AIRBORNE TOPOGRAPHIC LiDAR REPORT

SOUTH PLATTE RIVER, COLORADO

Contract No. G10PC00026
Requisition No. 0040120602
Task Order No. G14PD00001

December 17, 2014

Completed by Photo Science, Inc.

PHOTO SCIENCE
Geospatial Solutions

Submitted by:
Michael Shillenn, Program Manager
523 Wellington Way
Lexington, KY 40503
Phone: (859) 277-8700 | Email: mshillenn@quantumspatial.com

Table of Contents

List of Figures

LIST OF TABLES

LIST OF APPENDICES

1. SUMMARY / SCOPE

1.1. SUMMARY

This report contains a summary of the emergency task order for LiDAR acquisition to support response and recovery efforts for the 2013 flood of the South Platte River in Colorado. The task order was issued by the United States Geological Survey's (USGS) National Geospatial Technical Operations Center (NGTOC), under their Geospatial Products and Services Contract (GPSC) on November 14, 2013. The USGS partnered with Federal Emergency Management Agency (FEMA) and Denver Regional Council of Governments (DRCOG) in order to issue the task order covering flood damaged areas of the South Platte River watershed. The DRCOG area overlaps the USGS area and extends outward in the southeastern section of the watershed. The intent of this document is to only provide specific validation information for the LiDAR data acquisition/collection work completed for the USGS, FEMA and DRCOG.

1.2. SCOPE

The scope of the South Platte River flooding and DRCOG task order included the acquisition of aerial topographic LiDAR using state of the art technology, along with 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

Collection Area	Average Point Density	Flight Altitude (AGL)	Field of View	Minimum Side Overlap	RMSEz
High Priority Mountain Reaches and Damage Areas (USGS)	4.05 pts / m^2	5,499 ft	35.0 degrees	12.19%	9.25 cm or better
Eastern Plains (USGS & DRCOG)	3.53 pts / m^2	5,997 ft	34.0 degrees	11.97%	9.25 cm or better
High Relief Mountain Region (USGS)	1.30 pts / m^2	6,998 ft	34.0 degrees	11.14%	18.5 cm or better

1.3. LOCATION / COVERAGE

The USGS task order is comprised of three LiDAR collection areas. They are the High Priority Mountain Reaches and Flood Damage Areas, a High Relief Mountain Region, and the Eastern Plains. All three areas cover approximately 4,616 square miles of the South Platte River watershed, as shown in Figure 1 on the following page. The task order also covers 1,020 square miles of the DRCOG area of interest (AOI), which is shown in Figure 2. The DRCOG AOI mainly covers the Eastern Plans, but also covers portions of the High Priority Mountain Reaches and Damage Areas, as well as the High Relief Mountain Region.

Figure 1. South Platte River, Colorado USGS LiDAR Areas

Legend

☐ High Priority Mountain Reaches and Damage Areas

☐ High Relief Mountain Region

☐ Eastern Plains

Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.
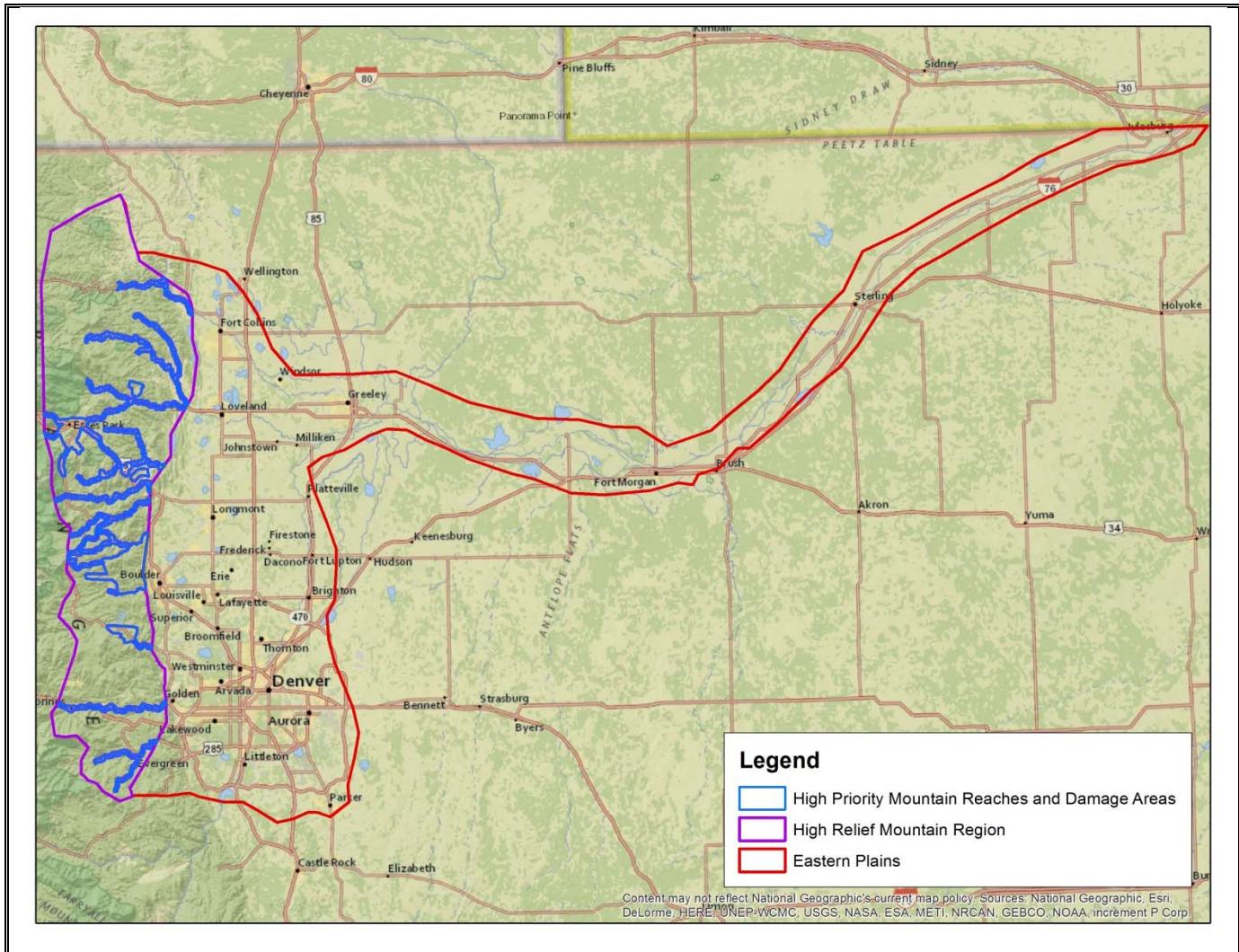
Figure 2. DRCOG LiDAR Area
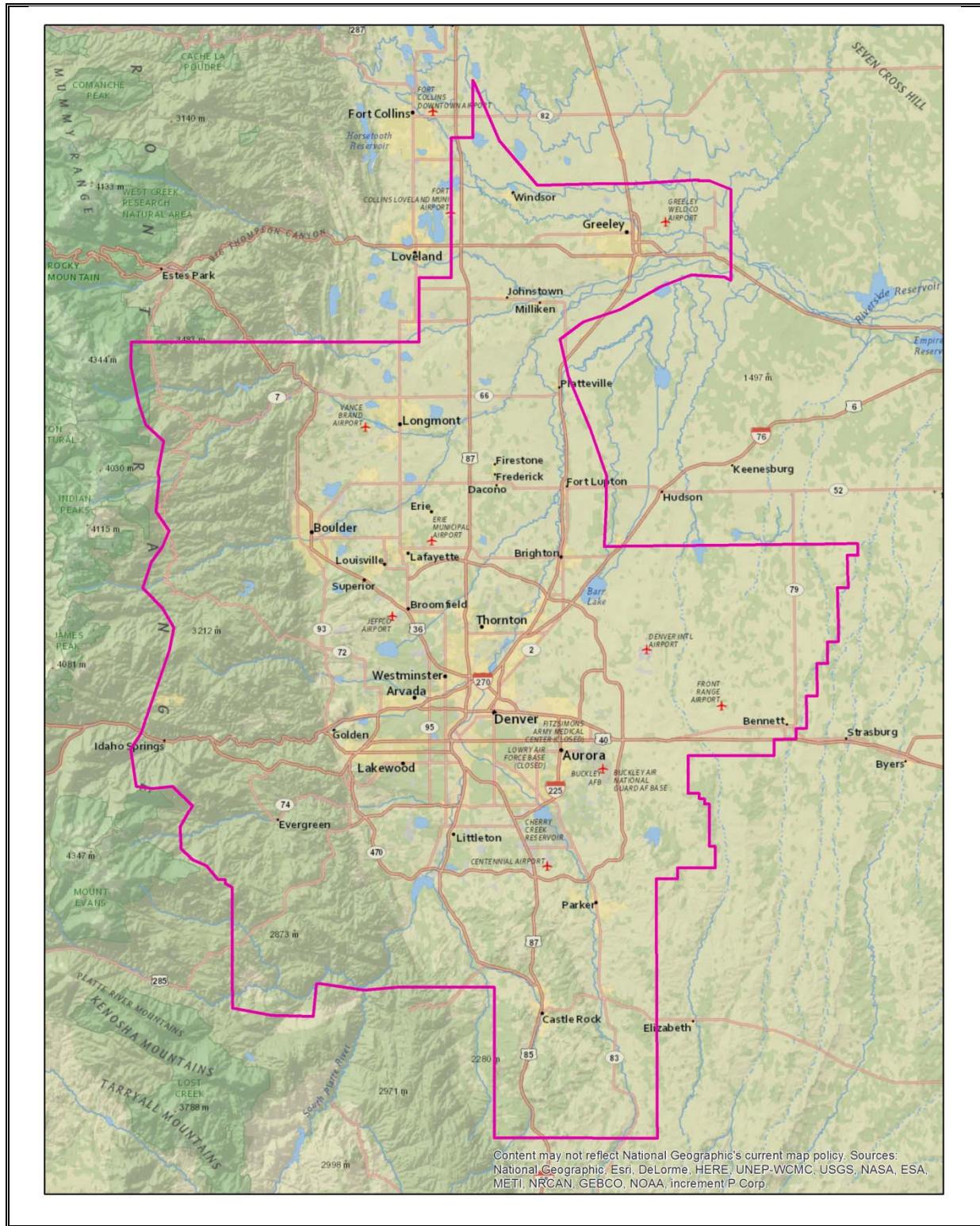
1.4.   DURATION

The first mission was flown on October 16, 2013 and it took seventy-nine total lifts to complete coverage for all areas. See section 2.4 for more details.

1.5.   ISSUES

With the collection of the dataset starting in late Fall, the possibility of snow coming in over the mountains was always in the back of our minds. Snow did in fact accumulate in a small area around Rocky Mountain National Park, which was part of the High Relief Mountain Region. As a consequence, collection was called off and flight crews were remobilized to collect for this small area in the middle of July, 2014, as better collection conditions were presented (e.g. absence of snow).

Another issue that occurred during dataset collection for the project was that one of the planes developed issues with the IMU. This problem was identified during the initial processing phase of the raw LiDAR dataset. The faulty unit was then replaced with a new one and tested prior to any additional collection in the project area.

2.   PLANNING / EQUIPMENT

The entire target area (both USGS and DRCOG) was comprised of 1167 planned flight lines. Please refer to Figure 3 on the following page.

Figure 3. Originally Planned Flight Lines for Entire Project Area
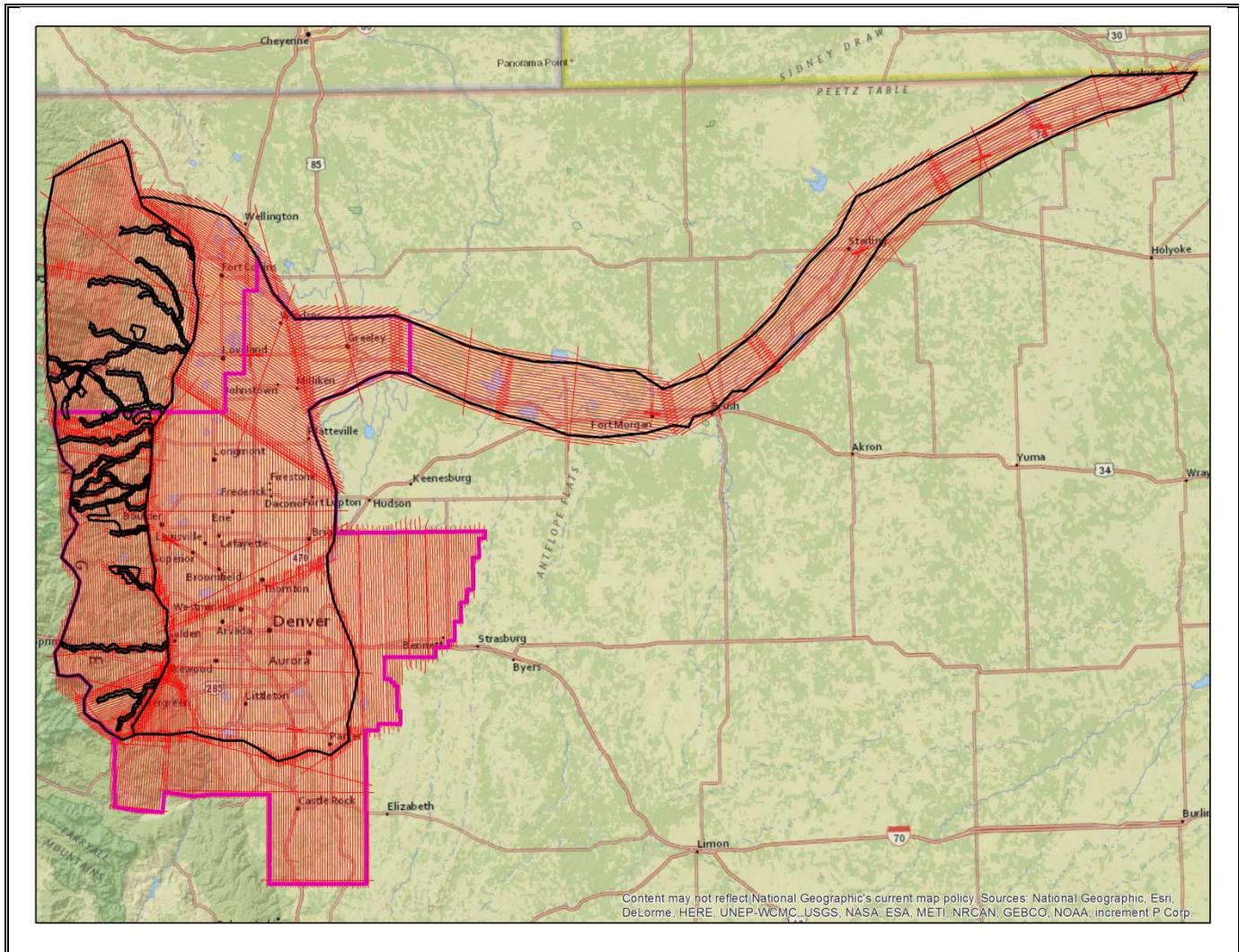
Detailed project flight planning calculations were performed for the project using Optech ALTM Nav planning software and the Leica Mission Pro planning software. Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount / type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity. Please note that certain values in the table below are listed as "Variable" due to the various flight plans used, as described in Section 1.5 of this document. A brief summary of the aerial acquisition parameters for the project are shown in the LiDAR System Specification Table 2 below:

Table 2. LiDAR System Specifications

		High Priority Mountain Reaches and Damage Areas (USGS)	Eastern Plains (USGS & DRCOG)	High Relief Mountain Region (USGS)
Terrain and Aircraft	Flying Height AGL	5499 ft	5997 ft	6998 ft
	Recommended Ground Speed (GS)	150 kts	150 kts	150 kts
Scanner	Field of View (FOV)	35º	34º	34º
	Scan Rate Setting used (SR)	44.2 Hz	41.2 Hz	25.1 Hz
Laser	Laser Pulse Rate used	330,400 Hz	304,400 Hz	130,800 Hz
	Multi Pulse in Air Mode	Enabled	Enabled	Disabled
Coverage	Full Swath Width	1056.88 meters	1117.75 meters	1304.25 meters
	Line Spacing	928.10 meters	984.0 meters	1158.92 meters
Point Spacing and Density	Maximum Point Spacing Across Track	0.87 m	0.93 m	1.54 m
	Maximum Point Spacing Along Track	0.87 m	0.94 m	1.54 m
	Average Point Density	4.05 pts / m^2	3.53 pts / m^2	1.3 / m^2

2.1. EQUIPMENT: AIRCRAFT

All flights for the project were accomplished through the use of customized twin-engine Piper PA-31 Navajo's (Tail Numbers: N262AS, N22GE) and a twin-engine Cessna 402 (Tail Number: N34MM). These aircrafts provided an ideal, stable aerial base for LiDAR acquisition. The aerial platforms have relatively fast cruise speeds which are beneficial for project mobilization / demobilization while maintaining relatively slow stall speeds which proved ideal for collection of high-density, consistent data posting using state-of-the-art Leica and Optech LiDAR systems.

2.2. LiDAR Sensors

Photo Science utilized Leica LiDAR sensors, serial numbers 7178 and 7170, during the project. A Leica sensor is capable of collecting data at a maximum frequency of 500 kHz, which affords elevation data collection of up to 500,000 points per second. The Leica system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to 4 returns per outgoing pulse from the laser and these come in the form of 1st, 2nd, 3rd and last returns. The intensity of the returns is also captured during aerial acquisition.

Photo Science also utilized an Optech LiDAR sensor, serial number 309 during the project. This system is capable of collecting data at a maximum frequency of 167kHz, which affords elevation data collection of up to 167,000 points per second. The system utilizes a Multi-Pulse in the Air option (MPIA). This sensor is also equipped with the ability to measure up to 5 returns per outgoing pulse from the laser and these come in the form of 1st, 2nd, 3rd, 4th, and last returns. The intensity of the first four returns is also captured during aerial acquisition. During mission collection for the project the LiDAR operator monitored point density and swath to ensure data integrity and desired coverage were obtained.

Figure 4. Leica ALS70 LiDAR System

Figure 5. Optech Gemini LiDAR System
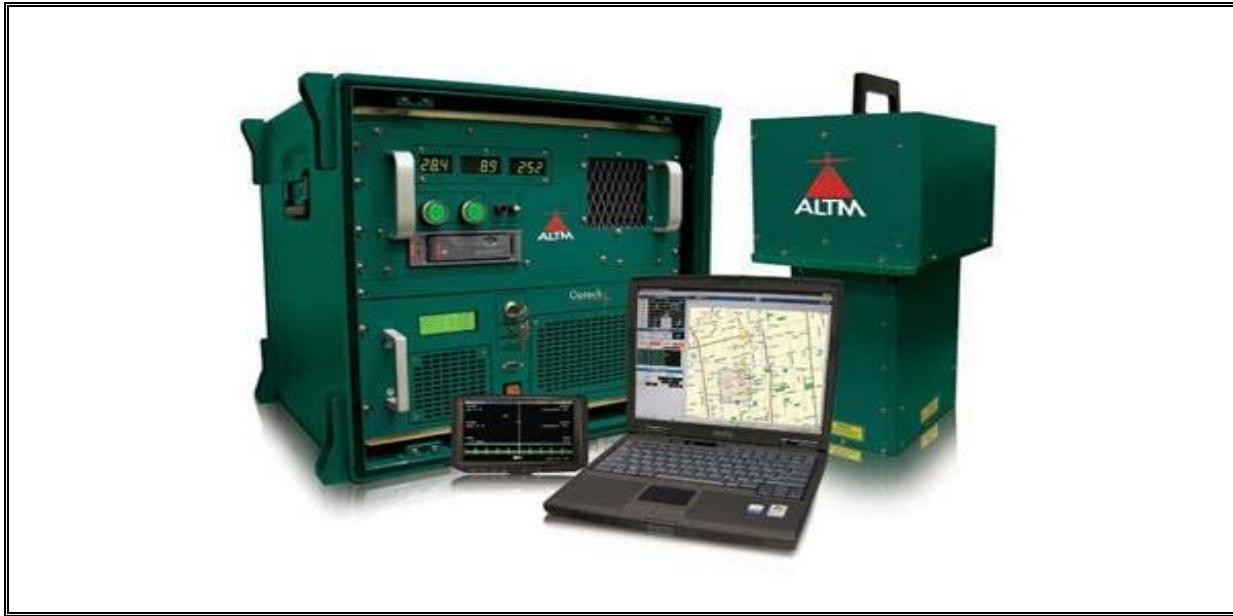
2.3.   BASE STATION INFORMATION

GPS base stations were utilized during all phases of flight. The base station locations were verified using NGS OPUS service and subsequent surveys. Log sheets used during station occupation are available in Appendix A.

2.4. TIME PERIOD

Project specific flights were conducted over several months. Seventy-nine sorties, or aircraft lifts were completed. Accomplished sorties are listed below:

- 110513A_309
- 110313C_309
- 110313B_309
- 110313A_309
- 110213B_309
- 110213A_309
- 120313A_309
- 111813A_309
- 111313B_309
- 111213B_309
- 111213A_309
- 110813A_309
- 110813B_309
- 101613A_7178
- 101713A_7178
- 101913A_7178
- 101913B_7178
- 102113A_7178
- 102113B_7178
- 102213A_7178
- 102313A_7178
- 102313B_7178
- 102413A_7178
- 102413B_7178
- 102513A_7170
- 102513A_7178
- 102513B_7170
- 102513B_7178
- 102613A_7170
- 102613A_7178

- 102613B_7170
- 102613B_7178
- 102713A_7170
- 102713A_7178
- 102713B_7178
- 110113A_7178
- 110213A_7170
- 110213A_7178
- 110213B_7170
- 110313A_7170
- 110313B_7170
- 110713A_7170
- 110713A_7178
- 110713B_7170
- 110913A_7170
- 110913A_7178
- 110913B_7170
- 110913B_7178
- 111013A_7170
- 111013A_7178
- 111013B_7170
- 111013B_7178
- 111113A_7170
- 111213A_7170
- 111313A_7178
- 111313B_7178
- 111313A_7170
- 111313B_7170
- 111413A_7178
- 111413B_7178

- 111413A_7170
- 111513A_7170
- 111613A_7170
- 111813A_7170
- 111813A_7178
- 111813B_7178
- 111913A_7178
- 111914B_7178
- 112013A_7178
- 112013B_7178
- 112013C_7178
- 112713A_7170
- 112713B_7170
- 112813A_7170
- 071014A_7178
- 071414A_7178
- 071814A_7178
- 071914A_7178
- 072214A_7178

3. PROCESSING SUMMARY

Applanix + POSPac Mapping Suite 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. POSPac combines aircraft raw trajectory data with stationary GPS base station data yielding a "Smoothed Best Estimate Trajectory (SBET) necessary for additional post processing software to develop the resulting geo-referenced point cloud from the LiDAR missions.

During the sensor trajectory processing (combining GPS & IMU datasets) certain statistical graphs and tables are generated within the Applanix POSPac processing environment which are commonly used as indicators of processing stability and accuracy. This data for analysis include: Max horizontal / vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory. All relevant graphs produced in the POSPac processing environment for each sortie during the Photo Science project mobilization are available in Appendix B.

The generated point cloud is the mathematical three dimensional composite of all returns from all laser pulses as determined from the aerial mission. Laser point data are imported into TerraScan and a manual calibration is performed to assess the system offsets for pitch, roll, heading and scale. At this point this data is ready for analysis, classification, and filtering to generate a bare earth surface model in which the above-ground features are removed from the data set. Point clouds were created using the Leica ALS Post Processor software and the Optech DashMap Post Processor software. GeoCue distributive processing software was used in the creation of some files needed in downstream processing, as well as in the tiling of the dataset into more manageable file sizes. TerraScan and TerraModeler software packages were then used for the automated data classification, manual cleanup, and bare earth generation. Project specific macros were developed to classify the ground and remove side overlap between parallel flight lines.

All data will manually be reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper was used as a final check of the bare earth dataset. GeoCue was used to create the deliverable industry-standard LAS files for the All Point Cloud Data. In-house software was then used to perform final statistical analysis of the classes in the LAS files.

Metadata was generated for the project on a deliverable level.

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 C.

3.2. LAS CLASSIFICATION SCHEME

The classification classes are determined by the USGS Version 1.0 specifications 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:

- Class 1 – Processed, but Unclassified – These points would be the catch all for points that do not fit any of the other deliverable classes. This would cover features such as vegetation, cars, etc.
- Class 2 – Bare earth ground – This is the bare earth surface.
- Class 7 – Noise – Low or high points, manually identified above or below the surface that could be noise points in point cloud.
- Class 9 – In-land Water – Points found inside of inland lake/ponds.
- Class 10 – Ignored Ground – Points found to be close to breakline features. Points are moved to this class from the Class 2 dataset. This class is ignored during the DEM creation process in order to provide smooth transition between the ground surface and hydro flattened surface.
- Class 17 – Overlap Default (Unclassified) – Points found in the overlap between flight lines. These points are created through automated processing methods and not cleaned up during processing.
- Class 18 – Overlap Bare-earth ground – Points found in the overlap between flight lines. These points are created through automated processing, matching the specifications determined during the automated process, that are close to the Class 2 dataset (when analyzed using height from ground analysis).
- Class 25 – Overlap Water – Points found in the overlap between flight lines that are located inside hydro features. These points are created through automated processing methods and not cleaned up during processing.

3.3.   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 TerraScan macro functionality. A buffer of 0.7 meter was also used around each hydro flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 10). 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.

All overlap data was processed through automated functionality provided by TerraScan to classify the overlapping flight line data to approved classes by USGS. The overlap data was classified to Class 17 (Overlap Default) and Class 18 (Overlap Ground). These classes were created through automated processes only and were not verified for classification accuracy. Due to software limitations within TerraScan, these classes were used to trip the withheld bit within various software packages. These processes were reviewed and accepted by USGS through numerous conference calls and pilot study areas.

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 the All Point Cloud Data. Photo Science 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.

3.4.   HYDRO FLATTENING BREAKLINE PROCESS

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 Ponds and Lakes, Inland Pond and Lake Islands, Inland Streams and Rivers and Inland Stream and River Islands using TerraModeler functionality.

Elevation values were assigned to all Inland streams and rivers using Photo Science proprietary software.

All ground (ASPRS Class 2) LiDAR data inside of the collected inland breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 0.7 meter was also used around each hydro flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 10).

The breakline files were then translated to ESRI Shapefile format using ESRI conversion tools.

3.5.   HYDRO FLATTENING RASTER DEM PROCESS

Class 2 LiDAR in conjunction with the hydro breaklines were used to create a 0.75 meter Raster DEM. Using automated scripting routines within ArcMap, an ERDAS Imagine IMG file was created for each tile. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

4. DELIVERABLES

- Uncalibrated, unclassified raw point cloud swath LAS in version 1.2 format
- Calibrated, unclassified tiled LAS in version 1.2 format
- Classified point cloud tiled LAS in version 1.2 format
- Hydro flattened raster DEM in ERDAS .IMG format
- Hydro flattened breaklines in shape file format
- Intensity Images
- Ground control points in shape file format
- As-flown flightlines in shape file format
- Tile index in shape file format
- Project and deliverable level metadata in XML format
- Accuracy Assessment in XLS format
- 1 Foot Contours in ESRI Geodatabase format. These were provided in the appropriate Colorado State plane zone, US Survey Foot

5. PROJECT COVERAGE VERIFICATION

The USGS and DRCOG area coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 6 below.

Figure 6. Flightline Swath LAS File Coverage for Entire Project Area
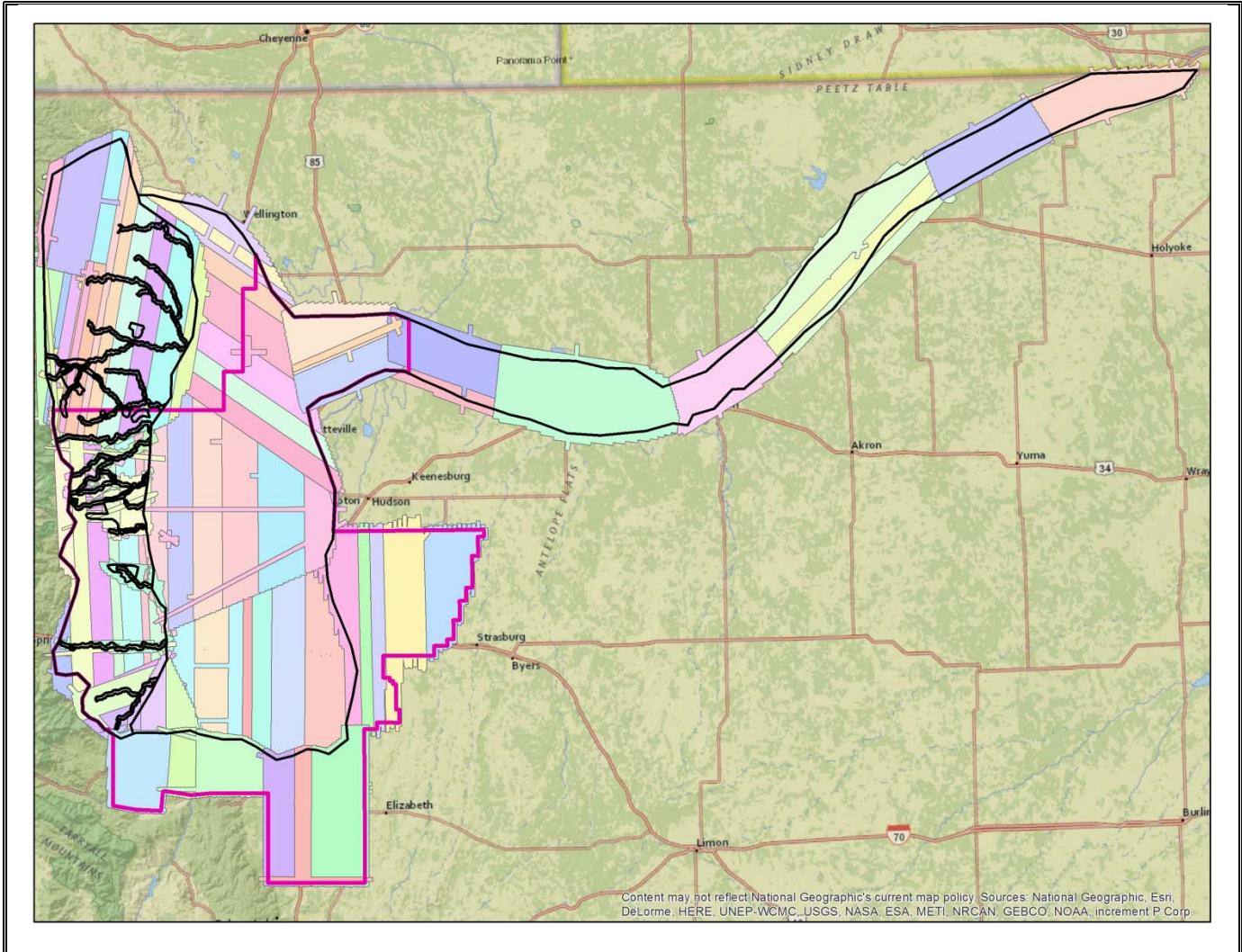
6. GROUND CONTROL AND CHECK POINT COLLECTION

Photo Science completed a field survey of ground control (calibration) points along with blind QA points in five different land cover classifications as an independent test of the accuracy of this project. The land cover classifications were selected from the dominant classifications for this project area. These included:

- Bare earth/Open Terrain
- Forested and Fully Grown
- Brush lands and Trees
- Tall weeds/Crops
- Urban

A combination of precise GPS surveying methods, including static and RTK observations were used to establish the 3D position of ground calibration points and QA points for the point classes above. GPS was not an appropriate methodology for surveying in the forested areas during the leaf-on conditions for the actual field survey (which was accomplished after the LiDAR acquisition). Therefore the 3D positions for the forested points were acquired using a GPS-derived offset point located out in the open near the forested area, and using precise offset surveying techniques to derive the 3D position of the forested point from the open control point. The explicit goal for these surveys was to develop 3D positions that were three times greater than the accuracy requirement for the elevation surface. In this case of the blind QA points the goal was a positional accuracy of 5 cm in terms of the RMSE.

Please note that two valid points fall outside of the data area – DENCOTW57 and DENCOBL68. They are not included in the statistics but are included in the survey points and values.

Figure 7 shows the location of each bare earth calibration point for the project area. Table 3 depicts the Control Report for the LiDAR bare earth calibration points shown in Figure 7, as computed in TerraScan as a quality assurance check. Note that these results of the surface calibration are not an independent assessment of the accuracy of these project deliverables, but the statistical results do provide additional feedback as to the overall quality of the elevation surface.

The project was delivered using the following horizontal projection(s): NAD 83, UTM, Zone 13, meters, as well as NAD83 Colorado State Plane Central, Survey Feet. In this document, horizontal coordinates for ground control and QA points for all LiDAR classes are reported in UTM Zone 13, meters.

The required accuracy testing was performed on the LiDAR dataset (both the LiDAR point cloud and derived DEM's) according to the USGS LiDAR Base Specification Version 1.0 (2012). The locations for all tested blind QA points are shown in Figures 8 thru 13. The summary below provides the results of this testing:

Point Cloud Testing

- Raw Fundamental Vertical Accuracy (Raw FVA): Based on the entire project area (Both USGS and DRCOG areas combined), the tested Raw FVA for the dataset was found to be 0.045 meters in terms of the RMSEz. The resulting FVA stated as the 95% confidence level (RMSEz x 1.96) is 0.089 meters. This dataset *meets* the required FVA of 9.25 cm at the 95% confidence level (according to the National Standard for Spatial Database Accuracy (NSSDA)), based on TINs derived from the final calibrated and controlled LiDAR swath data. This is summarized in Table 4.

Digital Elevation Model (DEM) Testing

- Fundamental Vertical Accuracy (FVA): Based on the entire project area, the tested FVA for the dataset captured from the DEM using bi-linear interpolation to derive the DEM elevations was found to be 0.057 meters in terms of the RMSEz. The resulting accuracy stated as the 95% confidence level (RMSEz x 1.96) is 0.112 meters. This dataset *meets* the required FVA of 9.25 cm at the 95% confidence level (based on NSSDA). This is summarized in Table 5.

- Supplemental Vertical Accuracy (SVA): Based on the entire project area, the tested SVA accuracies for the dataset for each of the land cover classes other than open ground are summarized below. The target SVA was 26.9 cm in terms of the 95th percentile error (based on ASPRS guidelines), for each of the land cover classes other than open ground.

  The following land cover classes were tested and the resulting 95th percentile error values are listed below:

    o Forested and Fully Grown: 0.117 m (Table 6)
    o Brush lands and Trees: 0.168 m (Table 7)
    o Tall weeds/Crops: 0.155 m (Table 8)
    o Urban: 0.044 m (Table 9)

- Consolidated Vertical Accuracy (CVA): Based on the priority areas, the tested CVA for the dataset captured from the DEM using bi-linear interpolation for all classes (including the bare earth class) was found to be 0.118 which is stated in terms of the 95th percentile error. Therefore the data *meets* the required CVA of 26.9 cm based on the 95th percentile error (based on ASPRS guidelines) across all land cover categories. This is summarized in Table 10.

Figure 7. LiDAR Ground Control Points Used in Calibration
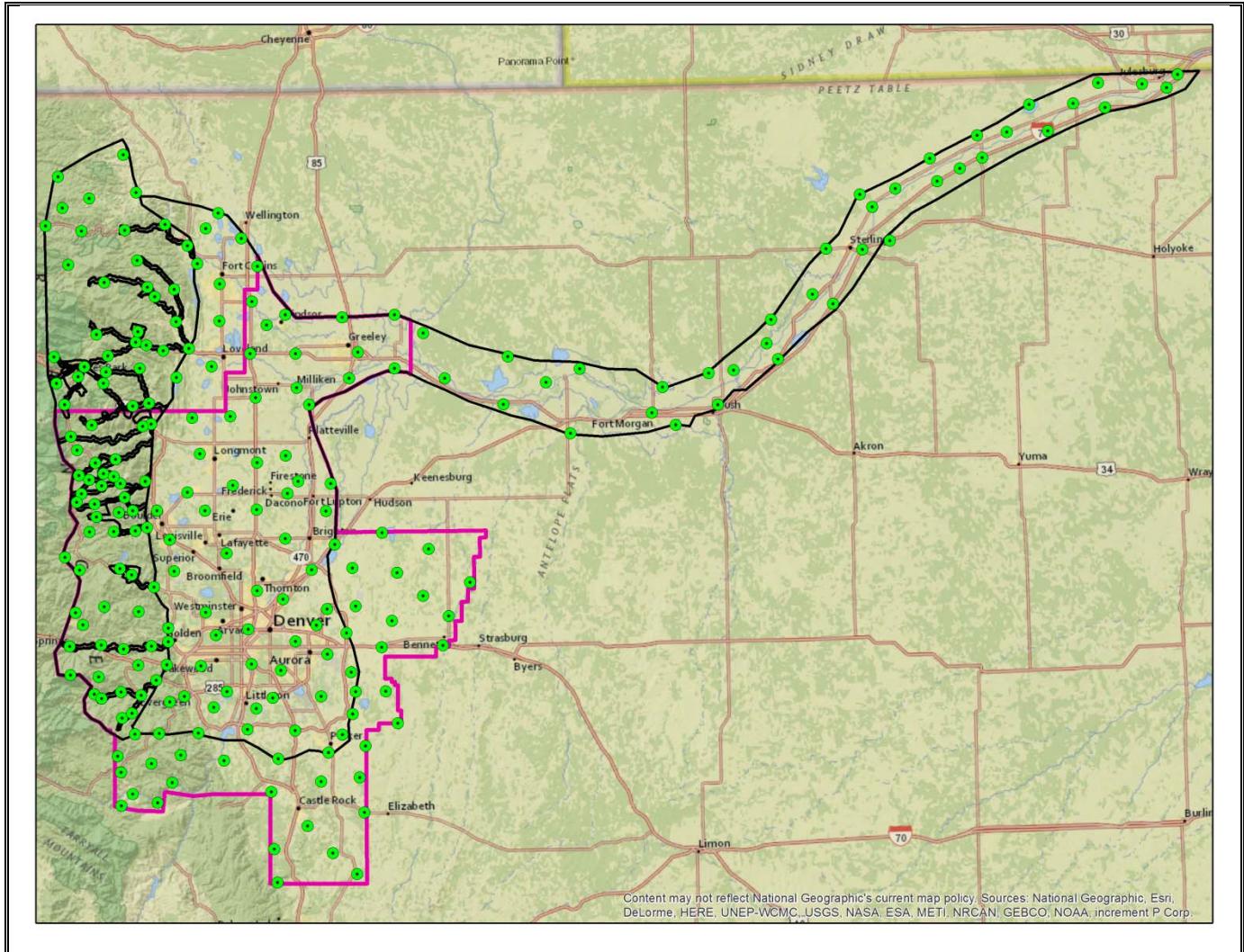
Figure 8. All Final LiDAR QA Point Locations
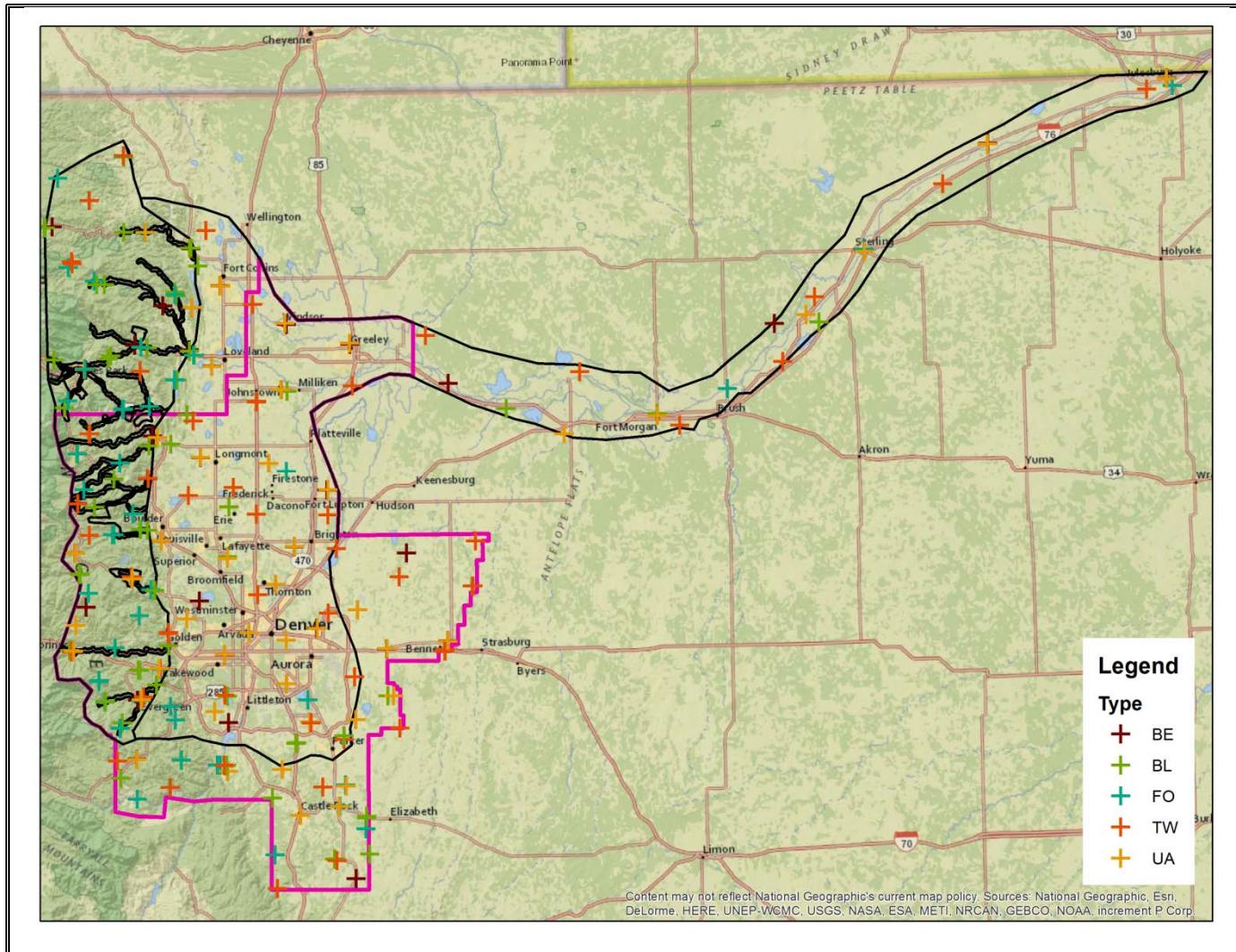
Figure 9. Bare Earth (BE) QA Point Locations
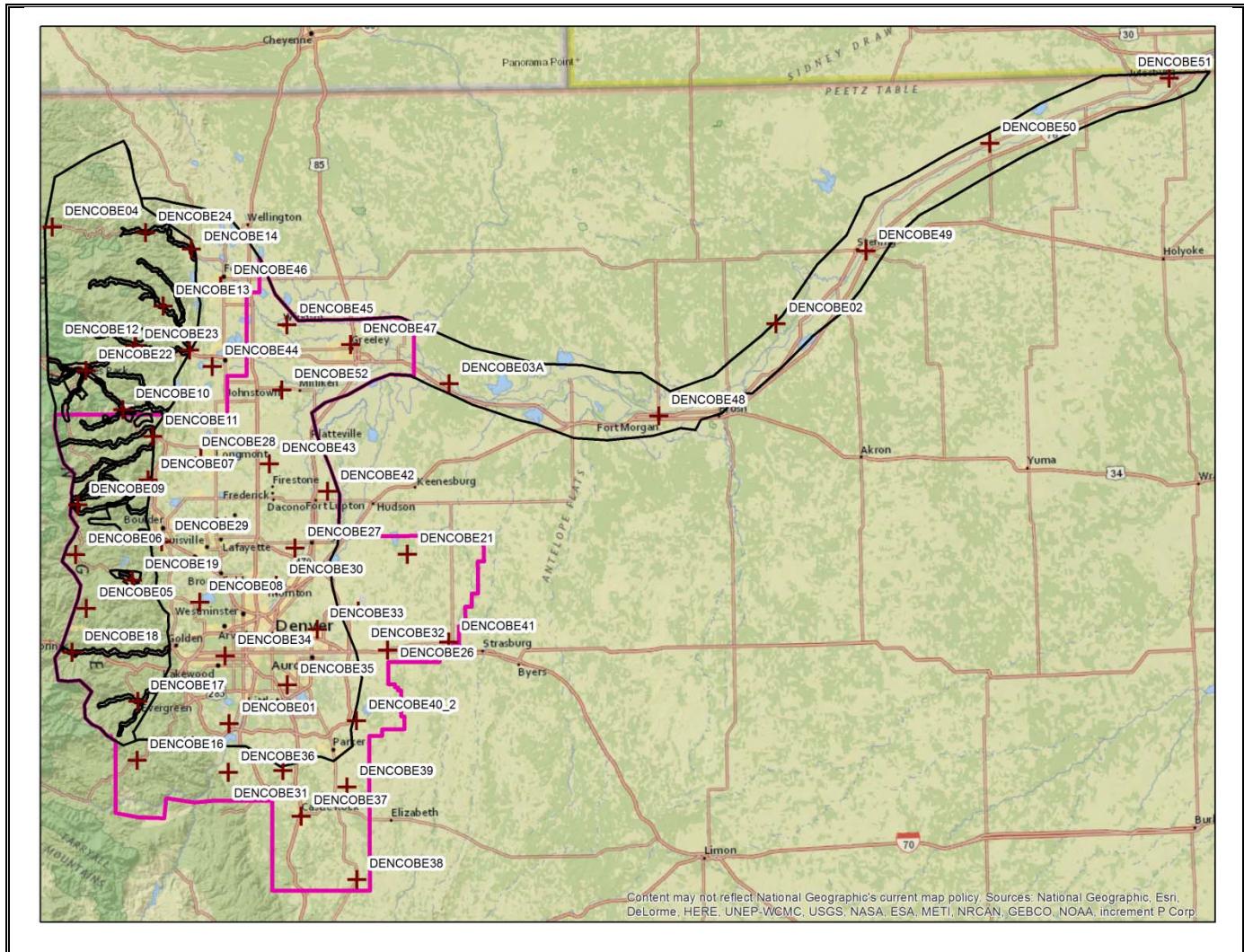
Figure 10. Forested (FO) QA Point Locations
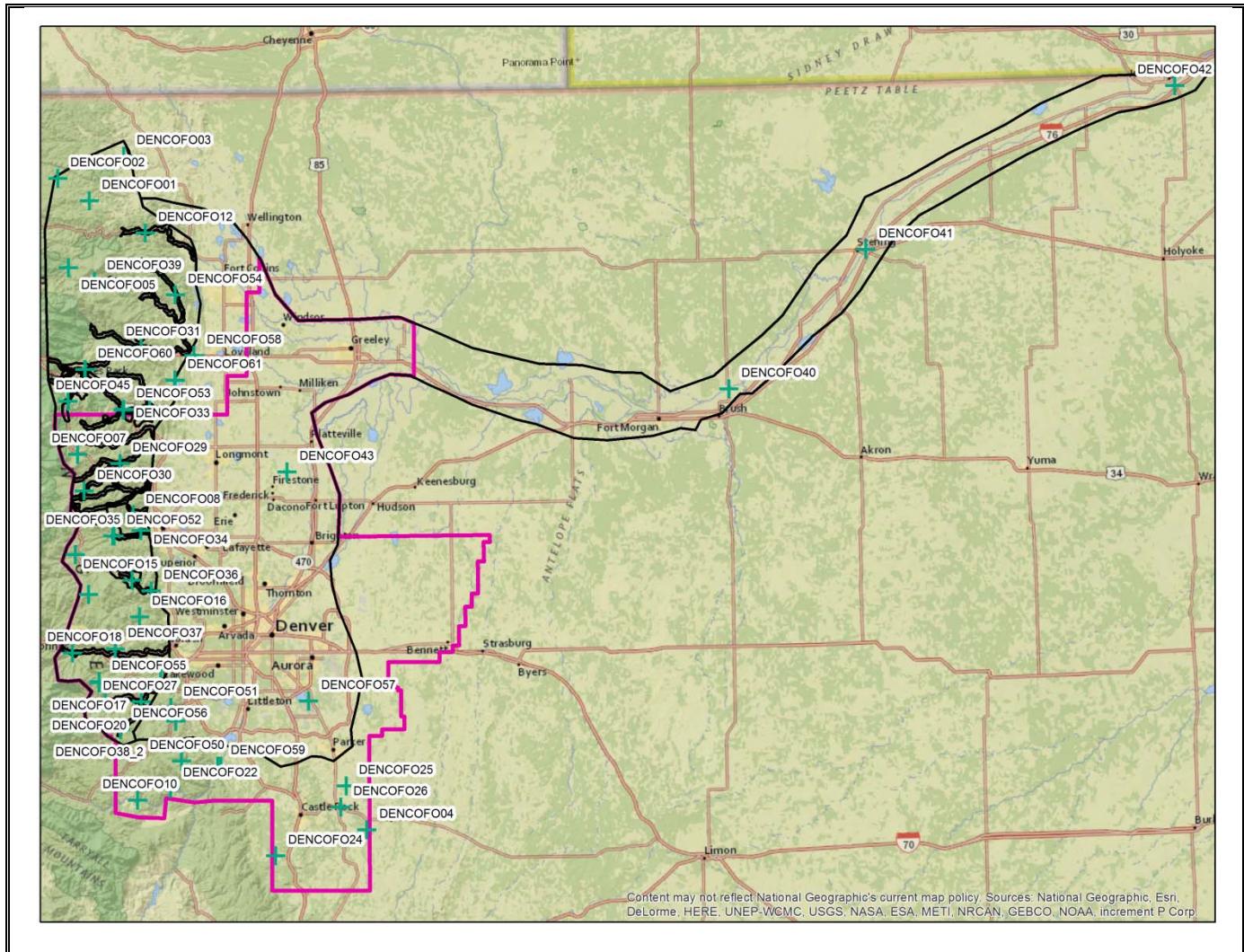
Figure 11. Brush Lands and Trees (BL) QA Point Locations
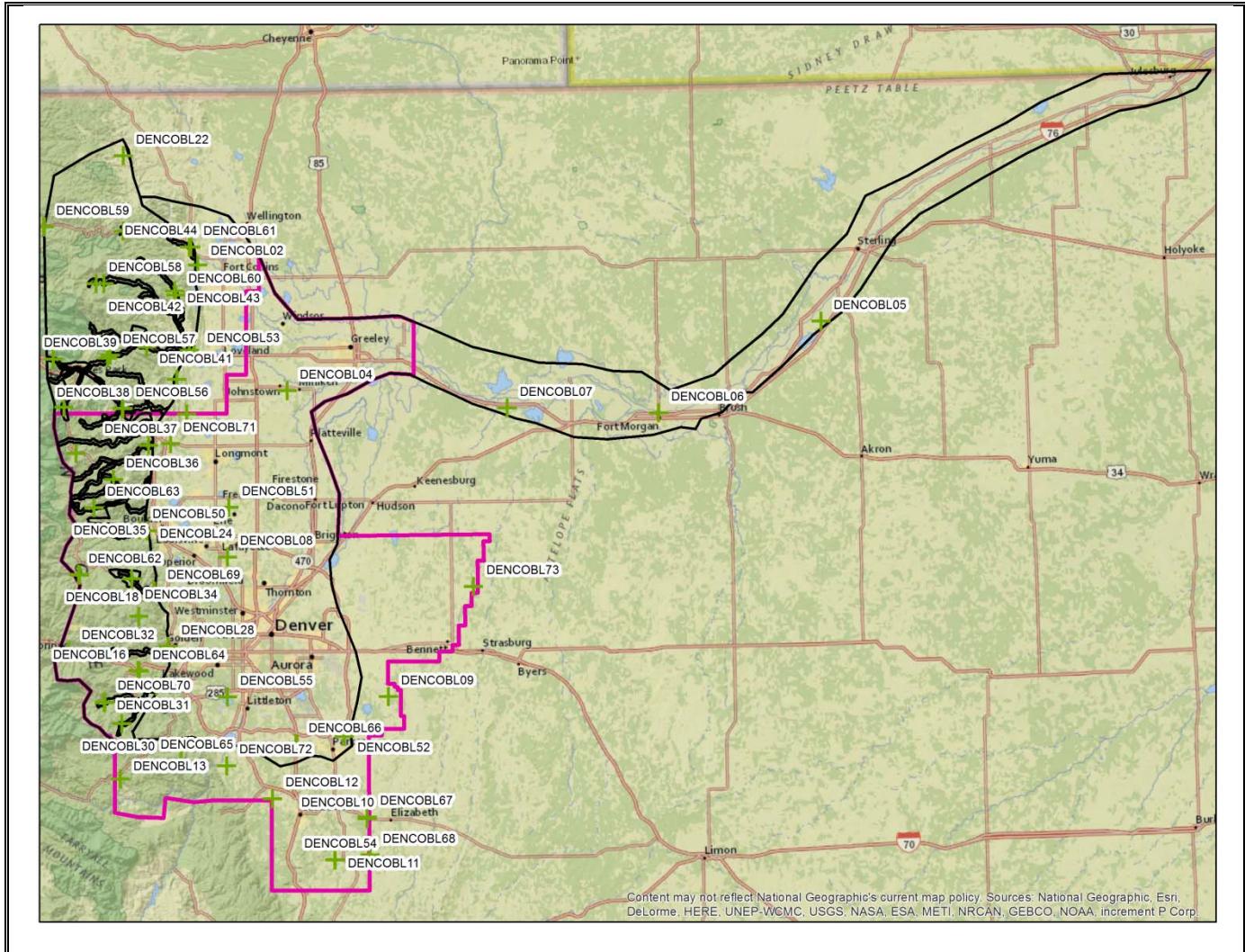
Figure 12. Tall Weeds/Crops (TW) QA Point Locations
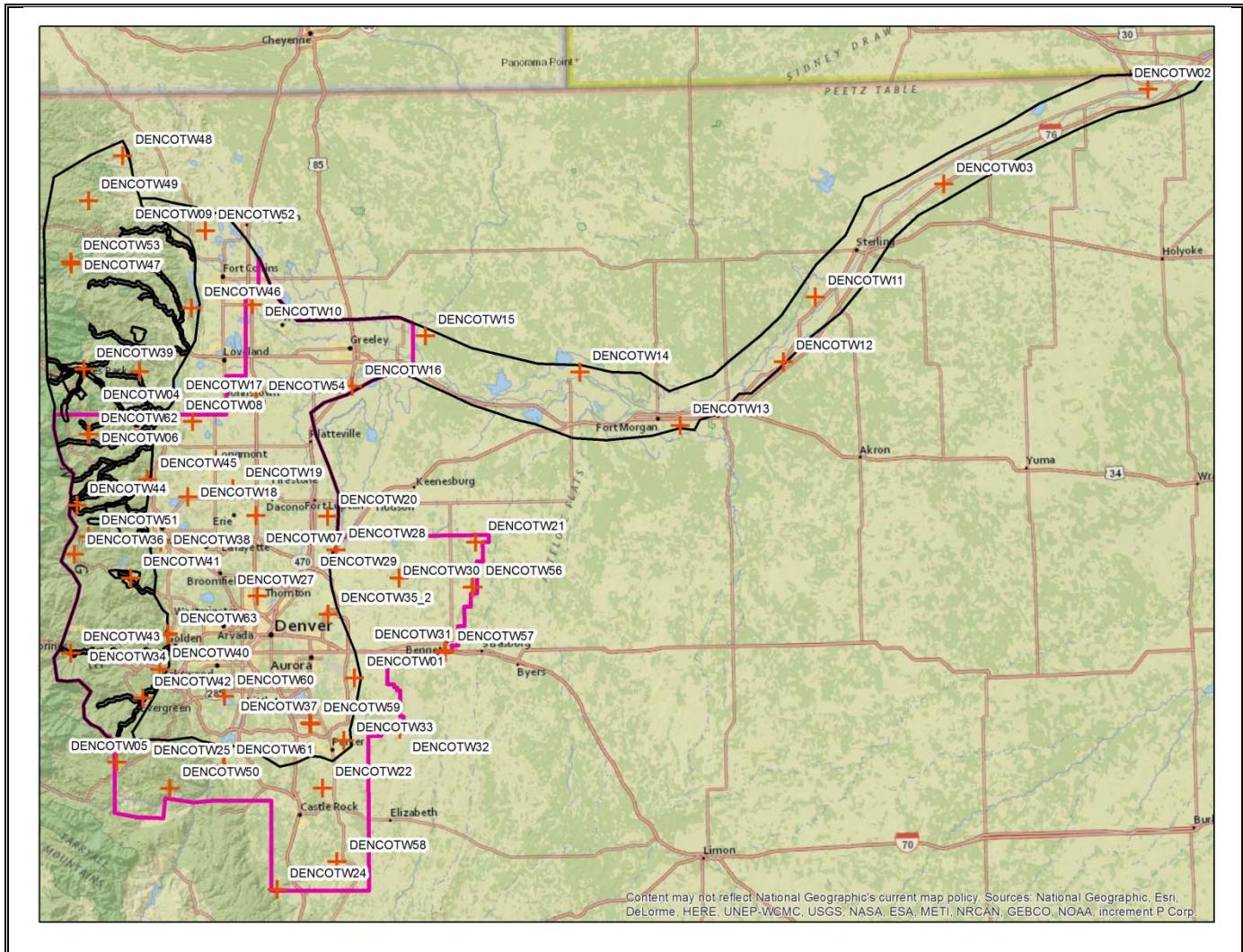
Figure 13. Urban Area (UA) QA Point Locations
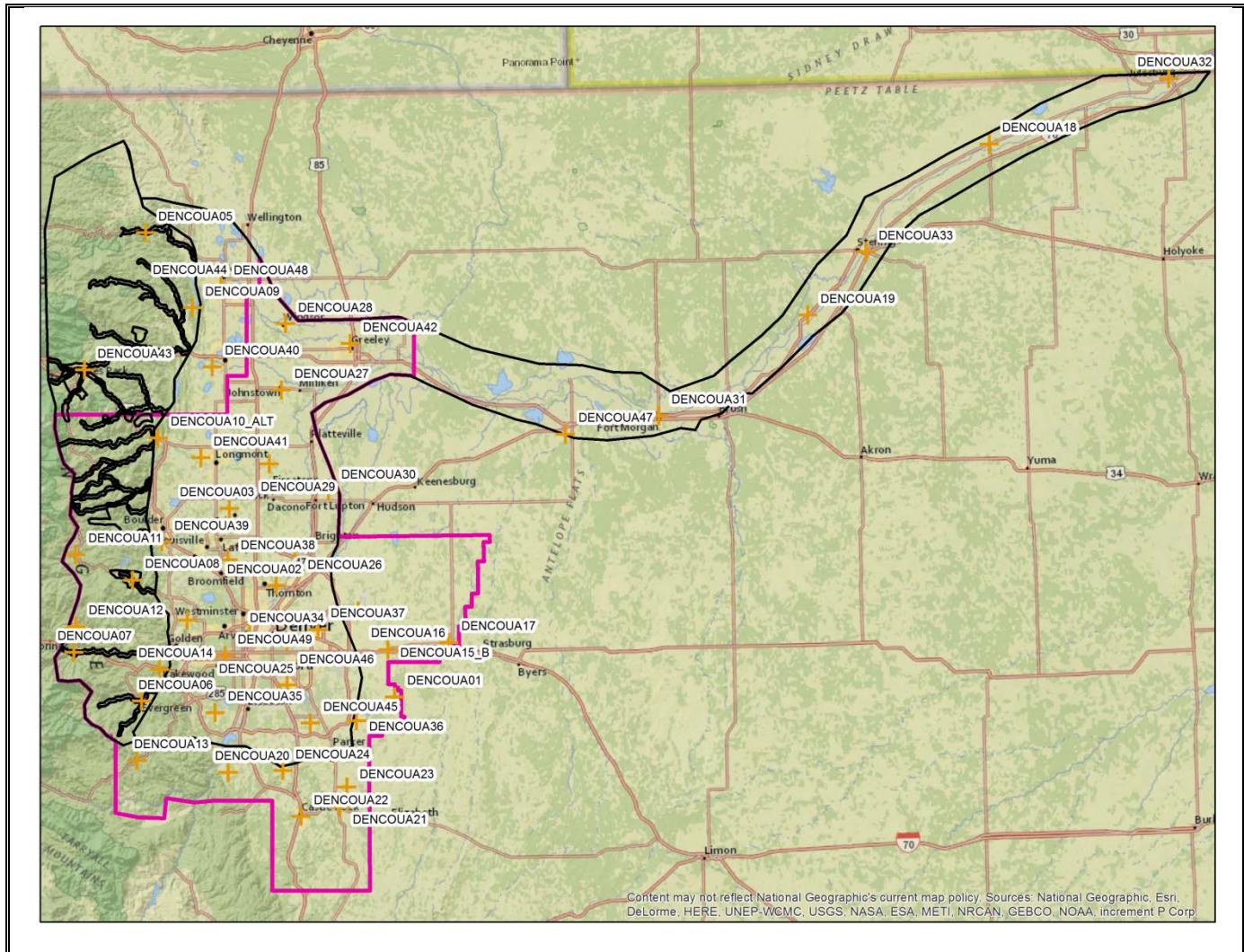
Table 3. LiDAR Ground Control Point Report (Units = Meters)

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCO001	734537.427	4542014.814	1051.92	1051.89	-0.03
DENCO002	716221.008	4533785.636	1126.283	1126.28	0.00
DENCO003	714492.136	4539993.953	1106.156	1106.13	-0.03
DENCO004	697097.479	4534608.672	1132.179	1132.19	0.01
DENCO005	701746.418	4527987.375	1127.678	1127.64	-0.04
DENCO006	683881.39	4526879.345	1140.384	1140.4	0.02
DENCO007	685150.261	4521237.829	1148.639	1148.59	-0.05
DENCO008	673789.407	4515379.209	1174.743	1174.75	0.01
DENCO009	671976.482	4521146.208	1169.914	1169.87	-0.04
DENCO010	654304.658	4512132.909	1204.29	1204.32	0.03
DENCO011	661817.925	4500531.148	1269.912	1269.91	0.00
DENCO012	654837.224	4498309.296	1212.167	1212.19	0.02
DENCO013	630632.807	4474745.939	1249.54	1249.58	0.04
DENCO014	618279.096	4459362.044	1286.494	1286.49	0.00
DENCO015	616003.319	4467398.381	1301.463	1301.47	0.01
DENCO016	607571.921	4454351.373	1309.107	1309.07	-0.04
DENCO017	604280.528	4463948.949	1357.78	1357.8	0.02
DENCO018	601610.048	4457446.97	1318.118	1318.11	-0.01
DENCO019	581117.289	4452433.777	1391.809	1391.81	0.00
DENCO020	583452.767	4468680.231	1332.269	1332.26	-0.01
DENCO021	564205.841	4459782.181	1369.084	1369.1	0.02
DENCO022	565390.246	4471775.321	1408.28	1408.27	-0.01
DENCO023	536782.488	4468950.358	1423.597	1423.56	-0.04
DENCO024	536924.798	4482488.445	1466.811	1466.82	0.01
DENCO025	525361.527	4466539.274	1426.217	1426.18	-0.04
DENCO026	527565.737	4473085.81	1417.144	1417.1	-0.04
DENCO027	523624.719	4481911.323	1449.534	1449.5	-0.03
DENCO028	515216.394	4459951.689	1448.99	1449.01	0.02
DENCO029	509322.889	4482618.888	1468.105	1468.16	0.06
DENCO030	511856.045	4472839.061	1511.501	1511.58	0.08
DENCO031	520541.629	4440086.908	1531.907	1531.87	-0.04
DENCO032	509220.897	4447174.483	1485.855	1485.87	0.01
DENCO033_2	495322.433	4457150.361	1519.775	1519.85	0.07
DENCO034	481849.756	4466971.636	1758.904	1758.92	0.02
DENCO035	500394.653	4472867.558	1502.167	1502.16	-0.01
DENCO036	484987.22	4474266.412	1558.582	1558.59	0.01
DENCO037	492818.022	4490510.13	1526.405	1526.37	-0.04
DENCO038	498357.503	4501923.344	1573.255	1573.24	-0.02
DENCO039	471908.059	4513596.154	1886.069	1886.1	0.03
DENCO040	484810.942	4500082.095	1573.034	1573.03	0.00
DENCO041	479216.293	4505481.383	1638.896	1638.91	0.01
DENCO042	469036.317	4504081.09	1791.48	1791.49	0.01
DENCO043	481770.886	4481052.128	1622.16	1622.15	-0.01
DENCO044	474678.979	4489714.406	1988.636	1988.68	0.04
DENCO045	472115.872	4496502.693	2511.832	2511.78	-0.05
DENCO046	463736.972	4491040.751	2336.355	2336.34	-0.01
DENCO047	481365.499	4489187.122	1767.819	1767.83	0.01
DENCO048	487211.323	4495625.471	1561.211	1561.22	0.01
DENCO049	478539.937	4473778.655	1693.8	1693.78	-0.02

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCO050	474290.993	4475163.562	1801.033	1801.01	-0.02
DENCO051	471593.417	4475882.626	1875.72	1875.74	0.02
DENCO053	461769.487	4477937.831	2212.025	2212.01	-0.01
DENCO054	464554.477	4472487.052	2136.386	2136.46	0.07
DENCO055	458673.626	4469781.013	2273.371	2273.39	0.02
DENCO056	451011.727	4472338.839	2456.475	2456.57	0.10
DENCO057	451613.98	4465683.657	2433.169	2433.23	0.06
DENCO058	453647.1	4460296.413	2768.02	2767.95	-0.07
DENCO059	463413.276	4465590.506	2356.518	2356.55	0.03
DENCO060	472634.877	4469310.974	2081.463	2081.46	0.00
DENCO061	474885.538	4460542.196	1767.746	1767.73	-0.02
DENCO062	457058.192	4467266.474	2368.983	2368.95	-0.03
DENCO063	470782.866	4459829.853	1950.4	1950.34	-0.06
DENCO064	475394.879	4455250.295	1680.678	1680.66	-0.02
DENCO065	475394.853	4455250.297	1680.69	1680.66	-0.03
DENCO066	466375.314	4446415.595	2129.603	2129.72	0.12
DENCO067	461283.734	4445575.612	2348.298	2348.21	-0.09
DENCO068	457711.945	4437811.191	2775.553	2775.54	-0.01
DENCO069	461024.314	4435173.908	2417.57	2417.57	0.00
DENCO070	465762.091	4428232.905	2077.183	2077.21	0.03
DENCO071	461521.663	4432017.864	2295.022	2295.03	0.01
DENCO072	468601.627	4436872.249	2090.159	2090.17	0.01
DENCO073	473852.202	4440831.258	1778.624	1778.65	0.03
DENCO074	470594.152	4433468.086	2156.151	2156.24	0.09
DENCO075	474237.159	4429217.337	1668.468	1668.41	-0.06
DENCO076	467563.502	4440337.333	2095.637	2095.64	0.00
DENCO077	460439.092	4455076.501	2423.307	2423.29	-0.02
DENCO078	455105.156	4452249.922	2526.621	2526.58	-0.04
DENCO079	467338.777	4418893.226	2604.523	2604.44	-0.08
DENCO081	481026.587	4418206.33	1834.699	1834.69	-0.01
DENCO082	454598.188	4399434.126	2315.652	2315.81	0.16
DENCO083	468175.644	4398651.071	2070.701	2070.68	-0.02
DENCO084	479400.586	4400465.295	1758.383	1758.35	-0.03
DENCO085	468732.919	4523158.532	1989.398	1989.47	0.07
DENCO086	452244.72	4517709.69	2472.852	2472.87	0.02
DENCO087	449091.451	4505300.265	2206.19	2206.09	-0.10
DENCO088	460099.611	4512181.48	2363.799	2363.79	-0.01
DENCO089	454752.231	4495458.686	2449.203	2449.15	-0.05
DENCO090	463336.735	4409329.015	2546.399	2546.39	-0.01
DENCO091_2	453517.912	4421869.163	2598.968	2598.99	0.02
DENCO092	454698.015	4392218.156	3327.315	3327.22	-0.10
DENCO093	460636.32	4387317.581	2391.663	2391.63	-0.03
DENCO094	462544.798	4386241.006	2309.646	2309.6	-0.05
DENCO095	467688.78	4381271.562	2422.284	2422.29	0.01
DENCO096	479059.546	4394613.356	2118.895	2118.88	-0.01
DENCO097	483430.666	4386625.993	1884.986	1885.01	0.02
DENCO098	486901.018	4377389.242	1809.566	1809.53	-0.04
DENCO099	470923.596	4377199.435	2611.315	2611.32	0.01
DENCO100	477004.239	4377385.03	2396.303	2396.3	0.00

Photo Science
Geospatial Solutions

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCO101	472480.765	4386967.624	2152.634	2152.65	0.02
DENCO102	456086.671	4407854.583	2572.356	2572.29	-0.07
DENCO103	476693.074	4433445.693	1661.177	1661.15	-0.03
DENCO104	488815.685	4433374.63	1540.905	1540.83	-0.08
DENCO105	501873.036	4433587.984	1550.405	1550.39	-0.01
DENCO106	519352.379	4433090.122	1537.59	1537.61	0.02
DENCO107	487625.494	4447725.418	1536.007	1536.01	0.00
DENCO108	479948.304	4426182.614	1631.417	1631.37	-0.05
DENCO109	479399.326	4403864.9	1878.745	1878.85	0.11
DENCO110	488859.128	4407752.758	1668.325	1668.38	0.06
DENCO111	501819.427	4413171.402	1644.161	1644.15	-0.01
DENCO112	515621.88	4418365.612	1550.51	1550.51	0.00
DENCO113	494214.051	4422686.035	1658.778	1658.74	-0.04
DENCO114-ALT	501990.188	4445434.293	1480.594	1480.6	0.01
DENCO115	509067.039	4426284.422	1575.611	1575.59	-0.02
DENCO116	525447.468	4392513.005	1727.795	1727.75	-0.05
DENCO117	507765.451	4393104.109	1645.336	1645.31	-0.03
DENCO118	487630.529	4394304.711	1811.791	1811.79	0.00
DENCO119	511296.963	4377948.934	1804.194	1804.21	0.02
DENCO120	499238.211	4378218.471	1717.668	1717.66	-0.01
DENCO121	523180.285	4376841.959	1862.386	1862.4	0.01
DENCO122	516768.729	4404403.514	1626.253	1626.2	-0.05
DENCO123	494109.558	4387787.312	1689.629	1689.68	0.05
DENCO124	499606.962	4403514.382	1597.648	1597.67	0.02
DENCO125	506944.469	4370795.284	1975.811	1975.82	0.01
DENCO126	501774.515	4461761.604	1489.934	1489.94	0.01
DENCO127	492538.539	4508319.868	1613.239	1613.23	-0.01
DENCO128	731742.535	4538733.061	1071.842	1071.83	-0.01
DENCO129	642242.347	4487102.94	1224.337	1224.31	-0.03
DENCO130	453320.292	4509814.384	2407.403	2407.37	-0.03
DENCO131	549477.872	4466390.986	1378.776	1378.81	0.03
DENCO132	500923.848	4485969.338	1478.416	1478.4	-0.02
DENCO133	517873.38	4386473.805	1772.599	1772.57	-0.03
DENCO134	708198.227	4534873.433	1094.409	1094.39	-0.02
DENCO135	725554.521	4539634.033	1072.914	1072.92	0.01
DENCO136	691408.782	4527668.647	1120.489	1120.44	-0.05
DENCO137	679518.961	4518579.931	1168.025	1168.03	0.00
DENCO138	663204.563	4513636.661	1169.286	1169.26	-0.03
DENCO139	657366.601	4509035.159	1180.931	1180.87	-0.06
DENCO140	645685.911	4498581.123	1238.954	1238.88	-0.07
DENCO141	647411.663	4484708.978	1230.904	1230.9	0.00
DENCO142	631734.354	4480734.409	1302.907	1302.85	-0.06
DENCO143	633508.868	4470785.598	1255.022	1255.03	0.01
DENCO144	622294.804	4468119.366	1270.424	1270.45	0.03
DENCO145	574972.511	4465253.446	1342.981	1342.97	-0.01
DENCO146	544091.341	4477854.016	1413.2	1413.18	-0.02
DENCO147	476313.333	4390806.169	2040.827	2040.82	-0.01
DENCO148	467435.412	4387907.004	2237.167	2237.13	-0.04
DENCO149	470209.664	4382493.525	2325.183	2325.23	0.05

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCO150	462484.907	4399703.09	2204.532	2204.55	0.02
DENCO151	475176.598	4399376.259	1867.048	1867.02	-0.03
DENCO152	470317.703	4417309.428	2346.413	2346.38	-0.03
DENCO153	475864.491	4414274.692	2017.177	2017.07	-0.11
DENCO154	471241.492	4428384.511	1809.998	1809.95	-0.05
DENCO155	456483.276	4435663.128	2838.52	2838.48	-0.04
DENCO156	462795.909	4439844.951	2574.261	2574.21	-0.05
DENCO157	459658.661	4441327.632	2599.442	2599.34	-0.10
DENCO158	457152.231	4442483.313	2600.344	2600.22	-0.12
DENCO159	463300.961	4442869.324	2584.148	2584.21	0.06
DENCO160	465875.195	4442110.229	2234.278	2234.36	0.08
DENCO161	473289.361	4454687.943	1733.493	1733.49	0.00
DENCO162	464103.676	4468435.856	2599.25	2599.15	-0.10
DENCO163	508422.694	4411024.191	1565.318	1565.3	-0.02
DENCO164	500371.877	4394695.272	1593.959	1594.02	0.06
DENCO165_2	485717.573	4456767.782	1567.411	1567.33	-0.08
DENCO166	512131.391	4464250.197	1448.592	1448.6	0.01
DENCO167_2	504583.354	4480079.459	1464.637	1464.64	0.00
DENCO168	492747.481	4481104.906	1557.037	1557.01	-0.03
DENCO169	489389.223	4504445.738	1577.209	1577.17	-0.04
DENCO170	502433.486	4494842.889	1540.636	1540.63	-0.01
DENCO171	490707.444	4469677.832	1535.152	1535.14	-0.01
DENCO172	484466.925	4438020.731	1564.467	1564.43	-0.04
DENCO173	512319.809	4440690.61	1507.208	1507.2	-0.01
DENCO174	519499.718	4397111.291	1686.155	1686.09	-0.07
DENCO175	505664.425	4386155.711	1683.616	1683.64	0.02
DENCO176	519637.989	4372342.686	1784.736	1784.73	-0.01
DENCO177	479721.492	4385317.798	2077.306	2077.28	-0.03
DENCO178	491438.995	4402057.022	1668.372	1668.35	-0.02
DENCO179	511522.187	4400389.683	1623.47	1623.47	0.00
DENCO180	471794.365	4394542.473	2336.845	2336.95	0.11
DENCO181	461854.627	4391669.561	2804.986	2805.01	0.02
DENCO182	471967.614	4408068.778	2500.297	2500.28	-0.02
DENCO183	457904.627	4404855.267	2630.11	2630.1	-0.01
DENCO184	457150.632	4418636.896	2569.423	2569.38	-0.04
DENCO185	459739.055	4428180.302	2495.479	2495.53	0.05
DENCO186	467132.167	4433040.054	2208.869	2208.82	-0.05
DENCO187	456681.921	4448786.417	2503.034	2502.99	-0.04
DENCO188	458137.562	4504002.066	2170.145	2170.08	-0.07
DENCO189	472171.484	4478618.599	2124.254	2124.34	0.09
DENCO190	476490.712	4487369.645	1850.954	1850.96	0.01
DENCO191	509660.914	4437606.859	1523.987	1523.95	-0.04
DENCO192	495860.058	4439687.578	1518.882	1518.88	0.00
DENCO193_2	519434.988	4408438.894	1620.298	1620.28	-0.02
DENCO194	501459.457	4383473.524	1676.996	1677.03	0.03
DENCO195	490772.773	4383885.839	1718.497	1718.55	0.05
DENCO196	521481.964	4424750.946	1550.462	1550.45	-0.01
DENCO197	533466.727	4427645.082	1543.925	1543.9	-0.02
DENCO198	545188.649	4423495.598	1547.603	1547.57	-0.03

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCO199	526684.95	4409200.39	1633.984	1633.97	-0.01
DENCO200	537221.83	4417526.45	1616.867	1616.84	-0.03
DENCO201	555552.62	4415032.47	1587.557	1587.57	0.01
DENCO202	525907.72	4418796.36	1616.827	1616.8	-0.03
DENCO203	543706.62	4411663.04	1613.243	1613.21	-0.03
DENCO204	550147.53	4406512.97	1635.317	1635.27	-0.05
DENCO205	535826.8	4405368.51	1646.856	1646.81	-0.05
DENCO206	524385.75	4402405.21	1668.601	1668.6	0.00
DENCO207	533191.2	4398820.09	1683.358	1683.36	0.00
DENCO208	548590.88	4399124.5	1682.155	1682.15	0.00
DENCO209	526600.35	4387668.41	1772.767	1772.74	-0.03
DENCO210	534179.35	4387693.22	1805.77	1805.8	0.03
DENCO211	537133.83	4379601.07	1872.029	1872.17	0.14
DENCO212	525839.95	4382026.47	1845.162	1845.19	0.03
DENCO213	529029.04	4373896.9	1933.975	1933.95	-0.02
DENCO214	527427.25	4366005.09	1986.037	1985.99	-0.05
DENCO215	528659.4	4357221.15	2045.652	2045.58	-0.07
DENCO216	526706.1	4341710.91	2110.504	2110.47	-0.03
DENCO217	506591.64	4339676.75	2086.81	2086.72	-0.09
DENCO218	505797.71	4348115.07	2018.156	2018.11	-0.05
DENCO219	514291.53	4353851.2	1988.666	1988.65	-0.02
DENCO220	520637.37	4346995.1	2080.637	2080.62	-0.02
DENCO221	505175.74	4362521.08	1850.668	1850.65	-0.02
DENCO222	517727.69	4365012.31	1884.297	1884.23	-0.07
DENCO223	493325.86	4370447	1708.038	1708.1	0.06
DENCO224	476490.49	4359909.68	2035.146	2035.19	0.04
DENCO225	466461.91	4371704.97	2481.633	2481.66	0.03
DENCO226	475032.89	4369771.48	2617.655	2617.67	0.01
DENCO227	470200.65	4362140.92	2102.373	2102.4	0.03
DENCO228	467340.08	4359174.91	2373.431	2373.4	-0.03
DENCO229	467313.61	4367620.18	2530.243	2530.3	0.06
DENCO230	480195.41	4364984.52	1986.429	1986.37	-0.06
DENCO231	482385.14	4371908.35	2341.728	2341.75	0.02

Average dz	-0.010 m
Minimum dz	-0.124 m
Maximum dz	0.158 m
Root Mean Square	0.044 m
Std Deviation	0.043 m

Table 4. Raw FVA - Bare Earth QA – Unclassified Points (Units = Meters)

Number	Easting	Northing	Known Z	LiDAR Z	Dz
DENCOBE01	494284.314	4381186.295	1678.537	1678.510	-0.03
DENCOBE02	631469.942	4480437.628	1300.576	1300.530	-0.05
DENCOBE03A	549685.834	4465873.240	1382.883	1382.900	0.02
DENCOBE04	450761.686	4505528.905	2182.382	2182.260	-0.12
DENCOBE05	458775.875	4410230.868	2809.800	2809.730	-0.07
DENCOBE06	456124.811	4423716.593	2520.187	2520.220	0.03
DENCOBE07	474362.766	4442239.100	1744.515	1744.510	-0.01
DENCOBE08	487112.119	4411635.341	1705.568	1705.640	0.07
DENCOBE09	456830.890	4436106.316	2795.074	2795.030	-0.04
DENCOBE10	468203.537	4459817.253	2056.527	2056.610	0.08
DENCOBE11	475529.815	4453107.969	1657.032	1657.050	0.02
DENCOBE12	471311.455	4475828.007	1874.905	1874.980	0.08
DENCOBE13	478379.218	4485650.537	1707.844	1707.800	-0.04
DENCOBE14	485478.544	4499877.283	1570.321	1570.340	0.02
DENCOBE16	471232.373	4372161.061	2612.802	2612.820	0.02
DENCOBE17	471510.650	4386935.125	2158.117	2158.110	-0.01
DENCOBE18	455083.991	4399303.157	2306.681	2306.670	-0.01
DENCOBE19	470281.404	4417209.212	2343.127	2343.170	0.04
DENCOBE21	539037.885	4423338.170	1599.218	1599.190	-0.03
DENCOBE22	458996.131	4469669.939	2266.831	2266.870	0.04
DENCOBE23	484874.585	4474637.741	1566.534	1566.610	0.08
DENCOBE24	474059.057	4504083.724	1730.863	1730.850	-0.01
DENCOBE26	533975.079	4399397.780	1686.047	1685.990	-0.06
DENCOBE27	510955.333	4425064.301	1547.797	1547.760	-0.04
DENCOBE28	487542.529	4447683.779	1532.237	1532.270	0.03
DENCOBE29	477714.247	4426753.816	1659.161	1659.210	0.05
DENCOBE30	506270.000	4415694.070	1571.034	1571.050	0.02
DENCOBE31	507618.609	4369400.515	2001.560	2001.560	0.00
DENCOBE32	526713.203	4409195.438	1634.359	1634.380	0.02
DENCOBE33	516428.505	4404661.820	1625.576	1625.520	-0.06
DENCOBE34	493355.875	4398141.351	1648.498	1648.550	0.05
DENCOBE35	508888.677	4390850.594	1677.871	1677.860	-0.01
DENCOBE36	493992.443	4369087.397	1744.101	1744.110	0.01
DENCOBE37	512131.802	4357942.335	1890.252	1890.180	-0.07
DENCOBE38	525968.899	4342054.701	2082.775	2082.770	-0.01
DENCOBE39	523608.020	4365190.956	1917.668	1917.620	-0.05
DENCOBE40_2	526062.801	4381771.500	1861.217	1861.220	0.00
DENCOBE41	549230.911	4401327.626	1669.587	1669.600	0.01
DENCOBE42	519223.348	4439110.612	1521.867	1521.890	0.02
DENCOBE43	504645.918	4446103.520	1478.560	1478.520	-0.04
DENCOBE44	490510.324	4470468.588	1532.354	1532.430	0.08
DENCOBE45	509250.537	4480858.152	1463.288	1463.370	0.08
DENCOBE46	492790.736	4490585.321	1527.817	1527.790	-0.03
DENCOBE47	525143.151	4475795.509	1420.414	1420.380	-0.03
DENCOBE48	602042.272	4457556.478	1316.712	1316.700	-0.01
DENCOBE49	654036.169	4498525.999	1200.634	1200.650	0.02
DENCOBE50	685079.448	4525265.757	1130.602	1130.600	0.00
DENCOBE51	729974.581	4541337.511	1061.881	1061.820	-0.06
DENCOBE52	507897.880	4464543.547	1463.629	1463.640	0.01

Average dz	0.00 m
Minimum dz	-0.122 m
Maximum dz	0.083 m
Root Mean Square	0.045 m
95% Confidence	0.089 m

Table 5. FVA - Bare Earth QA – Derived DEMs Classified (Units = Meters)

Number	Easting	Northing	Known Z	LiDAR Z	Dz
DENCOBE01	494284.314	4381186.295	1678.537	1678.571	0.03
DENCOBE02	631469.942	4480437.628	1300.576	1300.535	-0.04
DENCOBE03A	549685.834	4465873.240	1382.883	1382.866	-0.02
DENCOBE04	450761.686	4505528.905	2182.382	2182.251	-0.13
DENCOBE05	458775.875	4410230.868	2809.800	2809.737	-0.06
DENCOBE06	456124.811	4423716.593	2520.187	2520.204	0.02
DENCOBE07	474362.766	4442239.100	1744.515	1744.512	0.00
DENCOBE08	487112.119	4411635.341	1705.568	1705.627	0.06
DENCOBE09	456830.890	4436106.316	2795.074	2795.038	-0.04
DENCOBE10	468203.537	4459817.253	2056.527	2056.553	0.03
DENCOBE11	475529.815	4453107.969	1657.032	1657.043	0.01
DENCOBE12	471311.455	4475828.007	1874.905	1874.990	0.08
DENCOBE13	478379.218	4485650.537	1707.844	1707.866	0.02
DENCOBE14	485478.544	4499877.283	1570.321	1570.341	0.02
DENCOBE16	471232.373	4372161.061	2612.802	2612.816	0.01
DENCOBE17	471510.650	4386935.125	2158.117	2158.099	-0.02
DENCOBE18	455083.991	4399303.157	2306.681	2306.662	-0.02
DENCOBE19	470281.404	4417209.212	2343.127	2343.179	0.05
DENCOBE21	539037.885	4423338.170	1599.218	1599.190	-0.03
DENCOBE22	458996.131	4469669.939	2266.831	2266.879	0.05
DENCOBE23	484874.585	4474637.741	1566.534	1566.788	0.25
DENCOBE24	474059.057	4504083.724	1730.863	1730.857	-0.01
DENCOBE26	533975.079	4399397.780	1686.047	1685.988	-0.06
DENCOBE27	510955.333	4425064.301	1547.797	1547.759	-0.04
DENCOBE28	487542.529	4447683.779	1532.237	1532.311	0.07
DENCOBE29	477714.247	4426753.816	1659.161	1659.219	0.06
DENCOBE30	506270.000	4415694.070	1571.034	1571.026	-0.01
DENCOBE31	507618.609	4369400.515	2001.560	2001.536	-0.02
DENCOBE32	526713.203	4409195.438	1634.359	1634.374	0.02
DENCOBE33	516428.505	4404661.820	1625.576	1625.538	-0.04
DENCOBE34	493355.875	4398141.351	1648.498	1648.536	0.04
DENCOBE35	508888.677	4390850.594	1677.871	1677.849	-0.02
DENCOBE36	493992.443	4369087.397	1744.101	1744.107	0.01
DENCOBE37	512131.802	4357942.335	1890.252	1890.175	-0.08
DENCOBE38	525968.899	4342054.701	2082.775	2082.775	0.00
DENCOBE39	523608.020	4365190.956	1917.668	1917.598	-0.07
DENCOBE40_2	526062.801	4381771.500	1861.217	1861.227	0.01
DENCOBE41	549230.911	4401327.626	1669.587	1669.593	0.01
DENCOBE42	519223.348	4439110.612	1521.867	1521.900	0.03
DENCOBE43	504645.918	4446103.520	1478.560	1478.528	-0.03
DENCOBE44	490510.324	4470468.588	1532.354	1532.431	0.08
DENCOBE45	509250.537	4480858.152	1463.288	1463.378	0.09
DENCOBE46	492790.736	4490585.321	1527.817	1527.760	-0.06
DENCOBE47	525143.151	4475795.509	1420.414	1420.381	-0.03
DENCOBE48	602042.272	4457556.478	1316.712	1316.698	-0.01
DENCOBE49	654036.169	4498525.999	1200.634	1200.653	0.02
DENCOBE50	685079.448	4525265.757	1130.602	1130.604	0.00
DENCOBE51	729974.581	4541337.511	1061.881	1061.850	-0.03
DENCOBE52	507897.880	4464543.547	1463.629	1463.645	0.02

Average dz	0.00 m
Minimum dz	-0.131 m
Maximum dz	0.254 m
Root Mean Square	0.057 m
95% Confidence	0.112 m

Table 6. SVA Forested and Fully Grown Trees QA – Derived DEMs (Units = Meters)

Number	Easting	Northing	Known Z	LiDAR Z	Dz
DENCOFO01	460056.012	4512095.094	2357.497	2357.414	-0.08
DENCOFO02	452174.719	4517744.873	2471.449	2471.347	-0.10
DENCOFO03	468740.274	4523177.591	1988.622	1988.693	0.07
DENCOFO04	528467.340	4354517.205	2055.838	2055.754	-0.08
DENCOFO05	454718.543	4495398.806	2449.927	2449.875	-0.05
DENCOFO06	474876.478	4460481.010	1767.680	1767.660	-0.02
DENCOFO07	456791.440	4448736.087	2509.642	2509.571	-0.07
DENCOFO08	470609.041	4433462.832	2156.569	2156.608	0.04
DENCOFO09	459341.811	4413670.371	2789.021	2788.946	-0.08
DENCOFO10	471265.660	4362211.581	2083.755	2083.681	-0.07
DENCOFO11	492104.581	4370623.831	1693.632	1693.597	-0.04
DENCOFO12	474027.353	4503989.706	1741.431	1741.463	0.03
DENCOFO13	458729.887	4469962.236	2285.094	2285.064	-0.03
DENCOFO14_2	456074.032	4423716.164	2527.799	2527.776	-0.02
DENCOFO15	470239.711	4417208.315	2355.425	2355.473	0.05
DENCOFO16	472000.110	4408031.470	2484.008	2483.915	-0.09
DENCOFO17	461886.070	4391617.769	2805.585	2805.559	-0.03
DENCOFO18	455170.089	4399115.842	2327.209	2327.183	-0.03
DENCOFO19	477216.492	4394666.701	2242.222	2242.190	-0.03
DENCOFO20	463271.539	4386554.512	2307.534	2307.538	0.00
DENCOFO21	480910.217	4381884.201	2167.451	2167.398	-0.05
DENCOFO22	479555.010	4365090.530	1981.358	1980.893	-0.47
DENCOFO24	505661.220	4348105.306	2010.406	2010.317	-0.09
DENCOFO25	523454.093	4365538.946	1901.169	1901.137	-0.03
DENCOFO26	522052.486	4360215.930	1901.604	1901.563	-0.04
DENCOFO27	472322.835	4386850.218	2165.780	2165.775	-0.01
DENCOFO29	467334.688	4446393.891	2089.500	2089.752	0.25
DENCOFO30	458405.227	4439567.219	2665.197	2665.122	-0.07
DENCOFO31	472855.588	4475383.744	1853.586	1853.607	0.02
DENCOFO33	468151.514	4459762.543	2044.616	2044.656	0.04
DENCOFO34	472449.999	4429589.659	1779.483	1779.485	0.00
DENCOFO35	465419.226	4428335.653	2098.775	2098.770	0.00
DENCOFO36	474949.146	4414489.777	2066.956	2066.768	-0.19
DENCOFO37	465916.607	4399998.497	2139.360	2139.483	0.12
DENCOFO38_2	467061.285	4379939.972	2550.881	2550.860	-0.02
DENCOFO39	461214.934	4492005.497	2487.058	2486.817	-0.24
DENCOFO40	619527.841	4464253.289	1272.754	1272.805	0.05
DENCOFO41	653969.121	4498874.921	1197.746	1197.778	0.03
DENCOFO42	731294.193	4539548.516	1053.598	1053.673	0.07
DENCOFO43	509076.207	4444015.951	1518.580	1518.608	0.03
DENCOFO44	481298.032	4467088.921	1759.997	1759.977	-0.02
DENCOFO45	454446.459	4461974.216	2721.699	2721.701	0.00
DENCOFO50	482320.733	4371926.751	2354.870	2354.810	-0.06
DENCOFO51	479730.858	4385280.953	2075.065	2074.980	-0.09
Average dz	-0.03 m				
Minimum dz	-0.465 m				
Maximum dz	0.252 m				
Root Mean Square	0.102 m				
95th Percentile	0.117 m				

Table 7. SVA Brush Lands and Trees QA – Derived DEMs (Units = Meters)

Number	Easting	Northing	Known Z	LiDAR Z	Dz
DENCOBL01	511211.342	4376109.940	1826.483	1826.497	0.01
DENCOBL02	487231.107	4495603.812	1560.237	1560.246	0.01
DENCOBL03_2	484227.457	4458389.220	1617.945	1617.964	0.02
DENCOBL04	509351.554	4464081.147	1461.181	1461.258	0.08
DENCOBL05	642566.930	4480735.558	1233.067	1233.239	0.17
DENCOBL06	601925.763	4458071.968	1302.197	1302.260	0.06
DENCOBL07	564185.582	4459468.043	1372.741	1372.700	-0.04
DENCOBL08	494166.930	4422679.913	1659.436	1659.386	-0.05
DENCOBL09	534152.704	4387649.345	1805.526	1805.556	0.03
DENCOBL10	528659.874	4357221.742	2045.641	2045.567	-0.07
DENCOBL11	520637.251	4346985.337	2080.785	2080.753	-0.03
DENCOBL12	505137.650	4362317.004	1844.873	1844.832	-0.04
DENCOBL13	467243.547	4367500.300	2539.730	2539.834	0.10
DENCOBL16	471766.952	4394485.234	2338.386	2338.435	0.05
DENCOBL17	471978.122	4408044.859	2489.878	2489.838	-0.04
DENCOBL18	457069.182	4418571.593	2567.221	2567.205	-0.02
DENCOBL20	456564.099	4448745.653	2503.929	2504.109	0.18
DENCOBL21	481879.043	4467041.485	1762.868	1762.855	-0.01
DENCOBL22	468754.503	4522917.250	1987.564	1987.681	0.12
DENCOBL23	449052.893	4505265.027	2206.420	2206.311	-0.11
DENCOBL24	474182.482	4429339.120	1698.642	1698.678	0.04
DENCOBL26	464537.478	4472508.394	2134.665	2134.673	0.01
DENCOBL27	453645.819	4460267.952	2767.337	2767.423	0.09
DENCOBL28	479373.248	4400461.484	1757.970	1757.909	-0.06
DENCOBL29	476258.124	4390768.657	2050.887	2050.869	-0.02
DENCOBL30	467630.031	4381278.274	2425.324	2425.370	0.05
DENCOBL31	463259.404	4386529.398	2302.329	2302.283	-0.05
DENCOBL32	454527.339	4399438.645	2317.220	2317.319	0.10
DENCOBL33	475874.355	4414289.469	2017.080	2016.923	-0.16
DENCOBL34	470331.569	4417408.710	2353.815	2353.838	0.02
DENCOBL35	461027.393	4435174.008	2417.527	2417.512	-0.02
DENCOBL36	465858.592	4442162.053	2247.401	2247.497	0.10
DENCOBL37	474715.665	4450682.411	1676.724	1676.963	0.24
DENCOBL38	468176.130	4459814.814	2055.201	2055.245	0.04
DENCOBL39	451030.356	4472305.202	2448.042	2448.075	0.03
DENCOBL40	485007.614	4474240.672	1557.881	1557.910	0.03
DENCOBL41	474369.419	4475132.464	1798.208	1797.909	-0.30
DENCOBL42	463753.858	4491028.376	2334.244	2334.293	0.05
DENCOBL43	481368.071	4489098.501	1766.701	1766.749	0.05
DENCOBL44	485143.662	4500103.115	1592.137	1592.143	0.01
DENCOBL45	468730.098	4504067.044	1814.719	1814.668	-0.05
DENCOBL50	472378.758	4429513.786	1752.138	1752.153	0.01
DENCOBL51	494690.464	4435041.273	1521.692	1521.771	0.08
DENCOBL52	523165.740	4377746.585	1887.942	1887.880	-0.06
DENCOBL53	486187.238	4473271.288	1544.138	1544.110	-0.03
Average dz	0.02 m				
Minimum dz	-0.299 m				
Maximum dz	0.239 m				
Root Mean Square	0.085 m				

95th Percentile	0.168 m

Table 8. SVA Tall Weeds/Crops QA – Derived DEMs (Units = Meters)

Number	Easting	Northing	Known Z	LiDAR Z	Dz
DENCOTW01	525894.235	4392477.944	1729.693	1729.701	0.01
DENCOTW02	724931.550	4538627.846	1072.346	1072.306	-0.04
DENCOTW03	673781.813	4515160.993	1174.924	1175.025	0.10
DENCOTW04	472616.816	4469300.530	2083.675	2083.756	0.08
DENCOTW05	466436.584	4371718.914	2483.067	2483.127	0.06
DENCOTW06	459917.201	4453758.540	2512.657	2512.717	0.06
DENCOTW07	501537.309	4433254.954	1557.129	1557.120	-0.01
DENCOTW08	485766.494	4456772.427	1566.720	1566.700	-0.02
DENCOTW09	489229.855	4504447.921	1575.451	1575.409	-0.04
DENCOTW10	500913.580	4485915.684	1478.497	1478.511	0.01
DENCOTW11	641568.021	4487084.647	1238.770	1238.751	-0.02
DENCOTW12	633514.629	4470957.265	1254.680	1254.738	0.06
DENCOTW13	607587.488	4455153.590	1306.265	1306.295	0.03
DENCOTW14	582664.036	4468604.024	1331.896	1332.071	0.18
DENCOTW15	544126.117	4477855.624	1413.186	1413.282	0.10
DENCOTW16	525767.901	4465342.354	1429.636	1429.681	0.05
DENCOTW17	501746.887	4461698.765	1484.988	1484.981	-0.01
DENCOTW18	484505.293	4437936.782	1565.199	1565.296	0.10
DENCOTW19	495747.171	4439905.188	1515.783	1515.867	0.08
DENCOTW20	519392.433	4432974.582	1541.008	1541.107	0.10
DENCOTW21	556359.970	4426218.051	1523.837	1523.871	0.03
DENCOTW22	517736.317	4364985.660	1885.449	1885.383	-0.07
DENCOTW24	506319.533	4339684.130	2100.282	2100.250	-0.03
DENCOTW25	493328.791	4370436.844	1708.143	1708.210	0.07
DENCOTW27	501709.064	4413077.119	1632.598	1632.537	-0.06
DENCOTW28	521490.067	4424542.748	1547.031	1547.055	0.02
DENCOTW29	537212.103	4417418.146	1617.315	1617.281	-0.03
DENCOTW30	555460.151	4415010.996	1586.450	1586.454	0.00
DENCOTW31	548561.765	4399185.502	1680.819	1680.768	-0.05
DENCOTW32	537153.546	4379635.625	1872.183	1872.208	0.02
DENCOTW33	523175.219	4376806.311	1857.447	1857.420	-0.03
DENCOTW34	479410.198	4403771.222	1874.632	1874.785	0.15
DENCOTW35_2	519402.350	4408435.395	1620.750	1620.714	-0.04
DENCOTW36	456117.961	4423762.533	2519.385	2519.422	0.04
DENCOTW37	514684.746	4381325.089	1746.785	1746.768	-0.02
DENCOTW38	477703.339	4426687.670	1661.841	1661.812	-0.03
DENCOTW39	458751.622	4470029.318	2293.630	2293.624	-0.01
DENCOTW40	477203.118	4394845.767	2241.776	2241.731	-0.04
DENCOTW41	470104.274	4417794.727	2413.814	2413.817	0.00
DENCOTW42	472967.196	4387748.282	2157.153	2157.142	-0.01
DENCOTW43	455003.395	4399092.110	2363.107	2363.148	0.04
DENCOTW44	456798.189	4436065.865	2789.601	2789.704	0.10
DENCOTW45	474500.003	4442357.712	1735.864	1735.893	0.03
DENCOTW46	485664.991	4485117.488	1683.382	1683.453	0.07
DENCOTW47	455780.449	4496318.979	2425.020	2424.991	-0.03
DENCOTW48	468722.909	4523264.525	1992.930	1993.049	0.12
DENCOTW49	460128.682	4512128.267	2361.840	2361.863	0.02
DENCOTW50	479586.038	4365112.711	1968.519	1968.332	-0.19
DENCOTW51	459695.686	4428172.757	2494.025	2494.330	0.30

Average dz	0.03 m
Minimum dz	-0.187 m
Maximum dz	0.305 m
Root Mean Square	0.083 m
95th Percentile	0.155 m

Table 9. SVA Urban Areas QA Points – Derived DEMs (Units – Meters)

Number	Easting	Northing	Known Z	LiDAR Z	Dz
DENCOUA01	535604.733	4387678.185	1822.738	1822.669	-0.07
DENCOUA02	506229.070	4415688.565	1572.701	1572.690	-0.01
DENCOUA03	494668.478	4435011.220	1523.625	1523.661	0.04
DENCOUA04	483961.797	4407115.659	1720.319	1720.270	-0.05
DENCOUA05	474046.334	4504033.810	1730.976	1730.961	-0.02
DENCOUA06	472464.204	4386960.657	2152.860	2152.803	-0.06
DENCOUA07	455584.978	4399301.277	2303.485	2303.493	0.01
DENCOUA08	470304.007	4417207.712	2343.060	2343.082	0.02
DENCOUA09	485693.559	4485207.625	1677.632	1677.676	0.04
DENCOUA10_ALT	476939.354	4452773.201	1636.300	1636.356	0.06
DENCOUA11	456199.540	4423692.053	2518.324	2518.313	-0.01
DENCOUA12	456155.912	4405692.226	2566.876	2566.878	0.00
DENCOUA13	471224.044	4372113.356	2615.032	2615.029	0.00
DENCOUA14	476998.878	4394863.256	2252.310	2252.150	-0.16
DENCOUA15_B	534041.431	4399488.300	1685.835	1685.832	0.00
DENCOUA16	526687.504	4409164.286	1634.481	1634.508	0.03
DENCOUA17	549254.674	4401262.166	1669.911	1669.956	0.04
DENCOUA18	684983.040	4525140.054	1130.931	1130.933	0.00
DENCOUA19	639370.650	4482590.744	1231.636	1231.649	0.01
DENCOUA20	493984.685	4369055.157	1747.761	1747.785	0.02
DENCOUA21	521815.928	4360137.143	1891.398	1891.393	0.00
DENCOUA22	512116.829	4357966.104	1890.604	1890.559	-0.04
DENCOUA23	523605.754	4365194.473	1917.575	1917.537	-0.04
DENCOUA24	507642.471	4369406.770	2001.472	2001.418	-0.05
DENCOUA25	508839.955	4390800.994	1679.843	1679.848	0.01
DENCOUA26	510951.362	4425135.630	1546.077	1545.985	-0.09
DENCOUA27	507841.114	4464540.213	1465.190	1465.231	0.04
DENCOUA28	508885.666	4481093.011	1460.651	1460.689	0.04
DENCOUA29	504704.753	4446085.258	1478.479	1478.450	-0.03
DENCOUA30	519458.527	4439255.040	1520.737	1520.728	-0.01
DENCOUA31	602013.533	4457574.724	1316.133	1316.105	-0.03
DENCOUA32	729908.725	4541327.418	1061.930	1061.955	0.03
DENCOUA33	653995.902	4498334.054	1200.701	1200.714	0.01
DENCOUA34	499522.826	4403591.832	1599.055	1599.032	-0.02
DENCOUA35	490759.797	4384018.953	1721.232	1721.264	0.03
DENCOUA36	526099.461	4381766.376	1859.045	1859.056	0.01
DENCOUA37	516578.428	4404640.498	1625.120	1625.078	-0.04
DENCOUA38	494193.915	4422211.389	1646.504	1646.562	0.06
DENCOUA39	477660.609	4426754.183	1661.713	1661.695	-0.02
DENCOUA40	490521.239	4470427.393	1533.156	1533.155	0.00
DENCOUA41	487596.304	4447711.387	1534.503	1534.546	0.04
DENCOUA42	525070.186	4476039.776	1419.831	1419.844	0.01
DENCOUA43	458657.854	4469836.550	2275.554	2275.559	0.00
DENCOUA44	492818.463	4490519.480	1526.682	1526.674	-0.01
DENCOUA45	514595.599	4381259.335	1749.426	1749.415	-0.01
DENCOUA46	508841.169	4401742.364	1614.310	1614.274	-0.04
DENCOUA47	578742.066	4453149.826	1386.822	1386.835	0.01
DENCOUA48	492817.252	4490510.024	1526.405	1526.383	-0.02
DENCOUA49	493300.479	4398213.805	1650.449	1650.474	0.03

Average dz	0.00 m
Minimum dz	-0.160 m
Maximum dz	0.058 m
Root Mean Square	0.040 m
95th Percentile	0.044 m

Table 10. CVA for the Five Classified Land Cover Classes (Units = Meters)

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCOBE01	494284.314	4381186.295	1678.537	1678.571	0.03
DENCOBE02	631469.942	4480437.628	1300.576	1300.535	-0.04
DENCOBE03A	549685.834	4465873.240	1382.883	1382.866	-0.02
DENCOBE04	450761.686	4505528.905	2182.382	2182.251	-0.13
DENCOBE05	458775.875	4410230.868	2809.800	2809.737	-0.06
DENCOBE06	456124.811	4423716.593	2520.187	2520.204	0.02
DENCOBE07	474362.766	4442239.100	1744.515	1744.512	0.00
DENCOBE08	487112.119	4411635.341	1705.568	1705.627	0.06
DENCOBE09	456830.890	4436106.316	2795.074	2795.038	-0.04
DENCOBE10	468203.537	4459817.253	2056.527	2056.553	0.03
DENCOBE11	475529.815	4453107.969	1657.032	1657.043	0.01
DENCOBE12	471311.455	4475828.007	1874.905	1874.990	0.08
DENCOBE13	478379.218	4485650.537	1707.844	1707.866	0.02
DENCOBE14	485478.544	4499877.283	1570.321	1570.341	0.02
DENCOBE16	471232.373	4372161.061	2612.802	2612.816	0.01
DENCOBE17	471510.650	4386935.125	2158.117	2158.099	-0.02
DENCOBE18	455083.991	4399303.157	2306.681	2306.662	-0.02
DENCOBE19	470281.404	4417209.212	2343.127	2343.179	0.05
DENCOBE21	539037.885	4423338.170	1599.218	1599.190	-0.03
DENCOBE22	458996.131	4469669.939	2266.831	2266.879	0.05
DENCOBE23	484874.585	4474637.741	1566.534	1566.788	0.25
DENCOBE24	474059.057	4504083.724	1730.863	1730.857	-0.01
DENCOBE26	533975.079	4399397.780	1686.047	1685.988	-0.06
DENCOBE27	510955.333	4425064.301	1547.797	1547.759	-0.04
DENCOBE28	487542.529	4447683.779	1532.237	1532.311	0.07
DENCOBE29	477714.247	4426753.816	1659.161	1659.219	0.06
DENCOBE30	506270.000	4415694.070	1571.034	1571.026	-0.01
DENCOBE31	507618.609	4369400.515	2001.560	2001.536	-0.02
DENCOBE32	526713.203	4409195.438	1634.359	1634.374	0.02
DENCOBE33	516428.505	4404661.820	1625.576	1625.538	-0.04
DENCOBE34	493355.875	4398141.351	1648.498	1648.536	0.04
DENCOBE35	508888.677	4390850.594	1677.871	1677.849	-0.02
DENCOBE36	493992.443	4369087.397	1744.101	1744.107	0.01
DENCOBE37	512131.802	4357942.335	1890.252	1890.175	-0.08
DENCOBE38	525968.899	4342054.701	2082.775	2082.775	0.00
DENCOBE39	523608.020	4365190.956	1917.668	1917.598	-0.07
DENCOBE40_2	526062.801	4381771.500	1861.217	1861.227	0.01
DENCOBE41	549230.911	4401327.626	1669.587	1669.593	0.01
DENCOBE42	519223.348	4439110.612	1521.867	1521.900	0.03
DENCOBE43	504645.918	4446103.520	1478.560	1478.528	-0.03
DENCOBE44	490510.324	4470468.588	1532.354	1532.431	0.08
DENCOBE45	509250.537	4480858.152	1463.288	1463.378	0.09
DENCOBE46	492790.736	4490585.321	1527.817	1527.760	-0.06
DENCOBE47	525143.151	4475795.509	1420.414	1420.381	-0.03
DENCOBE48	602042.272	4457556.478	1316.712	1316.698	-0.01
DENCOBE49	654036.169	4498525.999	1200.634	1200.653	0.02
DENCOBE50	685079.448	4525265.757	1130.602	1130.604	0.00
DENCOBE51	729974.581	4541337.511	1061.881	1061.850	-0.03
DENCOBE52	507897.880	4464543.547	1463.629	1463.645	0.02

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCOBL01	511211.342	4376109.940	1826.483	1826.497	0.01
DENCOBL02	487231.107	4495603.812	1560.237	1560.246	0.01
DENCOBL03_2	484227.457	4458389.220	1617.945	1617.964	0.02
DENCOBL04	509351.554	4464081.147	1461.181	1461.258	0.08
DENCOBL05	642566.930	4480735.558	1233.067	1233.239	0.17
DENCOBL06	601925.763	4458071.968	1302.197	1302.260	0.06
DENCOBL07	564185.582	4459468.043	1372.741	1372.700	-0.04
DENCOBL08	494166.930	4422679.913	1659.436	1659.386	-0.05
DENCOBL09	534152.704	4387649.345	1805.526	1805.556	0.03
DENCOBL10	528659.874	4357221.742	2045.641	2045.567	-0.07
DENCOBL11	520637.251	4346985.337	2080.785	2080.753	-0.03
DENCOBL12	505137.650	4362317.004	1844.873	1844.832	-0.04
DENCOBL13	467243.547	4367500.300	2539.730	2539.834	0.10
DENCOBL16	471766.952	4394485.234	2338.386	2338.435	0.05
DENCOBL17	471978.122	4408044.859	2489.878	2489.838	-0.04
DENCOBL18	457069.182	4418571.593	2567.221	2567.205	-0.02
DENCOBL20	456564.099	4448745.653	2503.929	2504.109	0.18
DENCOBL21	481879.043	4467041.485	1762.868	1762.855	-0.01
DENCOBL22	468754.503	4522917.250	1987.564	1987.681	0.12
DENCOBL23	449052.893	4505265.027	2206.420	2206.311	-0.11
DENCOBL24	474182.482	4429339.120	1698.642	1698.678	0.04
DENCOBL26	464537.478	4472508.394	2134.665	2134.673	0.01
DENCOBL27	453645.819	4460267.952	2767.337	2767.423	0.09
DENCOBL28	479373.248	4400461.484	1757.970	1757.909	-0.06
DENCOBL29	476258.124	4390768.657	2050.887	2050.869	-0.02
DENCOBL30	467630.031	4381278.274	2425.324	2425.370	0.05
DENCOBL31	463259.404	4386529.398	2302.329	2302.283	-0.05
DENCOBL32	454527.339	4399438.645	2317.220	2317.319	0.10
DENCOBL33	475874.355	4414289.469	2017.080	2016.923	-0.16
DENCOBL34	470331.569	4417408.710	2353.815	2353.838	0.02
DENCOBL35	461027.393	4435174.008	2417.527	2417.512	-0.02
DENCOBL36	465858.592	4442162.053	2247.401	2247.497	0.10
DENCOBL37	474715.665	4450682.411	1676.724	1676.963	0.24
DENCOBL38	468176.130	4459814.814	2055.201	2055.245	0.04
DENCOBL39	451030.356	4472305.202	2448.042	2448.075	0.03
DENCOBL40	485007.614	4474240.672	1557.881	1557.910	0.03
DENCOBL41	474369.419	4475132.464	1798.208	1797.909	-0.30
DENCOBL42	463753.858	4491028.376	2334.244	2334.293	0.05
DENCOBL43	481368.071	4489098.501	1766.701	1766.749	0.05
DENCOBL44	485143.662	4500103.115	1592.137	1592.143	0.01
DENCOBL45	468730.098	4504067.044	1814.719	1814.668	-0.05
DENCOBL50	472378.758	4429513.786	1752.138	1752.153	0.01
DENCOBL51	494690.464	4435041.273	1521.692	1521.771	0.08
DENCOBL52	523165.740	4377746.585	1887.942	1887.880	-0.06
DENCOBL53	486187.238	4473271.288	1544.138	1544.110	-0.03
DENCOBL54	520646.323	4347007.686	2080.113	2080.090	-0.02
DENCOBL55	494001.062	4387774.592	1689.043	1689.090	0.05
DENCOBL56	468335.913	4459886.426	2072.812	2072.825	0.01
DENCOBL57	465203.849	4473192.082	2121.653	2121.800	0.15

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCOBL58	461854.949	4491065.632	2471.927	2471.919	-0.01
DENCOBL59	448841.332	4505301.038	2218.133	2218.072	-0.06
DENCOBL60	481637.650	4488147.774	1752.326	1752.500	0.17
DENCOBL61	485453.956	4500041.911	1572.483	1572.579	0.10
DENCOBL62	457323.450	4418406.416	2553.741	2553.797	0.06
DENCOBL63	461000.522	4435161.323	2418.279	2418.375	0.10
DENCOBL64	472143.110	4394287.462	2314.276	2314.257	-0.02
DENCOBL65	482441.652	4371898.365	2338.520	2338.440	-0.08
DENCOBL66	511042.434	4375897.163	1827.770	1827.770	0.00
DENCOBL67	528719.169	4357607.167	2031.078	2031.050	-0.03
DENCOBL68	529385.791	4348171.469	2103.303	-	-
DENCOBL69	475973.252	4414260.074	2009.281	2009.208	-0.07
DENCOBL70	463428.565	4386693.313	2305.272	2305.275	0.00
DENCOBL71	480155.493	4451055.828	1591.542	1591.640	0.10
DENCOBL72	493728.336	4370647.864	1712.893	1712.910	0.02
DENCOBL73	555573.022	4415040.100	1586.962	1586.949	-0.01
DENCOFO01	460056.012	4512095.094	2357.497	2357.414	-0.08
DENCOFO02	452174.719	4517744.873	2471.449	2471.347	-0.10
DENCOFO03	468740.274	4523177.591	1988.622	1988.693	0.07
DENCOFO04	528467.340	4354517.205	2055.838	2055.754	-0.08
DENCOFO05	454718.543	4495398.806	2449.927	2449.875	-0.05
DENCOFO06	474876.478	4460481.010	1767.680	1767.660	-0.02
DENCOFO07	456791.440	4448736.087	2509.642	2509.571	-0.07
DENCOFO08	470609.041	4433462.832	2156.569	2156.608	0.04
DENCOFO09	459341.811	4413670.371	2789.021	2788.946	-0.08
DENCOFO10	471265.660	4362211.581	2083.755	2083.681	-0.07
DENCOFO11	492104.581	4370623.831	1693.632	1693.597	-0.04
DENCOFO12	474027.353	4503989.706	1741.431	1741.463	0.03
DENCOFO13	458729.887	4469962.236	2285.094	2285.064	-0.03
DENCOFO14_2	456074.032	4423716.164	2527.799	2527.776	-0.02
DENCOFO15	470239.711	4417208.315	2355.425	2355.473	0.05
DENCOFO16	472000.110	4408031.470	2484.008	2483.915	-0.09
DENCOFO17	461886.070	4391617.769	2805.585	2805.559	-0.03
DENCOFO18	455170.089	4399115.842	2327.209	2327.183	-0.03
DENCOFO19	477216.492	4394666.701	2242.222	2242.190	-0.03
DENCOFO20	463271.539	4386554.512	2307.534	2307.538	0.00
DENCOFO21	480910.217	4381884.201	2167.451	2167.398	-0.05
DENCOFO22	479555.010	4365090.530	1981.358	1980.893	-0.47
DENCOFO24	505661.220	4348105.306	2010.406	2010.317	-0.09
DENCOFO25	523454.093	4365538.946	1901.169	1901.137	-0.03
DENCOFO26	522052.486	4360215.930	1901.604	1901.563	-0.04
DENCOFO27	472322.835	4386850.218	2165.780	2165.775	-0.01
DENCOFO29	467334.688	4446393.891	2089.500	2089.752	0.25
DENCOFO30	458405.227	4439567.219	2665.197	2665.122	-0.07
DENCOFO31	472855.588	4475383.744	1853.586	1853.607	0.02
DENCOFO33	468151.514	4459762.543	2044.616	2044.656	0.04
DENCOFO34	472449.999	4429589.659	1779.483	1779.485	0.00
DENCOFO35	465419.226	4428335.653	2098.775	2098.770	0.00
DENCOFO36	474949.146	4414489.777	2066.956	2066.768	-0.19

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCOFO37	465916.607	4399998.497	2139.360	2139.483	0.12
DENCOFO38_2	467061.285	4379939.972	2550.881	2550.860	-0.02
DENCOFO39	461214.934	4492005.497	2487.058	2486.817	-0.24
DENCOFO40	619527.841	4464253.289	1272.754	1272.805	0.05
DENCOFO41	653969.121	4498874.921	1197.746	1197.778	0.03
DENCOFO42	731294.193	4539548.516	1053.598	1053.673	0.07
DENCOFO43	509076.207	4444015.951	1518.580	1518.608	0.03
DENCOFO44	481298.032	4467088.921	1759.997	1759.977	-0.02
DENCOFO45	454446.459	4461974.216	2721.699	2721.701	0.00
DENCOFO50	482320.733	4371926.751	2354.870	2354.810	-0.06
DENCOFO51	479730.858	4385280.953	2075.065	2074.980	-0.09
DENCOFO52	465760.618	4428283.044	2101.464	2101.431	-0.03
DENCOFO53	468377.916	4459938.931	2088.986	2088.950	-0.04
DENCOFO54	481381.428	4488472.443	1778.359	1778.475	0.12
DENCOFO55	461870.551	4391920.967	2792.196	2792.097	-0.10
DENCOFO56	467041.137	4380022.825	2547.312	2547.283	-0.03
DENCOFO57	514123.017	4386790.541	1696.395	1696.420	0.03
DENCOFO58	486017.569	4473296.713	1544.741	1544.860	0.12
DENCOFO59	491402.613	4370615.150	1678.478	1678.360	-0.12
DENCOFO60	458797.528	4469942.139	2291.597	2291.525	-0.07
DENCOFO61	481169.221	4467145.102	1779.194	1779.130	-0.06
DENCOTW01	525894.235	4392477.944	1729.693	1729.701	0.01
DENCOTW02	724931.550	4538627.846	1072.346	1072.306	-0.04
DENCOTW03	673781.813	4515160.993	1174.924	1175.025	0.10
DENCOTW04	472616.816	4469300.530	2083.675	2083.756	0.08
DENCOTW05	466436.584	4371718.914	2483.067	2483.127	0.06
DENCOTW06	459917.201	4453758.540	2512.657	2512.717	0.06
DENCOTW07	501537.309	4433254.954	1557.129	1557.120	-0.01
DENCOTW08	485766.494	4456772.427	1566.720	1566.700	-0.02
DENCOTW09	489229.855	4504447.921	1575.451	1575.409	-0.04
DENCOTW10	500913.580	4485915.684	1478.497	1478.511	0.01
DENCOTW11	641568.021	4487084.647	1238.770	1238.751	-0.02
DENCOTW12	633514.629	4470957.265	1254.680	1254.738	0.06
DENCOTW13	607587.488	4455153.590	1306.265	1306.295	0.03
DENCOTW14	582664.036	4468604.024	1331.896	1332.071	0.18
DENCOTW15	544126.117	4477855.624	1413.186	1413.282	0.10
DENCOTW16	525767.901	4465342.354	1429.636	1429.681	0.05
DENCOTW17	501746.887	4461698.765	1484.988	1484.981	-0.01
DENCOTW18	484505.293	4437936.782	1565.199	1565.296	0.10
DENCOTW19	495747.171	4439905.188	1515.783	1515.867	0.08
DENCOTW20	519392.433	4432974.582	1541.008	1541.107	0.10
DENCOTW21	556359.970	4426218.051	1523.837	1523.871	0.03
DENCOTW22	517736.317	4364985.660	1885.449	1885.383	-0.07
DENCOTW24	506319.533	4339684.130	2100.282	2100.250	-0.03
DENCOTW25	493328.791	4370436.844	1708.143	1708.210	0.07
DENCOTW27	501709.064	4413077.119	1632.598	1632.537	-0.06
DENCOTW28	521490.067	4424542.748	1547.031	1547.055	0.02
DENCOTW29	537212.103	4417418.146	1617.315	1617.281	-0.03
DENCOTW30	555460.151	4415010.996	1586.450	1586.454	0.00

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCOTW31	548561.765	4399185.502	1680.819	1680.768	-0.05
DENCOTW32	537153.546	4379635.625	1872.183	1872.208	0.02
DENCOTW33	523175.219	4376806.311	1857.447	1857.420	-0.03
DENCOTW34	479410.198	4403771.222	1874.632	1874.785	0.15
DENCOTW35_2	519402.350	4408435.395	1620.750	1620.714	-0.04
DENCOTW36	456117.961	4423762.533	2519.385	2519.422	0.04
DENCOTW37	514684.746	4381325.089	1746.785	1746.768	-0.02
DENCOTW38	477703.339	4426687.670	1661.841	1661.812	-0.03
DENCOTW39	458751.622	4470029.318	2293.630	2293.624	-0.01
DENCOTW40	477203.118	4394845.767	2241.776	2241.731	-0.04
DENCOTW41	470104.274	4417794.727	2413.814	2413.817	0.00
DENCOTW42	472967.196	4387748.282	2157.153	2157.142	-0.01
DENCOTW43	455003.395	4399092.110	2363.107	2363.148	0.04
DENCOTW44	456798.189	4436065.865	2789.601	2789.704	0.10
DENCOTW45	474500.003	4442357.712	1735.864	1735.893	0.03
DENCOTW46	485664.991	4485117.488	1683.382	1683.453	0.07
DENCOTW47	455780.449	4496318.979	2425.020	2424.991	-0.03
DENCOTW48	468722.909	4523264.525	1992.930	1993.049	0.12
DENCOTW49	460128.682	4512128.267	2361.840	2361.863	0.02
DENCOTW50	479586.038	4365112.711	1968.519	1968.332	-0.19
DENCOTW51	459695.686	4428172.757	2494.025	2494.330	0.30
DENCOTW52	489236.875	4504417.889	1574.725	1574.699	-0.03
DENCOTW53	455619.335	4496876.919	2404.792	2404.728	-0.06
DENCOTW54	501680.826	4461514.702	1481.426	1481.443	0.02
DENCOTW56	555662.985	4415016.806	1584.990	1585.037	0.05
DENCOTW57	548522.756	4398745.736	1685.749	-	-
DENCOTW58	521242.160	4346612.932	2088.364	2088.304	-0.06
DENCOTW59	514913.644	4381006.514	1745.252	1745.243	-0.01
DENCOTW60	493421.968	4388048.579	1700.059	1700.100	0.04
DENCOTW61	493135.336	4370606.786	1694.876	1694.994	0.12
DENCOTW62	459747.888	4453733.697	2521.915	2521.923	0.01
DENCOTW63	479326.257	4403555.813	1877.765	1878.018	0.25
DENCOUA01	535604.733	4387678.185	1822.738	1822.669	-0.07
DENCOUA02	506229.070	4415688.565	1572.701	1572.690	-0.01
DENCOUA03	494668.478	4435011.220	1523.625	1523.661	0.04
DENCOUA04	483961.797	4407115.659	1720.319	1720.270	-0.05
DENCOUA05	474046.334	4504033.810	1730.976	1730.961	-0.02
DENCOUA06	472464.204	4386960.657	2152.860	2152.803	-0.06
DENCOUA07	455584.978	4399301.277	2303.485	2303.493	0.01
DENCOUA08	470304.007	4417207.712	2343.060	2343.082	0.02
DENCOUA09	485693.559	4485207.625	1677.632	1677.676	0.04
DENCOUA10_ALT	476939.354	4452773.201	1636.300	1636.356	0.06
DENCOUA11	456199.540	4423692.053	2518.324	2518.313	-0.01
DENCOUA12	456155.912	4405692.226	2566.876	2566.878	0.00
DENCOUA13	471224.044	4372113.356	2615.032	2615.029	0.00
DENCOUA14	476998.878	4394863.256	2252.310	2252.150	-0.16
DENCOUA15_B	534041.431	4399488.300	1685.835	1685.832	0.00
DENCOUA16	526687.504	4409164.286	1634.481	1634.508	0.03
DENCOUA17	549254.674	4401262.166	1669.911	1669.956	0.04
DENCOTW31	548561.765	4399185.502	1680.819	1680.768	-0.05
DENCOTW32	537153.546	4379635.625	1872.183	1872.208	0.02

Post Flight Aerial Acquisition and Calibrated Report to USGS

Number	Easting	Northing	Known Z	Laser Z	Dz
DENCOUA18	684983.040	4525140.054	1130.931	1130.933	0.00
DENCOUA19	639370.650	4482590.744	1231.636	1231.649	0.01
DENCOUA20	493984.685	4369055.157	1747.761	1747.785	0.02
DENCOUA21	521815.928	4360137.143	1891.398	1891.393	0.00
DENCOUA22	512116.829	4357966.104	1890.604	1890.559	-0.04
DENCOUA23	523605.754	4365194.473	1917.575	1917.537	-0.04
DENCOUA24	507642.471	4369406.770	2001.472	2001.418	-0.05
DENCOUA25	508839.955	4390800.994	1679.843	1679.848	0.01
DENCOUA26	510951.362	4425135.630	1546.077	1545.985	-0.09
DENCOUA27	507841.114	4464540.213	1465.190	1465.231	0.04
DENCOUA28	508885.666	4481093.011	1460.651	1460.689	0.04
DENCOUA29	504704.753	4446085.258	1478.479	1478.450	-0.03
DENCOUA30	519458.527	4439255.040	1520.737	1520.728	-0.01
DENCOUA31	602013.533	4457574.724	1316.133	1316.105	-0.03
DENCOUA32	729908.725	4541327.418	1061.930	1061.955	0.03
DENCOUA33	653995.902	4498334.054	1200.701	1200.714	0.01
DENCOUA34	499522.826	4403591.832	1599.055	1599.032	-0.02
DENCOUA35	490759.797	4384018.953	1721.232	1721.264	0.03
DENCOUA36	526099.461	4381766.376	1859.045	1859.056	0.01
DENCOUA37	516578.428	4404640.498	1625.120	1625.078	-0.04
DENCOUA38	494193.915	4422211.389	1646.504	1646.562	0.06
DENCOUA39	477660.609	4426754.183	1661.713	1661.695	-0.02
DENCOUA40	490521.239	4470427.393	1533.156	1533.155	0.00
DENCOUA41	487596.304	4447711.387	1534.503	1534.546	0.04
DENCOUA42	525070.186	4476039.776	1419.831	1419.844	0.01
DENCOUA43	458657.854	4469836.550	2275.554	2275.559	0.00
DENCOUA44	492818.463	4490519.480	1526.682	1526.674	-0.01
DENCOUA45	514595.599	4381259.335	1749.426	1749.415	-0.01
DENCOUA46	508841.169	4401742.364	1614.310	1614.274	-0.04
DENCOUA47	578742.066	4453149.826	1386.822	1386.835	0.01
DENCOUA48	492817.252	4490510.024	1526.405	1526.383	-0.02
DENCOUA49	493300.479	4398213.805	1650.449	1650.474	0.03

Average dz	0.00 m
Minimum dz	-0.465 m
Maximum dz	0.305 m
Root Mean Square	0.078 m
95th Percentile	0.118 m