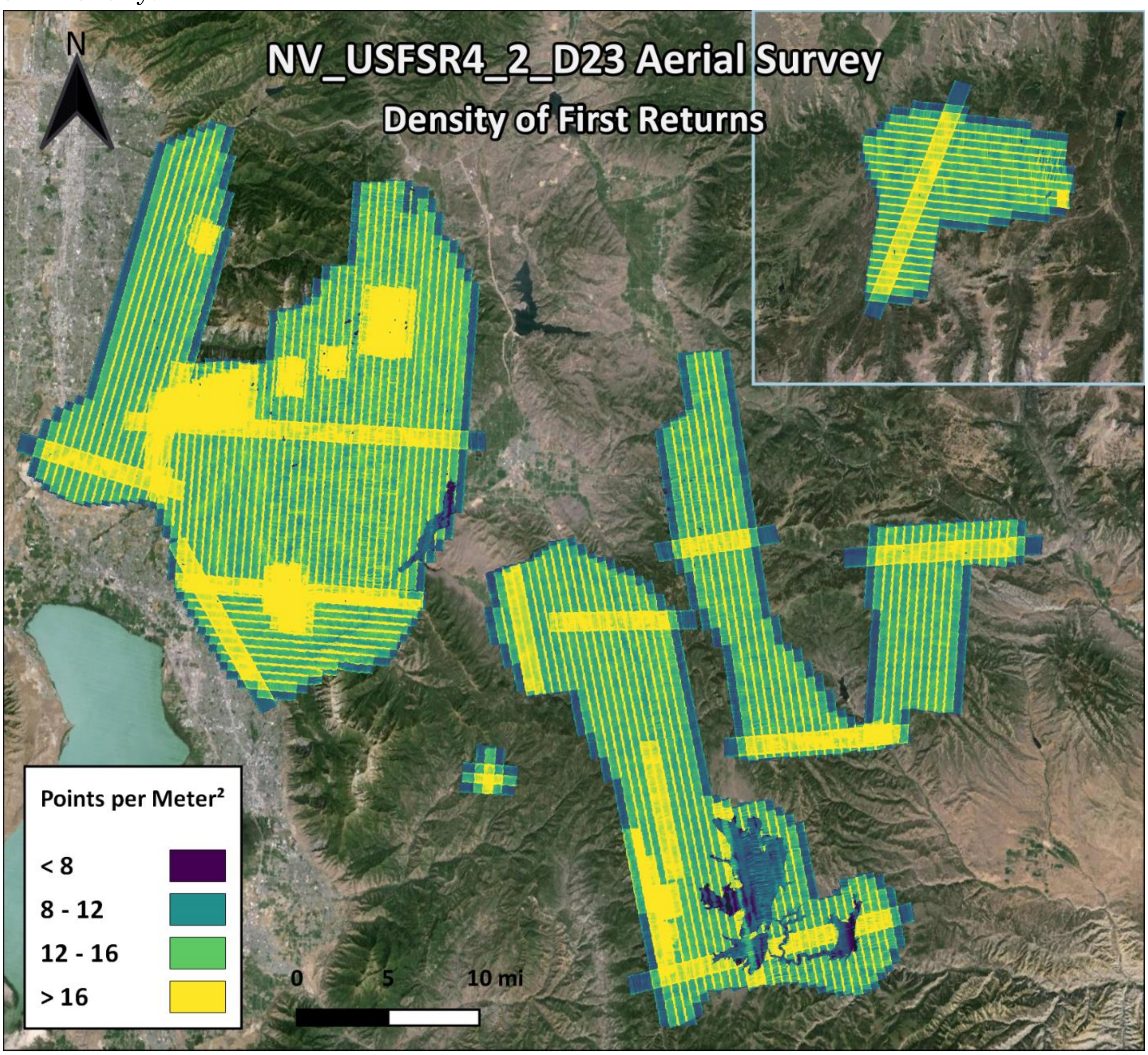


Exhibit 15: Density of first returns only in points per meter² for the NV_USFSR4_2_D23 project.

APPENDIX A – CHECK POINTS

Survey Point	NV_USFSR4_2_D23 Aerial Survey		
	Easting	Northing	Elevation (m)
NVA-001	-1297255.125	2070275.627	2055.955
NVA-002	-1295743.229	2048263.973	1687.23
NVA-003	-1296284.109	2060929.851	2720.44
NVA-004	-1317103.163	2036425.773	1482.302
NVA-005	-1319509.658	2046003.269	1559.954
NVA-005R	-1319509.65	2046003.258	1559.93
NVA-006	-1329089.394	2052864.737	1425.943
NVA-006R	-1329089.418	2052864.741	1425.945
NVA-007	-1322444.654	2057641.172	1523.592
NVA-007R	-1322444.665	2057641.144	1523.585
NVA-008	-1318330.802	2066114.464	1506.933
NVA-008R	-1318330.779	2066114.476	1506.929
NVA-009	-1317932.815	2074247.016	1491.888
NVA-009R	-1317932.804	2074247.025	1491.923
NVA-017	-1226926.974	2086740.831	2660.818
NVA-018	-1222977.488	2086499.058	2884.107
NVA-019	-1234021.192	2088502.07	2507.167
NVA-020	-1248884.887	2036372.383	2412.445
NVA-021	-1272228.969	2052470.046	2106.806
NVA-023	-1275568.295	2009356.704	2333.281
NVA-024	-1264849.404	2001514.94	2323.022
NVA-025	-1274006.251	2008697.622	2320.292
NVA-026	-1276236.639	2010337.056	2359.008
VVA-001	-1326505.25	2053875.04	1421.71
VVA-002	-1318775.44	2049364.94	1599.23
VVA-003	-1296145.57	2060578.29	2681.15
VVA-004	-1296642.38	2046813.41	1688.13
VVA-005	-1315412.95	2033981.37	1515.13
VVA-006	-1319279.46	2043747.77	1560.8
VVA-012	-1233669.62	2085821.79	2554.08
VVA-013	-1220086.73	2086072.92	3130.76
VVA-016	-1276817.52	2018672.85	2339.7
VVA-017	-1265941.94	2005947.54	2331.64

APPENDIX B – CALIBRATION CONTROL ACCURACY REPORT

NV_USFSR4_2_D23 Aerial Survey			
Survey Point	Known Z (m)	Laser Z (m)	Dz (m)
GCP-001	1596.23	1596.26	-0.03
GCP-002	1474.03	1474.127	-0.09667
GCP-003	1617.35	1617.345	0.005
GCP-004	1425.83	1425.875	-0.045
GCP-005	1535.61	1535.657	-0.04667
GCP-006	1461.67	1461.7	-0.03
GCP-007	1696.44	1696.355	0.085
GCP-008	1740.24	1740.11	0.13
GCP-009	2100.28	2100.125	0.155
GCP-017	2457.09	2457.085	0.005
GCP-018	3130.66	3130.65	0.01
GCP-019	2586.87	2586.885	-0.015
GCP-020	2047.36	2047.34	-0.02
GCP-021	2297.38	2297.36	-0.01
GCP-022	1774.38	1774.455	-0.075
GCP-023	1895.64	1895.515	0.125
GCP-024	2362.09	2362.1	-0.01
GCP-025	2338.69	2338.675	0.015
GCP-026	2322.88	2322.93	-0.05

Average Dz (m)	0.005
Minimum Dz (m)	-0.097
Maximum Dz (m)	+0.155
Average Magnitude	0.005
RMSE (m)	0.016
Std. Deviation (m)	0.07